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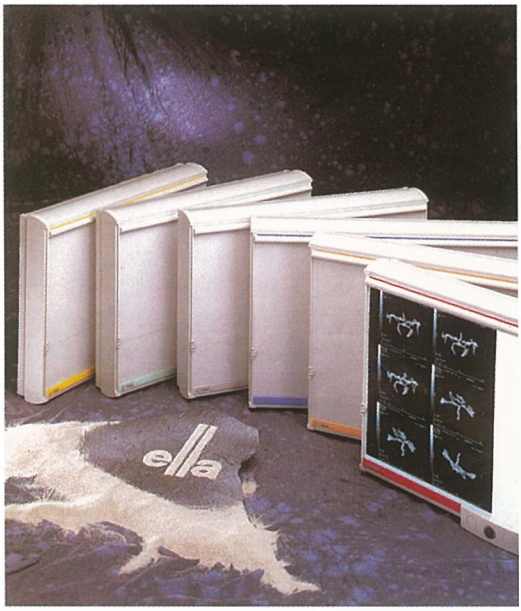

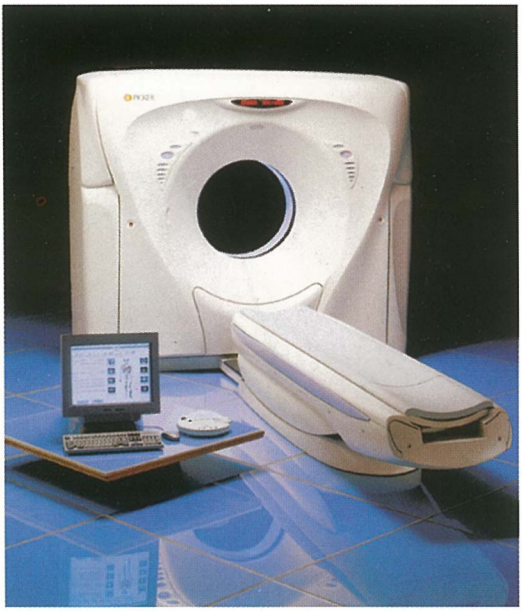

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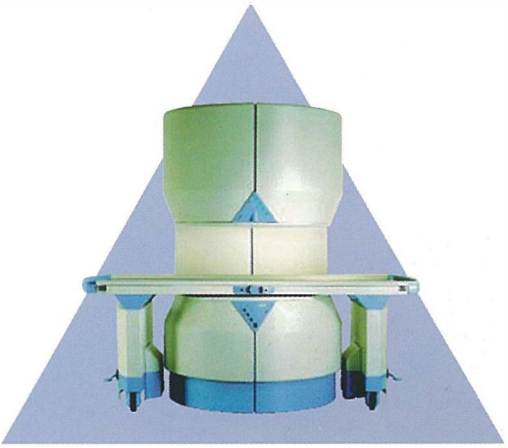

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CONTENTS

Radiology and Oncology is covered in *Biomedicina Slovenica, Chemical Abstracts, and EMBASE / Excerpta Medica*

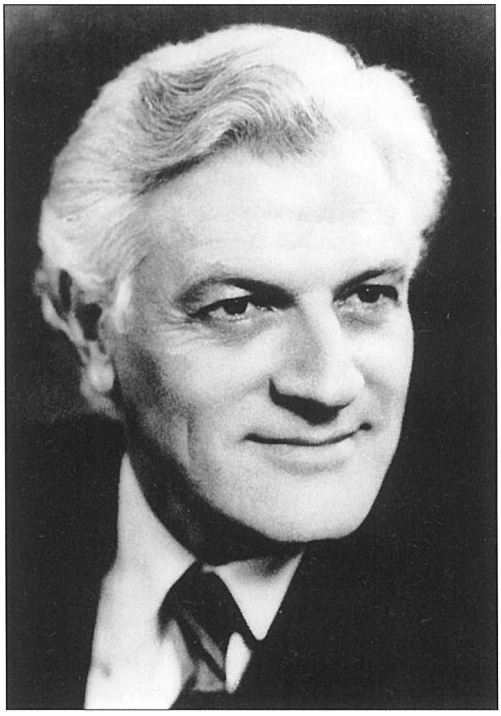
Foreword

Radiology is today one of the fastest expanding medical fields. The introduction of new imaging modalities, such as magnetic resonance, substantially increases diagnostic accuracy and influences favorably the therapy of different diseases. Novel interventional radiology procedures allow non-invasive treatment of diseases that were traditionally cured by operative surgery. However, the cost of new radiological imaging modalities is high and catching up with fast development of modern radiology is difficult even for rich countries. On the other hand, the technical level of central radiology departments reflects closely the quality of university medical centres. During the last decade, in spite of numerous difficulties which, unfortunately, were not always only financial, Clinical Radiology Institute was able to overcome all the obstacles and to follow general trends of radiology in developed countries.

This issue of Radiology and Oncology reflects the status of different fields of diagnostic and interventional radiology not only at the University Clinical Centre of Ljubljana but also in Slovenia. The issue is dedicated to Professor Ivo Obrez, M.D., (1930 - 1989), Head of the Institute of Radiology for many years, an outstanding radiologist with international recognition. With his contribution to Slovenian radiology, and Clinical Radiology Institute in particular, he laid the foundation for further development of modern radiology in Slovenia.

Vladimir Jevtič (Guest Editor)

Prof. Ivo Obrez, M.D., Ph.D. (1930-1989)



Ten years have passed since the death of Professor Ivo Obrez, head of the Institute of Radiology for many years, a teacher of several generations of Slovene radiologists, a founder of invasive and interventional radiology in Yugoslavia and Slovenia, and a researcher whose innovative work received wide international recognition.

Professor Ivo Obrez was born in Novo mesto in 1930. He graduated M.D. from the Faculty of Medicine in Ljubljana in 1955. He embarked on his radiology specialist training in 1958 and completed it in 1961. During the period 1961-1965 he headed the radiological unit of the Novo mesto General Hospital.

In 1963, during his study visit to Lund and Stockholm, where the first centralised radiological departments were set up, he witnessed an explosive development of modern radiology. There, he was introduced to the invasive angiocardiography, a special diagnostic technique to which he was devoting his limitless energy until his premature death. Professor Stanko Hernja, who headed the Institute of Radiology at the time, realised that it was necessary for his talented and ambitious colleague to forward his career in a larger medical centre. Professor Obrez accepted his invitation and in 1965 joined the Ljubljana Institute of Radiology.

After the initial impetus given to radiological science in Sweden, further advances in radiology were made in the U.S.A. Professor Obrez was convinced that radiologists from a relatively small and technologically inadequately developed country should extend and enhance their knowledge abroad, in institutions offering innovative programmes, and then apply the acquired knowledge to the radiological practice in their country. He, therefore, applied for the postdoctoral training post at the Stanford University, California, one of the leading medical centres in the world, which boasted an outstanding radiological department headed by Professor Margulis, a descendant of a Novi Sad family. Prompted by unconditional professional support given by Professor Hernja, hospital authorities in Ljubljana awarded Professor Obrez a scholarship for the proposed continuing education. The investment in his training paid off very soon. In the U.S.A., Professor Obrez was awarded the Newel Prize for his innovative

work. Immediately upon returning home, he set to introduce the new invasive angiocardiographic technique which was practically unknown at the time. He applied the knowledge and skills acquired in Sweden and the U.S.A. to the radiologists in Slovenia and Yugoslavia, pioneering routine use of catheterization of cardiac chambers and vessels. He unselfishly communicated his knowledge to his colleagues and soon brought together a team of competent invasive radiologists. Their close collaboration with clinicians, particularly with cardiovascular surgeons, resulted in markedly improved results of treatment in the University Medical Centre Ljubljana. In 1971, Professor Obrez and his co-workers from the Institute of Oncology won the Boris Kidrič award for their achievements in radiology. The same year, Professor Obrez defended his doctor's thesis »Renal angiography- A clinical and experimental study« at the Faculty of Medicine Ljubljana. The status of an Assistant Professor of Radiology was conferred on him in 1972. In 1973 he was elected lecturer at the Chair of Radiology, University of Ljubljana, and in 1979 Associate Professor of Radiology. He advanced to the rank of a Full Professor in Radiology in 1984.

In the 1970s it became evident that in the coming decades the trend in radiology would be towards interventional radiological techniques. In the school year 1971/72, Professor Obrez was staying at Stanford University as a visiting professor. On returning home, his primary aim was to initiate the new radiological procedures in Slovenia. The Ljubljana Institute of Radiology became a well-known teaching institution attracting prominent experts in interventional radiology from the whole territory of Yugoslavia. The development of radiology in the world continued at an extremely fast rate. To keep abreast of these advances, Professor Obrez held a visiting professorship at the Harvard University, Boston and at the University of California, San Francisco in the year 1981/82. His professional activities met with great acclaim. He was a member of the executive board of the European Society of Cardiovascular and Interventional Radiology, and its president for the period 1982-1983.In 1983, he organised the congress of European and American interventional radiologists in Dubrovnik, followed in 1984 by a very successful international symposium on contrast media and new technologies in radiology, which was held in Portorož, Slovenia. Professor Obrez was appointed a national representative in the bureau of European Association of Radiology in 1985, a honorary member of radiological societies of Czechoslovakia in 1981, of Hungary in 1984 and of Poland in 1986.

He was a member of the editorial boards of the following professional journals: Zdravstveni vestnik, Radiologia Iugoslavica, Radiologia Diagnostica, Cardiovascular and Interventional Radiology, European Journal of Radiology, Der Radiologe, Frontiers in European Radiology and Annales de Radiologie.

His bibliography includes more than one hundred papers published in the national and international literature. He contributed a number of chapters on radiology to professional manuals and handbooks. He was one of the pioneers of interventional radiology at the national and international levels, as shown by his numerous contributions to renowned international journals, such as Radiology, Investigative Radiology, Journal of Canadian Association of Radiology, most of them written together with the most distinguished experts in the field, like Professor Abrams.

During the period 1974-1989, Professor Obrez headed the Institute of Radiology in Ljubljana. After the restructuring of the University Medical Centre he was appointed a director of the Institute, and he held this office until his premature death in 1989. His taking office at the Institute of Radiology coincided with the moving of the Institute to new premises which boasted modern techno-

logical equipment. His predecessor, Professor Hernja, had set up a modern centralised radiological department separated into several diagnostic units according to the Swedish model. Professor Obrez continued with establishing the CT, ultrasound and cardiovascular radiology units, and with renovating the units at other locations. With great dedication and tenacity he strove to get quality technological equipment for the Institute and to ensure the funds required for its work. Like his predecessors, he frequently fought bureaucratic battles with those who tended to lessen the role of radiology in the clinical medicine.

Professor Obrez initiated a number of modern diagnostic and therapeutic procedures, many of which are still in routine use today. Also, he attracted and trained a skilled team of specialists who successfully carried on his work in the interventional radiology. Professor Obrez was known as an excellent teacher. His meticulously prepared lectures were admired not only for their high professional standard but also for the visual experience they provided.

Professor Obrez devoted the largest share of his time and energy to radiology, yet his interests were not restricted only to the field of medicine. History was his main interest away from hospital, and he intended to pursue his hobby after the retirement. Yet, his early death prevented him from carrying out his plans.

Professor Obrez will always be remembered as an outstanding radiologist and a Slovene intellectual with international reputation. Thanks to his professional excellence, language skills, and self-confidence and warmth in his behaviour towards other people he easily made friends world-wide. He was a true ambassador of Slovenia in the world.

Professor Obrez occupies a very special place in the history of Slovene medicine. In the memory of his colleagues who had the fortune to meet him and to work with him he will always stay as an understanding colleague, outstanding teacher and talented radiologist who had made invaluable contributions to the development of radiological science. His work constitutes a firm foundation on which we continue to build the edifice of modern radiology.

Vladimir Jevtič

Radiol Oncol 2000; 34(2): 85-91.

Defecography: a report on 35 cases

Breda Jamar, Katarina Šurlan

Clinical Radiology Institute, University Medical Centre, Ljubljana, Slovenia

Purpose. *To evaluate indications in the patients referred for defecography to our Institute between October 1996 and December 1999.*

Patients and methods. *In this period, 35 patients (31 women and 4 men, their mean age being 56,5 and 34,5 years, respectively) with defecation disorders of 1 month to 17 years of duration were referred to us for defecography - 26 from proctology specialists and 9 from internal medical out-patient departments. After the rectum was filled with thick barium paste, spot shots from lateral position were made in different phases of defecation, with the patient sitting on a specially designed commode.*

Results. *Rectocele was found in 21 cases, in 9 cases in association with rectorectal intussusception, in 3 with rectoanal intussusception and in 2 with herniation of rectal wall into ishiorectal fossa. Prolapse was found in 2 cases, and 4 rectorectal intussusception, 1 rectoanal intussusception and 3 fistulas were diagnosed. The findings were normal in only one case, while in 3 cases defecography showed functional abnormalities. In female patients, symptoms started after gynaecological operation in 11 cases and in 6 cases after delivery. Eight women had to press perineum with their hand to facilitate defecation.*

Conclusions. *Defecography proved useful in clarifying the pathology underlying patients' difficulties.*

Key words: defecation; rectal diseases - radiography; intussusception; ulcer

Introduction

Defecography is a very simple functional X-ray examination. It evaluates the anatomy and the function of the anal canal and rectum, and assesses movements of the pelvic floor in people with defecation disorders.[1] It was first described in 1952 [2], but only a few reports on the topic were published by 1984, when the interest in defecography started to rise again.[3] Since then, the examination has obtained an important role in the diagnosis of functional and structural abnormalities of the anorectum.

In Slovenia, the first defecografy was performed at the Ljubljana Clinical Institute of Radiology in 1993. Chronic constipation, difficult or prolonged evacuation, and incontinence were the most common referring diagnoses in our series. We were interested in whether the examination could clarify the pathology underlying the patients' problems, which - by their nature not life-threatening but quite often rather embarrassing - make

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patients uneasy to seek medical help and thus prolong their suffering.

Patients and methods

From October 1996 to December 1999 we performed defecography in 35 patients, 26 women (mean age 56,5 years) and 4 men (mean age 34,5 years). The referring physicians were proctologists in 26 cases and specialists of gastroenterology in 9 cases. The indications for the examination were: suspected rectocele (11), chronic obstipation (10), incontinence (3), solitary rectal ulcer (3), fistula (3), prolapse (2), psychoorganic syndrome (2), and pain at defecation (1).

The procedure of defecography was carefully explained to the patients. They were instructed to apply a laxative suppository (Dulcolax) two hours prior the examination. With the patient in the left decubitus position, the empty rectum was then filled with 250-300 ml of thick barium paste (Prontobario esofago, Bracco, Milan, Italy) by means of rectal sound and plastic syringes. The patient was seated on a specially designed commode (Figure 1), mounted on the footboard of fluoroscopy stand in an upright position. Spot films of the anal canal and rectum in lateral position were made at various phases of defecation: 1 - at rest (Figure 2), 2 - during squeezing (Figure 3), 3 - during straining (Figure 4, 5), and 4 - at the end of evacuation (Figure 6). Movements (elevation and descent) of the pelvic floor were observed as well as any structural anomalies which may have become evident during defecation (e.g. rectocele, intussusception etc.), and the time and the extent of rectal emptying were evaluated.

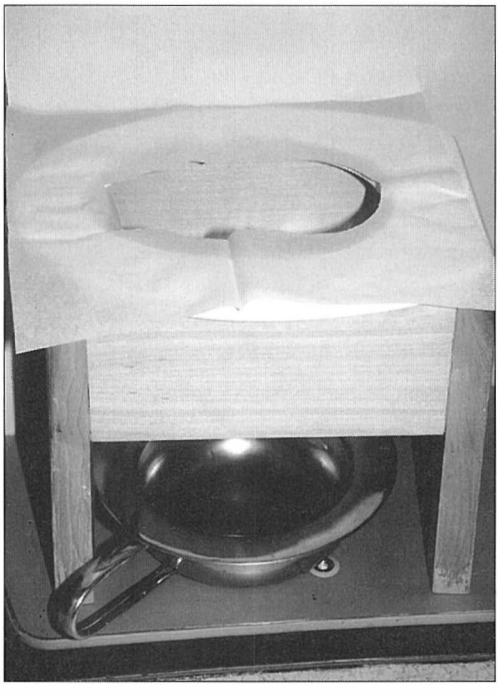

Figure 1. Commode for defecography.

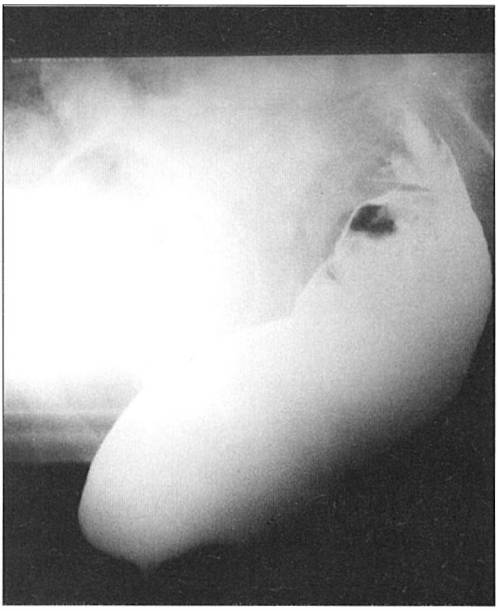

Figure 2. Rectum and anal canal at rest.

Results

In our group of patients, rectocele was diagnosed in 21 cases, many of them in association with other structural abnormalities. Anterior rectocele was found in 7 cases. The

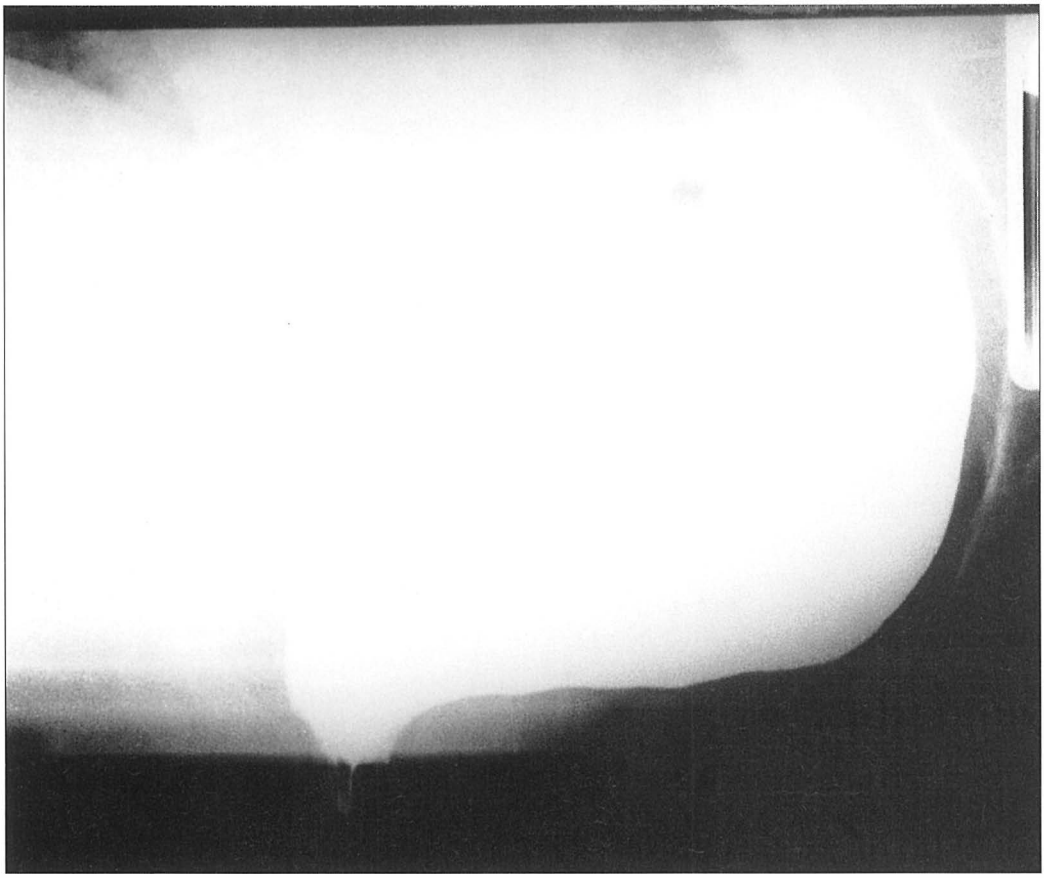

Figure 3. Rectum and anal canal during squeezing - pelvic floor is elevated.

indications for defecography were: suspected rectocele in 4, chronic obstipation in 2, and solitary rectal ulcer in 1. Rectocele in association with rectorectal intussusception was found in 9 cases, with indications as suspected rectocele in 5, and chronic obstipation in 4. Rectocele with rectoanal intussusception was found in 3 patients, all with the diagnosis of chronic obstipation. Rectocele with herniation of a part of rectal wall into ischiorectal fossa was diagnosed in 2 cases, in 1 patient with the diagnosis of chronic obstipation and in another with the diagnosis of psychoorganic syndrome. Rectorectal intussusception was found in 4 cases: 2 patients had diagnosis of suspected rectocele and 2 had solitary rectal ulcer. In 3 patients with clinically suspected fistulas we proved all three, one rectovaginal, one intraanal and one rectocutaneous. In 2 cases we confirmed the clinical diagnosis of prolapse, with no other structural changes. Rectoanal intussusception was diagnosed in 1 case of incontinence. Functional disturbances were found in 3 cases: in 2 clinically incontinent patients poor movement of pelvic floor and a wide open anal canal were observed, in 1 patient with the diagnosis of psychoorganic syndrome prolonged evacuation time and incomplete evacuation were noted.

The shortest period from the onset of symptoms to defecography was one month. This was the case of a woman, the oldest in our group, who had rectal prolapse. The patient, who had been suffering from disturbed defe-

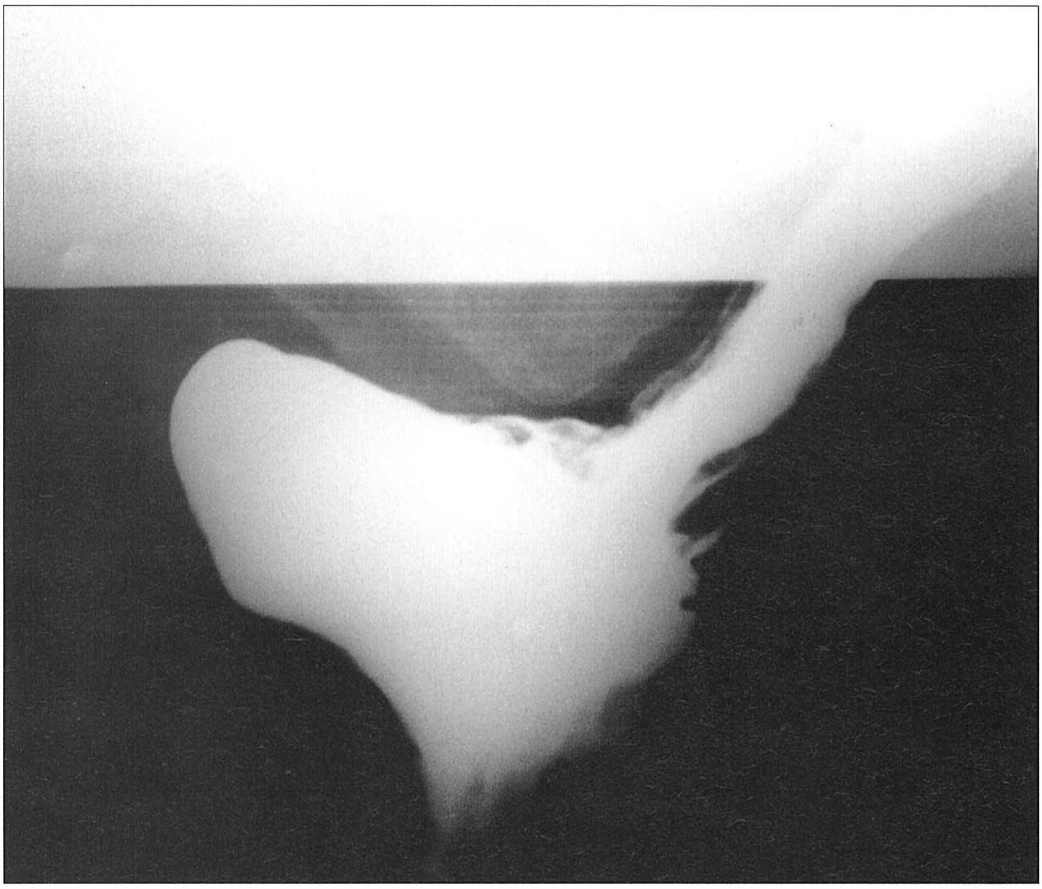

Figure 4. Rectum and anal canal during straining - formation of an anterior rectocele.

cation for 17 years, was a woman, a mother of four children. Her symptoms started at the birth of the first child and were getting worse with each delivery. In most female patients the symptoms lasted for several years, 4-5 years on the average. In 11 female patients the symptoms started after gynaecological operation, in 6 after birth delivery. Eight of these women had to help themselves to begin and/or to facilitate defecation by hand manipulation.

There were only 4 male patients in our group. Their symptoms were different from the women's: 2 had solitary rectal ulcer syndrome and 2 had fistulas.

Discussion

Defecography is a dynamic radiologic investigation of the rectum and anal canal in which the patient is studied seated on a special commode and recordings are obtained at rest, during straining and during evacuation.[4] Double contrast barium enema and endoscopy are static examinations that do not allow a detection of functional anomalies. Even proctoscopic examination during straining cannot reveal all the abnormalities.

The advantage of defecography is its ability to reveal internal (rectorectal or rectoanal) intussusception, as this may develop into rectal prolapse. Thirteen of our patients had intu-

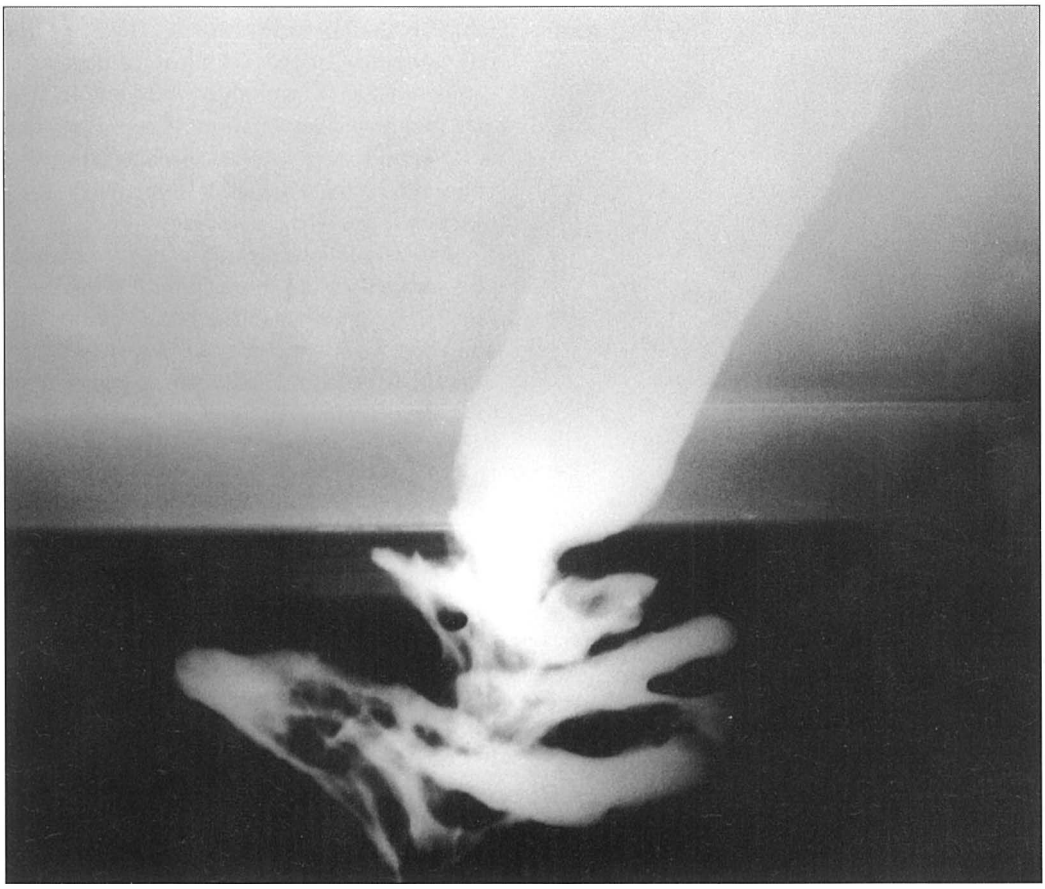

Figure 5. Rectum and anal canal during straining - formation of recto-anal intussusception.

ssusception of the proximal portion of the rectum into the distal one and 4 had intussusception into the anal canal. The internal rectal intussusception has various stages of severity and milder forms are now considered normal.[1] Elsewhere,[4] instussusception was found in only 19% of cases. Most likely, our relatively high number can be explained by two facts: first, also milder forms were found in our retrospective study, and second, only severe cases of difficult defecation were referred to us for defecography, the examination not being well known or even recognised as yet in Slovenia. It is only performed at our Institute.

Solitary rectal ulcer syndrome is an entity that consists of a benign rectal lesion, accompanied by disorders of defecation, most often caused either by rectal intussusception or spastic pelvic syndrome.[3] Three of our patients had endoscopically diagnosed solitary rectal ulcer. At defecography, rectal intussusception was found in two cases, and rectocele in one.

Rectocele is an outpouching (hernial protrusion) of the anterior rectal wall. It is a quite common finding, but most likely of no clinical importance unless large and associated with the retention of contrast material.[1] In our group of patients rectocele was found in 21 cases, the incidence being high, if compared to other studies.[1,3] However, in all our cases the retention of contrast material in the rectum was observed.

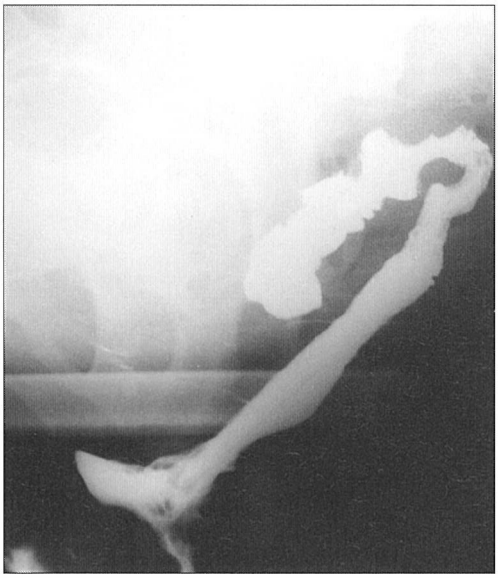

Figure 6. End of evacuation - rectum is empty, a small anterior rectocele is formed.

Defecography is a dynamic X-ray examination of functional and morphologic abnormalities of the anorectal region. It is also very useful and, as proved in 3 of our cases, sometimes the only imaging modality to detect fistulas. A young woman suffering from Crohn's disease was examined by a gastroenterologist, gynaecologist, proctologist, and abdominal surgeon because of her complaints suspective of a fistula. When it was not found at repeated endoscopic examinations, the patient's complaints were disbelieved by the examiners. At defecography, a rectovaginal fistula was proved. In the other two cases, both male patients with clinically suspected fistula and no prior examinations, fistulas were found at defecography: in the first one - a patient suffering from Crohn's disease - rectocutaneous fistula with subcutaneous abscess, and in the other - with previous surgical procedure - intraanal fistula was demonstrated.

In our series we found only three cases of functional anomalies with no structural changes: in two incontinent patients wide open anal canal and poor movement of pelvic floor, also reported by other studies [5], and in one patient with the diagnosis of psychoorganic syndrome, prolonged evacuation time and incomplete evacuation were noted. The latter abnormality was described as anismus - impaired rectal evacuation secondary to a functional disturbance of defecation.[6]

Two cases of lateral outpouching of the rectal wall were found in our group of patients. Since defecography is usually done in the lateral projection, the anomaly which could be described as lateral rectocele or herniation into the ischiorectal fossa, i.e. ischio-rectal hernia [7], was observed in the AP projection. Hence the recommendation given by Kaasbol et al.[8] that not only lateral but also AP and/or oblique projections should be used at defecography, gained validity.

As in other studies[1,6,9], the majority of our patients were women (31 out of 35). It has been well established[10,11] that symptoms of disturbed evacuation may start after gynaecological operation (11 cases in our group) or after birth delivery (6 cases). Most disturbing in our series is the long history of symptoms: women, especially those 8 in our group who had to help themselves with their hands at defecation, were too embarrassed to seek medical help earlier. And after they did, they were »treated« by bulk laxatives, given dietary advice and, two of them, even prescribed sedatives.

Conclusion

Defecation disorders have many causes and defecography is a useful imaging modality for detecting functional and structural abnormalities in the anorectal region. In our study the correlation between symptoms and defecographic findings was good, while in other studies this correlation was poor.[1,12] Our good result is most likely based on the fact that defecography is not yet a widely recognised examination in Slovenia, so that only patients

with long-lasting and severe symptoms were referred for the examination. This is also the cause of the small number of patients in our series.

We have no data of the impact of our defecographic results on clinical decisions or treatment of our patients. If nothing else, we could objectively assess the reasons for defecation problems and to explain them to the worried patients. It was quite a relief to many of them to hear their problems really had anatomic and physiologic explanation.

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Radiol Oncol 2000; 34(2): 93-9.

Transjugular intrahepatic portosystemic shunt (TIPS)

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[1]Clinical Institut of Radiology, [2]Gastroenterology Departmant of Internal Clinic, Clinical Centre, Ljubljana, Slovenia

Background. *A clear presentation of TIPS indications and contraindications, which can be divided into absolute and relative, is given. Absolute indications are fresh and renewed bleeding of varices and inveterate ascites. Relative indications, on the other hand, are splenomegaly with hypersplenism, Budd-Chiari syndrome, liver transplantation and hepatorenal syndrome. Absolute contraindications are severe liver dysfunction and right heart failure, while the relative ones are polycystic liver degeneration, neoplasm, obstruction of the portal vein and severe local and systemic infection. Before the TIPS procedure, the level of dysfunction of the liver, right heart and kidneys is determined. Biochemical and blood tests, including a blood coagulation test, are made, the ammonia level in the serum is determined and possible obstructions/strictures of the portal vein are checked. A detailed description of the procedure, a care for patient and a postoperative monitoring are given. The success rate of the procedure is between 93 % and 100 % and the mortality rate within 30 days because TIPS is between 1 % and 3 %. The hemorrhage is stopped in 95% to 100%, the ascites is improved in 87 % to 92 % and the kidney function in 81 %. In case of hypersplenism the trombocytopenia is improved in 75 % and levcopenia in 50 % of patients. There are relatively few complications during the procedure. Postoperative complications are more frequent due to the stricture and obstruction of the shunt. After a two-year treatment the shunt is passable in 50 % of patients. Thus, in a group of 29 patients, who were treated in the period of four years with an average monitoring period of two years, 22 patients (75,9 %) are still alive and only 7 died (24,1 %). Six of the dead patients suffered from alcoholic cirrhosis of the liver. In two cases the cause of death was not related to the TIPS and the cirrhosis of the liver.*

Conclusions. *TIPS is an efficient method in stopping recent varicose bleeding, unsuccessfully treated with endoscopic sclerosation or medicaments. It is the most efficient method to lower portal pressure before liver transplantation and ensures safe waiting for liver transplantation and improves conditions for its success.*

Key words: protosystemic shunt, transjugular intrahepatic

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Introduction

The creation of TIPS is a procedure of interventional radiology to lower the portal pressure and treat or avoid complications of the portal hypertension due to liver cirrhosis.

The portal hypertension is defined as a pressure in the portal vascular system over 10-12 mm Hg, or 17-20 cm H_2O.

Due to a high portal pressure, several complications are obtained: GI bleeding, ascites, splenomegaly with hypersplenism and liver encephalopathy. Complications can be treated conservatively, with endoscopic sclerosation and operative procedures - ligation of varicose veins, portal and mesocaval shunts and splenorenal shunts, and nowadays with TIPS.

The first report on TIPS was given by Rosch in 1969[1], and it was clinically introduced by Colopinto in 1982.[2]

After the use of a metallic stent for forming the shunt by Richter in 200 patients, the procedure became used more often.[3] Colopinto used only a balloon dilatation for the shunt formation through the liver tissue before that.

In Slovenia we performed our first TIPS in 1994 in a patient with re-bleeding from varicose veins.

Indications

Indications for TIPS are complications of portal hypertension due to liver cirrhosis. We divide them into absolute and relative. Absolute indications are acute bleeding from varicose veins, in cases where other less invasive methods are unsuccessful, varicose veins re-bleeding and ascites and/or hydrothorax unsuccessfully treated conservatively.[3,5-7] Relative indications are hypersplenism , avoidance of complications before and after liver transplantation, Budd-Chiari syndrome and hepatorenal syndrome.[3,5-7]

Contraindications

Contraindications are also divided into absolute and relative. Absolute are profound liver dysfunction and right heart failure.[5-7] Relative contraindications are polycystic liver disease, portal vein thrombosis, liver neoplasm, profound liver encephalopathy and systemic or local liver infection.[5-7]

Preprocedure patient preparation

Before performing TIPS we grade the liver dysfunction according to Child-Pugh, evaluate the right heart function and the renal function because of the use of contrast media. Laboratory liver tests are performed, with serum NH_3 measurement. Basic lab tests of prothrombin time and partial thrombin time are done. We determine the patients' blood group and Rh factor.

With a Doppler US or an indirect portography we obtain the portal vein patency.

Patients' clinical state must be stabile. In case of active bleeding the Blakemore's tube is placed to compress the varicose veins.

Technique

A patient is introduced with the plan and the purpose of the procedure. Most procedures are performed in general anesthesia with intubation. The procedure is performed with DSA equipment. The patient is in supine position, with head turned slightly to the left. The right side of the neck is sterile washed, the upper part of the body and head are then sterile covered.

We use transjugular approach, with the puncture of right internal jugular vein with 18 gauge puncture needle. The puncture is controlled by US, which is especially important in coagulopaths. A guide-wire of 0,035 inches is entranced into the right or intermediate liver

vein with the help of curved catheter of 5 F. A catheter sheath of 10F and 40 cm long, with a haemodynamic valve is introduced over guide-wire in the liver vein. A balloon catheter is entranced to close the hepatic vein and 20 ml of CO_2 is injected to obtain a portal venography with DSA. This is important for the determination of the direction and the site of the puncture of the portal vein. We introduce the catheter needle set for the puncture of one of portal veins into the chosen hepatic vein. It contains Teflon tapered catheter of 9 F, with Colapinto needle of 14 gauge inside. The needle has a curved edge to point the direction of the portal vein. The angiographic catheter of 5 F is introduced into the Colapinto needle, to help us, under the support of guide-wire, to introduce a quite rigid needle through the catheter sheath into the hepatic vein. At the puncture site, which is 2-3 cm away from hepatic vein branching, we remove the guide -wire and the catheter. The Colapinto needle is rotated, so its edge is pointed toward a chosen portal vein close to the bifurcation. This is controlled by fluoroscopy in a side projection. If the needle is in the right hepatic vein, the edge is rotated anteriorly and if it is placed in the intermediate vein, it is rotated posteriorly because the intermediate vein lies more anterior than the bifurcation of portal veins. The puncture is performed with a long, sharp needle coated in 5F smooth, Teflon catheter. The needle is 8 cm longer than the Colapinto needle. The distance between a puncture site and big branches of the portal vein is usually 4-6 cm. The puncture is blind or performed under the control of Doppler US. After the puncture, the needle and the catheter are removed slowly, with aspiration. When we aspirate greater amount of blood, we inject contrast. If we, therefore, see one of bigger portal veins, we introduce guide-wire, usually Terumo »J« 0,035 inches or Teflon wire of the same diameter with a very soft edge. The guide-wire is introduced into the superior mesenteric or splenic vein. The catheter is then pushed into a portal vein stem. Through this catheter the guide -wire is exchanged, for 180 cm long, with 0,035 inches diameter, firmer, for better support during the further catheterisation. The first catheter is exchanged for the aortographic catheter through which we measure the portal pressure and perform the portography. After removing the Colapinto needle and the catheter we perform a dilatation of the tract between the portal vein and hepatic veins in the liver tissue with the use of two balloon dilatation catheters, with 8 and 10 mm in diameter. The length of the tract is measured, and a metallic stent of 12 mm in diameter is placed into it. The metallic stent can reach as deep in the right portal branch as is the bifurcation and 0,5-1 cm deep into the hepatic vein. If the hepatic veins' orifice is narrowed, the stent is placed deep into the veins towards the orifice (Figures 1a, 1b).We mostly use self-expanding stents-Wallstents for TIPS, because it is flexible, with grate radial force.[8] Its disadvantage is the uneven shortening of the stent while expanding, so the precise positioning is demanding. It has been improved lately, but not completely. After the stent placement the aortography catheter is introduced and the control portography is obtained (Figure 2), with the measurement of the portal pressure. If the shunt is adequate on portogram, with smooth contours, and without grater flow through varicose veins, the portal pressure is usually satisfactory. If not, a dilatation is repeated with a balloon dilatation of 10 mm, in particular the sites of a passage through the vein wall. If the bifurcation of hepatic veins is narrowed, and the portal pressure is therefore still high, due to regenerated liver tissue pressure, another stent is placed into the stenosis (Figures 1a, b). When the portal pressure is satisfactory, which is usually between 20-28 mm Hg, the procedure is finished and the catheter sheath is removed from the jugular vein.

Patients, who are coagulopaths of underwent complications during the procedure, are

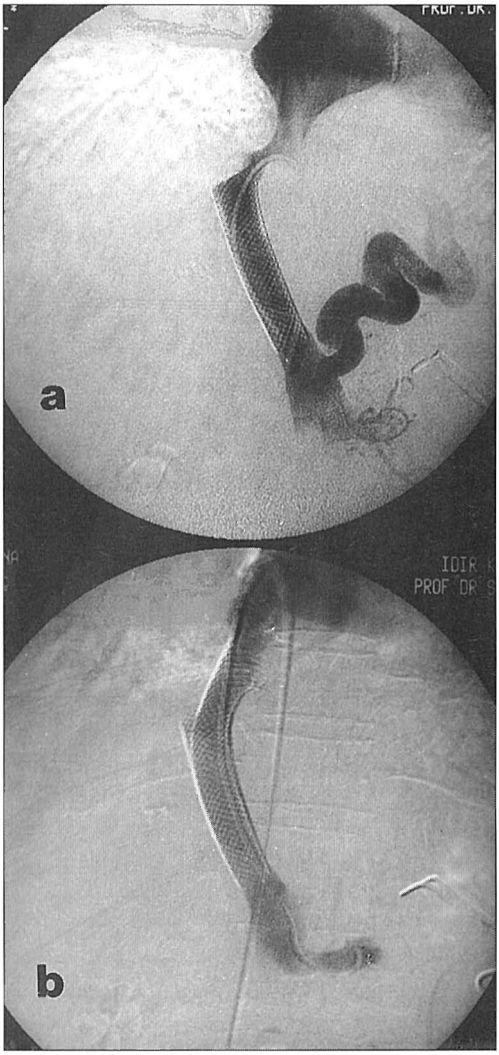

Figure 1a, 1b. Control portography and pressure measurement in portal vein.
a. Ostial stenosis of hepatic veins and hepatic segment of VCI, caused by regenerated liver tissue in cirrhotic liver and fibrosis. Pressure drop in portal vein to 30 cm H_2O was insufficient for the ascites treatment. This was confirmed with a collateral blood flow.
b. With a dilatation of stenosis we showed that stenosis was elastic. After the additional Wallstent placement the pressure in the portal vein dropped to 20 cm H_2O and the vein collateral system was not seen any more. With a diuretic support ascites resolved.

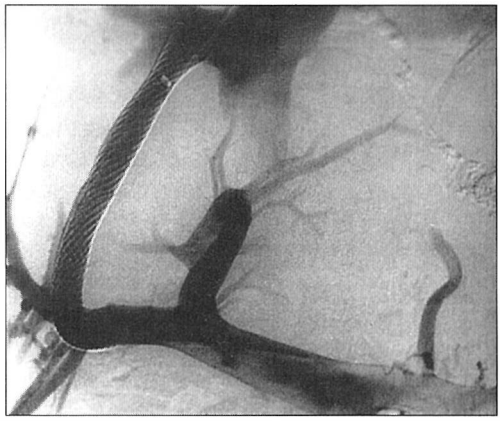

Figure 2. TIPS was preformed in a patient with recurrent bleeding from varicose veins. Quite a long shunt created with Wallstent connects the right branch of the portal vein with hepatic veins close to its orifice. A stent is placed in the portal vein peripheral from the bifurcation. Portal blood flow through the branches is preserved. Collateral blood flow is not seen.

transported to the intensive care unit, and otherwise into the half-intensive care for the first 24 hours. During hospitalization the control laboratory liver tests are performed and serum NH_3 level is measured. The control Doppler US is performed to obtain blood flow in the shunt and portal vein.

Long term TIPS patency

TIPS patency is first controlled after 3 months and then every 6 months. The patency is diagnosed with Doppler US and portal venography. Doppler US is a very reliable method.[9,10] The signs of the shunt malfunction are drop of shunt velocity below 90 cm/sec, change in blood flow direction, and greater drop in portal vein velocity. According to US, we can decide to do the venography with the pressure measurement, which is a golden standard for the definitive diagnosis of the shunt patency.

The shunt occlusion is important if stenosis over 50 % of pressure gradient between the portal vein and the right atrium is greater than 15 mm Hg and if varicose veins are fulfilled

again. Varicose vein bleeding or any other clinical sign is, of course, the sign of shunt occlusion. Patients suffering with shunt occlusion have clinical problems in 25%.[11]

A success rate in TIPS

TIPS is successfully performed in 93-100 %. The mortality rate is inside first 30 days approximately 10 %,[11] due to TIPS procedure in 1-3 % of cases. TIPS does not effect the original disease. The survival rate is not only dependent on the shunt function, but also on the liver function and original disease.

Success rate in different indications

Varicose veins bleeding is stopped in 90-100 %. Re-bleeding after TIPS occurs in 20 % of cases in longer time period.[11]

Re-bleeding can be stopped with sufficient procedures on TIPS - dilatation, thrombolysis, thrombectomy, another stent placement and additional TIPS. Inveterate ascites and hydrothorax , unsuccessfully treated conservatively are improved in 87-92 %.[12] Secondary hypersplenism is improved in 30 days after TIPS, thrombocithopenia in 75 %, leucopenia in 50 % and both together in 33 %.[13] In hepatorenal syndrome the kidney function is improved in 81 % after TIPS.[14]

Complications

A bigger haematoma due to arterial puncture in coagulopaths is obtained.

Severe cardiac arrythmia is experienced due to guide-wire and catheter entrance through the right atrium.

Due to almost blind puncture of the portal vein, hepatic artery injury, biliary tract injury, or hepatic capsular damage and consequently abdominal bleeding can occur.

Pneumothorax and right atrium injury can occur. To avoid these complications an experienced radiologist is essential. The stent can be misplaced or moved by itself or can bent during the entrance and shunt can be occluded by additional thrombosis.

Late complications

Late complications are related to the shunt patency, which progressively lowers with time, due to intimal hyperplasia in the parenchimal part of the shunt and/or neointimal hyperplasia in the hepatic vein. The patency after first 6 months is 71 %,[11] after 12 months 58-66 %[11,15] after 2 years 42-49 %.[11,15] One of the main reasons for intimal hyperplasia in the shunt is biliary fistula. The entrance of bile and thrombogenic mucin into the shunt accelerates thrombosis and hyperplasia. Some authors, therefore, suggest the exchange of the stent for endoprothesis.[12]

The causes of neointimal hyperplasia are probably hepatic vein reaction on the injury during the shunt performance, chronical irritation due to the stent placement, and change in haemodynamics in the hepatic vein due to the stent placement.[16] In our cases stenosis in the upper part of the shunt was caused by too low placement of the stent or by stenosis of veins at or around bifurcation, due to the regenerated liver tissue in the cirrhotic liver.

TIPS and liver encephalopathy

After TIPS the liver encephalopathy occurs in 12-36 % of cases.[11,17] It is often hard to find out if the complication preexisted or not.[18] The causes of higher probability for the development of encephalopathy are: preexisting liver encephalopathy, non-alcoholic liver disease, a grade of liver dysfunction, age over 60 years, shunt diameter , gradient pressure between the portal and the systemic vein blood flow.[7,8,19,20]

Experience of The Clinical Institute of Radiology in Ljubljana with TIPS

In The Clinical Institute of Radiology we treated 41 patients between March 1994 and December 1998, mostly from The Internal Clinic of Gastroenterology in Ljubljana.

The procedure was successful in all cases. We have known data for 29 patients, treated and followed between March of 1994 and March 1998, with average follow up time of 2 years. The cause of the portal hypertension was alcoholic liver disease in 15 patients (50,4 %), inflammatory liver cirrhosis in 13 patients (44 %) and Budd-Chiari syndrome in one patient (3,4 %). According to Child-Pugh's clinical grading, 3 patients (10,3 %) were in group A, 12 (41,3 %) in group B and 14 (48,2 %) in group C.

The indication for TIPS was in 24 (82 %) re-bleeding from varicose veins. 3 (10,3 %) needed TIPS due to inveterate ascots. In one case TIPS was performed before the liver transplantation to avoid complications before and during the transplantation. In a young patient, 23 years old, we performed TIPS because of hepatic vein thrombosis and saved her life.

Treatment evaluation

Out of 29 patients 22 are still alive (75,1 %), 7 patients died. Four patients haven't survived 6 months. One of those, 34 years old alcoholic died 3 month after in a car accident, and 23 years old patient died from bleeding out from the undiagnosed aortic aneurysm of descending aorta. Six out of 7 patients, who died, were alcoholics.

Complications

Two patients had severe bleeding after TIPS. One was bleeding into the pleural space one day after the procedure. The bleeding started after the removal of a portal vein catheter, used for the portography during TIPS. The other was bleeding due to, probably, the injured liver capsule. Both received transfusion. In the first case thoracic drainage was performed. Both patients were alcoholics, age 34 and 35. The first lived 2 years after TIPS. In the second patient the shunt occluded due to stent bending. He refused the additional TIPS, and died 2 months after leaving the hospital, probably from varicose vein bleeding.

We had 3 late complications with theshunt occlusion, in 2 patients we performed the dilatation and in the third we placed a stent. Occlusion was diagnosed with Doppler US in 2 patients, and in one the varicose bleeding occurred.

Conclusion

TIPS is an efficient method in stopping the recent varicose bleeding, unsuccessfully treated with the endoscopic sclerosation or medicaments. It is usually the bleeding from gastric varicose veins. Most often we lower the portal pressure in re-bleedings and inveterate ascites. Shunt stenosis or occlusion prevents the primary long or life lasting pressure control in the portal system. The secondary shunt patency can improve that, but for that we need a good follow up of patients, which is especially hard in patients with alcoholic liver disease. TIPS is the most efficient method to lower the portal pressure before the liver transplantation and ensures the safe waiting for the liver transplantation and improves conditions for its success.

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review

Diagnostic imaging, indications and measurements for the treatment of aortic aneurysm by endoprosthesis

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Background. *This paper presents imaging diagnostics of an aneurysm of the aorta, indications, common contraindications and measurements for the construction and selection of an endoprosthesis. The examination using ultrasound is the most handy and economically justifiable method for detecting an aneurysm of the aorta, for monitoring asymptomatic aneurysms as well as patients having undergone an operation or those with an endoprosthesis. Another examination to visualise the aortic aneurysm is CT with or without contrastive medium. The plan for treating an aneurysm can be made with the help of a DSA, helical CT angiography and/or MRA. DSA shows well the lightness of the aneurysm and the aorta, as well as the changes inside of it, large arteries close to the aneurysm and the condition of pelvic arteries for the selection of the approach. The helical CT angiography and MRA in two or three dimensional reproduction in several directions enable an accurate measurement of an aneurysm, the aorta diameter above and below the aneurysm, and the evaluation of the quality of its wall.*

Conclusions. *The indication areas for endoprosthesis are aneurysms of the abdominal aorta and those of the descending part of thoracic aorta. The treatment with endoprosthesis as a less invasive method is indicated in patients who risk a number of complications and even high mortality when treated surgically. Endoprosthesis is made of metal stent and prosthesis. The stent attaches the endoprosthesis to the unaffected part of the aorta above and below the aneurysm, it sets the stent asunder and provides support. The prosthesis is made of Dacron synthetic fabric, which has very good properties for this purpose such as small compliance, porosity, permeability and extensibility. The endoprosthesis is introduced into the aorta through a catheter system with the help of a special guide wire. The entering point is surgically opened common femoral or iliac artery.*

Key words: aortic aneurysm-diagnosis-therapy; tomography, x-ray computed; magnetic resonance angiography; angiography, digital subtraction; blood vessel prosthesis

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Introduction

Aortic aneurysms are consequences of atherosclerosis, inflammatory and degenerative changes in the aortic wall and posttraumatic changes of its wall. It is most commonly found in abdominal aorta, followed by the ascendent part of thoracic aorta and aortic arch, and less frequently in descendent aorta. The frequency of aneurysms, especially abdominal, is growing.[1,2] The reason for this is probably higher life expectancy and wider use of ultrasound and CT diagnostics.

Aneurysms are classified as asymptomatic and symptomatic. Symptomatic and very large asymptomatic lesions with the weakened vessel wall are life-threatening, the others being followed for enlargement. The treatment is by means of a surgical repair, lately being replaced by the percutaneous insertion of endoprosthesis[3,4] without actually opening the thorax or abdominal wall. This, less invasive approach, is becoming increasingly popular as alternative method, opposed to a surgical treatment of descending part of thoracic aorta and abdominal aorta. To be successful, it is very important to exactly plan the procedure, and various imaging techniques play a major role in it.

Imaging diagnostics

Aneurysms are most commonly found at ultrasound examination and native x-ray films. Especially ultrasound is very useful as the primary method for the detection of abdominal aneurysms. With ultrasound, it is possible to assess the extent of the aneurysm, and the presence of the thrombus in it or near it. Doppler US enables the evaluation of the remaining flow rate, its direction and quality. Ultrasound is most suitable for the follow-up of asymptomatic aneurysms and of postoperative assessment, having a very high cost-benefit as well.[5]

Aneurysms of thoracic aorta are usually found accidentally at chest radiograms or CT; less frequently it is specifically looked for due to dissection, local rupture, local pressure or haemorrhage. On chest films, it is often indistinguishable from expansive mediastinal lesions. In case of localised haemorrhage, a chest film demonstrates a local mediastinal widening or a pleural effusion. Diagnosis can be confirmed by an transthoracic or transoesophageal ultrasound examination, the latter being more reliable and accurate. It demonstrates aneurysm, dissection of the aortic wall, thrombus in the lumen or in surrounding tissues. The next diagnostic modality is CT with and without contrast material, defining aneurysms of thoracic and/or abdominal aorta, its wall, possible haemorrhage, thrombosis and contrast extravasation. It also delineates aorta above and below the affected segment.

Next, imaging modalities are directed towards the treatment planning. »Gold standard« remains digital subtraction angiography (DSA), which reliably shows aorta, aneurysms and her branches as well as iliac arteries and thus enables the possibility of treatment by stent-graft, the choice of the most appropriate entry site and implant route. DSA only demonstrates the lumen of the vessel and aneurysm. By contrast, CT angiography (CTA) and MR angiography (MRA) enable the visualisation of the aortic and aneurysmal wall, the demonstration of thrombus and the assessment of the flow within the aneurysm.[6,7]

It is important for the assessment of aortic wall quality that the endoprosthesis is firmly and permanently attached to the normal vessel wall, as opposed in the case of attaching it onto the thrombus or diseased aortic wall, where the permanence is not guaranteed. CTA (Figure 1) and MRA are very accurate imaging modalities for the procedure planning, due to the multidirectional view of tree-dimensional reconstructed images. CTA protocol is as follows: 50 rotations with the slice

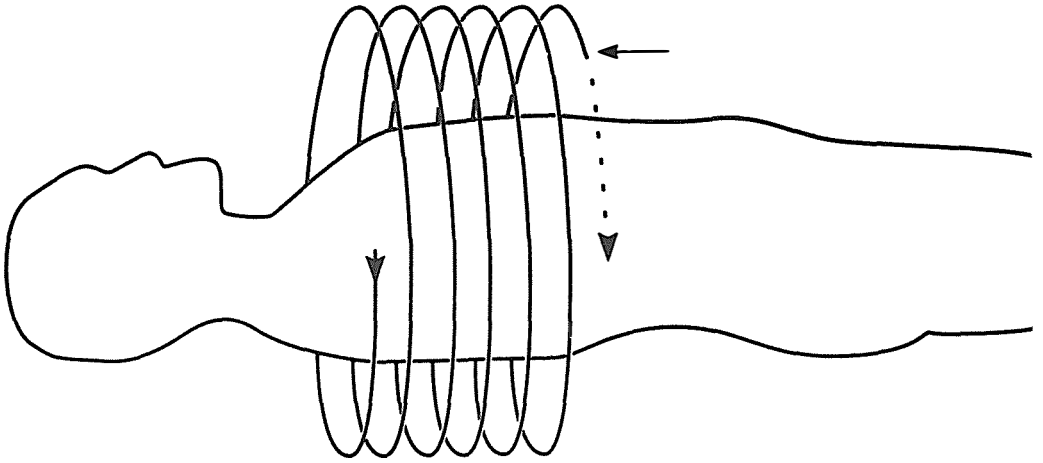

Figure 1. Schematical demonstration of spiral scan, made by x-ray tube during the table movement with the patient during CT angiography (CTA). Arrowhead indicates the scanning direction, and arrow the table direction.

thickness of 5 mm and table speed of 5 mm / sec and the continuous application of contrast material. The primary reconstruction is made with 2 mm interval so that overlapping slices improve the picture quality. Slices can be viewed in cine mode as well, so that the first impression about the endoprosthesis attachment site and the shape and the size of the aneurysm are noted. The exact measures of the width of aorta and the length of the aneurysm are possible on multiplanar reconstructed (MPR) images.[6] The alternative method is MRA, which also enables us to define the upper and the lower extent of aneurysm and its size, shape, thrombus and flow type within it.[7] As with CTA, the exact measurements are possible by MPR. Using different sequences, like two- and three-dimensional time-of-flight, turbo flash, and contrast enhancement, enables the increased diagnostic and prognostic accuracy of MRA.[8]

Indications

Indications for percutaneous treatment of aneurysms by the insertion of endoprosthesis are the same as for the surgical approach, yet the fact, that in contrast with the endoprosthesis insertion, the short- and long-term results of surgery are well known.[9,10] Planned surgical operations on aneurysms of ascendent thoracic and abdominal aorta in younger patients without additional vessel pathology are successful, but less favourable with the aneurysms of a descendent part of thoracic aorta.[10] A less favourable outcome is reported with urgent procedures, reoperations, and operations on the patients with coronary arteries disease, heart, lung or renal failure and other pathological conditions. A surgical treatment is less successful with older patients and severely diseased ones as well. In this part of the indication field, associated with a very high complication rate and high mortality, the insertion of endoprosthesis is becoming increasingly popular despite the lack of definitive long-term results, especially in the abdominal aorta, and carry a relatively high risk of complications. According to numerous reports by the group of authors from Stanford, USA, the insertion of endoprosthesis in the thoracic aorta is the treatment of choice within a definite range of indications.

General contraindications

Contraindications for the insertion of aortic endoprosthesis are i.e. sepsis, coagulopathies, contraindicated systemic anticoagulant protection during the procedure, inflamed aneurysm, extreme tortuosity and stenosed or occluded iliac arteries and/or terminal aorta. Patients with severe lung dysfunction need ventilatory support during the procedure.

Measurements

The aortic endoprosthesis is chosen individually for each patient on the basis of different diagnostic modalities, like chest radiograph, DSA, CTA and/or MRA. Chest radiograph is used to define the presence of pathology. DSA is used to assess the relations of aneurysms towards the aortic arch and great neck vessels in the upper part and celiac trunk in the lower part of descendent thoracic aorta; it also demonstrates intercostal and pelvic vessels as well. In the cases of abdominal aneurysms, the relations toward renal and iliac arteries are demonstrated. We use the calibrated catheter with measuring units, enabling us to measure the luminal diameter, as the vessel width is not a fixed constant at DSA and all units do not have associated measuring devices. CTA and/or MRA are very important for the accurate assessment of the diameter of aorta and the length of aorta above and below the aneurysm, where the stent-graft is to be inserted. The aortic length and the length of aneurysm can be different in each projection. Abdominal aneurysm and aorta above and below the lesion can produce different angles, as well as the overbifurcational aneurysm can deform the pelvic arteries angles (Figure 2). In these cases, CTA and MRA are invaluable tools to avoid the mismeasurements due to multidirectional views in three dimensions. With these multidirectional modalities, it is possible to determine the angle of bending for easier planning of treatment and to choose the most appropriate therapy. The length of unaffected segment cranially and caudally from the aneurysm should be at least 15 mm, as most of the endoprostheses have 10 mm of uncovered metallic parts for the increased longitude of the contact area with the aortic wall. It has been shown that the uncovered part of endoprosthesis does not significantly interfere with the flow through the vessels, even if it is partially inserted over them.[11,12] This is useful in cases, in which the distance between the aneurysm and renal or subclavian arteries is less than 15 mm.

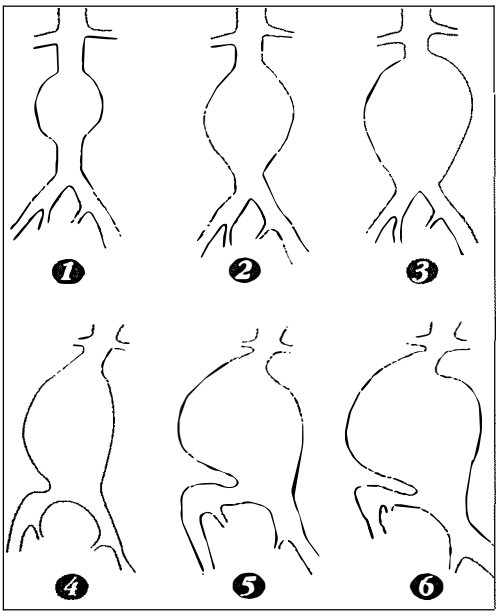

Figure 2. Morphology of the aneurysm in different stages.

Description of endoprosthesis

The aortic endoprosthesis is made of metal stent and prosthesis. A metal stent is often used for supporting the vessel wall at endoluminal dilation at the site of stenosis.[13] It is also used in the case of the endoprosthesis

insertion for its fixation towards the vessel wall, instead of sutures, and so the blood flow through the aneurysm is excluded, as well as the danger of a rupture. It sets the endoprosthesis asunder and provides it support. The stent can be of the same length or longer than the prosthesis itself. It is usually made of stainless steel or nitinol, in the first case being made on the basis of Gianturco or Palmaz stent,[3,4,11] and in the second case on the basis of thermical memory processed nitinol (mixture of nickel and titanium). Stents of this material are designed at 500°C, but during the cooling they are compressed to the lower diameter. At the body temperature it regains its former shape. Palmaz-type endoprosthesis is packed and pressed to the balloon part of the catheter, and after the release it is expanded by the same balloon to the final diameter. Other types are self-expandable, being expanded immediately after the release. Stainless steel endoprostheses expand like the spring coils, while the nitinol ones on the basis of thermal memory. Usually, the self-expandable type of endoprosthesis is being used, and it attaches itself by means of the radial pressure, forcing it to the width of two millimetres greater than aorta.

The prosthesis is made of Dacron synthetic fabric, industrially named polyethylene terephtalate (PET), which has very good properties for this purpose such as small compliance, porosity, permeability and extensibility. Inside, it is impregnated with collagen, gelatin, or albumin in order to reduce its thrombogeneity. The prosthesis is attached to the stent at many sites with 6-0 polypropylene sutures.

The endoprosthesis is introduced into the aorta through a catheter system, the width of which ranges from 17 to 27 F, depending on the size and structure of the prosthesis. The size of device is depending upon the width of aorta, the extent of pathology to be treated, and upon the quality and amount of the material used for the planned endoprosthesis. The catheter insertion systems are alike, yet every manufacturer has its special properties. All are equipped with the insertion catheter into which we insert the endoprosthesis or it is already inserted into it. It is introduced in the aorta with the use of vascular sheath or without it. Without sheath, the insertion catheter is being applied with the help of a special guide wire, measuring 0,0035 inches and 260 cm long. The entering point is surgically opened common femoral or iliac artery.

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Endovascular treatment of aortic aneurysm by endoprosthesis

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Aortic endoprosthesis are divided according to its shape, site of application, and construction material. Regarding the shape, there are tubular, unilateral and bifurcational endoprosthesis. Tubular are used mostly for treatment the thoracic aneurysms, and less for treatment of the abdominal aneurysms. For exclusion of abdominal aneurysm the bifurcational prosthesis is mostly used. Aortic endoprostheses are made of metallic support and prosthethic part. Supportive elements are made of stainless steel or nitinol, while the prosthetic part is made of dacron or PTFE. Metallic part of prosthesis attaches prosthesis to healthy part of aorta, above and below aneurysm, like sutures. It expands and gives support to the prosthesis. The procedure is precisely described for thoracic and abdominal aortic aneurysms. We describe the possible complications and the mechanism of leakage and its diagnosis. In the study are presented two cases of patients with aneurysm of thoracic aorta and one case with abdominal aorta, successfully treated in our Institution. The follow-up results after 2 years, in the patients with thoracic aortic aneurysm, and 6 months follow up in the patient with abdominal aortic aneurysm showed no signs of clinical or imaging complications. In conclusion, we were trying, on the basis of our experiences and results that have been recently published, to evaluate this method of treatment.

Key words: aortic aneurysm; blood vessel prosthesis

Introduction

Aortic endoprosthesis is used for exclusion of aortic aneurysm in abdominal and descending part of thoracic aorta. It is indicated as an alternative treatment to operation in high risk patients. It is introduced into aorta through delivery catheter system from femoral artery. First report about successfully treated aortic aneurysm of abdominal aorta was given by Benko in 1986.[1] The first results of treatment in human beings were published in 1991 and 1994.[2,3] The first placement of endoprosthesis in Slovenia was performed in 1994, under the American professor (prof. dr. Keller) supervision.[4] It was performed by ourselves in two patients with thoracic aneurysm in 1998 and in one patient with abdominal aneurysm one year later.

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Types of endoprostheses

Endoprostheses are divided according to shape, site of application and construction material. We define tubular (Figure 1a), unilateral and bifurcational (Figure 1b) prosthesis by shape. Endoprosthesis for descending part of thoracic aorta is tubular (Figure 1a), big, with diameter of 34-40 mm and 50 mm long or otherwise made by special order. It is made of self-expanding metallic support (Figure 2a) and prosthesis from dacron (Figure 1a).[3,4] Endoprostheses for abdominal aorta are tubular, unilateral or bifurcational (Figure 1b). They are made of Palmaz sent and dacron or PTEF [2,5] prothesis or Gianturco or nitinol self-expanding sent and dacron prosthesis.[3,4,6] Palmaz prosthesis is expanded with balloon catheter, others are self- expanding.[2,5] Tubular type is used for exclusion of aneurysm, which is 15-20 mm away from bifurcation. Bifurcational or unilateral type is used when aneurysm reaches bifurcation or one or both iliac arteries (Figure 1b). Tubular measure 22-30 mm, bifurcational 22-35 mm, iliac artery part 10-18 mm.

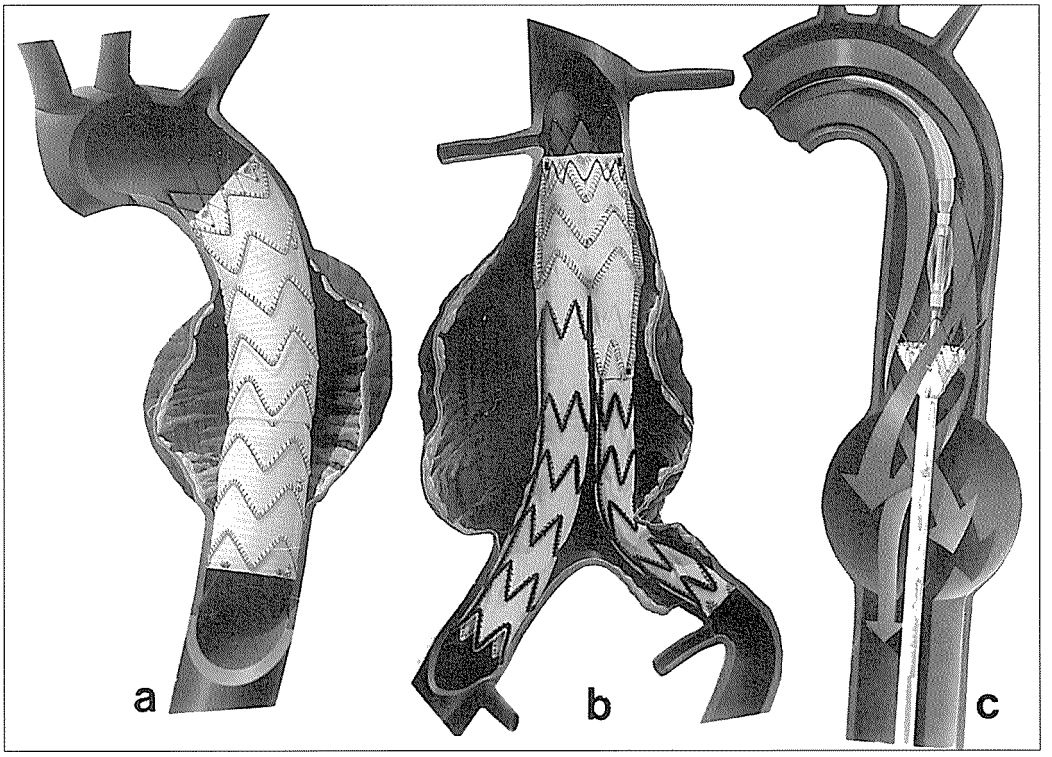

Figure 1. Schematic figure of tubular and bifurcational endoprosthesis and one of the delivery systems. A) Tubular endoprosthesis from dacron and nitinol crosses the aneurysm of descendent thoracic aorta. Endoprosthesis crosses the edges of dacron prosthesis to enlarge the attachment segment with aortic wall. B) Bifurcational endoprosthesis crosses the abdominal aneurysm, bifurcation and iliac arteries. Aortic neck between renal arteries and aneurysm is short, attachment site is enlarged by uncovered part of endoprosthesis, which goes over right renal artery orifice. Left part of endoprosthesis is introduced separately, through left common femoral artery. C) Delivery system with endoprosthesis is introduced over guide-wire, it is narrower in the front part and flexible to ease the introduction over stenosis and edges. Endoprosthesis is released with quick pulling down of outside catheter at chosen site. Latex balloon placed over endoprosthesis to improve its attachment to aortic wall above and bellow aneurysm.

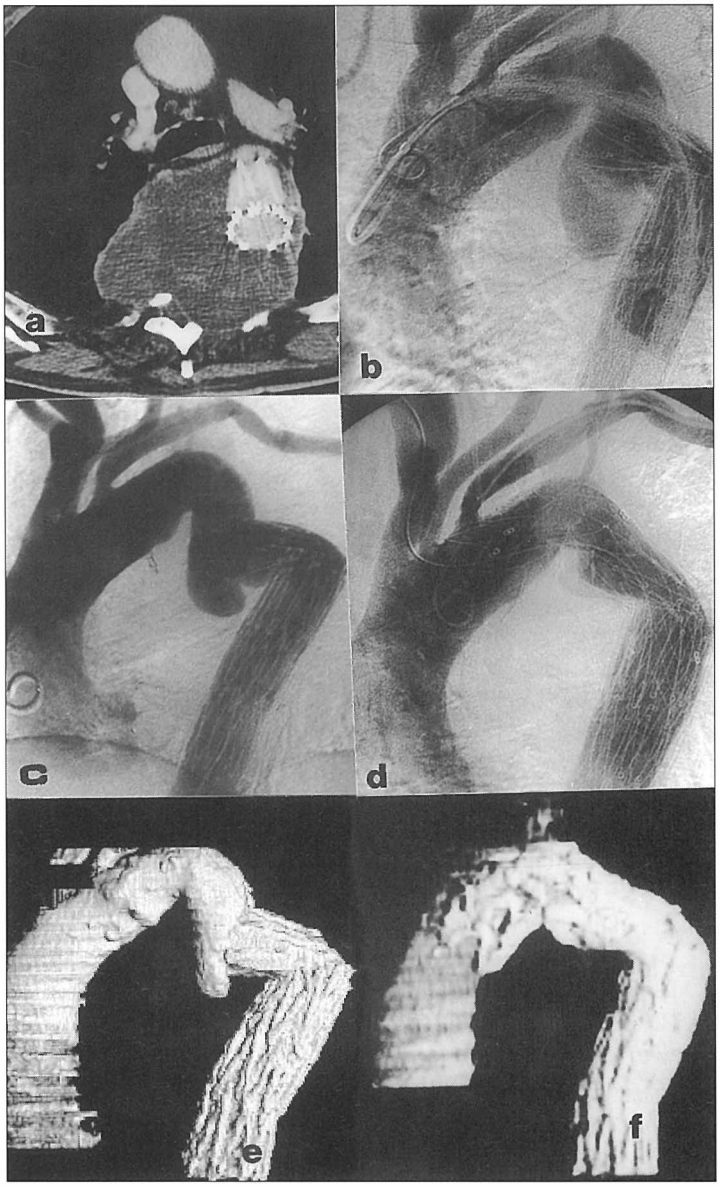

Figure 2. Late complication of endoprosthesis treatment in thoracic aorta and its cure. A) Transversal slice on spiral CTA shows bending of endoprosthesis with leakage into big aneurysm, which eroded thoracic spine segments. B) DSA of thoracic aorta in LAO shows movement and bending of prosthesis towards aneurysm, widened aorta over endoprosthesis and leakage to aneurysm. C) 3D reconstruction of spiral CTA in LAO projection confirms angiography. D) Introduction of delivery system with endoprosthesis over bending and curves as also highly positioned aortic arch towards subclavian artery, after which there is attachment site of new endoprosthesis. It is achieved with guide-wire, which is pulled through brachiocephalic and axillary artery out and additionally firmed. E) New endoprosthesis reaches up to left subclavian artery orifice and down to straight part of pre-existing endoprosthesis (marks shaped as no.8). Bending of endoprosthesis is sufficiently corrected, leakage is not obtained any more. F) Spiral-CTA in 3D reproduction shows good position of endoprosthesis, correction of bending and no leakage.

Procedure performance

Endoprosthesis for the thoracic aorta is introduced in general anaesthesia with intubation and ventilation. Catheter is placed into pulmonary artery and tube is placed into oesophagus for US control. Angiography catheter is introduced into ascendent aorta through one of brachial or axillary arteries for DSA control. Patient is given antibiotic protection, with cephalosporin application every 4 hours for 8 times. In Standford, USA [3], the procedure is performed on operation table, permeable for X-rays. Patient is sterile washed and placed in a way that immediate sternotomy can be performed, if necessary. In Slovenia procedure is performed on X-ray table in intervention radiology room, additionally prepared for this procedure. We have stand-by surgery team with extracorporeal equipment prepared. We are working under fluoroscopy and DSA control. Control angiography is performed at the beginning, to obtain the starting position. The surgeon prepares the femoral artery, on the site of arteriotomy we do the puncture of common femoral artery and introduce the guiding-wire (type »J« 0,035 inches, 260 cm long), with greater stiffness and better support. The front part, i.e. the softer part, is introduced into the ascending aorta. The patient receives 5000 I.E. heparin i.v. Through arteriotomy site, introducing sheath with haemodynamic valve is implanted over the guiding-wire. Sheath is placed on plastic dilator for support during the introduction. The choice of length and diameter of the sheath depends on aortic width, position of aneurysm and size and construction of the prosthesis. The front part of the sheath is placed over aneurysm, or otherwise over the site where the endoprosthesis will be released (Figure 1c). Endoprothesis is placed inside short catheter, from which it is introduced into sheath by using pushing catheter and placed at its edge. Introduction and precise positioning is controlled by DSA (Figure 2d). Endoprosthesis is released by holding pushing-catheter in a position and quickly pulling sheath down (Figure 1a,c). Endoprothesis is according to its self-expanding mechanism pressed against aortic wall and so excludes the aneurysm from the blood flow. Displacement of endoprosthesis during the procedure is disabled by lowering of aortic pressure to 50-60 mmHg for short time. Control DSA shows the exclusion of the aneurysm. After the catheter's removal the surgeon sutures the arterial opening and the operation site. Shorter iliac part may become longer with additional endoprosthesis, percutaneously introduced on the same side. For aneurysm exclusion, which reaches bifurcation and iliac arteries tubular endoprosthesis with distal narrowing can be used, it is placed deep into iliac artery and contralateral side is closed by embolisation. Limb vascularisation is provided by femoro-femoral by by-pass. Endoprosthesis for abdominal aorta is usually placed in local or spinal anaesthesia.

Our experience

We treated 3 patients with aortic aneurysm in our Institution, two patients with aneurysm in descendent part of thoracic aorta and one with abdominal aneurysm. In patients with thoracic aortic aneurysm the indication for treatment was a high risk for operation procedure. A patient with abdominal aortic aneurysm choosed this treatment as an easier procedure after having two open heart surgeries. In the first case, it was pseudoaneurysm, which caused hoarseness and in the second case due to the late complication with deformation of endoprosthesis and internal leakage (Figure 2a,b,c) after 2 treatments of percutaneous placement of endoprosthesis.

Results

Treatment with endoprosthesis is successful in cases where there is no leakage into aneurysm, where there is narrowing of aneurysm or no longer growth of it. In the cases of leakage the procedure is unsuccessful, and it is also the same, if aneurysm grows, even without obvious leakage. If aneurysm does not become smaller, even without leakage, we should state that aneurysm is not excluded, except if it is very calcified. In the cases where aneurysm stays the same (or grows bigger) with leakage present, there is quite a risk of its rupture.

Complications

Possible complications are divided by Dietrich[8] into 3 groups: complications during introduction, local/vascular and distant/systemic complications.

- Complications due to introduction are caused by missapproach, displacement of endoprosthesis, endoprosthesis' collapse, deformation and thrombosis.
- Local/vascular complications are: aneurysm rupture, leakage, stenosis of endoprosthesis, occlusion of renal arteries or subclavian artery, ileofemoral injury, embolism and bleeding.
- Distant/systemic complications: microembolisations, multisystemic failure, renal or cardiac failure, myocardial infarction, arrhythmia, stroke or transient vascular disturbance.

Endoprothesis can cause vascular disturbance of spinal cord and so transient or permanent paraparesis. The most frequent complication is leakage of blood at the site of attachment into aortic wall either above or bellow aneurysm. Leakage can be early or late. Causes of early leakage can be due to endoprosthesis or aortic wall. Endoprosthesis can bend or detach from the attachment site, its size or shape can be unsuitable or it can incompletely expand or be misplaced.

Aortic neck can be short, too wide or covered with recent thrombus or atheroma, so endoprosthesis is attached to a wounded neck. Small, fresh bleeding usually stops spontaneously in few weeks. If leakage is present after 3 months, and the patient is not coagulopath, we have to treat it. The leakage will persist if there is inflow and outflow in the aneurysm with a pressure difference. This kind of leakage does not stop spontaneously and risk of aneurysm's rupture persists. Blood flow direction in the aneurysm can flow from the upper to lower site of leakage (Figure 3a), from upper or lower to side branches (Figure 3b) or from lower to side branch-

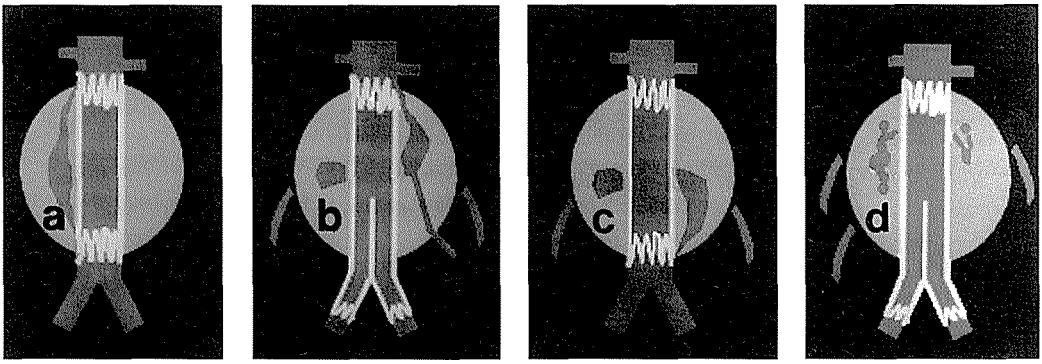

Figure 3. Schematic figure of blood flow direction in leakage into aneurysm. A) Blood flow between upper and lower leakage. B) Blood flow between upper leakage and side branches. C) Blood flow between lower leakage and side branches. D) Blood flow between arterial branches and aneurysm.

es (lumbar, hypogastric, AMI) or between branches and aneurysm itself (Figure 3d). Persistent leakage in aneurysm without outflow persists only if leakage is profound or outflow is not obtained. Late leakage is a complication diagnosed during follow-up of the patient without previous leakage. It is caused by displacement of endoprosthesis (Figure 2 b,c,d), deformation of parts of endoprosthesis, progressive dilatation of aorta at the attachment site. It is the most serious complication of this kind of treatment. Diagnosis and differentiation of leakage is important for its treatment (Figure 2).

Diagnosis of early and late complications

Displacement, deformation, and bending of endoprosthesis is most easily diagnosed by plain film of chest and abdomen in AP and side projection. In comparison with previous films we can evaluate the present state. US, which is relatively cheap and non-invasive method, can evaluate the size of aneurysm: it can be smaller, equal, or bigger. More profound leakage or/and blood flow in the aneurysm can be diagnosed by Doppler US. Small leakage and very small changes at the attachment site are better shown with spiral CTA, with 3 mm thick transversal slices. With spiral CTA a communication between aneurysm and side branches can be obtained, and also the changes in diameter and volume as well as the displacement of aneurysm (Figure 2a,c).[9]

Alternative method is MRA. It shows precise changes in aortic wall, size of aneurysm and thrombus in it.[10] It enables 3 D picture in few directions. Spiral CTA is more reliable for smaller leakage. MRA is in some regards better then CTA -there is no ionisation and nephrotoxic contrast media. MRA is used as a method of choice in treatment of patients before endovascular placement.[10] Ferro material in some endoprosthesis unables further MRA follow-up.

Treatment results, discussion and conclusion

Both our patients with thoracic aortic aneurysm have no clinical problems after 2 years and also our patient with abdominal aneurysm was without symptoms after a year. We found no changes on plain film in position or shape of endoprosthesis. We will perform spiral CTA one year after the procedure, or even sooner in the case of clinical problems or changes found on plain film. In Standford, there were 102 patients with aneurysm of descendent part of thoracic aorta of different aetiology treated between July 1992 and February 1997.[12] The procedure was successfully performed in all cases, 82% survived 35 months. 1,8 % of patients died in the period up to 35 days after the procedure. Nobody died during the procedure, 3,9 % remained paraplegic and 4 % suffered from partial thrombosis of aneurysm. These results are encouraging in comparison with operative treatment, with death rate between 12 %-17 %.[14] The most experienced with abdominal aneurysm intravascular endoprosthesis treatment is Parodi [5,15], but he did not follow up the patients. In large group of 765 patients from 31 European countries the results and complications of abdominal aneurysm treatment with endoprosthesis are published between the period of May 1994 and November 1997. 92 % were treated with bifureational prosthesis, only 8 % with tubular. The treatment was successful in 83 % after 3 months. 3,7 % patients died in the first 30 days. Internal leakage was diagnosed in 14 %, of those 68 % closed spontaneously. The results are comparable with operative.[16]

In conclusion, we can state that treatment of aortic aneurysm with endoprosthesis in descendent part of thoracic aorta is more successful than abdominal aneurysm treatment, especially on long-terms. In some indications it is even more successful than the operative treatment and so it becomes a method of choice for thoracic descendent aortic ane-

urysm. The biggest problem is attachment of endoprosthesis in abdominal aorta to the aortic wall between aneurysm and renal arteries, when this part is too short or weakened.

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Ultrasound-guided aspiration biopsy of subclinical regional metastases of head and neck carcinoma

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Background. *Studies concerned with the estimation of ultrasound (US) combined with ultrasound-guided aspiration biopsy (USGAB) in the detection of subclinical regional metastases from the planocellular carcinoma of head and neck are promising, but in few cases. Recently, the authors have pointed out the role of lymph node size parameters in order to decide about the use of USGAB. The aim of this study was to test the reliability of US-USGAB for the detection of subclinical regional metastases in patients with planocellular head and neck carcinomas, including the evaluation of lymph node size parameters.*

Patients and methods. *121 neck sides with no palpable metastases were examined by US in 77 patients with planocellular carcinomas of head and neck. Depending on the results obtained, USGAB was performed on 64 neck sides. After surgery, the results of US-USGAB were compared with histological findings of the dissected lymph nodes.*

Results. *The study showed 77 % overall sensitivity of US and USGAB, and 100 % specificity, while the 95% accuracy rate was reached. Negative predictive value was 94 %, and positive 100 %. The index of transversal / longitudinal diameter was the best predictor of metastatic lymph node involvement.*

Conclusion. *The results of this study established that USGAB is an appropriate method for detection the subclinical regional metastases on neck, and should be included into the routine diagnostic work up in the evaluation of the extent of head and necks carcinomas.*

Key words: head and neck neoplasms - pathology - ultrasonography; biopsy needle; lymphatic metastasis

Introduction

Planocellular carcinomas of head and neck frequently disseminate into the regional lymph nodes. Presence or absence of lymph node metastases is one of the most relevant prognostic factors, as the cure rate is 50% lower in patients with regional metastases.[1]

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Occult regional metastases represent a particular problem in the diagnosis and treatment of the patients with planocellular head and neck carcinomas, as they can be difficult to detect by imaging methods. Therefore, in most centers the elective treatment of neck is considered to be indicated when the risk of subclinical regional metastases, assessed on the basis of primary tumor site and size, exceeds 15 do 20 %.[2,3] However, treatment could be more directed and effective if the preoperative diagnosis of lymph node condition in the clinical stage N0 were comparable with histological findings of the dissected neck lymph nodes.

The assessment of metastatic neck lymph node involvement by palpation is unreliable, as the obtained results were false negative (up to 30 %) and false positive (up to 20 %).[4] Several authors found CT more sensitive than palpation.[5-7] Magnetic resonance with a contrast medium (MR) can detect up to 60 % of clinically occult metastases in the neck lymph nodes [8], and 70 % accuracy in stage N0 is the result of using only ultrasonography (US).[9] Nevertheless, the authors agree that the mentioned methods, by using only morphologic criteria, cannot reliably differentiate between reactive inflammatory changes and metastatic involvement of the lymph nodes.[8,10] Considering recent technologic development, the diagnosis of suspicious lymph nodes can be most accurate by using high resolution ultrasound in conjunction with guided fine - needle aspiration biopsy (USGAB). With this technique, the high sensitivity of US is complemented by the excellent specificity of aspiration biopsy.[11] In the available reports, the diagnosis of neck lymph node metastases in patients with planocellular head and neck carcinomas stage N0 with USGAB yielded 76 % sensitivity, 100 % specificity and 89 % accuracy.[9] These results are better than those reported for MR or CT.[5-8] The importance of particular sonographic lymph node size parameters is still controversial. While some authors believe that the transversal lymph node's diameter is the most important [8], others claim that the relation between the transversal and the longitudinal diameter more reliably predicts metastatic lymph node involvement.[12] Relevant for consideration is the reliability of negative US-USGAB findings. Some authors tried to solve this question by using Bayes' formula, which correlates the probability of subclinical neck metastases before and after US-USGAB procedure.[13] Few studies have been carried out on the use of US and USGAB in the diagnosis of subclinical regional metastases in groups of patients with previously untreated planocellular carcinomas of oral cavity, pharynx and larynx where elective dissection of the neck lymph nodes was foreseen as well (stage N0). Therefore we decided to test US-USGAB method in our institution by using the above mentioned criteria for selection of patients, also evaluating the size of lymph nodes.

Patients and methods

In the period from October 1995 to June 1997, there were 77 patients with previously untreated and histologically confirmed plannocellular carcinoma of the upper respiratory and gastrointestinal tract. The mean age of the patients was 56 years (range 37-76 yrs); there were 7 females (9 %) and 70 males (91 %). All these patients were planned for surgery of the primary tumor with neck dissection. There was no evidence of palpable nodes on the neck in 61 patients (79 %). In the remaining 16 patients (21 %) the enlarged lymph nodes could be palpated only on one side of the neck. Because these patients required bilateral neck dissection, only the neck sides without palpable lymph nodes were included into this study.

Following the clinical examinations with neck palpation performed by otorhinolaryngologists, each patient underwent the ultrasonography examination of the neck using a

linear 7.5 MHz probe of Sonolayer HR system, Toshiba SSA-270 A. USGAB was performed of lymph nodes with a transverse diameter exceeding 5 mm, lymph nodes with transverse vs. longitudinal diameter ratio greater than 0.40, ultrasonographically non-homogeneous lymph nodes, and in those with Doppler-US evidence of pathological vascularization. USGAB was also undertaken in borderline cases with respect to the above criteria, if three or more such lymph nodes were found in the most exposed anatomical levels. Aspiration biopsies were performed using thin needles with the inner diameter 0.6 and 0.7 mm, produced by TIK Kobarid. Each USGAB procedure was attended by two experienced radiologists specialized in sonography. In the first study, i.e. from October 1995 to November 1996, USGAB was carried out »free hand«, whereas from June 1997 on, aspiration biopsies were carried out by means of a micro-convex probe with guidance. After fixation and staining by Giemsa, the smears were reviewed and assessed by cytopathologists.

Though in some patients USGAB was not indicated, as the lymph nodes' transversal diameter did not exceed 5 mm, and their distribution and shape were inconspicuous. In other patients USGAB was performed according to criteria mentioned above, and the cytological smear could contain lymph node cells, squamous carcinoma cells, or material insufficient for a cytological diagnosis (nondiagnostic material). In the case when the aspirate contained malignant cells, the result of US-USGAB was considered positive. When aspiration biopsy failed to detect malignant cells or when USGAB was not indicated due to inconspicuous US findings, the overall US-USGAB result was considered negative.

After having completed the diagnostic procedure, all the patients underwent surgery of the primary tumor, together with either uni- or bilateral neck dissection. Primary tumors were arranged according to the TNM classification[12] taking into account their extent, as assessed during the surgery (Table 1).

In the case of negative US-USGAB findings, a selective dissection of the neck was performed, while a modified radical neck dissection (RND) was done only in the case of positive US-USGAB findings. All the dissected tissue samples were positioned and labelled. Using standard procedure, every 2 mm 4-5 μm thick slices were cut and stained with hematoxylin and eosin. The preoperative US and USGAB results were compared to the results of pathohistological evaluation, this being possible on the basis of the registered position and size of the described lymph nodes.

The value of US-established lymph nodes' size parameters, i.e. of transversal and longitudinal diameter and the transversal diameter in proportion to the longitudinal diameter, was statistically evaluated by means of Student's T-test and standardized normal distribution. The reliability of negative US and USGAB findings was evaluated using the curve deriving from Bayes' formula.

Table 1. Distribution of patients by primary tumor site and stage

Site: Stage:	Oral cavity	Oro- Pharynx	Hypo- pharynx	Larynx	Total
T1	3			2	5
T2	14	8		7	29
T3		4	11	13	28
T4			5	10	15
Total	17	12	16	32	77

Results

There were altogether 121 neck sides examined by US, 61 of them were ipsilateral with the primary tumor. In each examined side, US imaged 1-9 lymph nodes (3 on average), their transversal diameters ranging between 2 - 12 mm and the longitudinal diameters between 5 - 20 mm. In 55 cases, the lymph nodes were small, measuring up to 8 mm in longitudinal diameter and up to 5 mm in transversal diameter, and were oval-shaped and nonsuspicious for malignant involvement. In these 55 cases (neck sides) USGAB was not indicated, and thus the test findings (that is of US and USGAB) were assessed as negative. In the remaining 66 cases USGAB was performed and max. 3 lymph nodes per test side were punctured. Individual lymph nodes were aspirated one to four times, twice on average. Cytological samples from 41 neck sides showed only lymph node tissue, while from 5 neck sides they contained nondiagnostic material. In these cases, the test findings were also assessed as negative. In 20 cases, the cytological examination confirmed the presence of malignant cells. The longitudinal diameter of USGAB positive lymph nodes ranged between 7 and 17 mm (average 12 mm), their transversal diameter between 5 and 12 mm, while the index of transversal vs. longitudinal diameter in an individual USGAB positive lymph node ranged between 0.45 and 0.95. In 16 cases, US-USGAB positive lymph node belonged to the upper jugular group (level II), in 3 cases to the middle jugular (level III), and in only one case to the submandibular (level I). On only one neck side, the two aspirates from two different lymph nodes were cytologically positive, while in all others the cytologically positive sample was obtained from a single lymph node.

Totally in 77 patients, there were 82 lateral neck dissections performed, 31 supraomohyoid and 8 modified RND. Separate neck side surgical specimens contained from 9 to 50 histologically examined lymph nodes. Metastases could be found in altogether 32 lymph nodes, taken from 26 neck sides. In each of these cases, the evidence of metastases was confirmed in 1 - 3 lymph nodes with a longitudinal diameter 6 - 20 mm (average 13 mm), and a transversal diameter 5 - 12 mm.

In all 20 cases with positive cytological USGAB findings, the diagnosis was confirmed by the histological examination of the surgically removed lymph nodes. Out of the total of 46 negative USGAB, there were two false-negative; in both the aspirates contained lymphatic elements. None of the neck sides which yielded nondiagnostic material (aspirates from oval shaped lymph nodes, diameter 5-7 mm), showed histological evidence of metastatic involvement. Out of 55 US-based negative results, four were false negative. In all 6 false negative cases, the largest lymph nodes, assessed by pathologist, have transverse diameter 4 - 7 mm and were invariably situated on level II. In one of the mentioned cases, the pathologist found a single micrometastasis in the peripheral sinus of lymph node. Also in the remaining 5 cases focal metastatic growth in the lymph node was evident.

The estimation value of US and USGAB for detection of unpalpable regional metastases

Table 2. Results obtained in total 121 neck sides with respect to the use of USGAB

USGAB:	Yes	No (US only)	Total
test +	20	0	20
test -	44	51	95
false -	2	4	6
Total	66	55	121

Table 3. Cumulative results of US and USGAB obtained in 121 neck sides of 77 patients

Results	Histology +	Histology -	Total
US, USGAB+	20	0	20
US, USGAB-	6	95	101
Total	26	95	121

resulting from planocellular carcinoma showed 77 % sensitivity and 100 % specificity, the negative predictive value was 94 %, while the positive predictive value was 100 %. On the whole, 115 correct predictions were obtained by US - USGAB in 121 neck sides, the investigation's accuracy was 95 %. The results are presented in Tables 2 and 3.

Based on the results presented in Table 3, the basic indicators of cumulative success of US and USGAB were calculated as follows:

- Sensitivity: 20 / 26 = 77 %
- Specificity: 95 / 95 = 100 %
- Negative predictive value: 95 / 101 = 94 %
- Positive predictive value: 20 / 20 = 100 %
- Accuracy: 115 /121 = 95 %

In the free-hand performed USGAB of 18 neck sides, there were two false negative results whereas in the USGAB with the use of a micro-convex probe with guidance in 48 neck sides, there was no false negative results (the difference was statistically insignificant).

The value of lymph node size parameters

We evaluated the statistical significance of differences and averages between the groups of cases with and without histologically confirmed metastases, taking into account the largest lymph node parameters as determined by US in individual neck sides (transversal diameter, longitudinal diameter and the ratio between these two). In the neck sides without metastases, the average largest transversal diameter was 5.98 mm, while in the neck sides with metastases, it was 8,12 mm. The differences as calculated by T-test were statistically highly significant ($p < 0.005$). When calculating the ratio between the transversal and the longitudinal lymph node diameters, the T-test also showed statistically significant differences ($p < 0.001$), the index in neck sides with metastases being 0.64, and in those without metastases, 0.47. The comparison of longitudinal diameters yielded a statistically insignificant value. In this study we also evaluated the statistical significance of differences in the average largest US-determined size parameters in neck sides with or without cytologically confirmed metastatic involvement, with respect to transversal diameter, longitudinal diameter, and the ratio between the two. The ratio between the transversal and longitudinal diameter turned out to be statistically most relevant ($p < 0.0001$); in transversal diameter this was less ($p < 0.01$). There too, the longitudinal diameter turned out statistically insignificant.

The use of Bayes theorem in the evaluation of US and USGAB diagnosis

Using the formula based on Bayes theorem, the 100 % specificity and 77 % sensitivity obtained in this study, yielded the curve presented in Figure 1. This shows that with negative US and USGAB, the probability of subclinical lymph node metastases is decreased from the previous 20 % to 5.4 % in the neck sites without palpable metastases. On the other hand, the 20 % and 10 % probability of subclinical neck metastases after negative US and USGAB correspond to 52 % in 33 % probability without US and USGAB.

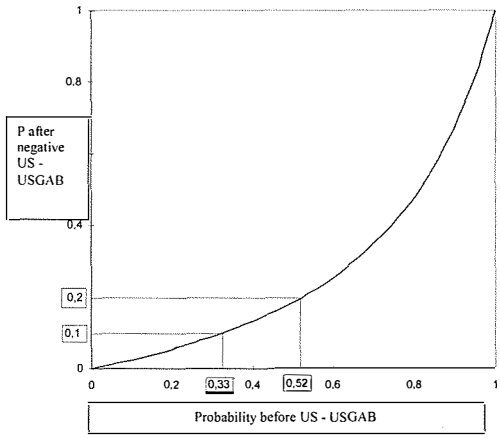

Figure 1. Probability of subclinical lymph node metastases before and after negative US-USGAB.

Discussion

Reports with comparable inclusion criteria are few. The results of our study are comparable with those reported by Brekel and coworkers.[9] In a large number of other reports, the inclusion criteria were broader, since authors also included patients with clinically evident neck metastases, patients with previous radiotherapy or patients with primary tumors which histologically did not correspond to planocellular carcinoma.

Rather than in the sensitivity of the test, the clinician is interested in the reliability of its negative findings, or what is the negative predictive value (NPV). Providing this parameter is sufficiently reliable, patients with negative findings could be spared elective neck treatment. In our study, there were altogether 6 false negative results, the NPV was thus 94 % (95/101). In the cases with USGAB performed, NPV was 96 % (44/46). In the Dutch study with inclusion criteria similar to ours [9], the use of USGAB resulted in 82 % NPV. This difference in NPV can be partly attributable to the difference in the rate of histologically confirmed cases with subclinical neck metastases (21.5 % in our study vs. 40 % reported by Dutch authors).

In neck sides with false negative results of US-USGAB, histological examination confirmed metastases exclusively in the lymph node level 2, originating from an extensive carcinoma of the supraglottis as primary tumor; and were at least partly due to the superposition. In all false negative cases, small metastatic islets were found in the lymph nodes, and in one of them situated only in a marginal sinus. As neither USGAB nor any other diagnostic method is able to detect micrometastases from planocellular carcinoma, we think that even a repeated USGAB on a greater number of lymph nodes would only slightly improve the sensitivity of this method.

Cases, for which USGAB fails to provide material for cytological diagnosis, represent a separate problem. In the study by Brekel et al.[9], there were 70 USGABs performed, out of these 6 yielded nondiagnostic material. When evaluating the results, those cases were defined as negative. The authors claim that the results would appear to be better if such cases were excluded from the study, as it was done in a majority of similar studies, in order to reduce the number of false negative results. In Takashima's et al.[12] report, such cases (7.7%) were excluded from the study, but none of the neck sides had metastatic involvement histologicaly confirmed. In our study, USGAB was performed on 66 neck sides, and nondiagnostic material was obtained in 5 cases. None of those five sides had histological evidence of metastases, and therefore the results of the present study remain practically unchanged, regardless of whether the cases with nondiagnostic material are excluded or included as negative by US-USGAB. In none of the reported studies USGAB was repeated in case of nondiagnostic material. There are controversial opinions whether these cases should be included or excluded from studies. We believe that in studies based on similar principles, that the cases in which USGAB provided nondiagnostic material should be included and defined as negative in order to obtain a more objective assessment of the usefulness of the method.

In the available reports, the authors describe only »free hand« performance of USGAB for the detection of subclinical neck lymph node metastases. Based on our own experience, in the first part of our study, »free hand« performed USGAB gave 2 false negative results, while no such cases were observed when the method was upgraded by means of an additional micro-convex probe with guidance. Despite the statistically insignificant difference in the frequency of false negative results, we believe that the use of probe with guidance facilitates USGAB and reduces the occurrence of errors.

Among the US parameters determining the probability of lymph node metastases,

particularly the relevance of size criteria has been pointed out in the last decade. While Dutch authors [8] report that the transversal lymph node diameter (minimal axial) is the most reliable size criterion for the detection of subclinical metastases, the Japanese investigators [12] proved that the ratio (index) between the transversal and longitudinal diameter is an even better predictive parameter. According to the results of their investigation, there are significantly more metastatically involved lymph nodes among those with the index above 0.55. The relevance of the diameter ratio has also been confirmed by calculating the area under the ROC curve, this being significantly greater than in either transversal or longitudinal lymph node diameter (0.83 / 0.65 / 0.44). After grouping the neck sides by the presence / absence of histological and cytological evidence of metastatic involvement, we obtained highly significant differences of average diameter ratio; the differences were significant in the transversal diameter, while the longitudinal diameter proved to be irrelevant for the diagnosis of subclinical regional metastases from head and neck carcinoma.

By improving the detection of subclinical neck metastases, it is possible to change to a certain extent the concept of elective lymph node treatment in patients with planocellular carcinoma of the upper respiratory and alimentary tract. Thus Brekel et al. [9], suggest that elective dissection should be omitted always when a reliable diagnostic method reduces the risk of subclinical neck metastases below 10-15 %, particularly in patients where the primary tumor can be removed by transoral approach, but under the condition that the patient is legible to regular follow up. The findings of our study also support the opinion that in certain cases the elective treatment of neck lymph nodes could be omitted on the account of better diagnosis. As evident from Bayes' curve (Figure 1) derived from our study results, the previous 33 % risk of subclinical metastases predicted on the basis of primary tumor site and size, was reduced to 10 % after negative US-USGAB. Better diagnosis, improved by means of US-USGAB, would be most valuable for patients who are generally not planned to undergo elective treatment of neck lymph nodes (initial carcinomas of the glottis, sinuso-nasal tract, skin of the head and neck), and where a therapeutic dissection could be carried out in the case of positive findings. Likewise, a decision on therapeutic neck dissection could be made in the case of positive findings in the candidates for an elective procedure. In patients planned for primary radiotherapy, the use of US-USGAB will improve the detection of nonpalpable regional metastases, and the irradiation field could be adjusted with respect to the obtained findings.

Conclusions

By combining the sensitivity of US examination with the specificity of US guided aspiration biopsy (US-USGAB) it is possible to detect a majority of subclinical regional metastases originating from planocellular carcinoma of head and neck

The ratio between the transversal and longitudinal lymph node parameters is to be the most relevant of US size parameters to be respected in deciding to perform USGAB. US-USGAB can be recommended as the routine investigations for evaluating regional metastatic spread of head and neck carcinomas.

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review

Computed tomographic angiography in intracranial vascular diseases

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Background. *The development of spiral computed tomography (CT) introduced a more precise imaging of the vessels also with computed tomographic angiography (CTA). Because it is a minimaly invasive method, it was widely accepted by radiologists and clinicians. In early 90 ties CTA also accompanied conventional angiography and magnetic resonance angiography (MRA) in imaging of intracranial vascular diseases. CTA is used for the detection and evaluation of intracranial aneurysms, vascular malformations, stenoocclusive diseases of intracranial arteries and pathological changes of venous sinuses. Comparing to conventional angiography as the »gold standard«, CTA has high specificity, sensibility and diagnostic accuracy concerning detections of intracranial aneurysms. Regarding vascular malformations, CTA is used for diagnostics and pre and postoperative evaluation of it. CTA can show good results in imaging of venous angiomas, and so invasive conventional angiography can be avoided in this pathology. Stenoses and occlusions of arteries can be diagnosed and evaluated in patients with cerebral vasospasm, patients with acute stroke, and patients with chronical arterial stenoses and occlusions. CTA is useful for the demonstration of occlusive and stenosing changes of intracranial venous sinuses.*

Conclusion. *With CTA it is possible to generate threedimensional reconstructed images which give a more accurate determination of anatomical relations in intracranial vascular diseases. The main disadventage of CTA in comparison to intraarterial angiography is the lower spatial resolution of CTA, but is constantly improving with the developement of better scanners and workstations, so that there are great possibilities for further developement and wider use of CTA in the diagnosis of intracranial vascular diseases.*

Key words: tomography, x-ray computed; cerebral artery diseases-diagnosis; cerebral aneurysm-diagnosis; angiography

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Introduction

Since its introduction in clinical practice in early 1970s, computed tomography has gone through a lot of important refinements and became more accurate and much faster from its beginnings till today. A progresive reduction in scan times and improved spatial and contrast resolution made CT imaging a workhorse for many years. In early 1990s computed tomography has been revolutionazed by technical advantages of spiral CT. Spiral CT scanning involves continous data aqusition throughout the volume of interest by simultaneous moving of the patient through the gantry while X-ray sources rotate.[1,2] As this proces is contiuonos rather than stepwise as in conventional CT scaning, the examination time is reduced. Besides advantages like increased patients throughput and reduction of motion artifacts, the spiral CT also offers additional properties which are not possible with conventional step by step CT scanning. Because of short acquisition time, scanning can be timed with the peak opacification of arterial or venous phase, after the peripheral intravenous application of contrast media. The resultant images (raw data) are processed with various computed rendering techniques, such as multiplanar reformatting (MPR), shaded surface display (SSD), maximum intensity projection (MIP) and volume rendering technique (VRT) to generate two or three-dimensional images of the vessels. As a result, CT angiography is performed less invasively, faster and at a lower cost than conventional intraarterial angiography.[3,4]

In neuroradiology, the diagnostics of cerebrovascular diseases represents one of its major fields of activity. It has progressed a lot during the last decade with the advent of MR imaging and spiral computed tomographic tehnology. CTA was increasingly used for the detection and evaluation of intracranial aneurysms, intracranial vascular malformations, intracranial vascular stenoses and occlusions and pathological changes on intracranial venous sinuses.

The purpose of this paper is to review the value of CTA in detection and evaluation of vascular intracranial diseases.

Intracranial aneurysms

Aneurysms are circumscribed dilatations of arteries that communicate directly with the vessel lumen. They may be saccular (berry) or fusiform.[5]

Intracranial saccular aneurysms

Saccular aneurysms are found in 1 % to 5,6 %.of population.[5,6] 15 % to 20 % of patients have multiple aneurysms.[7] Saccular aneurysms are an important part of vascular patology, because subarachnoid haemorhage (SAH) is in 80 %-90 % caused by a rupture of a saccular aneurysm. In 15 % SAH may be caused by the arteriovenous malformation, and 5 % by diverse causes.[8] SAH resulting from a ruptured aneurysm of intracranial arteries carries a poor prognosis and the mortality in untreated patients may be as high as 45 %.[8]

For many years the intraarterial cerebral angiography has been a technique of choice for the demonstration of the intracranial aneurysms, but it is invasive, expensive and has 1 % of complications, while 0,5 % of them develop permanent neurological deficits.[9,10] Therefore non-invasive MRA and minimaly invasive CTA have been increasingly used over the past few years.[11,12] Although MRA is capable of showing an accurate anatomy of intracranial vessels and vascular patology, there are some difficulties in detection and demonstraton of aneurysms with turbulent or slow blood flow.[13-17] MRA is contraindicated in patients with feromagnetic clips, pacemakers or life-support devices.[18]

CTA is insensitive to turbulent blood flow artifacts and in contrary to MRA, it can be

performed in patients with ferromagnetic implants.[19-21] In patients with SAH CTA demands little additional time and is easily performed immediately after the conventional CT.[22] CTA is highly accurate, sensitive and specific as compared to DSA (gold standard).[20,23-27]

Because of its minimal invasiveness, the indications for CTA in diagnostics of cerebral aneurysms are broader than for DSA and can be divided into six groups:

1. *Patients with acute SAH.* The patients are usually criticaly ill and clinically unstable. On time diagnosis of the etiology of bleedeng is essential for planning an early surgery or other intervention. Intraarterial conventional angiography performed within the first 6 hours after initial bleeding is associated with an increased rebleedeng rate.[28] CTA is very suitable in the acute stage after SAH because it does not require intraarterial catheterization, scaning time is only 50 seconds and it can be performed on the same scanner immediatly after the demonstration of SAH by conventional CT scan.[23-25,29]
2. *Patients with proved history of SAH, but with negative or indeterminate first angiography.* In a number of patients, no underlying cause of SAH is identified despite a complete neuroradiological investigation. In the literature this proportion varies between 3,8 % [30] and 46 % [31] with accepted mean of 15 %.[32] The etiology of angiogram-negative SAH remains elusive. Numerous theories have been proposed. One theory postulated that SAH may be due to leakage from the lenticulostriate and thalamoperforating vessels.[33] Another theory suggested a venous or capillary source for the patients with perimesencephalic SAH.[34] The most popular theory attributes bleeding to an aneurysm that undergoes thrombosis or is destroyed at the time of haemorrhage.[35] CTA performed about 3 weeks later, can demonstrate partially or completely recanalized aneurysm.
3. *Patients with a suggestive but uncertain history of SAH.* In these patients, instead of invasive DSA as first imaging modality, CTA or MRA can often make the diagnosis.[36,37] For example, we found an aneurysm at the bifurcation of the left middle cerebral artery in a 37 years old woman who suffered from a sudden strong headache two weeks before and did not seek medical help at that time (Figure 1).
4. *Patients without SAH, but with suspicious clinical signs of an intracranial aneurysm or an aneurysm-like lesion on conventional CT images or MR images.* In this group we have an example of a 68 years old woman suffering from paresis of the right third nerve, where we detected a large right internal carotid artery aneurysm (Figure 2).
5. *Screening in »high risk population«.* The existence of families with a history of intracranial aneurysms is well recognized. In large epidemiologic studies, the prevalence of familial intracranial aneurysms is higher than in general population (7% to 9%).[38-44] Even in the situation of sporadic case , relatives of the patients are often worried that they may also harbor an aneurysm. In screening we use CTA as an additional or alternative method to MRA in patients with a family history of aneurysmal disease and patients with predisposing hereditary disease, such as autosomal polycystic renal disease.
6. *Follow up of treated or non-treated aneurysms.* Once the aneurysm is detected and clipped, a question may arise as to the proper placement of the clip. One potential problem is to only partially clip the neck of the aneurysm and allow continued filling of the aneurysm. Another is a possible occlusion of vital arteries after the improper placement. The postoperative evaluation has traditionaly been done with a conventional angiography.[45] In a few cases we have had used CTA in order to clarify such

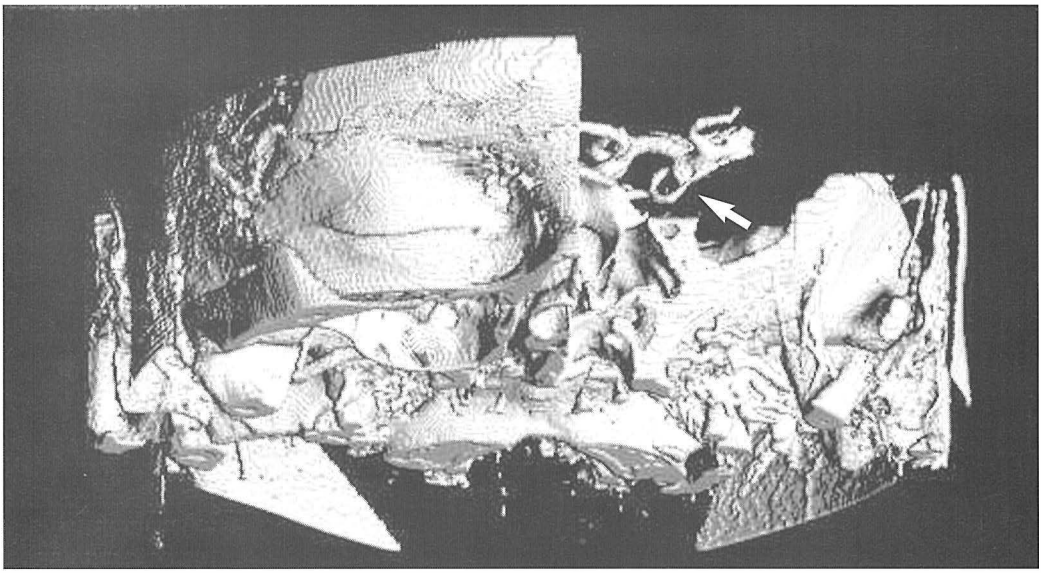

Figure 1. CT angiogram, volume rendering technique, anteroposterior view, demonstrates an aneurysm at the bifurcation of the middle cerebral artery and its relationship to the middle cerebral artery branches (arrow).

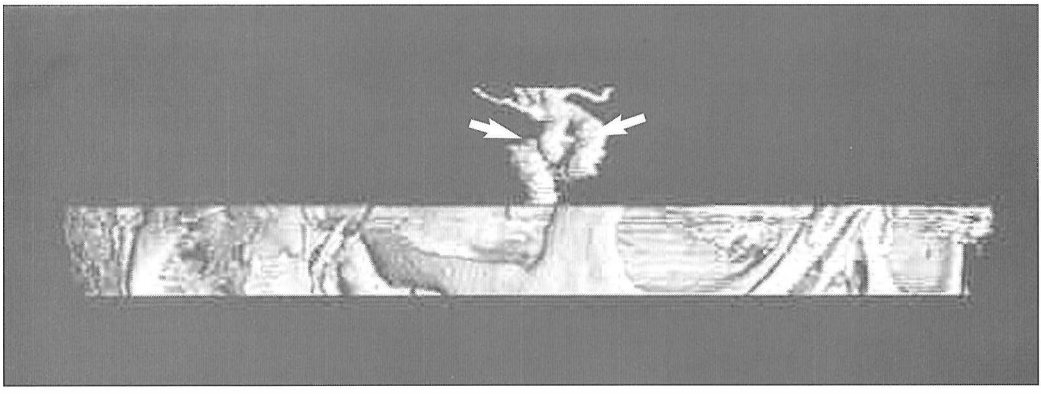

Figure 2. CT angiogram, volume rendering technique, right anterior oblique view, demonstrates a longish aneurysm coming out from the right internal carotid artery and spreading backwards and downwards in the area of the third nerve (arrows).

dilemmas. Depending on the size and orientation of the clip, a starshaped artifact in the immediate vicinity of the clip is seen. In most cases we have been able to demonstrate both clip and eventualy residual aneurism as well as patency of vessels despite this artifact (Figure 3). Inspite of this, CTA in its present form cannot replace DSA in all situations of the evaluation of the aneurysm clip placement.[46]

Finally, since CTA and DSA are in most cases complementary examinations, their combination often provides more data in the preoperative evaluation of intracranial saccular aneurysms than obtained with each of them separately. CTA could be considered useful tehnique in the preoperative evaluation due to their three-dimensional representation of outer and inner vessel surfaces. The so called endovascular view of both the neck and

Figure 3. CT angiogram, volume rendering technique, superior view, performed after basilar artery aneurysm cliping, demonstrates the clip (arrows), patent basilar artery and its branches (arrowheads) and no residual aneurysm.

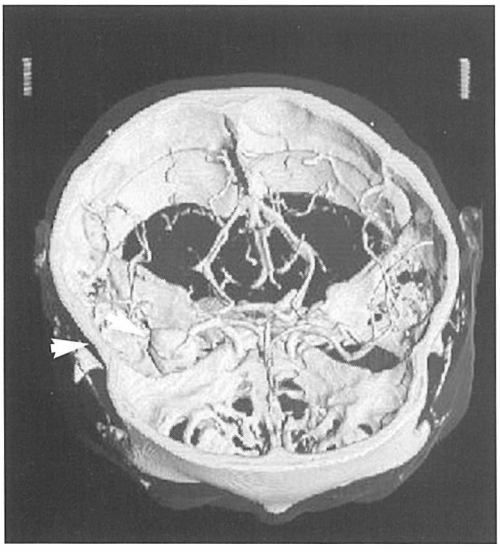

Figure 4. CT angiogram, volume rendering technique, anterosuperior view, demonstrates a large right middle cerebral artery aneurysm. The relationship of this aneurysm to the inner table of the skull is well shown (arrows).

sack of the aneurysm can demonstrate the relationship between the aneurysm and arterial branches.[47,48] CTA also allows the display of adjacent bone structures (Figure 4) and allow surgeons to plan a craniotomy with the best approach to the neck of the aneurysm.[26]

Intracranial fusiform aneurysms

Fusiform aneurysms are dilated and elongated atherosclerotic vessels. They commonly affect the supraclinoid segment of internal carotid artery and vertebrobasilar arteries. Mural thrombus is common. Hemorrhage is rare.[5] Surgical therapy is not possible in the majority of cases. CTA is able to clearly demonstrate this type of aneurysm and so to avoid DSA (Figure 5).

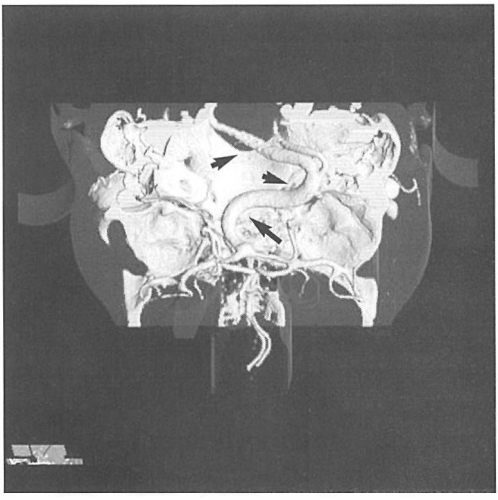

Figure 5. CT angiogram, volume rendering technique, posterosuperior view, demonstrates fusiformly dilated and elongated right vertebral artery and basilar artery (arrows). On the basis of this examination, it was decided that the patient was not an operative candidate. DSA was avioded in this case.

Intracranial vascular malformations

Intracranial vascular malformations are a diverse group of congenital lesions of blood vessels. These lesions are usually classified as

arteriovenous malformations (AVM), venous angiomas, cavernous angiomas and capilary teleangiectasias.[5]

Intracranial arteriovenous malformations

Patologically, the AVMs show clusters of abnormal arteries and veins. The vessel walls are typically thickened and contain elastin and smooth muscle. AVMs are subdivided into pial AVMs, dural AVMs and dural arteriovenous fistulas.

Pial AVMs consist of an plexus of arterial feeders, nidus and dilated draining veins. Because there is no intervening capillars, blood shunts directly from arteries to veins. These vessels are patological and are prone to rupture. The risk of hemorrhage is 2 % to 4 % per year. For each episode of hemorrhage there is a 29 % chance of death and 23 % chance of long term morbidity.[49] The therapy of AVMs can be surgical, radiosurgical or endovascular.

A pre-therapeutical neuroradiological evaluation requires a diversity of anatomical and hemodynamic information. From the morphological point of view, neuroradiological studies identify feeding arteries and draining veins and evaluate angioarchitecture of the nidus. From hemodynamic point of view, flow velocities in the different vascular compartments shoud be evaluated. Conventional angiography still represents the gold standard for evaluating feeding arteries, draining veins and the angioarhitecture of the nidus. It is also mandatory for hemodinamic evaluation of AVMs. The experience in the last few years showed that MRA and CTA can be useful in the diagnostics of AVMs.[50-52]

CTA can have important role in the following situations:

1. *Detection of AVM.* CTA can be useful in a diagnosis, excluding or confirming the presence of AVM in a sugestive clinical context.
2. *Pre-therapeutical evaluation of AVM.* In conjunction with conventional angiography, conventional MR and CT images, CTA can be used to obtain three-dimensional images of AVM. Reconstructed three-dimensional CTA images can be viewed from any perspective which can be used for an exact localisation of feeding arteries, nidus and draining veins (Figure 6).

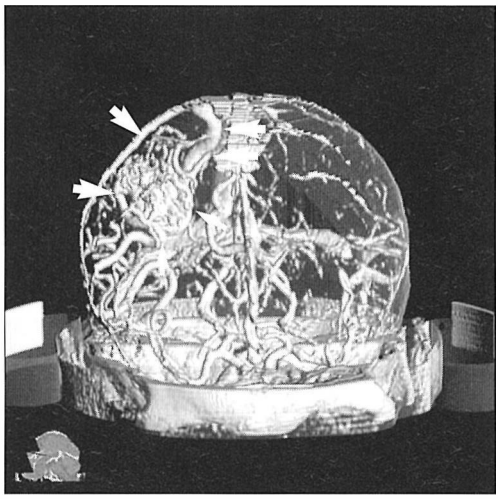

Figure 6. CT angiogram, volume rendering technique, anteroposterior view, shows pial arteriovenous malformation of the right hemisphere. Two main feeding arteries (arrows), nidus (arrowheads) and draining vein (open arrow) are well demonstrated.

3. *Post-therapeutical evaluation of AVM.* The analysis of AVM reduction after the treatment can be performed with CTA images. This technique offers a suitable method for a minimally invasive and reproducible follow up.

In dural AVMs and dural arteriovenous fistulas neither CTA nor conventional MR or MRA can substitute or complement a conventional angiography in a diagnosis and pre-treatment evaluation.[27,53,54]

Venous angiomas

Venous angiomas are congenital anomalies of the intracranial venous drainage. They represent anatomic variants resulting from the arrested embryological venous development causing the persistence of primitive medulary veins.[55] They are described as a local network of small, medulary veins, resembling so called caput medusae, which converge centrally into a large transmedullary vein that courses toward the cortical surface or the deep venous system.[56,57] Venous angiomas are most common incidental vascular malformations detected radiologically and at autopsy.[58] They are also designed »developmental venous anomalies« to emphasize their frequency and their benign nature. Usually they cause no symptoms but may rarely be associated with headache, seizure, or focal neurologic deficit [58,59] and even more rarely with acute symtomatic hemorrhage.[60] In most cases a surgical therapy is not necessary or possible.[58-60]

Today the technique of choice in the neuroradiological diagnosis of venous angiomas is MRA and conventional MRI with the administration of gadolinium. A stellate appearence on MR is said to be patognomonic of venous angiomas.[61] Only in rare circumstances, when the diagnosis is not certain, a conventional angiography needs to be performed. With the conventional angiography, a venous phase abnormality characterized by multiple dilated medulary veins converging on a larger trancortical vein, giving a »caput medusa« appearance is diagnostic.[58-61]

Instead the conventional angiography, CTA can also be used.[62] CTA demonstrates findings characteristic for venous angiomas: small vascular structures in deep white matter converging to a more dilated trancortical draining vein (Figure 7). The use of CTA in the diagnosis of venous angiomas shows good preliminary results and could obviate the need for the conventional angiography in most cases.

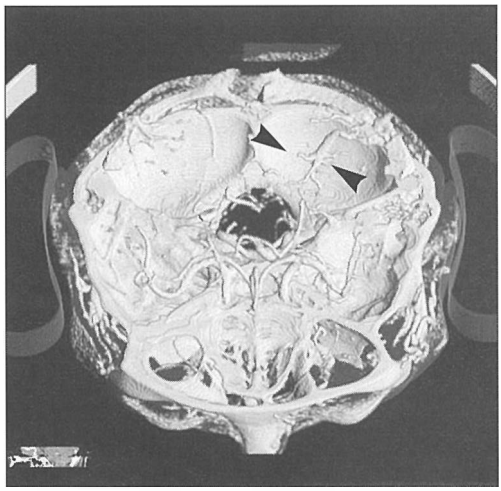

Figure 7. CT angiogram, volume rendering technique, anterosuperior view, shows venous angioma in left cerebelar hemisphere (arrows). The lesion has characteristic »caput medusa« configuration.

Cavernous angiomas and capillary telangiectasias

In cavernous angiomas and capillary talengiectasias, both conventional and non or minimaly invasive angiographic techniques fail to revel the majority of lesions, whereas a conventional MRI still remains the technique of choice.[5,27]

Intracranial vascular stenoses and occlusions

The intracranial stenotic and the occlusive vascular patology can be divided in cerebral vasospasm in patients with SAH, acute arterial occlusion in patients with acute ishemic stroke and chronic stenoticocclusive diaseases of arteries.

Cerebral vasospasm

The most debilating complication of acute SAH is the cerebral vasospasm, acounting for 14 % of deaths or severe disability in patients with SAH.[63] The onset of spasm occurs 4 to 11 days after hemorrhage in approximately

30 % of patients.[64] A current therapy includes the hypervolemic and pharmacologic therapy and its efficacy is well documented.[64]

A conventional angiography is one diagnostic method for this complication, but the risk of performing this procedure in the critically ill patient can limit its application. Transcranial Doppler sonography is noninvasive and rapidly performed, but does not provide anatomic information and is limited to a small acoustic window.[65,66] MR angiography is restricted in the evaluation of these patients due to a reduced intracranial blood flow.

CTA offers the potential for rapid, minimally invasive method of diagnosing and monitoring this complication (Figure 8).[67]

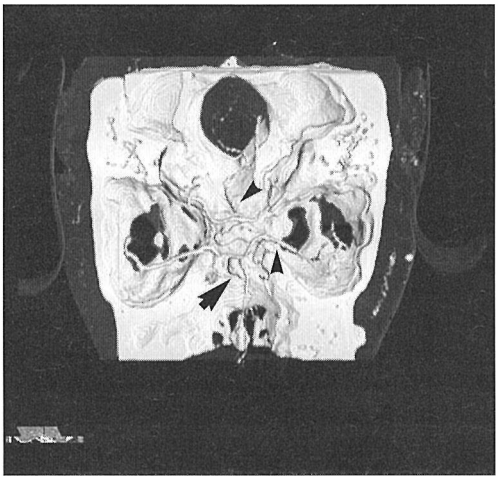

Figure 8. CT angiogram, volume rendering technique, superior view, shows vasospasm of intracranial arteries (arrowheads) after subarachnoidal haemorhage and an anterior communicating aneurysm (arrow).

Acute ischemic stroke.

Strokes are a major public health problem. Stroke is the third most common cause of death since one third of the patients die and another third are rendered permanently disabled.[68] In Slovenia the incidence of stroke is 190,5/100000 people. Mortality in the first 30 days is 21 %.[69] Ischemic infarction of brain tissue, because of the acute arterial occlusion, is the major causative factor. The majority of infarctions are caused by thrombembolism from underlying atherosclerotic disease.[70,71] The majority of stroke patients are treated conservatively.[72] Systemic intravenous or local intraarterial thrombolysis has recently shown the promise of improving the patient's outcome.[73,74] However, thrombosis must be identified and treated promptly for optimal results. Because trombolytic drugs produce intracranial hemorrhage in 6 % to 20 % of cases, the potential for salvaging the ischemic brain must be defined.[74,75] The reversibility of ischemic process not only depends on the time after ictus, but is primarily a function of the degree of persistent collateral flow to the affected tissues. Brain without sufficient collateral flow will die within minutes, whereas tissue with good collateral flow will remain viable. In the latter circumstances thrombolytic terapy can be effective.

Patients with acute stroke are examined with unenhanced CT of the brain to exclude intracranial hemorrhage or other rare causes for stroke. CT is also useful in assessing early signs of cerebral ishemia, such as parenhimal hypodensity and focal brain swelling.[76,77] But conventional CT does not show the extent of disturbed cerebral perfusion, which is determined by the site of occlusion and collateral blood supply and is not capable of showing the volume of viable tissue at risk from the low perfusion, which is the target of thrombolytic treatment.[78] Recently, MRA and MR imaging with hemodynamic and diffusion weighted pulse sequences are increasingly used in patients with acute stroke. Diffusion and perfusion images are highly sensitive to early infarction and an extent of infarcted brain tissue.[79,80]

In acutely ill stroke patients CTA is more practical and faster than MR imaging and can be performed immediately after the conventional unenhanced CT of the brain. Because

of these considerations, few authors studied whether CTA is capable of showing the site of arterial occlusion, estimating collateral circulation, and determining the extent of severe parenhimal perfuson deficit. Preliminary results of these studies showed that CTA is safe in cases of acute stroke and can add an important diagnostic information to those obtained by the conventional CT and may provide a rational basis for optimal treatments of patients with an acute stroke.[78,81,82]

Chronic stenoocclusive diseases

Chronic stenoocclusive diseases of intracranial arteries are most commonly caused by atherosclerosis,[5,83] less often by nonatheromatous causes, like fibromuscular dysplasia, vasculitides and idiopathic progressive arteriopathy (moyamoya).[5,84] Stenoocclusive diseases of intracranial arteries impeares the blood supply of the brain and increase the possibility of an ischaemic stroke. Early diagnosis and treatment of these pathologies has an important role in the stroke prevention.

In nonatherosclerotic stenoocclusive diseases a conventional angiography still plays a primary role, due to mainly changes on arteries of the second and the third order.[84] Spatial resolution of MRA and CTA is too low for precise imaging of these arteries, which measure less than 1 mm in diameter.[85]

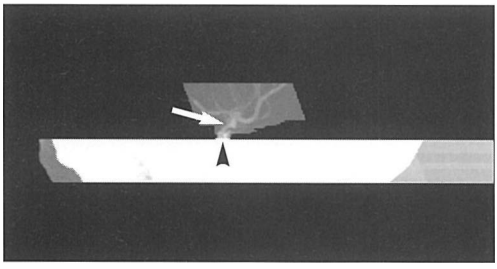

Figure 9. CT angiogram, maximum intensity projection, left anterior oblique view, demonstrates atherosclerotic stenosis of supraclinoid segment of left internal carotid artery (arrow) and extensive calcifications in this atherosclerotic lesion (arrowheads). Because of calcifications, angioplasty is contraindicated in this case.

Because atherosclerosis affects mostly larger intracranial arteries, like internal carotid artery, middle cerebral artery, basilar and vertebral arteries, useful and reliable diagnostic method is MRA[86,87] and nowadays also CTA.[88] CTA most reliably demonstrates calcifications in atherosclerotic lesion, which can have an important impact concerning further therapy (Figure 9).

Venous sinus compression and trombosis

The external compression of venous sinuses can cause their narrowing or obstruction. It is most commonly caused by the tumor or bone fragment with the impression fracture. Sinus thrombosis is a partial or complete obstruction of sinus lumen due to intraluminal clot and usually affects superior sagital sinus, then transversal, sigmoid and cavernous sinus.[5] Thrombosis can spread into cortical veins, straight sinus and internal cerebral veins. The interruption of venous outflow can cause local or diffuse cerbral edema and cortical venous infarcions, which are often haemorrhagical.[89]

In the past, the prognosis in patients with venous thrombosis has been poor, with the mortality rate between 30% and 80%, but has been improved in the later years by the effective systemic heparin anticoagulation, fibrinolytic therapy and anti-edema therapy.[90,91] The availability of a successful treatment has increased the need for the prompt and accurate diagnosis.

Besides conventional angiography, conventional CT,[92] MR and MRA[91,93,94] have increased the ability to detect this condition. The conventional contrast enhanced CT has low sensibilitiy in the diagnosis of dural sinus thrombosis.[95] MRA, the present examination of the choice for evaluation of dural sinuses, is limited by motion artifacts and the patient's contraindications.[92] Recently developed CTA with another name CT venography offers grea-

Figure 10. CT angiogram, multiplanar reconstruction, sagital reconstruction, shows absence of opacification in posterior and middle portion of superior sagittal sinus because of thrombosis (arrows).

ter sensitivity and specificity than a routine contrast-enhanced CT in the diagnosis of dural sinus thrombosis.[92,96] On CT venography, dural sinus thrombosis is seen as the absence of opacification of the affected dural sinus on the reconstructed images (Figure 10) and as a filling defect in the dural sinus on the source images.[92,96] Also, in cases of external venous compresion, CTA can reliably demonstrate venous sinuses and cortical veins, important for the preoperative planning (Figure 11).

Conclusion

CTA is the youngest angiografic imaging modality which has been quickly accepted especially for the detection and evaluation of intracranial saccular aneurysms, so far mostly diagnosed by the conventional intraarterial angiography.

An important part of CTA are post-processing techniques. Because threedimensional reconstructions of intracranial vessels offer anatomical imaging in the similar way as percepted with human vision, we can better understand the morphology of pathological

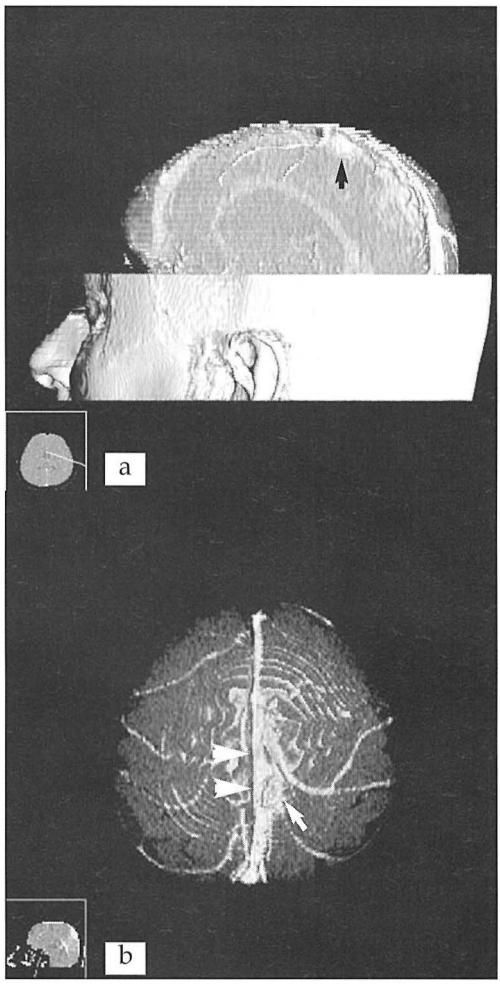

Figure 11. CT angiogram, volume rendering technique, left posterior oblique view (a) and inferior view (b) clearly demonstrates parasagittal meningeoma (arrows) and its relationship to the superior sagittal sinus (arrowhead) and cortical veins, which is important in preoperative planing.

proceses and its relations to surrounding structures.

Minimaly invasivenes of CTA represents an important advantage to conventional intraarterial angiography. The main disadvantage of CTA, has been and in some regard still is a lover spatial resolution compared to conventional angiography. Inspite of this, the balance between advantages and limitations still supports CTA in many clinical issuses.

A quick development of spiral CT scanners and image processing software enables further developement and improvement of CTA. A recent innovation of CT scanners with multiple detectors makes scanning of larger volumes with higher spatial resolution possible. Further improvement represent new software with volume rendering techniques and fast workstations, so that it is now possible to process larger quantity of data in much shorter time.

In conclusion, CTA, if combined with threedimensional techniques, has excellent possibilities to become a reliable and acceptable method for the evaluation of not only intracranial saccular aneurysms, but also of most intracranial vascular diseases.

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review

Computed tomographic angiography of body vasculature

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Background. *The introduction of helical CT scanners in combination with simultaneous opacification of vessels with contrast medium allows the demonstration of vessels within the chosen volume of interest. This examination is called CT angiography. Being a minimally invasive method, it has been quickly acctepted in the spectrum of vessel-imaging modalities, as for example: Doppler ultrasound, magnetic resonance angiography, transesophageal ultrasound etc. In the field of cardiovascular radiology, it has been used to demonstrate pathology of ascending and descending aorta, like the aneurysms, dissection, traumatic rupture or congenital anomalies. It is also very useful in pre-and postoperative follow - up in the aortic stent-graft insertion, a method which has recently become popular. Also the CT angiography has greatly influenced the preoperative calculations and has clearly demonstrated the postoperative anatomical changes as well as complications (i.e. peristental leakage).*

Conclusions. *In this context, it is comparable to intraarterial angiography and even offers some advantages over the latter. The only draw-back being somewhat lower spatial resolution and longer processing time, but with the advent of a new, so called multi-slice scanners and powerful workstations, these draw-backs will be minimized.*

Key words: tomography scanners, X-ray computed; aortic disease - ultrasonography - radiography

Introduction

The advent of spiral (helical) CT has made a great revolution at the performance of body CT and has enabled the development of CT angiography (CTA). It is minimally invasive investigation method of vascular system and can in many cases replace a conventional angiography. In CTA, there is a volume of data obtained rapidly with virtually no respiratory misregistration at peak vascular opacification following peripheral injection of contrast. The appropriate timing ensures that either venous or arterial tree is perceived and multiple overlapping slices can be obtained in order to generate two- and three-dimensional reconstructions with no increase in radiation dose to the patient. When performed as a dedicated study, CTA is faster, less invasive and (should be) cheaper than conventional angiography, with a reduced radiation dose.

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However, there is no significant contrast saving and spatial resolution is somewhat limited to the vessel diameter of 1-2 mm.

The technique must be meticulous if good-quality angiograms are to be obtained. The variables that can be altered are collimation ("beam width"), table speed, contrast volume and flow rate and reconstruction index, which are all set according to the volume of interest and suspected diagnosis. From this data, two - and three dimensional images can be generated, like multi-planar reconstructions (MPR), maximum-intensity projections (MIP), shaded surface display (SSD) and volume rendering tecnique (VRT).

Main indications for CTA of aorta and its branches are aneurysms and dissections of thoracic aorta, suspected blunt trauma or thoracic rupture; pulmonary embolism; in abdominal aorta, the diagnosis of aneurysms, dissections, rupture, and suspected pathology in renal or visceral arteries as well as pelvical arteries. It is very useful to perform CTA at first and afterwards surgical or interventional procedures on aorta and its branches.

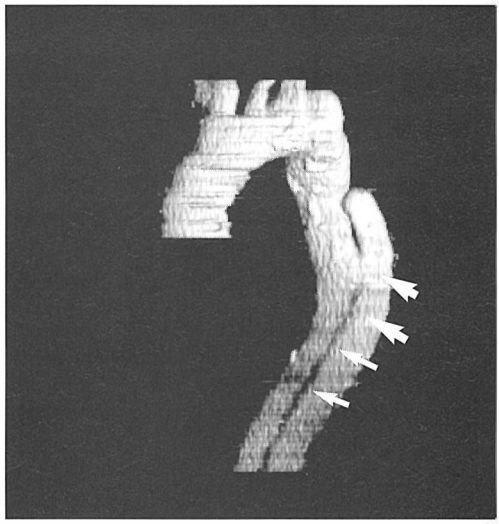

Figure 1a. A dissection of descendent aorta with intimal flap (arrows) are seen in "left anterior oblique" projection.

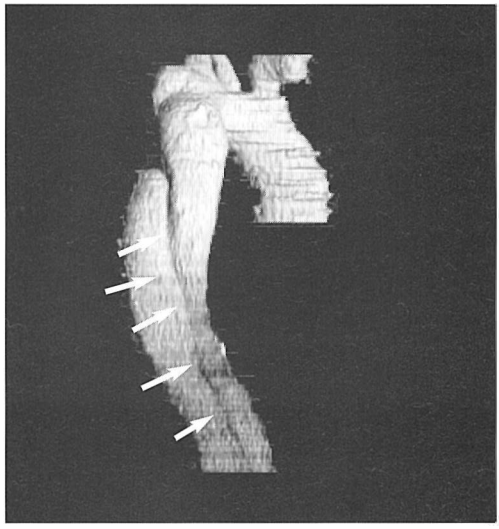

Figure 1b. The same patient with "right posterior oblique" view.

Thoracic aorta

Conventional CT has an established role in detection of aortic aneurysms and dissections. CTA has the advantage of thinner collimation and of more axial slices obtained during the peak vessel opacification.[1] Entire aorta can be imaged on a single spiral and excellent multiplanar reformats can also be obtained. It can actually demonstrate the size, the extent and the quality of the wall of aneurysm as well as the thickness of intimal flap in the case of dissection (Figure1). True and false lumen can be identified and followed, so the origin of the vessels from true or false lumen or the extension of the dissection into the branches can be determined accurately. Some authors prefer the use of CTA over conventional CT and catheter aortography in cases of blunt chest trauma or suspected aortic rupture, although the rate of technically suboptimal results may limit its usefulness.[2] Also, the determination and differential diagnosis of congenital anomalies is made (Figure 2). In our institution, we found CTA of a great benefit in preoperative treatment planning and postoperative follow-up at

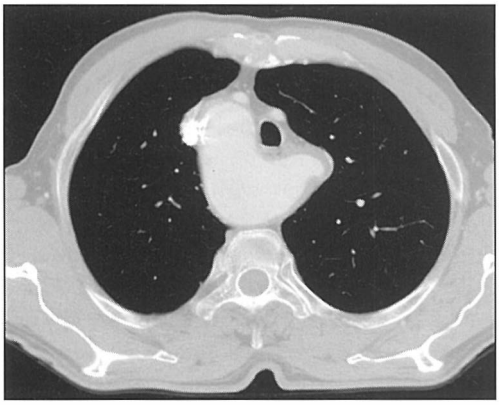

Figure 2a. A CT scan showing a right-sided aortic arch and retrotracheal left subclavian artery with a diverticulum at the orrifice.

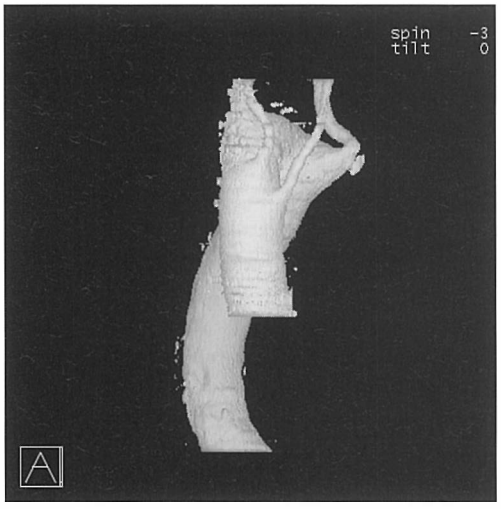

Figure 2b. Three-dimensional reconstruction showing a right aortic arch with mirror imaging of aortic branches.

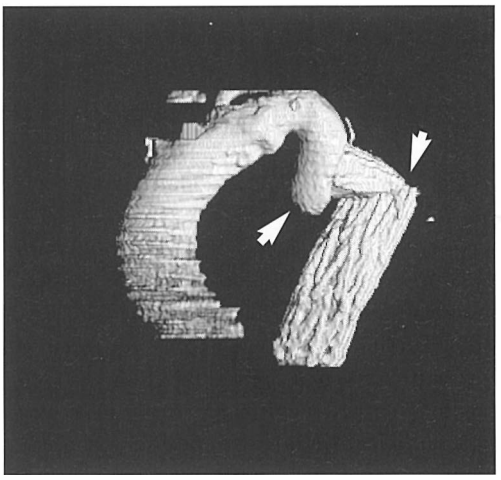

Figure 3a. An aneurysm of descending aorta (arrow) due to a kink of aortic endoprosthesis (arrowhead).

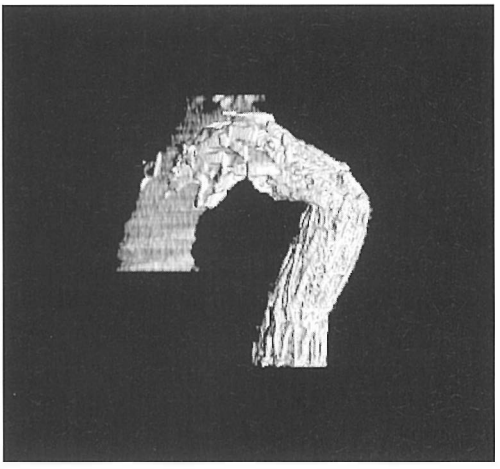

Figure 3b. Reduction of the aneurysm after the insertion of additional endoprosthesis.

the percutaneously or sugically inserted aortic endoprostheses (Figure 3).

Complex anatomy and the extent and the course of intimal flap can be determined by multiplanar reformats (MPR) or SSD and VRT, respectively.[3,4] In order to cover the entire thoracic aorta, it is used a collimation of 3mm, table speed of 4,5 mm/s (pitch 1,5), the volume of contrast is set to 140 ml with the infusion rate of 3 ml/s. In cases when the entire aorta is to be imaged it is used a 5mm collimator with a pitch of 1,5-2. If renal arteries are to be assessed precisely, two spirals are made, one for thoracic and the other for abdominal aorta.

Pulmonary circulation

With CTA it is possible to identify reliably the emboli in central and segmental arteries, but not in the vessels below the fourth division (subsegmental arteries) (Figure 4).[5] Therefore,

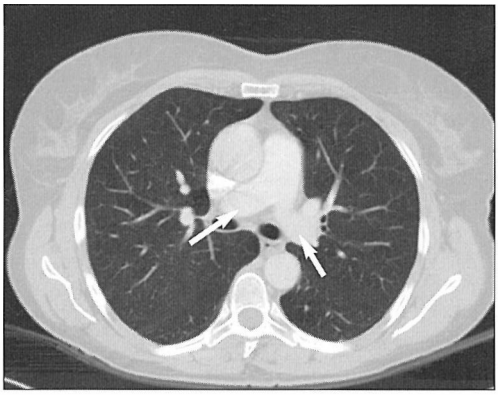

Figure 4a. Pulmonary arteries without filling defects (arrows).

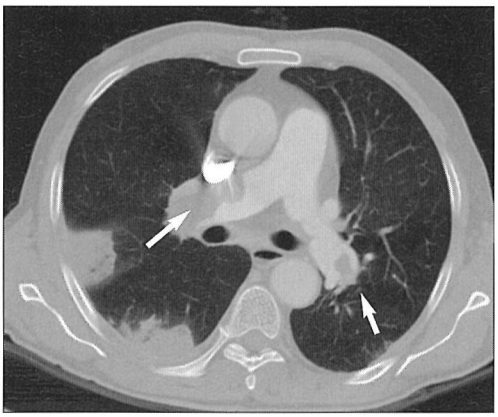

Figure 4b. Emboli in main pulmonarty arteries (arrows). Lung consolidation in the right lobe (arrowheads), indicating possible infarction.

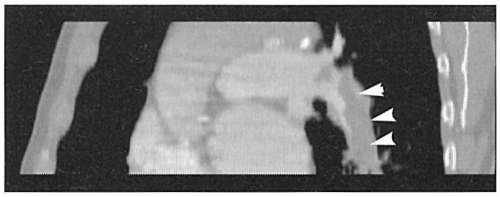

Figure 4c. Multiplanar reconstruction of left pulmonary artery, demonstrating a massive thrombus (arrows).

we scan the patient from the top of aortic arch down to the domes of diaphragm. Ideally, it is used a 3 mm slice with a pitch of 1,5, allowing the scanning time of 20 - 25 sec., but patients usually cannot hold the respiration so long, so we have to use the 5 mm slice and the pitch of 1-1,5, so that the scan duration of about 10 seconds is achieved.

Reported sensitivity and specificity for the detection of pulmonary emboli are 87 and 95%, in comparison with V/Q scans where the result is 65 and 94%. Therefore, many authors advise new protocols for highly suspicious PE: Doppler US of the lower limbs and CTA of pulmonary arteries, which not only reliably determines emboli, but enables a very accurate differential diagnosis.[6,7] Scintigraphy and pulmonary angiography should be reserved for negative CTA with possible subsegmental emboli.[8] CTA can also be used for follow-up, i.e. to determine the effectiveness of the treatment.[9]

Abdominal aortoiliac disease

Conventional CT with contrast was frequently used for the assessment of abdominal aortic aneurysms and provided accurate information about the size of the aneurysm, thrombus formation and diameter of true lumen.[10,11] CTA can provide all this information, as well as can accurately assess the concomitant renal or mesenteric artery stenoses (Figure 5). It also provides useful information for abdomino-iliacal stent-graft insertion, like the necessary device length and diameter, distance of the neck of aneurysm to renal arteries, and the involvement of pelvic arteries.[12,13] After the insertion, it is used to confirm the success of the procedure, and for detection of the complications, like kicking of the stent and peri-stent leaks.[14]

Although there exist many different protocols for performing abdominal and pelvic CTA, we are using the following method: after having made native scans, the collimation is set to 5 mm and table speed at 7,5 mm/s, enabling the scan from above the coeliac trunk or superior mesenteric artery down to external iliac artery in a single scan. Axial reconstruction is made at 3 mm interval, and

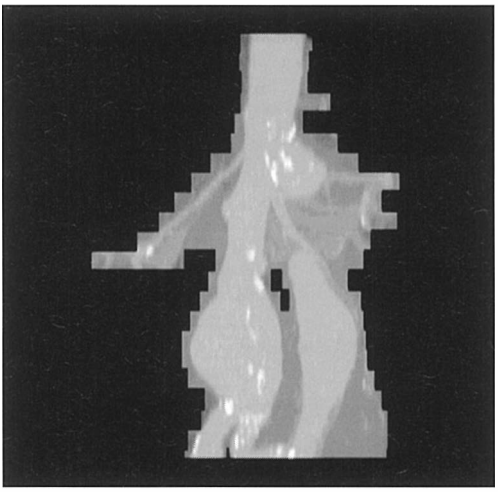

Figure 5a. MIP reconstruction demonstrates aneurysms of abdominal aorta with extensive calcination and concomitant aneurysm of superior mesenteric artery.

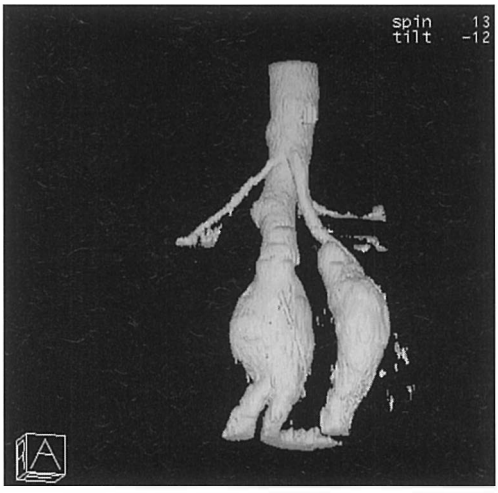

Figure 5b. SSD reconstruction demonstrates both aneurysms in their full extent.

if necessary (like in suspected renal artery stenosis), the segment of "raw data" from superior mesenteric artery to renal arteries is reconstructed at 1,5 mm interval in order to demonstrate selectively the pathology in this region.

Renal arteries

Hypertension is a common condition, and up to 10 % of patients have a renovascular cause. Although not all the renal artery stenoses cause hypertension it is important to diagnose significant stenoses, that is more than 50 %.[15] Presently, the gold standard for diagnosis is arteriography, after the Doppler US and potentially scintigraphy having been performed. The advantage of CTA over conventional arteriography is the identification of the vessel wall, leading to the improved differentiation between ostial and truncal stenoses.[16] With CTA, the presence and the extent of calcination at the site of stenosis is accurately demonstrated, so that therapeutic decision for dilatation and/or primary stent insertion should be made much easier (Figure 6).[17,18] The additional advantage of CTA is the ability to detect possible non-renal causes of hypertension, i.e. suprarenal tumors etc.[18]

This technique is of great importance. Usually, it is used a 2 mm slice with a table speed of 3 mm and the axial images reconstructed at 1-1,5 mm interval. Besides axial images, maximum intensity projection (MIP) is very useful to differentiate between calcifi-

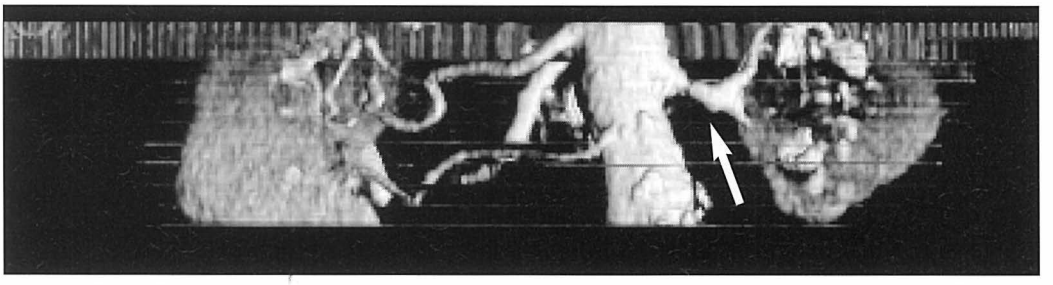

Figure 6. Subtotal stenosis of left renal artery is well demonstrated (arrow), as well as doubled right renal arteries.

cation and contrast-filled lumen, and SSD for the morphological assessment. MPRs are made for the measurements, and after the therapeutical procedures, the same imaging protocol is used for comparison.

Other indications

CTA has proven to be superior to conventional CT in the cases of preoperative assessment of live renal donors[19,20], evaluation of mesenteric ischaemia[21], portal vein and hepatic artery thrombosis, but these application fields have been still in the experimental phases.

Conclusion

The CTA technique offers several advantages over conventional arteriography. Although other noninvasive modalities are gaining popularity, CTA is in many cases the definite method of the vessel pathology diagnosis and differential diagnosis. Although MR angiography is being established in this field, and has many advantages over CTA, like the lack of radiation exposure and there is no iodinated contrast material needed, CTA will continue to be the forefront of noninvasive vascular imaging due to its availability, relatively low cost and effectiveness in diagnosis and treatment planning.

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Magnetic resonance arthrography of the glenohumeral joint

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Background. *The purpose of this study was to estimate the value of native magnetic resonance imaging (MRI) and direct gadopentate (Gd-DTPA) magnetic resonance artrography (MRA) in diagnosing posttraumatic pathological changes of the glenohumeral joint.*

Patients and methods. *In 27 consecutive patients with clinically significant trauma in whom native MRI of the glenohumeral joint was not diagnostically conclusive direct MRA with paramagnetic contrast agent was accomplished. Following intraarticular injection of Gd-DTPA diluted in saline (concentration 0.2 mmol/l) T1W spin echo (SE) and gradient echo (GE) images were performed. Diagnostic results of native MRI and MRA were compared.*

Results. *MRA revealed 5 rotator cuff lesions, 7 labral lesions, 4 osteochondral injuries and a loose body which were not definitely proved by native MRI. All the pathological findings of MRA were confirmed operatively or arthroscopically.*

Conclusion. *Direct MRA with Gd-DTPA showed to be a more sensitive technique for the demonstration of clinically significant intraarticular posttraumatic changes than noncontrast MRI.*

Key words: magnetic resonance imaging; shoulder joint - injuries; rotator cuff

Introduction

Owing to multiplanar imaging capabilities, to superb contrast and to high spatial resolution MRI is able to demonstrate noninvasively joint anatomy. Consequently, this modality has become the method of choice for joint imaging. However, MRI diagnosis of different intraarticular pathologic conditions in anatomically complex joints, such as the glenohumeral joint, may be difficult. Therefore several techniques of MRA were evaluated. These include intraarticular use of saline or Gd-DTPA (direct arthrography) and the intravenous application of Gd-DTPA (indirect arthrography). An important advantage of direct arthrography is the joint capsule distension which enables the better visualisation of intraarticular anatomic structures especially in tight joints. According to some authors MRA of the shoulder joint may provide some information of diagnostic importance about the labrum, the joint capsule and the rotator cuff which are not possible without the use of Gd-DTPA.[1-5] Vast majority of centres still use noncontrast MRI as a routine diagnostic method.

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The purpose of this study was to estimate the value of native MRI and direct Gd-DTPA MRA in diagnosing posttraumatic pathological changes of the glenohumeral joint and eventually to include MRA in a routine diagnostic work up.

Patients and methods

On the basis of history and physical examination the clinical diagnosis of rotator cuff tears (n=18) and the lesions of the labum and the capsule (n=9) was made following significant trauma. In all of these patients native MRI was performed 0.5 -2 months following trauma. Magnetic resonance images were obtained using dedicated shoulder coil on 1.5 T scanner (Magnetom SP 63, Siemens, Erlangen, Germany). A SE sequence with T1-weighted (TR 450 ms, TE 15 ms), PD-weighted (TR 1900 ms, TE 20 ms) and T2-weighted (TR 1900 ms, TE 80 ms) images was performed using angled coronal plane, followed by a GE T1-weighted FISP 2D images (TR 40 ms, TE 10 ms, flip angle 40•) in an axial plane. In all the patients the MRI diagnosis was inconclusive (3 possible rotator cuff lesions, 2 suspect labral lesions and 2 possible osteochondral injuries). Due to persisting clinical symptoms MRA was indicated and accomplished 0,5 - 1 months after the first examination. The joint was punctured under fluoroscopic control using local anaesthesia. The proper position of the needle was controlled with 1-2 ml of non-ionic iodinated contrast material (Ultravist, Schering, Germany) and 10-15 ml of 2 mmol/1 Gd-DTPA solution in saline (Magnevist, Schering, Germany) was then injected until the capsule became distended. After the injection passive and active movements of the shoulder joint were carried out for several minutes to achieve the uniform distribution of Gd-DTPA solution. Coronal oblique and axial 5 mm thick consecutive slices were obtained using a SE T1-wieghted images (TR 450 ms, TE 15 ms), a GE FISP 2D images (TR 40 ms, TE 10 ms, flip angle 40°). A field of view was 16 cm with data acquisition matrix of 256 x 256. (MRA has been approved by the Republic's Ethics Committee).

The images were analysed in a qualitative fashion and the diagnostic results of native MRI and MRA were compared.

Results

Out of 27 cases MRI revealed equivocal pathological findings in 7 patients (26%). A diagnosis of possible full thickness rotator cuff lesion was made in 3 cases, of suspect labral injury in 2 cases and of osteochondral lesions in 2 cases. In the remainder of 21 (78 %) patients no pathological findings could be demonstrated (Table1).

MRA confirmed rotator cuff lesions in all 3 cases with equivocal findings on MRI and proved 2 additional tears. In 3 of these patients the diagnosis of complete (Figure 1) and in 2 cases of partial rotator cuff rupture was made (Figure 2). Typical Bankart lesions were demonstrated in 7 patients using MRA, 2 of these were the cases with suspect labral lesions on native MRI (Figure 3). In patients with labral injuries 3 osteochondral (Sach - Hill) lesions of the posterolateral aspect of the humeral heads were revealed. MRA showed a loose body within the joint (Figure 4) which was not seen on native MRI (Table1). In all the patients pathological MRA findings were confirmed by the operative procedure or the shoulder artroscopy.

Discussion

MRI replaced the conventional arthrography in most institutions and has become a method of choice for depicting the posttraumatic joint pathological changes. Using different imaging

Table 1. MRI and MRA findings

Diagnostic modality	MRI				MRA			
Diagnosis	possible		definite		possible		definite	
	N	%	n	%	n	%	n	%
normal findings			**20**	**74**			**8**	**30**
pathological findings	**7**	**26**					**19**	**70**
rotator cuff lesions	3	11					5	19
labral lesions	2	7,5					7	26
osteochondral lesions	2	7,5					3	11
loose bodies			0				1	3
frozen shoulder			0				3	11

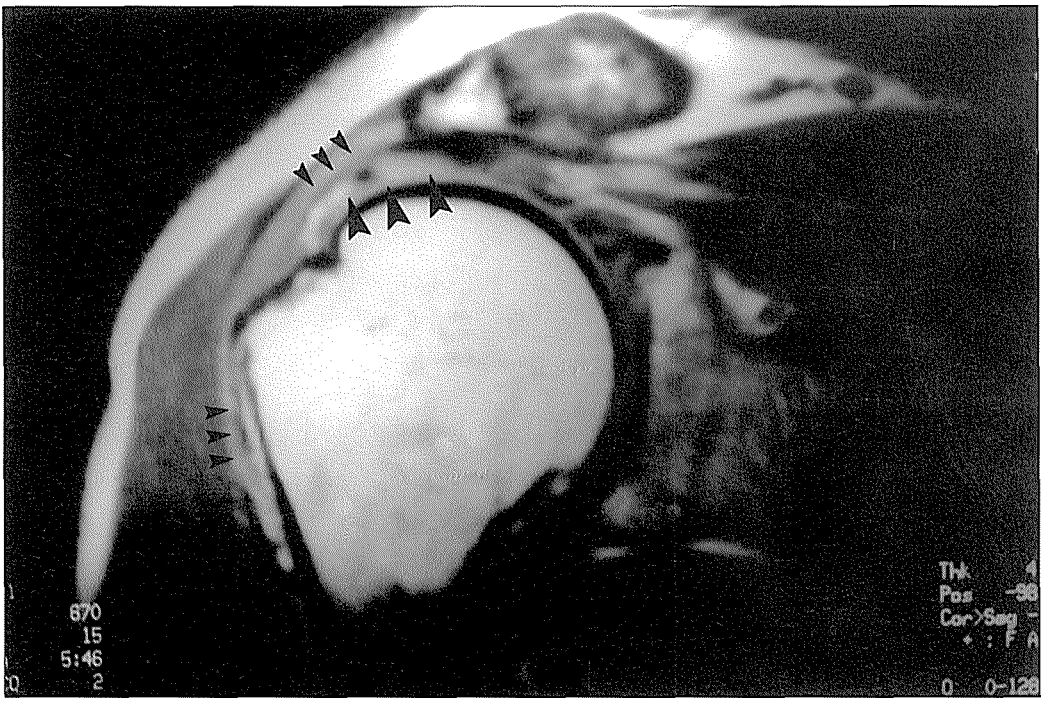

Figure 1. MRA, T1W spin echo image in an oblique coronal plane. Complete rotator cuff rupture is demonstrated with accumulation of paramagnetic contrast agent at the insertion of the m. supraspinatus terdon (big arrow heads). Leakage of contrast material into the subacromial-subdeltoid bursa is also revealed (small arrow heads).

protocols intra and paraarticular soft tissue structures can be demonstrated noninvasively with high contrast and spatial resolution in various planes. It has been proved that MRI shows high sensitivity and specificity for diagnosing the most of the clinically relevant pathological changes of the knee joint. Unfortunately the diagnostic results in some other anatomically tight joints, including glenohumeral, were not so good. In an attempt to increase the diagnostic accuracy of MRI several MRA methods were evaluated changing noninvasive native MRI in an invasive diagnostic procedure. The best results were achieved by the intraarticular application of gadopentate diluted in saline.[1-5]

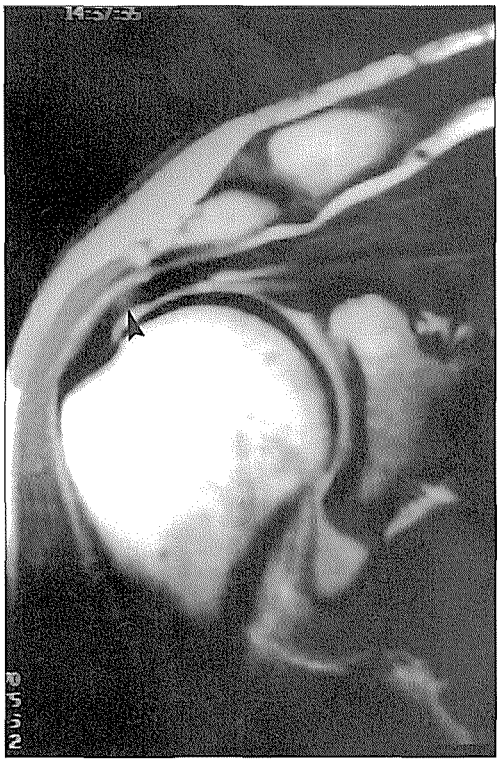

Figure 2. MRA, T1W spin echo image in an oblique coronal plane. Partial rotator cuff rupture. Small defect of the m. supraspinatus tendon is filled with paramagnetic contrast material (arrow head).

In our study native MRI revealed equivocal pathological changes only in 7 joints (26 %) out of 27 patients with significant clinical symptoms. In none of these MRI diagnosis was definite. There was a number of cases (n=20; 74 %) with normal findings in which the clinical symptoms could not be explained by MRI. On the other hand MRA proved to be much more accurate and revealed definite, clinically relevant pathological changes in 19 (70 %) of the shoulder joints resulting in an operative procedure which confirmed the MRA diagnosis.

Although the diagnostic results of MRA were much better than that of MRI in 8 (30 %) out of 27 cases with normal MRA findings clinical symptoms could not be substantiated by imaging features. It may be postulated that at least some of minor posttraumatic changes were spontaneously resolved in a period of several months following the initial trauma before MRA was accomplished, while some of them affected extraarticular anatomic structures not shown by MRA.

In all 3 cases with MRI diagnosis of possible full thickness rotator cuff tear MRA clearly demonstrated typical pathological findings, and proved 2 additional partial lesions not shown by MRI. MRI diagnosis was mainly based on T2-weighted SE images which revealed high signal intensity synovial fluid within the tendon of the supraspinatus muscle and an effusion within the subacromial - subdeltoid bursae. Using MRA in cases with complete tear the defect as well as the quality of neighbouring ends of the tendon were

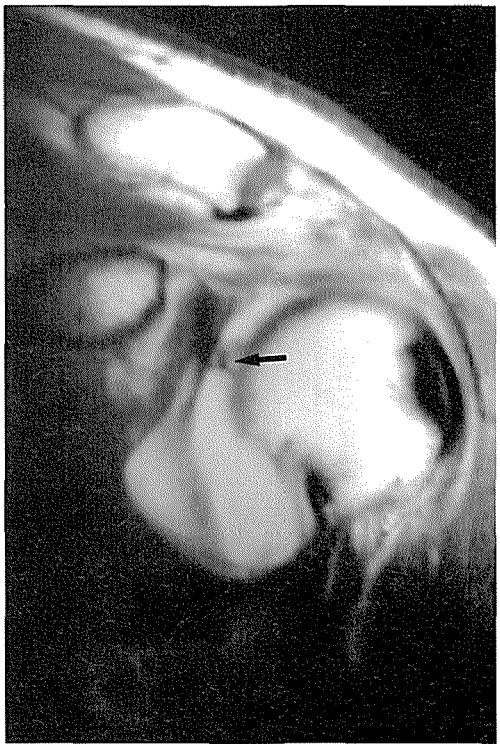

Figure 4. MRA, T1W spin echo image in an oblique coronal plane. Low signal intensity loose body is shown (arrow) surrounded by high signal intensity contrast material.

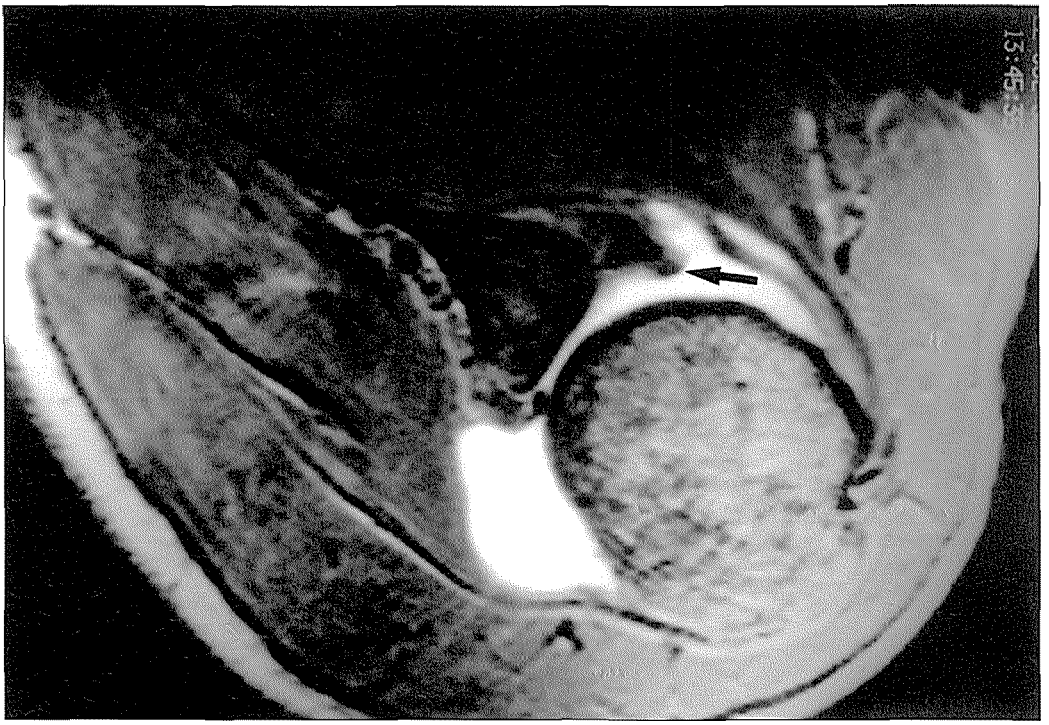

Figure 3. MRA, T1W gradient echo image in an axial plane. Bankart lesion is clearly demonstrated surrounded by high signal intensity solution of Gd-DTPA due to excellent capsular distension.

clearly outlined by the high signal intensity contrast agents on T1-weighted SE images (Figure 1). Leaking of the contrast agent into the subacromial and subdeltoid bursae was also demonstrated. In two joints with partial tear a small defect of the tendon was filled with high signal intensity gadopentate (Figure 2). There are several reasons for the superior diagnostic results of MRA. Firstly, the joint capsule distension resulted in better filling of the thorn tendon and in leaking of contrast agent out of the joint cavity.[3,4,6] Secondly, higher contrast resolution was achieved with the solution of gadopentate in comparison to synovial fluid in native MRI.[1,2,7] Thirdly, the spatial resolution on T1-weighted SE images in MRA was higher than on T2-weighted images which were diagnostic in MRI.[8,9]

Even greater differences between both examinations were documented in labral lesions. Only 2 possible labral lesions were shown by MRI, mainly using GE T1-weighted FISP 2D images. MRA proved each of these lesions and confirmed additional 5 Bankart lesions. Capsular distension with contrast accumulation within the capsulolabral lesions was the main reason for the better demonstration with MRA (Figure 3). MRI revealed 2 Sach-Hill lesions as high signal intensity areas on T2-weighted SE images and low signal intensity on T1-weighted SE images. The diagnosis of 3 osteochondral lesions with MRA was mainly based on the contrast accumulation within the defect of the humeral head.

Low signal intensity loose body representing cortical bone fragment was clearly demonstrated within a distended joint due to the surrounding high signal intensity gadopentate only using MRA (Figure 4).

In 3 cases the diminished capacity of the joint cavity with reduced bursae and the same

leakage of the contrast agent out of the glenohumeral joint indicated the frozen shoulder. Native MRI was not able to demonstrate these typical findings

There were no cases with pathological MRI findings which were not confirmed by MRA.

No adverse reactions to contrast agents or a complication due to intraarticular injection could be registrated.

In conclusion, in this study MRA proved to be more accurate than native MRI in diagnosing clinically relevant posttraumatic intraarticular changes of the glenohumeral joint. The results indicate that MRA may be used as a safe and reliable routine diagnostic procedure.

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review

Magnetic resonance of cardiac tumors and masses

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Cardiac tumors are rare and should be differentiated from nontumoral cardiac masses because of different therapeutic approach. For this purpose, spin-echo (SE) technique and gradient-echo (GE) technique are used in magnetic resonance imaging (MR). The first provides anatomic evaluation of the heart and tissue characterization, while the second provides dynamic information on the blood flow and heart contraction. Cardiac myxoma is differentiated from thrombus by paramagnetic contrast agent administration. Their mobility is evaluated with GE technique. Lipomas and subacute hemorrhage have the same, high signal intensity on T1-weighted spin-echo image, therefore, the fat suppression technique is appropriate to recognize them. MR is used in evaluating the response of the malignant tumor to chemotherapy. GE MR is useful to differentiate between the thrombus and slow-flowing blood; the administration of gadolinium helps to distinguish the thrombus from the tumor. In patients suspected of having a cardiac tumor, echocardiography is the first method of choice. MR is used to confirm the findings of echocardiography, to determine precisely the tumor location, extent, and its tissue characterization, to follow up patients under treatment, and to detect early tumor recurrence.

Key words: heart neoplasms; magnetic resonance imaging

Introduction

Cardiac tumors are rather rare entities. Because of their rarity and the nonspecific symptomatology, their diagnosis may be delayed. Cardiac surgery is still the preferred therapeutic approach for cardiac tumors. Nontumoral cardiac masses are much more frequent than true cardiac tumors and usually require medical treatment or no treatment at all.[1] Thus, accurate differentiation between the two conditions is highly important. The diagnosis of cardiac tumors and masses was very difficult before the availability of transthoracic (TTE) and transesophageal echocardiography (TEE), computed tomography (CT), and magnetic resonance imaging (MR). With the advent of modern imaging techniques abnormal masses are much more easily and frequently detected. As normal cardiac structures may be interpreted as abnormal by inexperienced people, precise knowledge of the normal cardiac anatomy and its variants

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is required. We wish to highlight the role of MR in the detection and differentiation of cardiac masses to stress the diversity of cardiac tumors, nontumoral masses, and normal variants, and to present our experience with MR in evaluating cardiac masses.

MR techniques of imaging cardiac tumors and masses

MR is one of the preferred imaging modalities in the evaluation of the patients with suspected cardiac masses.

Two types of ECG-triggered sequences are used for the evaluation of suspected cardiac masses with MR. The first is the spin-echo (SE) technique (dark blood), the second is the gradient-echo (GE) technique (bright blood).

The *SE sequence* can be T1- or T2-weighted. It provides excellent anatomic evaluation of the heart. The differentiation between benign and malignant neoplasms based on the pattern of signal intensity is still not possible, although a combination of T1- and T2-weighted measurements allows better description of the composition of cardiac masses.

Most soft tissue tumors have relaxation times shorter than fluid, and produce a relatively low signal on T1-weighted images and a relatively high signal on T2-weighted images.[2] Cystic fluid (pericardial cyst) has a very low signal on T1-weighted images and a very high signal on T2-weighted images. The masses with lipomatous composition (lipomas) have a relatively high signal on T1-weighted sequences and an intermediate signal on T2-weighted sequences. Fat suppression techniques selectively saturate the signal coming from the fat and can be used to prove the fatty composition of cardiac masses. Calcifications and mature fibrotic tissue have few mobile protons, resulting in low signal in both T1- and T2-weighted MR, while subacute and chronic hemorrhage shows a high signal intensity in both sequences.[3]

Many tumors have similar signal intensity as normal myocardium and the distinction between them is difficult.[4] Paramagnetic contrast agents, such as gadoliniumdiethylene triamine penta-acetic acid (Gd-DTPA), may be administered to improve discrimination. Gd-DTPA usually accumulates in the vascularized tissues or in tissues that contain higher proportion of interstitial space. Necrotic or cystic areas of a tumor do not accumulate contrast medium. This may help in the differential diagnosis or valuation of the efficacy of nonsurgical treatment on the follow-up. Acute and subacute thrombus does not have vascularization and therefore cannot be enhanced by Gd-DTPA, which may help to differentiate them from tumor. Chronic thrombi can rarely be enhanced after the administration of contrast medium.[5]

Gradient-echo MR is generally applied as a single-slice multiphase sequence. Images are obtained at different time points during the cardiac cycle in a single tomographic section. These images can be looked in a cine mode providing dynamic information on the blood flow and heart contraction (cine MR). It does not provide real-time imaging, but it is a very useful technique to evaluate the mobility of cardiac masses and to differentiate slow flow from thrombus.

Normal cardiac anatomy and variants

Several normal intracardiac structures can mimic pathologic masses.

False chordae or false tendons are sometimes found as normal variants in left ventricle. They are linear structures attached at both ends to the endomyocardium and are usually detected accidentally.

The moderator band is a thin muscular band extending from the midinterventricular septum and is attached to the free wall of the right ventricle near the base of the anterior papillary muscle. It may become very promi-

nent and may be mistaken for the right ventricular thrombus or tumor. It is unique for the right ventricle, which can be very helpful in differentiating the right from the left ventricle in congenital heart malformations.

Nodular thickening of the posterior right atrial wall corresponds to the *crista terminalis*. It is a prominent muscular ridge that extends along the posteriolateral wall of the right atrium between the orifices of the superior and inferior venae cavae. These structures have a similar signal intensity as myocardial tissue and should not be mistaken for neoplasm or thrombosis.

Primary cardiac tumors

Primary cardiac tumors of the heart and pericardium are extremely rare. They can be an incidental finding on chest radiography or cardiovascular diagnostic test. Clinical findings (flow disturbance, thromboembolism, arrhythmias, etc.) are determined primarily by the anatomic location of the tumor. Seventy-five percent of the primary tumors are benign. Nearly half the benign tumors are myxomas and predominate in adults, whereas rhabdomyomas predominate in children.

Benign cardiac tumors

Cardiac myxoma (Figure 1) is an intracavitary neoplasm that can occur anywhere in the heart. Seventy-five percent of myxomas occur in the left atrium, and, usually, have a pedunculated attachment to the atrial septum near the fossa ovalis. Systemic embolism occurs in 20 % to 25 % of patients with myxomas.

The signal characteristics of myxomas on MR depend on the tumor composition. The areas of low signal intensity correspond with calcification (30% of myxomas) or deposition of hemosiderin; the areas of high signal correspond with subacute intratumoral hemorrhage.[6] The surface of the tumor is often covered by thrombus. Myxomas are highly vascular showing significant enhancement after the administration of paramagnetic contrast agents (Gd-DTPA); the enhancement can be of a homogeneous or heterogeneous pattern. The areas of enhancement correspond with histologic tumor cells, while unenhanced regions reflect necrosis. Myxomas have a low

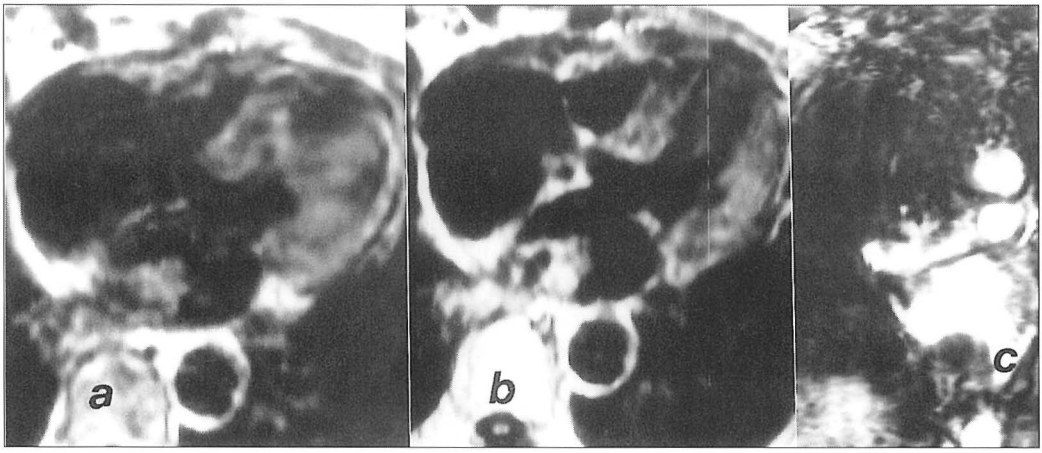

Figure 1. Left atrial myxoma. T1-weighted axial SE images before (**a**) and after (**b**) the administration of Gd-DTPA. There is a well-defined inhomogeneous mass in the left atrium attached to the posterior wall. The tumor demonstrates an inhomogeneous enhancement pattern after contrast administration with no enhancement in the medial part. This part has very low signal on the precontrast image, which corresponds with calcification. **c** Coronal GE image: the myxoma appears strongly hypointense, surrounded by the bright intracavitary blood.

signal intensity on cine MR; this technique may be used to detect atrioventricular tumor entrapment.

The differential diagnosis of myxoma includes other benign and malignant primary tumors, metastatic tumors, organized atrial thrombi, valvular vegetations and normal variants that may mimic cardiac masses.

Cardiac lipomas are benign tumors of encapsulated mature adipose cells and represent approximately 10 % of all cardiac neoplasms. They can be intracavitary, intramyocardial, or intrapericardial, and are most frequently located in the left ventricle and right atrium. Lipomas are usually asymptomatic and in most cases require no treatment. MR shows the nature, size and location of the tumor. The differential diagnosis includes subacute hemorrhage because both entities have a high signal intensity on T1-weighted MR. Fat suppression techniques can differentiate fatty tissue from subacute hemorrhage. T2-weighted MR is useful, too, because lipomas have an intermadiate signal intensity on T2, whereas subacute hemorrhage has a high signal intensity.

Rhabdomyoma represents 75 % of all primary cardiac tumors in early childhood and may regress spontaneously by the age of 2 years. They are frequently multiple, involve both atria and ventricles, and can have an intracavitary location. Differential diagnosis includes fibromas, which are infrequently multiple or located in the atria. A most important differential feature is the association of rhabdomyomas with tuberous sclerosis. Cardiac rhabdomyomas have a median to high signal intensity on T1-weighted MR and an intermediate signal intensity on T2-weighted images. The postcontrast enhancement of the tumor is similar to the surrounding myocardium.[7]

Malignant cardiac tumors

Primary malignant cardiac tumors consist of sarcomas, lymphomas, and mesotheliomas.

Soft tissue sarcomas are the most common malignant neoplasms of the heart, pericardium, and great vessels.[8] Among them, angiosarcoma and rhabdomyosarcoma are the most frequent. Occasionally, other rare primary sarcomas like liposarcomas, fibrosarcomas, leiomyosarcomas, etc. are found. Liposarcomas are usually diffuse and involve the right ventricle. The signal intensity is lower than that of fat on T1-weighted images. Leiomyosarcomas (Figure 2) predominate in the muscular arteries and great veins. When located in the inferior or superior vena cava, they may directly involve the right atrium.

Angiosarcoma. One-third of primary malignant cardiac tumors in adults are angiosarcomas. This highly aggressive malignant tumor can develop from the endothelium of the lymphatics, (lymphangiosarcoma), or blood vessels (hemangiosarcoma). Most cardiac angiosarcomas occur in the right atrium as single or multiple nodules infiltrating the myocardium and pericardium. The pericardial sac is filled with the blood. On MR, the angiosarcomas are usually seen as heterogeneous masses with characteristic mosaic pattern of increased and median signal intensity on T1-weighted images. The high signal areas result from intratumoral hemorrhage. T2-weighted images or gadolinium administration usually better delineate the tumor from the normal myocardium.

Rhabdomyosarcoma is the second most frequent primary malignant tumor of the heart and occurs anywhere in the heart. In about 40 % of the cases, the pericardium is involved by direct extension from the myocardium. On T1-weighted image, rhabdomyosarcoma appears as homogeneous mass, isointense or minimally hyperintense to the muscle. On T2-weighted images, the tumor is hyperintense to muscle. MR is used in evaluating the response of the tumor to chemotherapy.

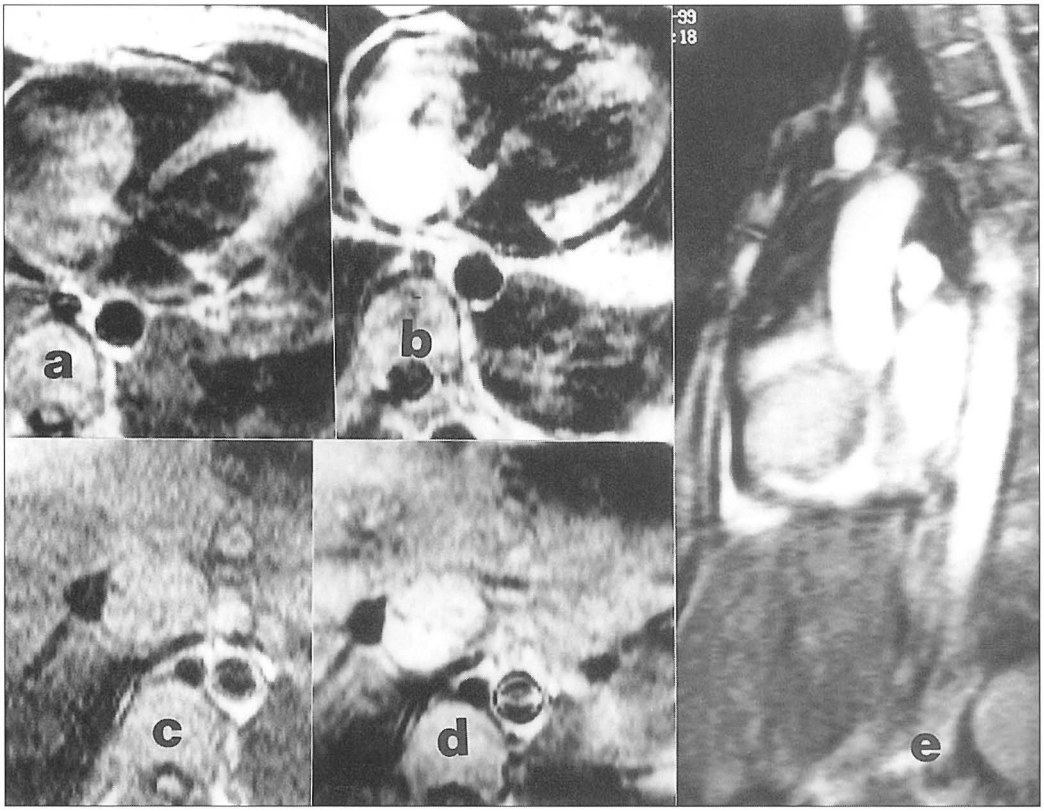

Figure 2. Leiomyosarcoma of the inferior vena cava extending to the right atrium. T1-weighted axial SE images before (**a** and **c**) and after (**b** and **d**) the administration of Gd-DTPA. The tumor almost completely fills the right atrium, bulges to the right ventricle and blocks VCI. Extensive enhancement after contrast administration (b and d); it is clear that the mass in VCI is not a thrombus but a tumor. **e** - GE in sagital plane. A mass of intermediate signal intensity surrounded by the bright intracavitary blood. We performed transjugular biopsy to determine the tumor nature.

Secondary cardiac tumors

Secondary tumors of the heart are approximately 30 times more frequent than primary tumors. Tumors originating in the lung, mediastinum, or breast can directly invade the pericardium or the heart. The most common tumors that metastasize (Figure 3) to the heart are of bronchial and breast origin, followed by melanomas, lymphomas (Figure 4), and leukemia.

Intracaval extension can occur in adrenocortical, hepatocellular, renal-cell and some other carcinomas. It can cause caval obstruction, extension of the tumor thrombus to the heart causing atrial occlusion, and tumor embolization. Accurate identification is essential to plan treatment and MR can show the extension of an intracaval tumor thrombus. The differentiation between the tumor component and the accompanying bland thrombus is still difficult. Gadolinium administration is helpful because the contrast usually accumulates in the tumor and, to lesser extent, in an old organized thrombus. Lymphomas can spread to the heart via the lymphatic vessels.

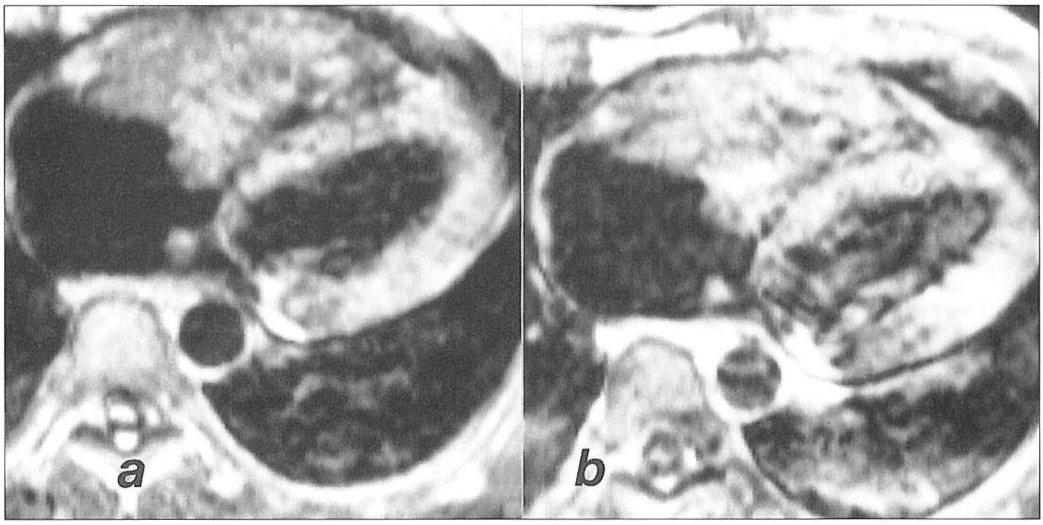

Figure 3. Metastatic seminoma to the right ventricle. T1-weighted axial SE images before (**a**) and after (**b**) the administration of Gd-DTPA. The right ventricle is almost completely filled with the tumor-thrombus, that can not be differentiated from the anterior ventricular wall (tumor ingrowth). On operation, anterior wall was invaded and the tumor could not be excised completely.

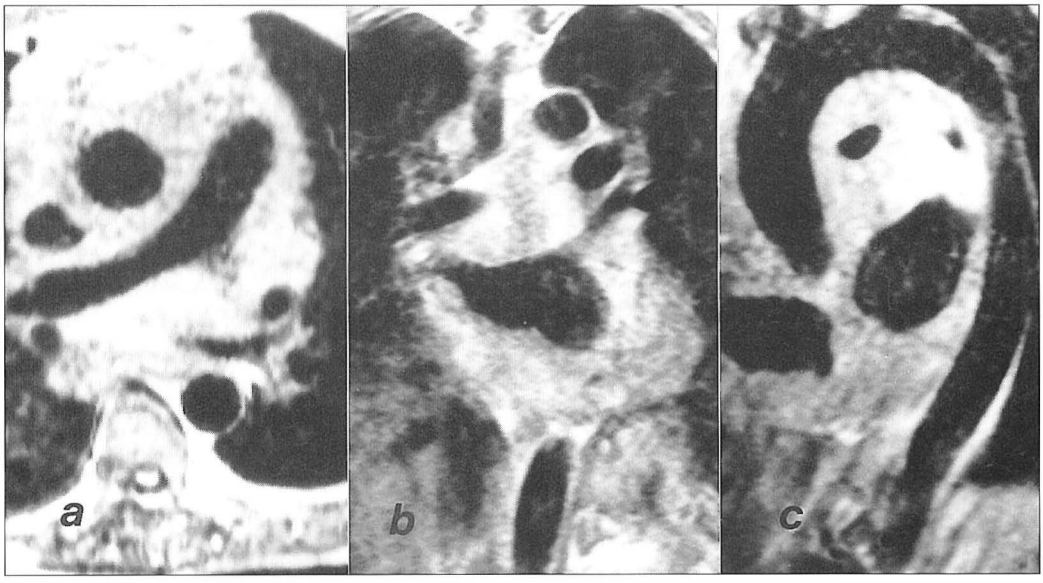

Figure 4. High-grade mediastinal lymphoma diffusely infiltrating the heart. T1-weighted SE images in **a** - axial, **b** - coronal, **c** - LAO plane. The lymphomatous tissue surrounds the ascendning aorta, pulmonary arteries and veins. There is a narrowing of the right pulmonary artery and left atrium due to a tumoral thickening of the atrial wall.

Nontumoral cardiac masses and mimics

Cardiac thrombi

Cardiac thrombi are much more frequent than cardiac tumors and usually occur in patients with regional or global wall motion abnormalities (atrial fibrillation, myocardial infarction, dilated cardiomyopathy). Thrombi are mostly found in the atria. The left atrial thrombi are generally attached to the posterior left atrial wall by a broad base. The right atrial thrombi are found in patients with generally poor condition often associated with central venous catheter. Ventricular thrombi are rare in patients with normal cardiac function.[9]

The cardiac thrombi usually have higher signal intensity than the normal myocardium on SE MR. Differentiation between thrombus and slow-flow may be difficult on SE, because of the increased MR signal produced by slow-flowing blood. On gradient-echo (GE), the thrombus always shows a lower signal intensity than does the flowing blood[4], but is iso- to hyperintense compared with myocardium. That is why the differentiation between thrombus and myocardium on GE is more difficult. The thrombus and the signal intensity change according to its age and degree of organization (loss of water, condensation of paramagnetic iron complexes, calcifications).

The majority of thrombi are immobile. If they are pedunculated and mobile, it may be difficult to distinguish them from a myxoma. Gadolinium administration is helpful because myxomas are highly vascular showing significant enhancement after paramagnetic contrast agents administration. Therefore, GE MR is useful to differentiate between the thrombus and slow-flowing blood, whereas gadolinium administration is helpful to distinguish the thrombus from the tumor.

Lipomatous hypertrophy

Lipomatous hypertrophy of the atrial septum is not a true neoplasm. It is a hypertrophy of preexisting fat and not infrequently associated with increased epicardial fat.[10] The fat accumulates within the interatrial septum, usually in front of the fossa ovalis. The typical appearance is high signal intensity on T1-weighted MR. The differential diagnosis includes lipoma, liposarcoma, and nonacute hematoma. Liposarcoma has a lower signal intensity and inhomogeneity. Fat suppression techniques can be used to differentiate lipomatous hypertrophy of the atrial septum from nonlipomatous tumors and conditions.

Conclusions

With the new cardiac imaging modalities such as echocardiography, CT, and MR, normal anatomic heart structures can be very well recognized and differentiated from pathologic structures.

In patients suspected of having a cardiac tumor, echocardiography is the first method of choice. MR is used to confirm the findings of echocardiography, to determine precisely the tumor location, extent, and its tissue characterization, to follow up of patients under treatment, and to detect early tumor recurrence.

Major advantages of this technique are the excellent spatial resolution, large field of view, natural contrast between the flowing blood and the surrounding heart walls or tumor masses, multiplanar imaging capability, and use of paramagnetic contrast agents for better visualisation of the tumor borders. The large field of view is a clear advantage over echocardiography, while the multiplanar imaging capability without radiation is a clear advantage over CT. On the other hand, MR lacks the ability for real-time imaging though it may become clinically available in the near future.

With MR, cardiac masses can be very accurately depicted or ruled out. MR can be helpful in tissue characterization; however, the differentiation between tumor and nontumoral conditions, or between benign and malignant tumors, is often not possible without histology.

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review

Magnetic resonance of the thoracic aortic disease

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Conventional ECG gated spin-echo (SE) magnetic resonance imaging (MR) and magnetic resonance angiography (MRA) are excellent methods for diagnosing thoracic aortic disease. SE image provides a good spatial resolution for defining aortic anatomy and relationships to adjacent tissues. MRA shows flow but temporal resolution is inferior to conventional MR images. Contrast-enhanced 3D (three-dimensional) MRA is very accurate for defining thoracic aortic anatomy and is particularly good for defining branch vessel abnormality. The sensitivity and specificity for diagnosing aortic dissection are the highest in comparison to other modalities (echocardiography, CT angiography) and range from 95 % to 100 % and 94 % to 100 %, respectively. MR can define clearly the full diameter of aortic aneurysm and also shows the amount of thrombi within it and its craniocaudal extent. A combination of SE and cine MRA is usually necessary. The same sequence with contrast enhancement provides all the required information on the congenital abnormalities of the aorta. MR is very reliable in congenital aortic abnormalities, aortic aneurysm and aortic dissection in hemodynamically stable patients. It should be used for all chronic thoracic aortic disease and postsurgical follow-up. Unstable patients that need intensive hemodynamic monitoring are unsuitable for MR.

Key words: aortic disease; aorta, thoracis; magnetic resonance angiography

Introduction

Examination of the thoracic aorta was one of the first uses of conventional ECG gated spin-echo magnetic resonance imaging (SE MR) and remains the fundamental imaging method in diagnosing the thoracic aortic disease. MR provides, non-invasively, the information on anatomy, function, and blood flow with no exposure to ionising radiation. It has become increasingly useful for evaluating suspected aortic dissection, aneurysm, and congenital anomaly. We present our experience with MR technique in evaluating the pathologic conditions of the thoracic aorta.

MR aortic imaging techniques

Magnetic resonance (MR)

Conventional ECG-gated SE is in many respects the reference standard for thoracic aortic MR imaging. It provides a good spatial

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resolution for defining an aortic anatomy and relationships to adjacent tissues. However, it can be time consuming, and complicated 3D anatomy may be difficult to represent.[1] Artefacts related to slow flow or flow within the imaging plane may mimic thrombus, and, unfortunately, the conventional SE is susceptible to respiratory artefacts.

Breath-hold imaging methods are fast, but may lack the spatial resolution required for making confident anatomical diagnosis. Techniques, such as HASTE and turbo-FLASH, may provide adequate information in some cases. Most turbo-FLASH sequences without gadolinium enhancement do not have adequate signal-to-noise ratios and spatial resolution in the chest. With contrast enhancement, the turbo-FLASH technique is relevant for diagnosing aneurysms and dissections.[2]

Magnetic resonance angiography (MRA)

Non-breath-hold time-of-flight MRA - cine MRA is useful for the assessment of some lesions - coarctation, flow abnormalities (identifying true and false lumens in the patients with aortic dissection). Image quality can be improved in most patients by reducing respiratory artefacts with breath-hold cine MRA, although temporal resolution is slightly inferior to conventional non-breath-hold cine MRA.

Contrast-enhanced 3D MRA is very accurate for defining thoracic aortic anatomy and particularly good for branch vessel abnormality.[3] 3D image processing is easier due to the high signal provided by vascular contrast enhancement. Very short TR and TE are necessary. Timing the injection is very important for proper enhancement and to prevent aortic anatomy being obscured by adjacent veins. Contrast enhancement is useful for defining the abnormalities that may be obscured or mimicked by a slow or turbulent flow.

Pathology of the thoracic aorta on MR

Dissection

MR is suitable for the patients with chronic dissection or in postoperative evaluation.[2] It can be used also in acute dissection if the patients are hemodynamically stable. MR can image intramural hemorrhage, intimal tears, stagnant blood flow versus thrombosis and periaortic blood (Figure 1).

With SE sequences, errors can occur related to slow flow mimicking thrombus, chemical shift artefacts, respiratory artefacts, signal from adjacent veins (superior vena cava), etc. The use of MRA and contrast-enhanced MRA has largely improved the MR accuracy. The sensitivity for diagnosing aortic dissection ranges in different studies from 95 to 100 % and is the highest compared to other modalities (86 to 100 % for transesophageal echocardiography (TEE), and 94 to 100 % for CTA). The same is true for the specificity - 94 to 100 % for MRA, 67 to 94 % for TEE and 87 to 100 % for CTA.[4,5]

MR is probably the most reliable method for detecting postoperative complications such as anastomotic aneurysms, further dilatation, and extension of false lumens into branch vessels. It is the best way for routinely following the patients with chronic or progressive aortic abnormalities, such as patients with Marfan syndrome.

Aortic ulceration and intramural hematoma

Aortic ulcers are seen as focal outpouchings from the lumen of the aorta and frequently progress to aneurysm. Ulcers are typically found in the descending or abdominal aorta and may be filled with thrombus. Increased signal from ulcers on T1- and T2-weighted images can mimic an intramural hematoma or thrombosed false lumen in aortic dissection.[6]

The intramural hematoma is characterised by a localised thickening of the aortic wall due to hematoma formation without an inti-

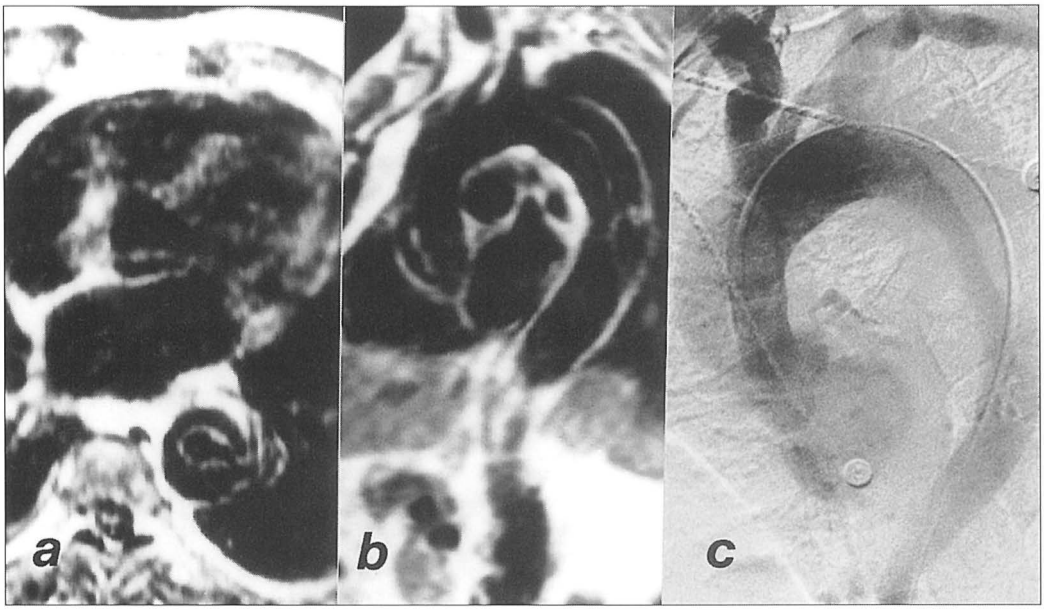

Figure 1. Aortic dissection type A. **a** - Axial SE image showing a near circular intimal flap in the descending aorta. **b** - Axial SE image in LAO plane. Intimal flap is seen as thin structure of increased signal intensity passing across the ascending aorta, through the aortic arch, into the descending aorta. **c** - corresponding angiography confirms MR findings showing flow in both lumens.

mal tear or a double lumen. It can precede classic aortic dissection. An acute intramural hematoma may be overseen on T1 images due to the isodense appearance of the blood and aortic wall; a high signal intensity on T2 images might be helpful.

Occasionally, the chemical shift artefact from the surface of the luminal thrombus may simulate a dissection. The differentiation between the slow flow in a false lumen and thrombus can be made using cine or contrast-enhanced MRA (Figure 2). The differentiation of the intramural hematoma from true aortic dissection is important as the distal (type B) hematoma may resolve without surgical treatment, while the proximal (type A) hematoma usually progresses to dissection and requires surgical treatment.[6]

Figure 2. Aortic dissection type B. **a** - Axial SE image in the thoraco-abdominal region shows an increased aortic diameter, signal-void centrally (flowing blood) and increased signal around it (slow, turbulent flow or thrombosed false lumen). **b** - GE at the same level shows intermediate signal parietally corresponding to thrombosed lumen.

Aortic aneurysm

MR can define clearly the full diameter of aortic aneurysm and also shows the amount of thrombi within it and its craniocaudal extent (Figure 3). Many thoracic aneurysms extend into the abdomen and, hence, the ability to image the entire aorta is important. The relationship of the aneurysm to the major branch arteries, particularly the head and neck vessels, is essential when planning the surgical approach. MR can define the branch vessel anatomy and congenital variations. In ascending aortic aneurysm, the assessment of aortic valve morphology, aortic regurgitation, and relationship of aneurysmal disease to the coronary arteries are required. To provide all this information, a combination of imaging protocols is usually necessary. The combina-

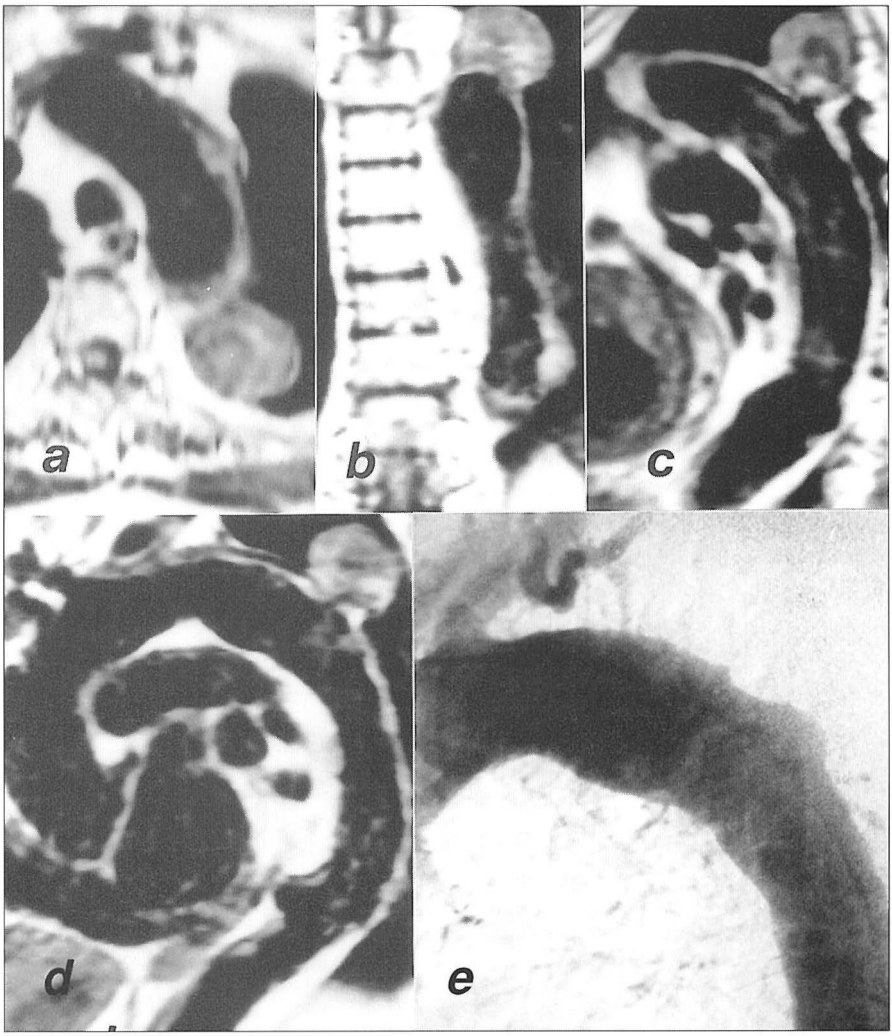

Figure 3. Aortic pseudoaneurysm. SE images in axial, coronal, sagital and LAO plane (**a-d**) show round mass of different signal intensity attached to the dorsal wall of the proximal descending aorta. Various signal intensity corresponds to the thrombus of different age. Aortic ulceration is seen distally on **d. e** - Corresponding aortography confirms small outpouching - most of the pseudoaneurysm is filled with thrombus.

tion of SE and cine MRA will show the size of the aneurysm (SE), branch vessel involvement and aortic regurgitation (MRA). The contrast-enhanced 3D MRA is excellent to define branch vessel anatomy, but the unenhanced SE sequence may also be required to define more precisely the true diameter of the thrombosed part of the aneurysm.[7]

Congenital abnormalities of the aorta

MR with MRA usually provides all the information required about aortic anatomy, its relationships to adjacent structures, and branch vessel anatomy, and is as accurate as angiography.[8]

Conclusion

The advantages of MR for vascular diagnosis are well known and include non-invasiveness, wide field of view, multiplanar imaging, and the ability to show complicated 3D relationships which is not always possible with conventional angiography. Similar information may be acquired using echocardiography and CT angiography. Transthoracic echocardiographes, TTE and TEE, are widely available and are the usual initial methods for investigating aortic disease. Large parts of the aorta are obscured by the overlying lung or bone and are inaccessible to echocardiography. The high specificity of MR, its non-invasive nature and the ability to image the aorta below the diaphragm are major advantages over TEE.

CTA and MRA are extremely accurate in evaluating the thoracic aorta. CTA uses large volumes of iodinated (more toxic) contrast medium, and inflow dilution effects may mimic or obscure the disease; nevertheless, it has no potential to assess aortic regurgitation. The branch vessel anatomy may be obscured by calcifications in the vessel wall.

In many instances, no contrast medium needs to be given with aortic MRA and complicated 3D anatomy can be evaluated non-invasively. When branch vessel anatomy is unclear, the contrast-enhanced 3D MRA allows accurate definition of branch vessel anatomy. The accuracy of this combined approach using MR has limited the use of aortography mainly to those patients who are ineligible for MR (metal implants, pace-makers, claustrophobia). In addition to defining the aortic anatomy, a simultaneous imaging of intracardiac abnormalities (including valve lesions and congenital abnormalities) and complications of aortic diseases (hemopericardium, left ventricular dysfunction, valvular regurgitation) is possible during the same examination.

MR has also some limitation in evaluating aortic diseases. The patients with acute thoracic aortic dissection are medical emergencies and may be unstable. The need for intensive hemodynamic monitoring makes them unsuitable for MR. The same problems arise in traumatic aortic rupture. CTA and TEE are more appropriate in these circumstances.

MR is very reliable in congenital aortic abnormalities, aortic aneurysm and aortic dissection in hemodynamically stable patients. It should be used for all chronic thoracic aortic diseases and postsurgical follow-up.

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Hydrocolonic sonography in the detection of large bowel disease

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Background. *The presence of fluid in the bowel lumen improves the sonographic visualisation of the gastrointestinal tract, thus permitting earlier and more accurate detection of pathological changes. Hydrocolonic sonography (HS) is a method of examining the colon after it has been cleaned and filled with water.*
Patients and methods. *We have evaluated the method in a group of 56 patients by comparing its results with the findings of colonoscopy, double-contrast barium enema or surgery.*
Results. *HS had an overall accuracy of 86 %, a sensitivity of 81 %, a specificity of 92 %, a positive predictive value of 91 % and a negative predictive value of 82 %.*
Conclusions. *The technique is not suitable for examining the rectum, but apart from that it is comparable in usefulness to double-contrast barium enema. The main limitation of HS is that it requires a lot of experience and skill on the part of the sonologist, which affects its acceptability for diagnostic evaluation of the colon.*

Key words: colonic diseaes-ultrasonography; colonic neoplasms-ultrasonography; hydrocolonic ultrasonography; polyps

Introduction

Ultrasonic examination of the abdomen is a widely used diagnostic method, which usually represents the first step in the evaluation of various abdominal symptoms. In examining the bowel, we are hampered by the physical limitation of the technique, based on the fact that the difference in acoustic impedance between solid tissue and gas is so great that almost the entire emitted ultrasound wave returns to the transducer, producing an artefact instead of a useful image. Therefore, the examination of the gastrointestinal tract seemed impossible at first. However, a solution was suggested already in the seventies by Lutz and Rettenmaier with the description of the »pathological cocarde«; they noticed that a much better visualisation of the gastrointestinal tract was obtained if pathological changes were present in its wall.[1,2] The criteria of a pathologically altered bowel wall are: thickening, loss of compressibility, changes in luminal width and peristaltic activity, absence of

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colonic haustration, altered blood supply and changes in surrounding tissues related to the diseased bowel. The terms used in the literature for a pathological alteration of the bowel wall are a pathological target when seen in the transverse view and a pseudokidney when seen in the longitudinal view. However, imaging of a pathologically altered bowel wall also has its limitations. It is possible only in advanced disease and not at the stage of minor incipient changes. Moreover, intraluminal masses are not displayed, and the posterior wall is not clearly visible. Finally, a pathological target is not a specific sign and it can be false positive. A further step towards ultrasonographic assessment of the gastrointestinal tract was made in the late seventies by Fleischer who noted that the image was significantly improved if at least 90 % of the bowel lumen was filled with fluid; this allowed him to distinguish between the small and the large intestine as well as between the intestine and other abdominal structures.[3] A more detailed visualisation of the gastrointestinall tract was not possible because of the inadequate resolution of the compound scanners used at the time. In the mid-eighties, after the appearance of high resolution scanners providing real-time images, this idea was revived, developed further and tested clinically by Limberg who named his method of examining the colon hydrocolonic sonography.[4] We have tested the method in a group of 56 patients and now report the results of our evaluation.

Patients and methods

Patients

A total of 56 patients (37 women and 19 men, average age 61.3 years) gave their consent for the examination. They shared a history suggestive of colonic disease. Two patients with a history of a malignant tumour of the colon treated by resection required evaluation of the anastomosis.

Methods

Hydrocolonic sonography (HS) is a method of examining the colon after it has been cleaned and filled with water to improve the visualisation. The success of HS depends to a large extent on the preparation of the colon, accomplished with a diet and use of laxatives according to different schemes. Our patients did not ingest any solid food a day before the examination. In the afternoon on the preceding day, they took a laxative (Coloclens) with a double quantity of water. Early in the morning on the day of the examination, they drank three litres of an electrolyte solution (Golytely). Directly before the examination, they received an intravenous injection of 0.5 to 1 ml of glucagon at a concentration of 1 mg/ml (GlucaGen, Hypo Kit) to relax the bowel. The colon was then filled with 1000 to 1500 ml of water at body temperature, instilled with the use of an enema delivery system (Nicholas Kolon-Diagnostic-System), usually employed for barium enemas. During the instillation of water, the patients changed position to achieve optimal filling of all segments of the colon. The filling of the colon with water was observed with a low-frequency transducer (3.75 MHz). It was terminated when the caecum and ileocaecal valve came into view. Then we started examining carefully the colon segment by segment with the low-frequency transducer to evaluate the position of the bowel loops, the width of the bowel lumen etc. If a pathological change was noted, we tried to analyse more accurately the structure of the colonic wall using a high-frequency transducer (7.5 MHz). The examination was performed on the patient lying supine and in both lateral positions. In some younger patients, the rectum and sigmoid were examined also in the upright position. For demonstrating the flexures, a lateral intercostal route was usually chosen. The duration of the examination was limited by the action of the relaxant to about 15 minutes. After emptying the water from the colon, the patients immediately under-

went colonoscopy (CS). If CS was not feasible, the sonographic findings were compared with the results of surgery or double-contrast barium enema. The patients gave a written informed consent for the examination. Afterwards they were asked to describe their tolerance for HS as compared to CS or barium enema. The ultrasonic examinations were performed with Toschiba ultrasonography units (SSA-270A and 100A), using 3.75 and 7.5 MHz transducers.

The sonographic diagnosis was based on the following criteria: a constant thickening of the colonic wall, changes in the luminal width of the colon and the sonographic structure of its wall (the quantity of echoes and presence of the normal layers), evidence of intraluminal masses fixed to the wall, loss of haustration and changes in pericolonic tissues. The HS findings were compared with the results of CS, double-contrast barium enema or surgery. With the use of statistical analysis the accuracy, sensitivity, specificity and the positive (PPV) and negative predictive value (NPV) of the method were assessed.

Results

Feasibility

In three female patients of advanced age (average 80.3 years), HS could not be performed because they were unable to retain the instilled water, and so they were excluded from the series. CS could not be carried out in eight of the 56 patients because of poor general status (two patients) or intolerance for the procedure (six patients). Three of the eight patients were the previously mentioned women who were excluded from the study. In the remaining five patients, the results of HS were in four cases compared with surgical findings and in one case with double-contrast barium enema.

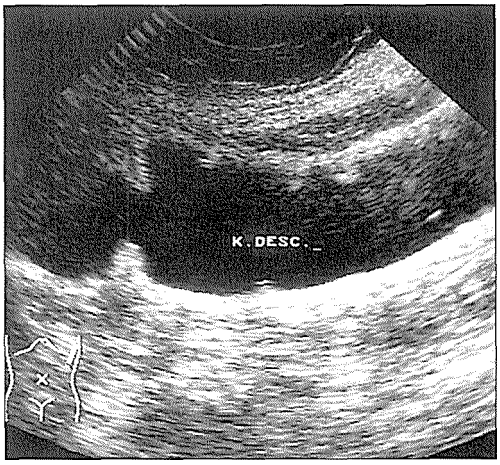

Figure 1. Normal colon descendens as displayed by hydrocolonic sonography. Five layers differing in echogenicity can be seen within the colon wall.

Normal findings

In 29 patients who all subsequently underwent CS, the HS result was interpreted as normal. HS missed six polyps (four < 7 mm in diameter in the sigmoid and two = 7 mm involving the sigmoid and rectum) in four patients, and one rectal tumour located at a depth of 10 cm. It identified correctly faecal material in patients with inadequate bowel preparation and even the remnants of an undigested pill in a patient's caecum. This

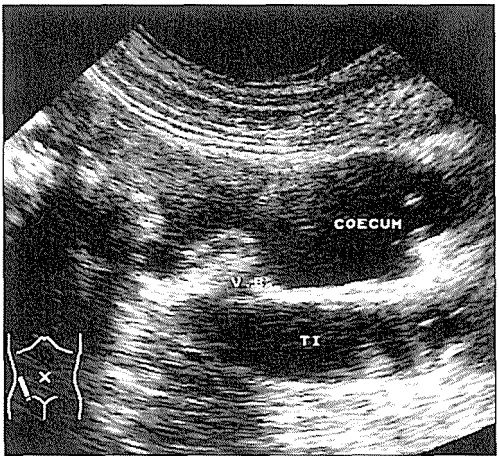

Figure 2. Normal coecum, ileocaecal valve and terminal ileum as displayed by HS.

group included the two patients with a history of colonic resection who both had a normal anastomosis.

Tumours

In 17 patients, HS demonstrated tumours, of which 65 % were located in the left colon. In four of the 17 patients, the finding was confirmed at surgery, CS having proved impossible. The remaining 13 patients underwent CS, which was complete only in three; in the other 10 patients, the bowel was displayed only to the level of the tumour stricture, impassable for the colonoscope. CS confirmed 12 of the 13 tumours and missed one involving the colon and rectum. This patient was later subjected to a double-contrast barium enema, which confirmed the result of HS. The HS findings were accurate in all 17 patients. In six of the 17 patients (35 %), the tumour was visible also on conventional abdominal sonography.

Polyps

HS detected polyps in four patients, who all subsequently underwent CS. Two polyps (one of 5 mm in diameter located in the sigmoid, and the other of 20 mm in the transverse colon) were confirmed on CS, while two (one of 7 mm in the transverse colon, and the other of 17 mm in the caecum) were not.

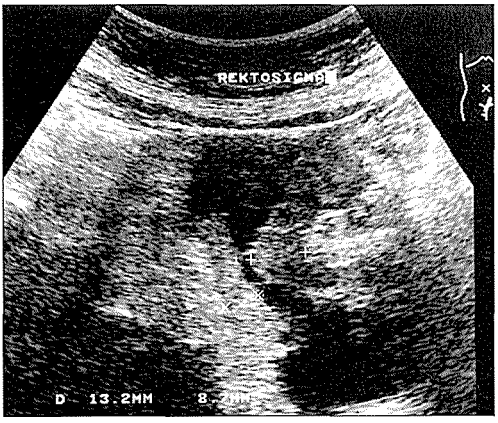

Figure 3. Colonic carcinoma (rectosigma): concentric thickening of the wall and narrowing of the lumen.

Diverticulosis

HS detected two cases of diverticulosis; one was confirmed by CS and the other by double-contrast barium enema.

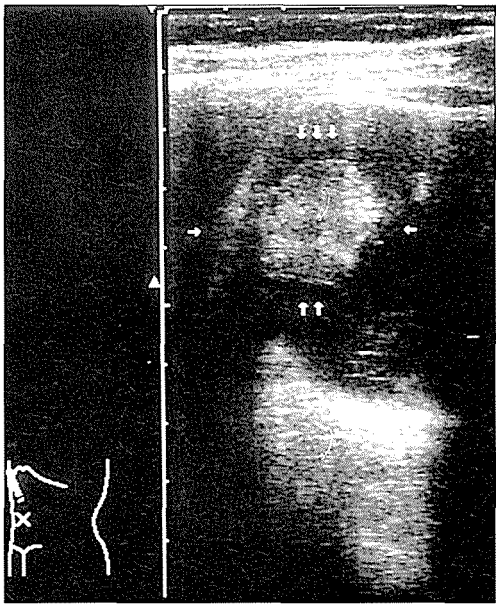

Figure 4. Colonic carcinoma (hepatic flexure): intraluminal mass.

Crohn's disease

In a patient with known Crohn's disease, HS, performed in the course of preoperative preparations, disclosed three strictures, located under the splenic flexure, at the transition from the transverse colon to the splenic flexure, and at the transition from the caecum to the terminal ileum, which were all confirmed at surgery. None was visible on CS, as this had to be terminated in the descending colon because of pain.

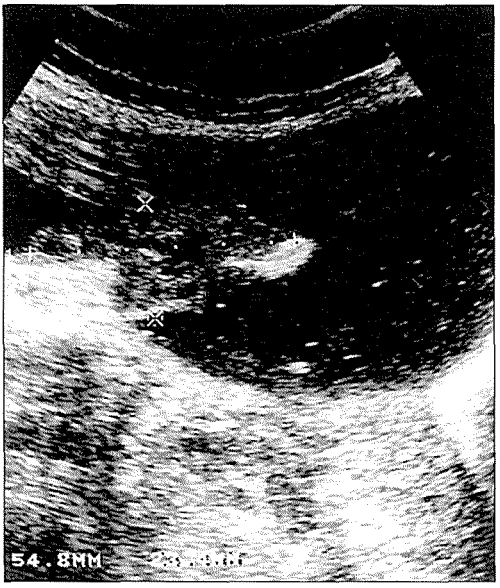

Figure 5. Colonic carcinoma (coecum): eccentric thickening of the wall. Missed on colonoscopy.

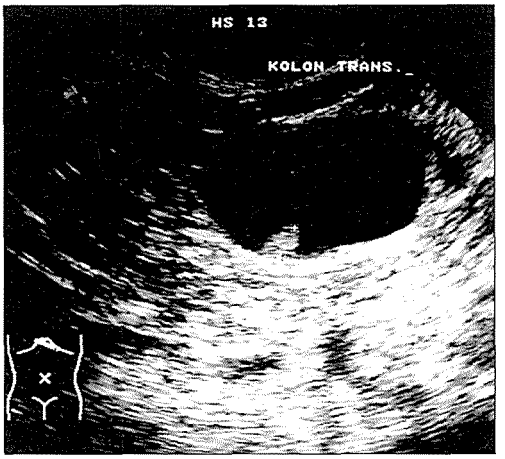

Figure 6. Small colonic polyp (7 mm); the structure of the colon wall remains intact.

Statistical results

The calculated accuracy of HS was 86 %, sensitivity 81 %, specificity 92 %, PPV 91 % and NPV 82 %.

Tolerance for HS

The examination was well tolerated. The patients experienced no pain, only some discomfort due to the retention of water. They evaluated both CS and double-contrast barium enema as painful because of the insufflation of air.

Discussion

Two basic facts vital to the understanding of ultrasonic evaluation of the gastrointestinal tract are that good visualisation is possible if the wall of the gastrointestinal tract is pathologically altered and if at least 90 % of the lumen is filled with fluid.[1-3] In the seventies, attempts to display pathological changes of the colon after it had been filled with water were limited by the technical shortcomings of the compound scanners used at the time.[5,6] When these limitations were overcome, Limberg developed hydrocolonic sonography, with which he was able to display the colon from the rectosigmoid border to the caecum in 97 % of patients.[4,7-15] Later on several authors reported that they could not demonstrate the flexures[16-18] or even the greater part of the colon with HS.[19] We had no such difficulties, provided that the instillation of water did not pose a problem. We also confirmed the experience of those authors who found it impossible to adequately visualise the rectum by HS,[8,11-4,16,19,20] as we missed a rectal tumour and a 7 mm rectal polyp. We exceptionally managed to display the rectum in young and slim patients, and we even diagnosed a rectal tumour in the form of an intraluminal mass.

The main aim of investigations of the colon is an early detection of cancer. Colonic cancer has a high incidence in the developed world. In Slovenia, the survival of these patients is below the European average, mainly on account of late detection.[21] The value of HS must be analysed by comparing this method with conventional ultrasound, double-con-

trast barium enema and CS. Of the 17 tumours correctly diagnosed by HS, six (35%) were seen also on conventional ultrasonography. This compares well with data from the literature[12,22], suggesting that HS is able to detect two thirds more tumours than conventional ultrasonography. On HS, a tumour is seen as a stenosed segment of bowel with associated concentric or eccentric incompressible thickening of the wall or as an intraluminal mass. Of special interest in our series is the case of the patient with a caecal tumour, which was missed on CS but confirmed on double-contrast barium enema and at surgery. We also managed to demonstrate a rectal tumour located at a depth of 8 cm; to our knowledge the detection of tumours in a similar location by HS has not been reported in the literature. HS thus showed a sensitivity of 100 % and a specificity of 100 % for the diagnosis of cancer of the colon excluding the rectum. Similar results have been reported by several authors.[10,11,23,24] In other studies, however, the method was less successful.[16,17,19] In comparing HS with CS, we must bear in mind that the colonoscopist does not reach the caecum in 10 % [25] to 30 % [26] or, according to some reports, even up to 45 % [10,16] of cases. Consequently, about 10 % of colonic tumours are missed on CS.[16] So, in case of disagreement between the radiological and endoscopic results, it is advisable to carry out further investigations rather than rely on the result of CS,[27] which may be inaccurate, as illustrated by the missed caecal tumour in one of our patients. Moreover, CS in our series was able to display the colon beyond a tumour stenosis in only three cases, whereas HS managed to do so in as many as 15 cases. An undisputed advantage of CS is the possibility of biopsy. Except in one case (the rectal tumour missed by CS), a comparison with double-contrast barium enema was not performed for two reasons: first, because contrast studies cannot be done after HS as the residual water would interfere with contrast coating the mucosa, and second, because most authors use CS as the gold standard. In comparing HS with double-contrast barium enema, which has been shown to have a sensitivity of 95-98 % for the detection of colorectal cancer[28], we must consider also the missed rectal tumour. If this is taken into account, the sensitivity of HS in our patients was 94.5 %. As a representative of cross-section imaging techniques, HS, in contrast to CS and barium enema, can display the bowel in cross-section with all its layers and adjacent tissues, which makes it suitable for cancer staging. In other studies, HS permitted accurate assessment of the T-stage for 86-97 % of evaluated tumours[13,16,22,23] and the N-stage for 35 % [16] to 50 % [22] of tumours. In our patients, we were mostly able to distinguishing the normal wall layers with the low frequency transducer, but we rarely managed to use the high frequency transducer because of poor depth penetration, and we were unable to assess reliably the T-stage of tumours or to display the adjacent lymph nodes.

Since most colorectal cancers develop from neoplastic polyps/adenomas, an early detection of these lesions constitutes an important preventive measure. A polyp is not visible on conventional ultrasonography, but on HS it can be seen as a solid moderately echogenic mass, which is fixed to the bowel wall and can thus be distinguished from faecal material. We managed to demonstrate two polyps, and rule out their infiltration into lower layers. Two masses that met all morphological criteria of polyps on HS were not confirmed on CS, but we were unable to follow the previously mentioned advice of Laufer and Thoeni[17] because the patients did not consent to double-contrast barium enema. Using HS, we overlooked six polyps, four of them less than 5 mm in diameter and two of 7 mm. The number of polyps was too small to be statistically representative, but the results are comparable to data for small series.[17] In large series, Limberg diagnosed polyps of more than 7 mm with a sensitivity

of 91 % and a specificity of 100 %, and polyps of less than 7 mm with a sensitivity of 25 % and a specificity of 97 %. The detection of polyps smaller than 7 mm is thought to be of minor clinical importance, since the likelihood of colorectal cancer in patients with small polyps is the same as in the population at large.[10] An interesting comparison of HS and double-contrast barium enema was made by Candia and co-workers who found HS to be less sensitive (80 % vs. 92 %) but more specific (100 % vs. 92.8 %).[24] CS gives false negative results in 15 % of cases, yet its advantage over HS and barium enema lies in the possibility of removing the polyps found.

We diagnosed two cases of diverticula, appearing as small luminal protrusions filled with gas and faecal material and therefore highly echogenic. A successful detection of diverticula by HS has been reported only by Limberg.[29] In the patient with known Crohn's disease, HS correctly identified three areas of stenosis. The result was confirmed at surgery, CS having failed because of pain. On HS, the affected segments of the gut wall were appreciably thickened and moderately echogenic (scarring associated with chronic inflammation). The normal wall architecture and haustrations were not visible. We had no cases of ulcerative colitis. Limberg found HS to be significantly more sensitive than conventional ultrasound for the diagnosis of Crohn's disease (96 % vs. 71 %) and ulcerative colitis (91 % vs. 62 %). He also found HS to be highly specific for both conditions (100 % for Crohn's disease and 98 % for ulcerative colitis). Using HS, he managed to distinguish between the two conditions in 93 % of cases.[4,7-9,13-15]

We were able to compare the overall sensitivity (81 %) and specificity (92 %) of HS in our patients with the data from another study, where a sensitivity of 67 % and a specificity of 96 % were obtained.[17] The feasibility of HS in our patients was comparable to that observed by several other authors[16,17,19,30] and inferior to the results reported by Limberg whose patients had no problems with the instillation and retention of water.[8,13-15] With the exception of a study where a patient experienced two vasovagal episodes and another developed diaphoresis,[19] no authors have encountered any complications using HS, which agrees with our experience. The average duration of the examination in our patients (15 minutes) was comparable to that reported by other authors. The retention of water caused the patients some discomfort, but apart from that they evaluated the examination as painless, whereas CS and barium enema were both described as painful. HS is thus comparable in usefulness to double-contrast barium enema, over which it has the advantages of not involving ionising radiation, being better tolerated by patients, being a cross-section imaging method and being feasible in the acute stage of inflammation.31 Its shortcoming is the inability to display adequately the rectum. It can be used in place of colonoscopy when the latter fails for subjective reasons, either on the part of the patient or the colonoscopist, or because of an objective problem, such as stenosis or acute inflammation. The main limitation of HS lies in the fact that it is technically very demanding and can therefore be performed only by a select group of highly experienced sonologists. We believe this to be the main reason for the limited popularity of HS despite the excellent results reported by its users.

Conclusions

With HS we correctly diagnosed tumours and polyps, diverticula and stenoses in Crohn's disease, and evaluated the condition of anastomoses after colonic resection. No complications were encountered, and the examination was well tolerated by the patients. HS is comparable in usefulness to double-contrast barium enema. The main advantages of HS are the absence of ionising radiation and the

absence of pain, while its main limitation lies in the technical demands placed on the sonologist.

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Strictures of the male urethra: how to perform and evaluate radiourethrography and sonourethrography to avoid mistakes

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Introduction. *Precise evaluation of the urethral stricture localisation, length, depth and quality of wall changes are necessary for the selection of the optimal treatment to prevent recurrences. Decision for urethral dilatation, internal urethrotomy or open surgery depends on urethroscopic, radiourethrographic-RUG, and recently, according to Mc Anninch, also sonourethrographic-SUG results. SUG adds information about the depth and density of spongiofibrosis. Previously published findings of RUG length underestimation, compared to SUG and endoscopy, were responsible for inappropriate treatment and recurrences. In our article, we evaluate SUG as a new imaging method in the diagnosis of urethral strictures and treatment planning, and describe both imaging methods together with usual pitfalls in performance or interpretation, possible reason for incorrect length measurements, and RUG length underestimation.*

Patients and methods. *In the period of 20 months, we evaluated SUG compared to RUG and endoscopy in 51/130 males with suspected urethral strictures.*

Results. *Compared to RUG, sonography was correct in 92 % radiographycally detected strictures. Length measurements by sonography were for 22 % shorter than radiographic lengths, which could be explained by radiographic magnification, as it was proved with wire measure placed on penis. Considering radiographic magnification, we did not find important differences in any measurement. Opposite to previously published RUG results compared to endoscopy and SUG, radiographic length underestimation was not found.*

Conclusion. *The combination of both imaging methods provides optimal information about urethral stricture anatomy. We conclude that published radiographic length underestimation could be only a misinterpretation. We realise how important it is to avoid performance mistakes, misinterpretation, wrong comparison and wrong conclusions for proper treatment planning. We advice to perform dynamic RUG according to Mc Callum RW.*

Key words: urethral stricture - radiography - ultrasonography

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Introduction

Etiology, patohistology

The urethral stricture is the result of inflammation and trauma, and is suspected in the patients with obstructive symptoms, recurrent urinary tract infections, and in cases of inability to pass the catheter. Repeated instrumentation and treatment of recidives, increase a risk for additional iatrogenic trauma with pressure necrosis and secondary inflammation, with penetration into the submucosa and underlying corpus spongiosum, resulting in subepithelial microabscesses, thrombosis and fibrosis- the urethral scar. Inelastic scar shortens the circumference, reduces the urethral lumen, and causes significant urodinamic effect.[1,2]

Treatment planning

In the absence of exposure to infections or additional iatrogenic trauma, the recurrences of strictures after treatment are believed to be the consequence of inappropriate choice of treatment.[1-5]

The localisation and length of stricture are decisional, however the depth and quality of periurethral changes must be included in the treatment planning.[6-10] According to recent literature, urethral dilatation and internal urethrotomy can be curative for short 1 cm long focal strictures, involving the epithelium alone or superficial spongiosum. For diffuse, longer and deeper strictures, reconstructive surgery is advised.[1,11-14] As a first treatment choice, open surgery is indicated in severe urodynamically important strictures with deep spongiofibrosis or full-thickness-scar, for diffuse long stricture, in strictures, which extend into the membranous urethra. In penile region, tension free reanastomoses are limited to 2-3 cm long strictures[10,12,15], and longer are treated with full-thickness skin or free graft or flap urethroplasty. For strictures close to the membranous urethra, posterior or transsphincter uretroplasty is necessary.[11]

Imaging diagnosis of the urethral strictures

The location and the length of stricture can be evaluated by urethroscopy or urethrography, and the depth from the appearance of the urethra on contrast studies, the elasticity noted at urethroscopy and the depth and density of the fibrosis evidenced during sonourethrography.[1,2,3,6-11]

Aim of the study

Until recently, radiourethrography was a standard technique in diagnostic imaging of urethral strictures in our department, where we perform 100 radiourethrographies per year. The earlier described sonourethrographic advantages without radiation risks were the reasons for the application of sonourethrography together with radiourethrograpy to gain information about:

1. Sonouretrography as a new imaging technique in urethral strictures;
2. Radiographic length underestimation compared to sonography - the possible reason for inappropriate treatment decision found in previously published studies, or confirmation of our prediction that the length underestimation could be only interpretational mistake.

Patients and methods

In the period of 20 months, we performed subsequent radiourethrography (RUG) and sonourethrography (SUG) in 51/130 males (age 21-79 years, mean 52.7) with clinically suspected urethral strictures, according to the urodynamic studies, endoscopy, or in cases of inability to pass a catheter. The selection of patients for both subsequent imaging methods during the same visit was accidental, de-

pending on the availability of technical facilities, time, and radiologists.

First, we performed RUG, than SUG without complete disclosure of the results, and we finished both imaging methods with a radiographic film of voiding to avoid two installations of balloon catheter or a clamp.

Dynamic RUG [1,2,11], with retrograde contrast application under fluoroscopy and voiding as an integral part of the study was performed on a Siemens Siregraph D-2 by the radiologist with the assistance of the radiographer. Adequate contrast application without additional trauma provides constant visualisation of the posterior urethra, the membranous part, bulbar conus and also secondary softer strictures in the presence of primary harder one. Sufficiently oblique position is necessary to avoid the superposition and not to overlook bulbar strictures (Figure 1,2,3). We slightly modified standard RUG. We did not make AP film. We prefer two different oblique films usually with different quantity of contrast application for better length measurements and delineation of softer secondary strictures (Figure 3).

The duration of radiourethrography with the aseptic installation of devices for contrast application, hence without voiding, was approximate 20 minutes with the varying voiding time.

The whole urethra delineation is diagnostically important for recognition of all strictures and their precise localisation. Measurements are made from the films, and other observations are detected also during fluoroscopy. Such measurements and technical mistakes may be re-checked from the films also later.

In length measurements, we included tapering on both sides, "conning-down", and not only the length of a tight stricture. The degree of stricture was determined from anteroposterior diameter of the strictured area compared to the normal luminal diameter (Figure 1,3).The strictures were classified by Devine as: mild- less than a third, moderate-a third to half, and severe - more than half of the lumen reduction.

For objectivation of radiographic magnification in our study, we placed Lunderquist wire vessel measures or metal wires on penis in 7 patients, and analysed 10 different mea-

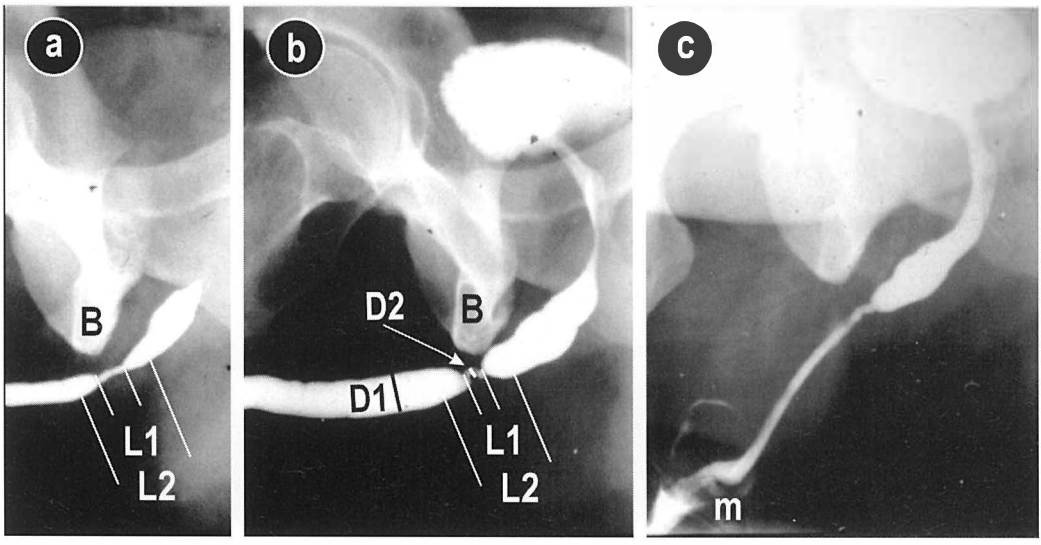

Figure 1. Radiographic urethrography(RUG)- evaluation of the stricture and measurements; a) Less contrast application, b) More contrast application, c) During voiding. B-bulbar stricture, L2-the length of the whole stricture, L1-the length of a tight stricture, D1-normal diameter, D2- reduced lumen, m- suspected meatal stricture.

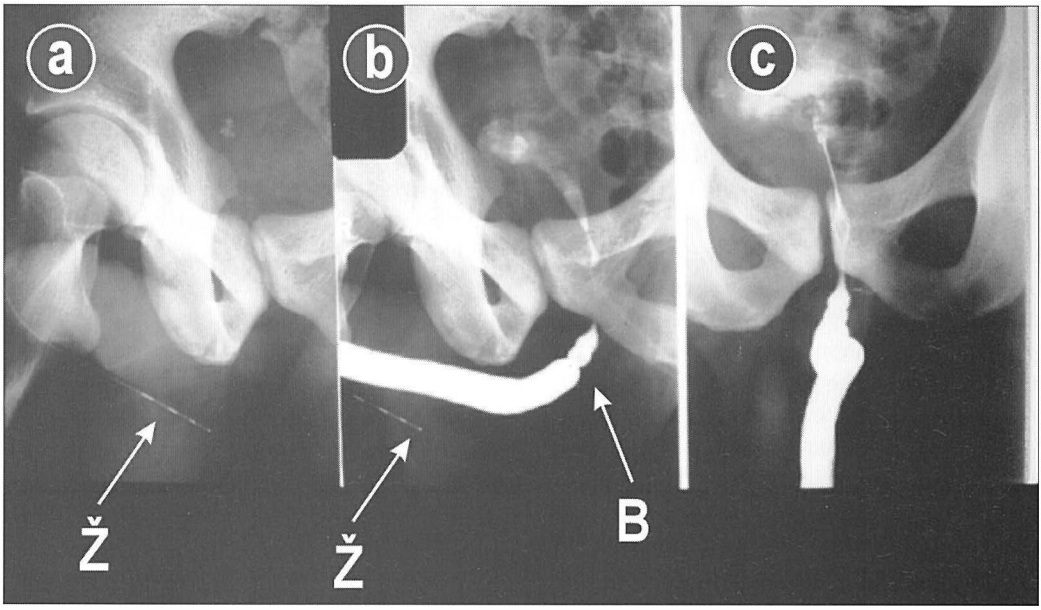

Figure 2. Radiographic urethrography (RUG); a,b) Correct oblique position, c) AP position with superposition of bulbar urethra. B-bulbar stricture, ž-wire measure.

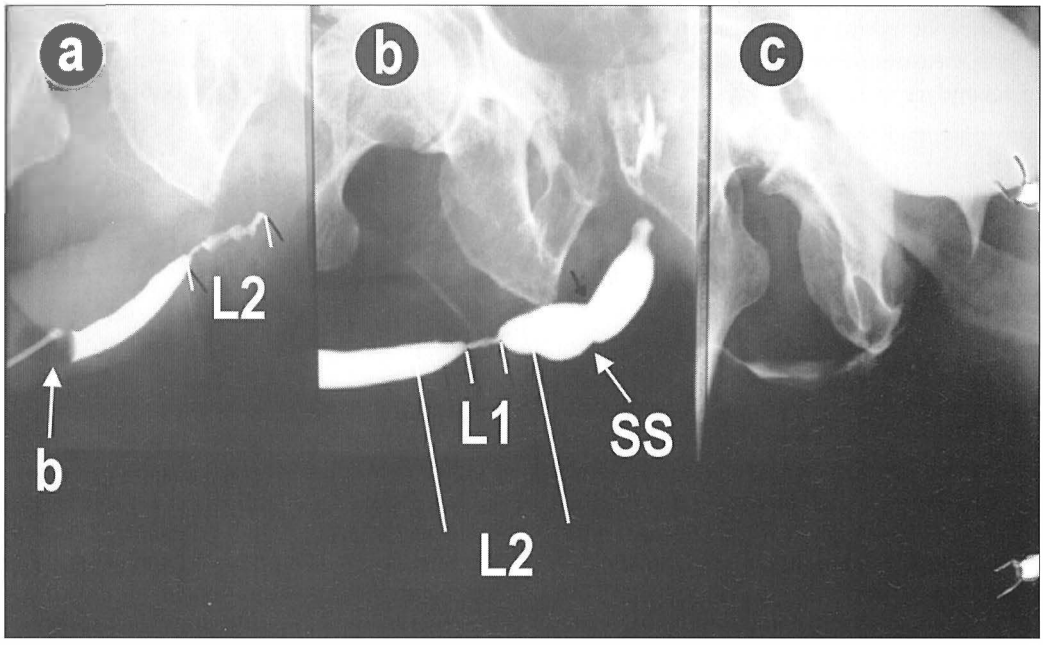

Figure 3. Radiographic urethrography(RUG); a) Less contrast application, b)More contrast application. L2-the length of the whole stricture, L1-the length of a tigth stricture, SS- secondary soft stricture, b-baloon of the urethral catheter.

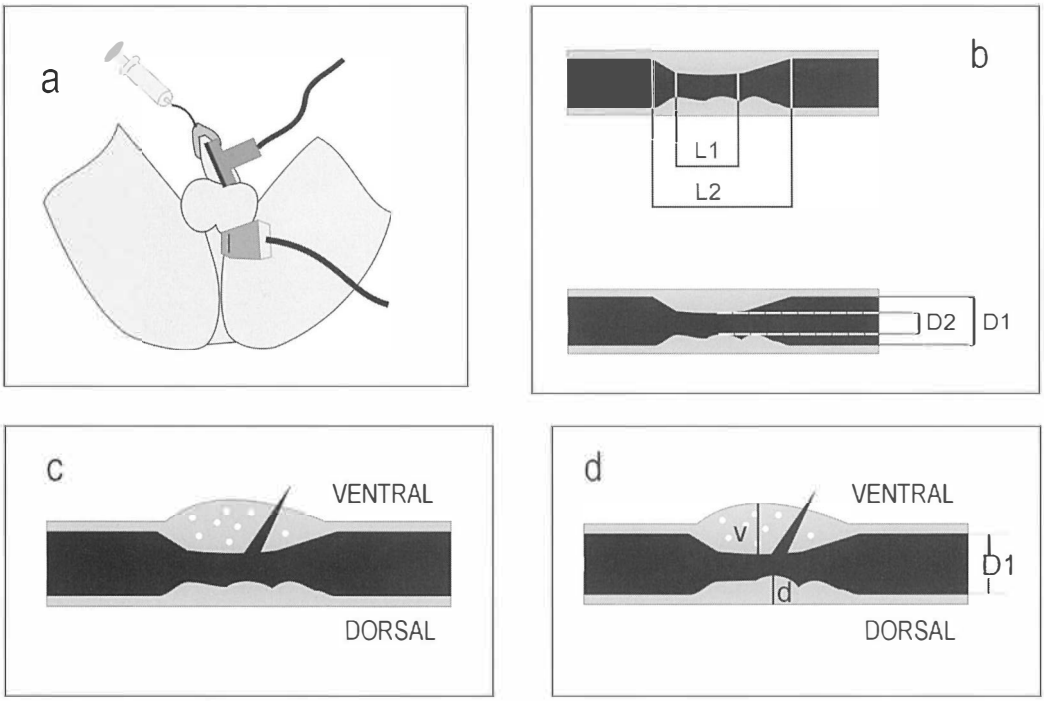

Figure 4. Evaluation of the stricture; a) Sonographic urethrography(SUG)-transducer position b) The length and diameter, c-d) Ventral(v) and dorsal(d) spongious changes and expansion outside spongiosum. L2-The length of the whole stricture, L1- the length of a tigth stricture, D1- normal diameter, D2-reduced diameter.

surements, which varied depending on patients' constitutions and different oblique positions (Figure 2).

Sonourethrography, according to Mc Annich, which was slightly modified from the first report in 1988, was performed by sonologyst with the assistance of radiologist on Siemens Sonoline Sl-400 and Toshiba SSA-270 A with 7.5 MHz linear probe placed ventrally on penis. Transcrotally and for perineal approach, we used also convex 3.75 MHz probe.

Multiple transverse and longitudinal measurements with electronic caliper were made (Figure 4) during constant adequate application of saline solution, but avoiding too much transducer compression. In selected patients, additional application of sonographic contrast Levovist was used for better delineation (Figure 5,6). The duration of sonography, when devices for contrast application were already installed at radiourethrography, ranged from 20 to 40 minutes. The evaluations of a stricture presence, number location and measurements were made by the sonologyst.

Normally, 20 ml of saline solution was sufficient, sometimes requiring up to 40ml. In selected patients, we used also 4 ml of sonographic contrast Levovist.

Measurements and technical mistakes are usually performer-dependant, sometimes impossible to detect and correct later.

Descriptive analyses and Wilcoxon nonparametric test were made in SPSS program for Windows.

Results

Six patients had normal urethra diagnosed by both imaging techniques, and others had 70 strictures by RUG and 59 by SUG. Ten separated strictures by RUG were considered as 5

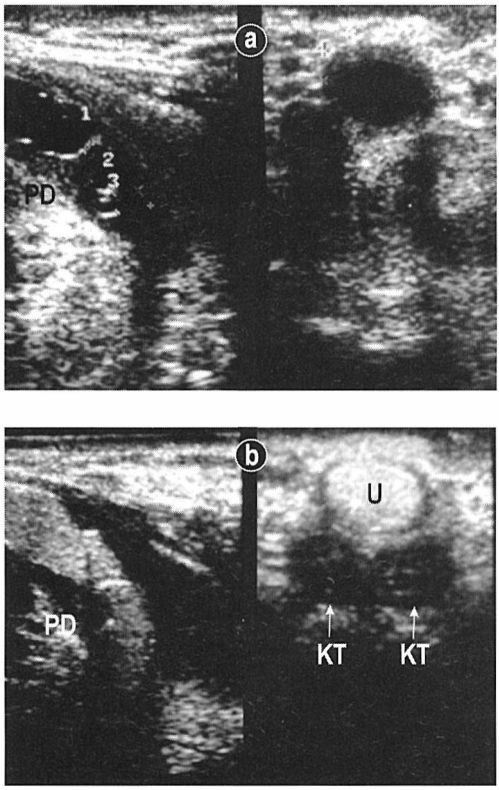

Figure 5. Sonographic urethrography(SUG)- longitudinal and tranversal scans; a) Application of saline solution, b) Application of sonographic contrast Levovist. U-urethral lumen, PD-dorsal periurethral fibrosis, KT-corpus cavernosus.

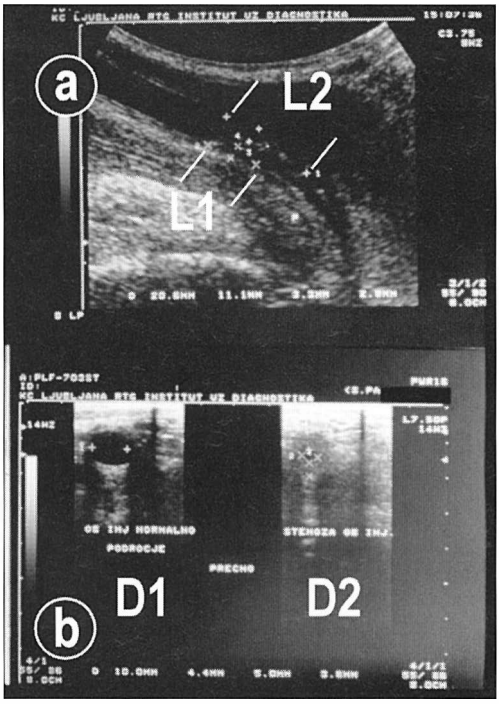

Figure 6. Sonographic urethrography-measurements of strictures; a) Longitudinal scan, b) Transverse scans. L2-the whole length, L1-the length of a tigth stricture, D1-normal diameter, D2-reduced diameter.

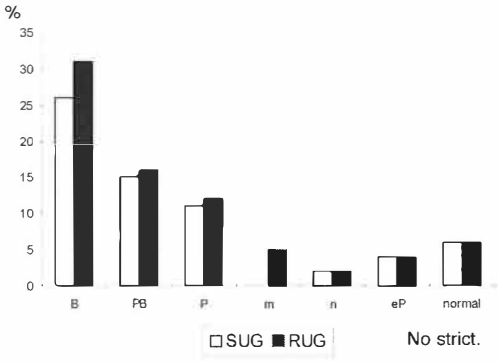

Figure 7. The location of strictures found by sonography (SUG) and radiography(RUG). B-bulbar, PB-penobulbar, P-penile, m-meatal, n-navicular, eP-entire penile, normal.

strictures by SUG, and were measured together in the same or separated anatomical region, and caused differences in number and site of strictures. Sonography really missed 6 strictures; 5 meatal and one penile (Figure 7).

In contrast to previous reports, the radiogaphical lengths were 22 % longer than sonographical (Figure 8), and we did not find any significant differences neither in the lumen reduction (Figure 9) nor in Devine classification (Figure 10).

Radiographic magnification present in all measurements was proved by wire measurements (25 %).

Valuable additional sonographic evaluations were direct delineation and measurements of the depth of spongiofibrosis observed ventrally deeper in 55.7 % of strictures (Figure 4cd,5,11), and suspected outside spongiosum expansion in 31 %.

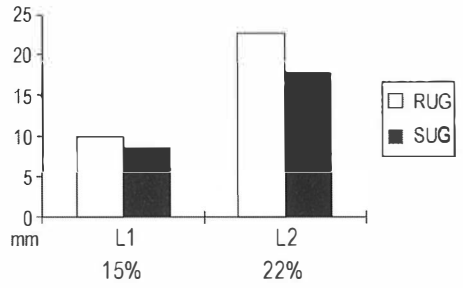

Figure 8. Mean length of strictures found by sonography (SUG) and radiography (RUG). The percent of radiographic magnification. L1-the length of a tigth stricture, L2-the entire stricture length.

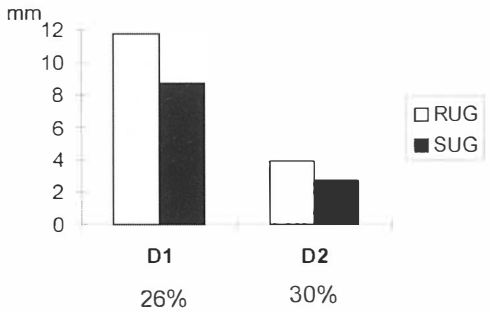

Figure 9. Mean normal urethral lumen (D1) and reduced lumen (D2) found by sonography (SUG) and radiography (RUG). The percent of radiographic magnification.

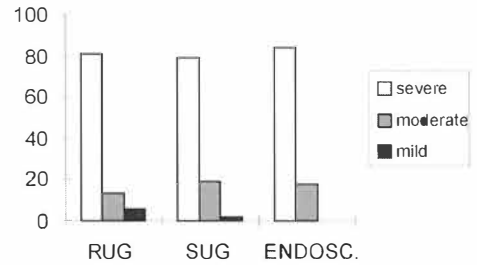

Figure 10. Devine classification of urethral strictures by radiography (RUG), sonography (SUG), and endoscopy (endosc.).

Treatment decision, based on clinical symptoms, imaging, surgeon routine and experiences, differed from the proposed by our imaging technique in 82 %; internal urethrotomy was made instead of reconstructive surgery and observed recurrence was 62 %.

Discussion

Until recently, the purpose of urethrography was to delineate the primary stricture and to describe the length of a tight stenosis. Such incorrect measurements could be the reason for published radiographic underestimation compared to sonography. Especially when radiourethrography is statically performed (without fluoroscopy) or modified voiding against Zipser clamp is evaluated, as it is obvious from previous reports, only a tight stricture is measured. We avoid static urethrography, which may contribute to the underestimation of length and grade and, consequently, also to inappropriate treatment decisions.[7,11]

In static urethrography, the membranous urethra is not usually visualised, and only the primary stricture is recognised. In a significant number of patients, secondary soft scars proximal to the primary stricture cannot be diagnosed in the fully distended urethra, because of paradoxical dilatation at urethrography or during voiding.[11] Consequently, such an improper comparison of two different lengths, the radiographic length of a tight stricture only without tapering on both sides and the sonographically directly visible entire length of wall changes, is therefore a misconception, leading to wrong conclusions (Figure 12). In such improper comparisons, we also found similar radiographic length underestimation in our patients, as mentioned in previous reports. SUG lengths in such wrong comparisons were for 78 % longer than RUG.

By correct dynamic urethrography with voiding, we evaluated the whole stricture involvement and by accurate localisation of the membranous urethra also proximal strictures. Elongated, narrowed, irregular or asymmetric bulbar conus with presence of primary bulbar stricture (Figure 13), represents its extension to membranous part and indicates transsphincter urethroplasty.[11] Proper oblique patient's position, proper contrast application during exposure, voiding and cor-

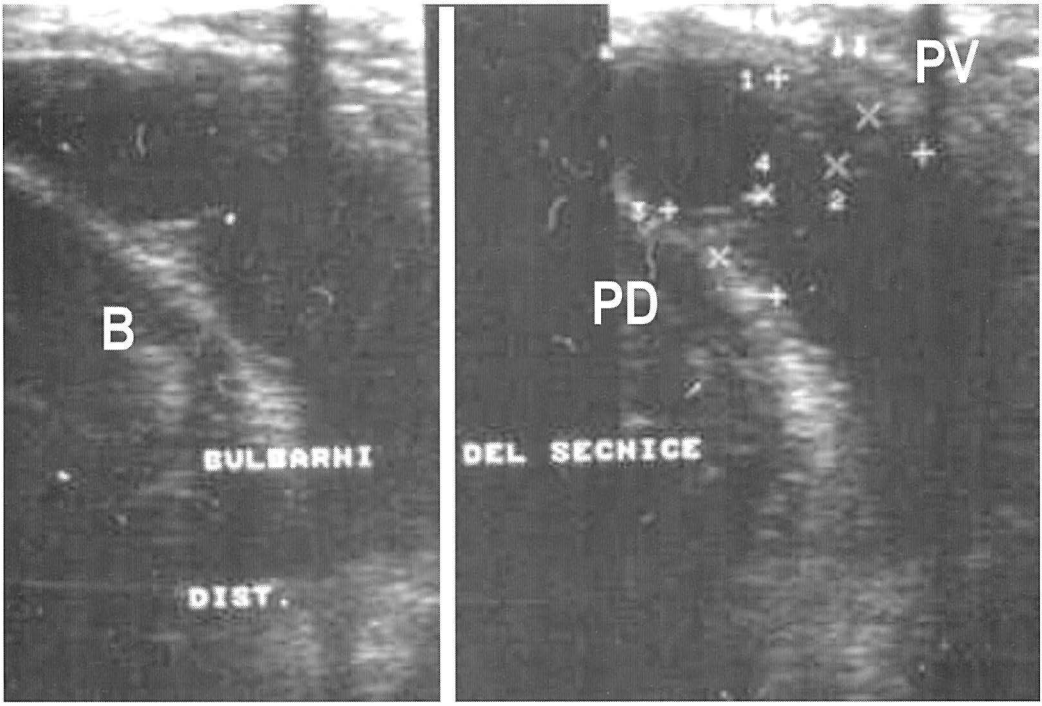

Figure 11. Sonographic urethrography-measurements of the periurethral changes ventrally (PV), and dorsally (PD).

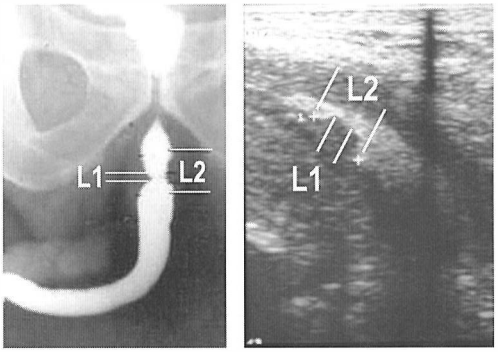

Figure 12. Radiographic and sonographic appearance of the same stricture. (Different degree of photographic magnification - direct length comparison is impossible). L1-the length of a tigth stricture, L2-the whole length of the stricture.

rect measurement of the stricture length, the tight stricture with "conning down" segment which illustrates its involvement in the scar, contribute to better evaluation of the stricture as well as better treatment outcome. At the same time, we can observe primary hard stricture with obstructive symptoms, and secondary softer ones without symptoms of outlet obstruction. The latter could contract and produce obstruction after surgical treatment of primary stricture alone.[1,11]

Our prediction that previously published radiographic length underestimation could be only interpretation mistake is proved by our results. RUG magnification affects equally measurements of urethral lumen diameter at normal and reduced sites of the same patient, and was present in wire measurements.

Until recently, the majority (95 %) of strictures were treated with one or more urethrotomies, either blindly (Otis method) in strictures with wide calibre, or under direct vision (Sachse method). Reported recurrences after urethrotomy were from 15 % up to 75 % or even 92 % in selected patients.[4,12,13,14]

According to the findings of a significant trend for radiographic length underestimation, the reported additional or better sono-

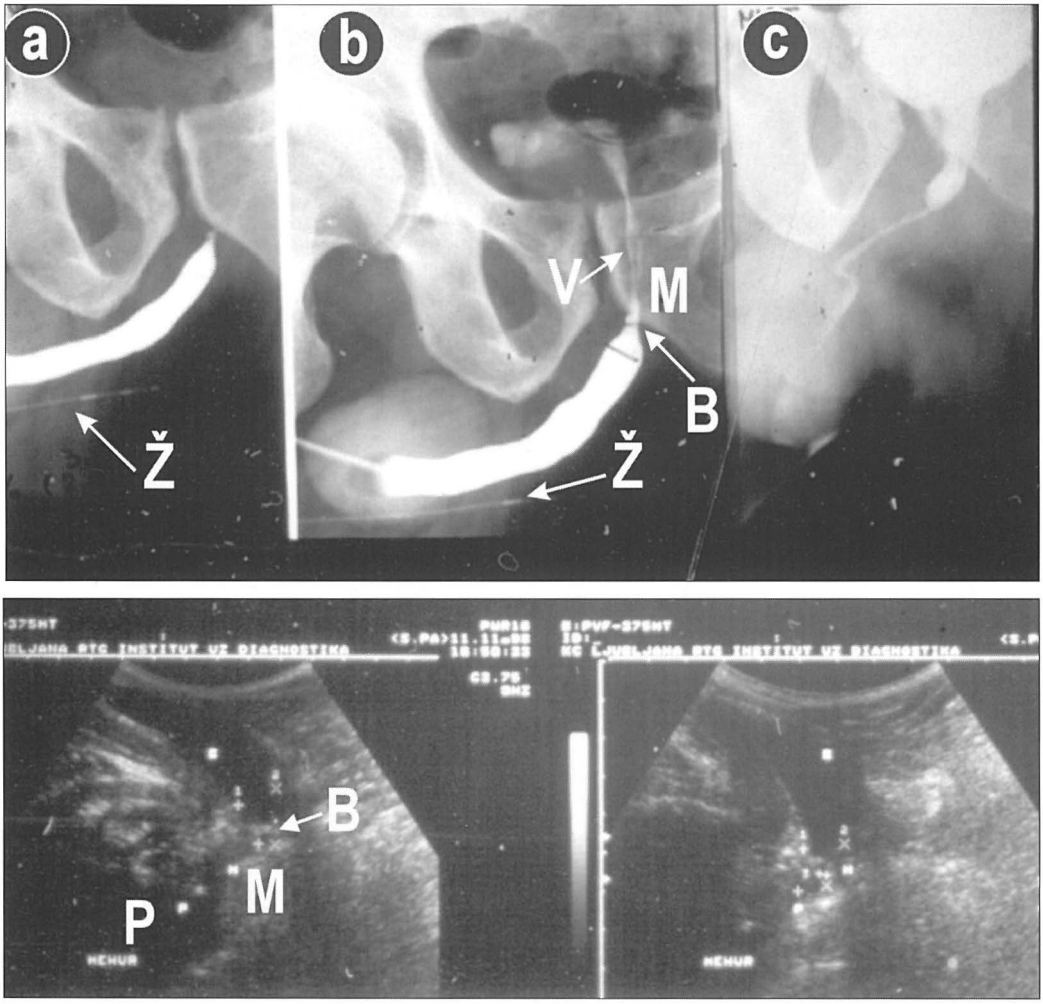

Figure 13. Evaluation of bulbar stricture (B) with suspected extension to membranous part (M) near prostatic portion (P) by radiography (a,b,c) and sonography.

graphic evaluations of urethral strictures compared to radiourethrography, changed urethrotomy to reconstructive surgery in 16%. According to other recent reports on sonography, the treatment changed, too: 33% of strictures were treated by urethrotomy and 63% by reconstructive surgery. In other reports, the reconstructive surgery was also changed after sonourethrography in 37%[15] of bulbar strictures with radiourethrographic intermediate length; graft or flap urethroplasty was made instead of end-to end reconstruction.

Adding sonographic evaluation of the stricture length, lumen reduction and classification to radiourethrography there was no need to change treatment to more reconstructive surgery in our study. According to recent literature, the majority had been already indicated by radiographic results, based on our performance, described measurements, and interpretations. Different surgeons' decisions were the result of their experience and doctrine and is not based entirely on our imaging evaluations.

Considering mean 22 % radiographic magnification and longer strictures found by RUG, that are contradictory to the published results, the study did not demonstrate any difference in measurements.

We can conclude that in everyday routine RUG is still the method of choice. We propose dynamic RUG by Mc Callum. Radiation-free SUG is valuable additional method with direct visualisation of the depth and quality of spongious changes. Sonography, detecting 92 % of the strictures, may replace RUG, but in view of the sonologists-dependant mistakes, the combination of both imaging methods is optimal.

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review

The role of sonographic evaluation of spinal canal in children

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Background. *Spinal sonography is a valuable diagnostic imaging modality as it has the ability to demonstrate good anatomic detail of the spinal canal, its contents, and the surrounding structures. The examination technique, the anatomy of the cord, the most common anomalies, and the evaluation of the sonography compared to magnetic resonance imaging are presented.*

Conclusions. *Spinal sonography is recommended as the primary imaging modality for congenital anomalies of the lower spine in infants and as the screening modality for closed spinal dysraphism in infants and small children. The examination technique, the anatomy of the cord, the most common anomalies, and the evaluation of the sonography compared to magnetic resonance imaging are presented.*

Key words: spinal dysraphism-ultrasonography; spinal canal- ultrasonography; child

Introduction

High-resolution real-time sonography of the spinal canal in children has been performed for over fifteen years.[1] It has the ability to demonstrate good anatomic detail, is noninvasive, easy to use, can be brought to bedside, does not require sedation, and is of low cost. The application of sonography is possible in the neonate and in children up to school age because of poor ossification of the posterior vertebral elements. It can demonstrate the spinal canal, its contents, that is the cord, the cauda equina, the dural sac and intracanalicular, as well as related extracanalicular masses. It is used to measure the spinal canal, to determine the level of the conus medullaris, to detect cord anomalies, and examine soft tissue abnormalities. The most common indications are to determine the level of the conus medullaris, looking for a tethered spinal cord in infants with midline back abnormalities,[1,2] to study the spinal cord for associated malformations in the newborn period in children with spinal dysraphism, such as myelomeningocele and meningocele, and to look for retethered cord after myelomeningocele repair.[3]

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Technique of examination

Examination is usually performed with the child prone or in a lateral decubitus position

with thoracolumbar spine flexed to separate the spinous processes, using a high frequency linear array transducer. Small infants can be scanned over the midline between the spinous processes, but in older infants and larger children it is better to scan with the transducer placed slightly lateral and aimed medially into the spinal canal.[1] Transverse and longitudinal scanning of the entire spine is performed, preferably starting over the sacrum where the spinal canal is easily found.[1] A standoff pad can be used to improve nearfield resolution. Longitudinal and transversal pictures are taken for documentation.

Normal cord anatomy

In the spinal canal the spinal cord is visualised as a slightly more echogenic structure than the surrounding anechoic cerebrospinal fluid, it has an echogenic dorsal and ventral surface and a central echo complex just ventral to the central canal (Figure 1).

The cervical cord, as seen in the transverse plane, is oval in shape, thoracic circular and lumbar circular but larger than thoracic. The conus is tapered caudally and is well seen in the longitudinal plane. The normal cord usually ends above the L-2 level, and so the tip of the conus medullaris is seen cranially to the L-3[1,4] and is central in the spinal canal. Caudally to the conus the roots of the cauda equina are visualised as echogenic strands in longitudinal plane and as echogenic dots in the transverse plane. The tip of the thecal sac often corresponds to S-2.[1] To estimate the vertebral level of the conus on the sonogram, palpable landmarks are used: the tip of the lowest rib corresponds to the level of the L-2, and the same rib as followed back to the spine locates T-12, the iliac crest corresponds to the L-5.[4] For the orientation it is also important to know that the cocyx in neonate is unossified and is a hypoechoic structure just distal to the sacral segments. It should not be mistaken for a cystic lesion.

The anterior spinal artery and epidural veins can be demonstrated using colour flow Doppler imaging. During the examination, the spinal cord and cauda equina oscillations in dorsoventral and cephalocaudal direction are observed with heart beating, breathing,

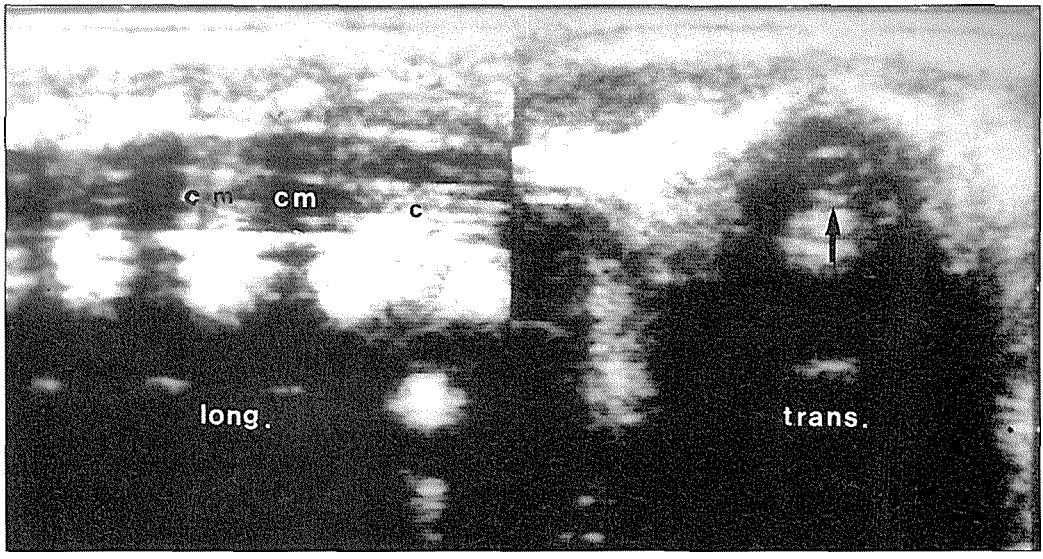

Figure 1. Normal lumbosacral canal. Longitudinal scan: spinal cord (c) with central echo complex, conus medullaris (cm), cauda equina (c). Transverse scan: spinal cord with central echo complex (arrow).

crying, and moving. Oscillation can be documented with M-mode sonography.[1]

The tethered spinal cord

The most common indication for sonography is to determine the vertebral level of the tip of conus medullaris, that is to diagnose or to rule out tethered spinal cord.[1] A conus medullaris that terminates in the spinal canal below the superior aspect of L-3 is probably a tethered cord.[1] A tethered cord is a pathologic fixation of the spinal cord in an abnormal caudal location, so that the cord suffers mechanical stretching, distortion and ischemia with daily activities, growth, and development.[5,6] It results in neurologic deficits as reflex changes, sensory loss, muscle wasting, power loss, and sphincter problems. The child might be normal at birth and develop deficits later. A child with an occult tethered cord can present with a lower-extremity deformity or abnormal gait.[1]

There are several pathologic entities that can cause spinal cord tethering, the most common are leptomeningocele, intraspinal lipoma, thick filum terminale, diastematomyelia, and dermal sinus. Risk factors for tethered cord are also lumbosacral skin abnormalities, anorectal malformations, presacral anomalies and lipomeningomyelocele.[1]

To diagnose a tethered cord on sonography one has to 1) estimate the vertebral level of the tip of the conus using on the longitudinal views the sonographic landmarks, as mentioned above (the L-2 corresponds to the level of the tip of the lowest rib and L-5 to the iliac crest). When one is not certain in determining the vertebral level of the tip of the conus, a radiopaque marker can be placed on the skin at the level of the conus tip to take a radiographic film and then to determine the level on that film. One also 2) looks for the position of the conus within the spinal canal. The tethered cord is usually eccentric, more dorsal than normal. In addition, one has 3) to observe for cord oscillations which are diminished or absent at or above the point of tethering[7] (but may be normal in the newborn until tethered later[1]).

Skin abnormalities and occult tethered spinal cord

Midline, lumbosacral, skin abnormalities as subcutaneous lipoma, hair tuft, sinus tract, skin defect, dimple, hemangioma, skin tag or appendage, or pigmented nevi can be associated with an occult spinal dysraphism (that is spina bifida occulta) and a tethered cord. Children with these abnormalities can develop, as they grow, foot and lower extremity deformity, decreased sensation, scoliosis, weakness, abnormal gait and bladder disfunction.[1]

So sonographic screening for these children was recommended in infancy[8] in order to detect a tethered cord and any other associated abnormalities and to treat the children (early surgical treatment or close neuropediatric follow-ups). Among the above mentioned skin abnormalities, the lumbosacral dimple has been studied for its significance most commonly.[1] Lumbosacral dimples and pits are common skin abnormalities and when they are only shallow and superficial and not deep crater like or connected to a dermal sinus (which appears as a hypoechoic band which might extend to the dural sac) they do not indicate a high risk of occult spinal dysraphism and there is no need to screen for a tethered cord.[9]

Lipomas

Lipomas are subcutaneous masses of fat and fibrous tissue which may be associated with dermal sinuses, hamangioma, nevi, myelomeningocele (Figure 2), and meningocele. They can be only superficial or are deep and extend into the spinal canal and attach to the meninges, cord, conus, or filum terminale, can tether the cord, and even grow into the

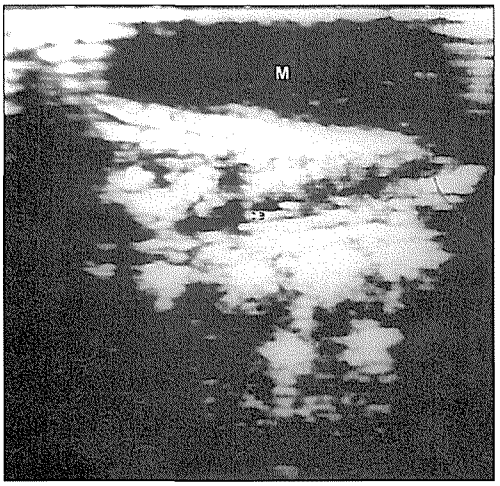

Figure 2. Lumbosacral meningocele. Longitudinal view: cauda equina (ce), meningocele (M).

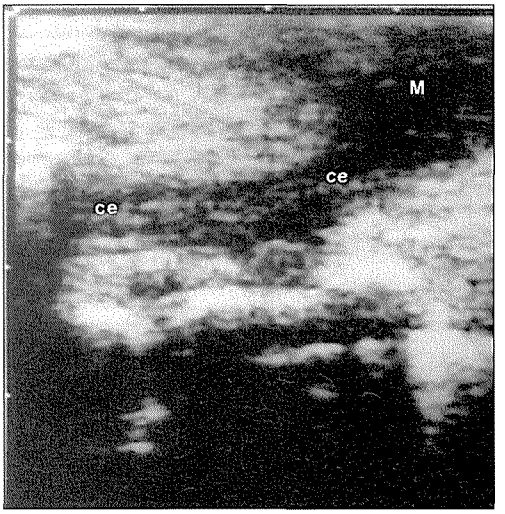

Figure 3. Lumbosacral myelomeningocele. Longitudinal view: cauda equina (ce) with the nerve roots extending into the myelomeningocele (M). Myelomeningocele enlarged with crying.

cord (complete surgical removal is then not possible).[1,10] On sonography they are echogenic masses, the tethered cord is dorsal and does not oscillate freely.

Hydromyelia, diastematomyelia

Hydromyelia is a dilatation of the cord's central canal that can be focal or involves the entire cord and can be found with myelomeningocele and diastematomyelia. On sonography, the central echogenic lines are separated and the central canal is distended by hypoechogenic fluid. In diastematomyelia the cord is split and two hemicords with central canal in each are demonstrated on sonography. The vertebral column is nearly always abnormal, spina bifida is common.

Myelomeningocele

The abnormal fusion or the closure of embryonic dorsal structures results in myelocele or myelomeningocele.[11] The abnormality is visible and imaging is not needed, only occasionally sonography is performed to distinguish a meningocele (Figure 3) from a myelomeningocele (in the former the sac is empty, in the latter nerve roots can be seen) (Figure 4) and to diagnose associated anomalies. For sonographic scanning, the sac is covered by a plastic wrap and scanned gently. The spinal cord is usually thinner than normal.

After myelomeningocele repair, neurologic functions should not deteriorate. If they do, it may be caused by retethered spinal cord (incidence 15 %)[12] due to adhesions and scarring. The cord in myelomeningocele is low and remains low after surgery, but oscillates normally. When retethered, it does not oscillate normally, it is fixed to the posterior wall of the spinal canal and dense adhesions may be present.[12] The oscillation of the cord is more easily assessed with sonography than with MR. In myelomeningocele scanning over the cervical canal and toward the foramen magnum can demonstrate echogenic tissue of the cerebellar vermis of the Chiari II malformation.

Sonography and magnetic resonance imaging (MR)

With the availability of MR, the imaging modality which is the best for the demonstra-

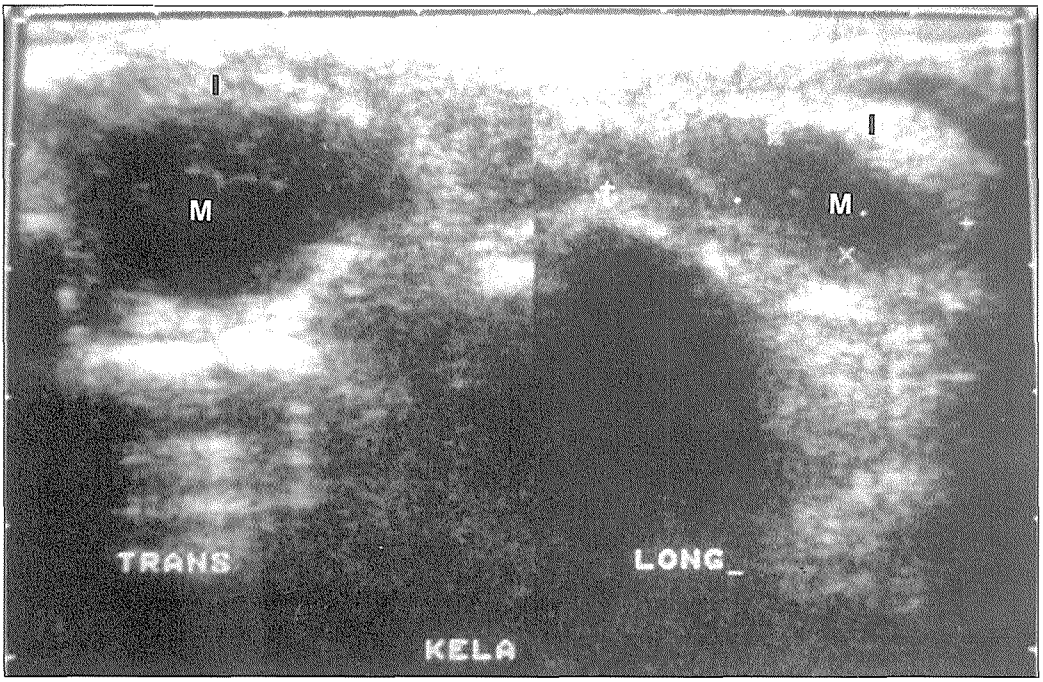

Figure 4. Lumbosacral lipoma associated with meningocele. Transverse and longitudinal views: poorly defined hiperechoic lipoma (l) and hypoechoic meningocele (M).

tion of the anatomic details of the spinal canal, spine, and surrounding soft tissues, the role of sonographic imaging had to be reevaluated. Several studies comparing sonography and MR were conducted. Evaluating 755 children with myelomeningocele in a study conducted to propose a diagnostic radiological model to accurately evaluate the neurological problems in the myelomeningocele child[3] the authors found MR to be the best modality to evaluate the posterior fossa and the total spine. At times MR may not adequately diagnose subtle cases of tethering of the spinal cord, cord infarction, arachnoid cysts, or diastermatomyelia. In these cases, further evaluation is necessary with sonography to look at cord pulsations in cases of tethering, and computed tomography (CT) for other cases. In severe scoliosis MR is not adequate and CT is indicated.

As spinal sonography has become an accepted study to screen for occult dysraphism in neonates and infants, it was important to correlate sonography and MR. The authors of a study correlating sonography and MR confirmed the role of sonography in screening and stressed that MR is most useful when sonographic findings are abnormal or equivocal or when the normal skeletal maturation limits the sonographic visualisation of the intracanalicular contents.[11] In another study of imaging of terminal myelomeningocele (in a low number of patients) the authors compared sonography, CT, and MR and concluded that MR is the imaging modality to diagnose and evaluate children with a myelomeningocele.[3] Important are the results of the study on diagnostic value of spinal sonography, a comparative study with MR imaging in paediatric patients.[13] In 32 of 38 examinations sonography allowed exactly the same diagnosis as MR. In five examinations, sonography depicted the main abnormality but MR revealed additional findings. Whenever sono-

graphy scans were normal, MR images also did not depict any spinal disorder. In all 24 examinations with abnormal MR findings, sonography enabled detection of the abnormality.

Concluding, spinal sonography represents a valuable diagnostic tool for congenital anomalies of the lower spine in infants and small children and is recommended as the primary imaging modality in those patients.

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Renal cell carcinoma in the ectopic kidney prospects of diagnosing and treatment of the carcinoma of the kidney: case report

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Background. *An extensive use of ultrasonography and computed tomography have enormously contributed to the early detection of adenocarcinoma of kidney taking into consideration that they have been so far often detected by chance. In addition to provide us with an image of a tumor and contributing to define more easily the nature of tumor, MRI is most helpful in detecting the infiltrations of tumor into its surrounding and changes in the veins.*

Case report. *This case report presents the patient with adenocarcinoma of the ectopic kidney. The ultrasonography, computed tomography and magnetic resonance imaging detected an abundant non-homogenous tumor mass in pelvis minor. Additionally to the suspected ectopia of one of the kidneys, it was also suspected that there was another pathological process of different etiology too. This suspicion was based on the detection of a different tumor mass in between the intestinal loops. Two months after the nonradical excision of the adenocarcinoma from the ectopic kidney, the following changes were observed: progress of the residual tumor in the pelvis minor and the tumor in between the intestinal loops (that was not removed during the first operation). The patient was given immunochemotherapy and local radiotherapy.*

Conclusions. *According to the available data in literature, the localization of tumor in ectopic kidney is extremely rare.*

Key words: kidney neoplasms - diagnosis - ultrasonography - surgery; carcinoma, renal cell; tomography, computed, magnetic resonance imaging

Introduction

Renal cell carcionoma (adenocarcinoma) of kidney is quite a frequent malignant tumor. It is diagnosed in 90 % of all malignant tumors of kidney. This tumor type is characterized by different clinical and morphological properties. It is considerably well radiosensitive. The only mode of treatment assuring a complete cure is surgical removal of primary tumor and solitary metastases.[1]

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Survival of patients depends on their clinical status at the time of diagnosis. The patient's clinical status is determined by spread of disease, involving local infiltration in the surrounding tissue and the presence of distant metastases.

The examinations, such as ultrasonography (US), computer tomography (CT) and magnetic resonance (MR) have enormously contributed not only to obtain better possibilities of detecting malignant or benign tumors of kidneys but also to their more successful detection.[2] Each renal mass having different density after the injection of contrast media is considered as a tumor until it's proven differently.

Adenocarcinoma of kidney is a rare malignancy in childhood and adolescence. At the time of diagnosis, one half of patients have no signs of hematorrhea; tumor is usually detected by chance.

Case report

A 37-year-old patient was treated at the Institute for Family Planning in the year 1988, where the dysfunction of the left ectopic kidney accompanied by a compensatory enlargement of the right kidney were observed.

In May 1996, the patient's sperm had been taken for the in vitro fertilization. At that time, hematospermia was observed. The patient was therefore referred to the urologist. Cytoscopic examination detected a substantially enlarged median lobe of the prostate and the wall of bladder was slightly pushed upwards to the usual location of the left ostium. The subsequent US examination confirmed the ectopia of the left pelvic kidney.

By the end of 1996, the patient complained of the problems in discharge of excreta despite normal appetite and digestion. He felt a stifling pain in the lower part of abdomen. In February 1997, the patient himself palpated the tumor by digital examination of rectum. He was immediately referred to the urologist.

The diagnostic procedure included also US examination which detected a profuse heterogeneous tissue of serous and solid structure, its size was 8x8.3 cm at the back of bladder on the left. These findings were the reason that we suspected a pathologically changed left ectopic kidney or left seminal vesicle. After having performed the biopsy examination, the cytologic findings could not reliably define the nature of this process. The cells resembled to those of spermatogenesis. On the other hand, the suspicion of tumor could not be definitely excluded.

CT examination discovered a non-homogenous tumor mass of 8x8 cm behind the urinary bladder (Figure 1a). The core of the tumor was hypodense, while the peripheral area was seen as a granular soft-tissue accumulation spreading towards the center. There was no infiltration of the tumor into the bladder observed, while the tumor margins on the side of the prostate, rectal wall and internal obturator muscle were not clear. Seminal vesicles were not seen, while the same examination detected other soft-tissue tumor masses between the loops of the jejunum (Figure 1b).

At the beginning of March 1997, the MR of the pelvis minor confirmed further growth of the tumor mass behind the bladder (Figure 2a). On T2-weighted image, the intensity of signal was different: It was hyperintensive in the core of tumor and hypointensive in its peripheral area. In the sagittal plane, the complete size of tumor mass could be seen, protruding into the wall of the urinary bladder and rectum (Figure 2b). On the T1-weighted image, the tumor was well differentiated after the injection of contrast media, with hypointensive signal in its core and weak hyperintensive signal in the periphery (Figure 3).

The MR image of the tumor was similar to the findings of CT examination. They both

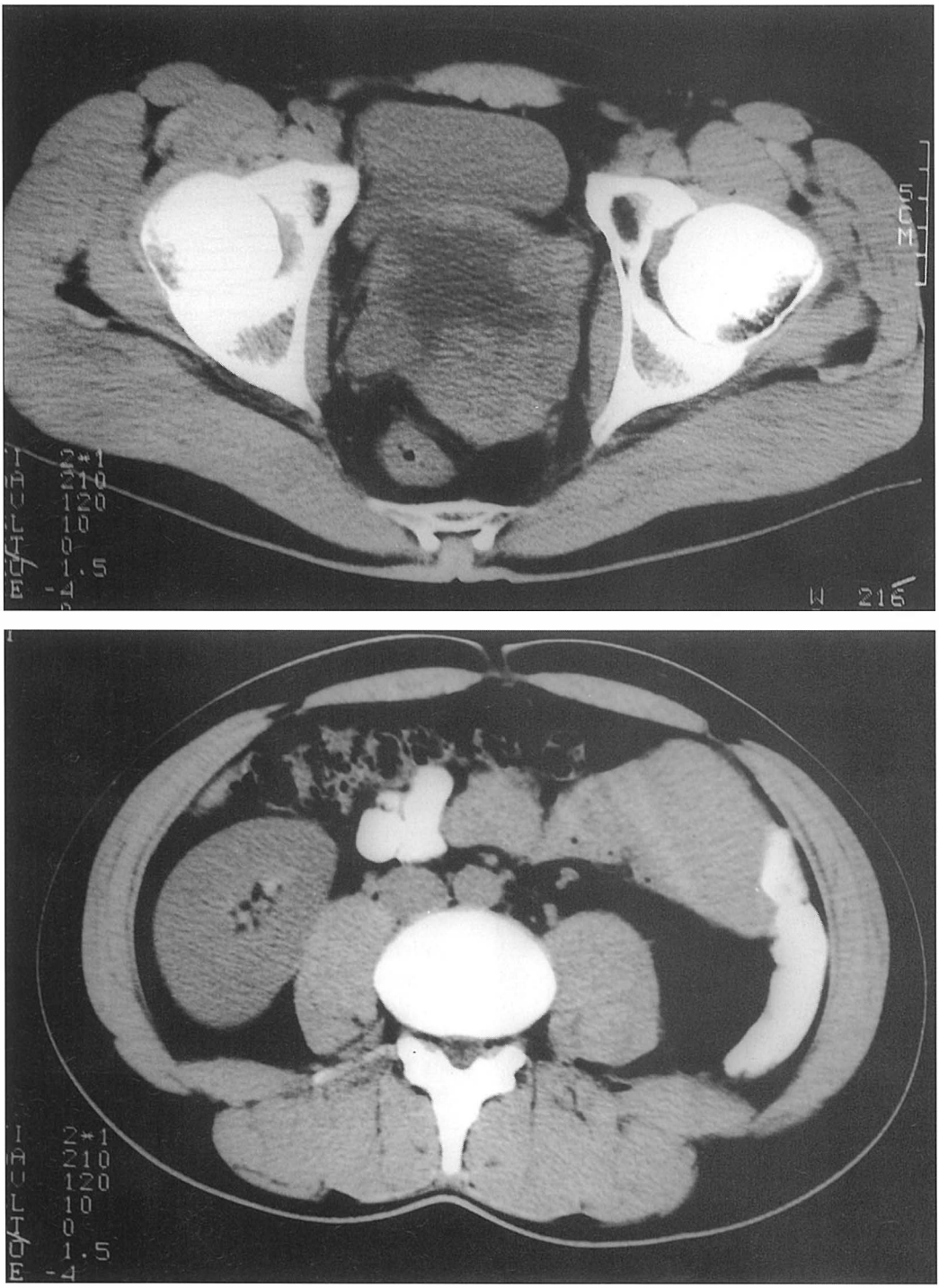

Figure 1. (a) CT visualization of non-homogenous well differentiated tumor in pelvis minor: The core of tumor is hypodense, whereas the periphery is granular soft tissue. (b) Soft tissue tumor.

Figure 2. (a) MR image of tumor: On T2-weighted image, the signal in tumor core is hyperintensive, whereas in the periphery the signal is hypointensive. (b) Sagittal plane: The T1-weigthed image of tumor.

confirmed the tumor in the ectopic kidney. Another differential option of these findings was germinal tumor or malignant tumor of another etiology.

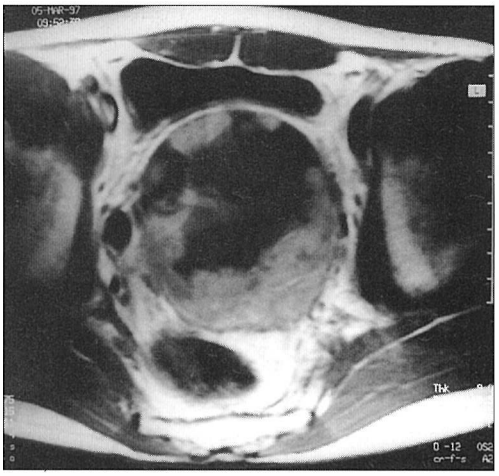

Figure 3. T1-weighted image of tumor: After the injection of contrast medium, the signal in the tumor core is hypointensive, whereas in the periphery the signal is mildly hyperintensive.

After the MR examination, the tumor in the pelvis minor was surgically removed. The histology findings confirmed the tissue of primarily papillary and partly solid clear cell carcinoma of the kidney, grade II-III. On one spot of the tumor area, the angioinvasion of tumor tissue was observed.

Post-operative treatment of the patient was normal. After having been discharged from the hospital to home care he was quite in a good condition.

At the beginning of May 1997, pains in the lower part of abdomen started again. The patient complained of having complications with excretion as well as of the constant stifling pain in the lower part of abdomen. The US examination at the end of May discovered an echosolid and also palpable formation (size 5x5cm) in the right inferior part of abdomen (Figure 4). It was assumed that this formation was either a residuum of tumor after the operation or recurrence.

Afterwards the patient underwent further diagnostic examinations, among them also the X-ray of thorax which findings were within limits. The cytoscopic findings detected that the trigone and orifice of bladder and

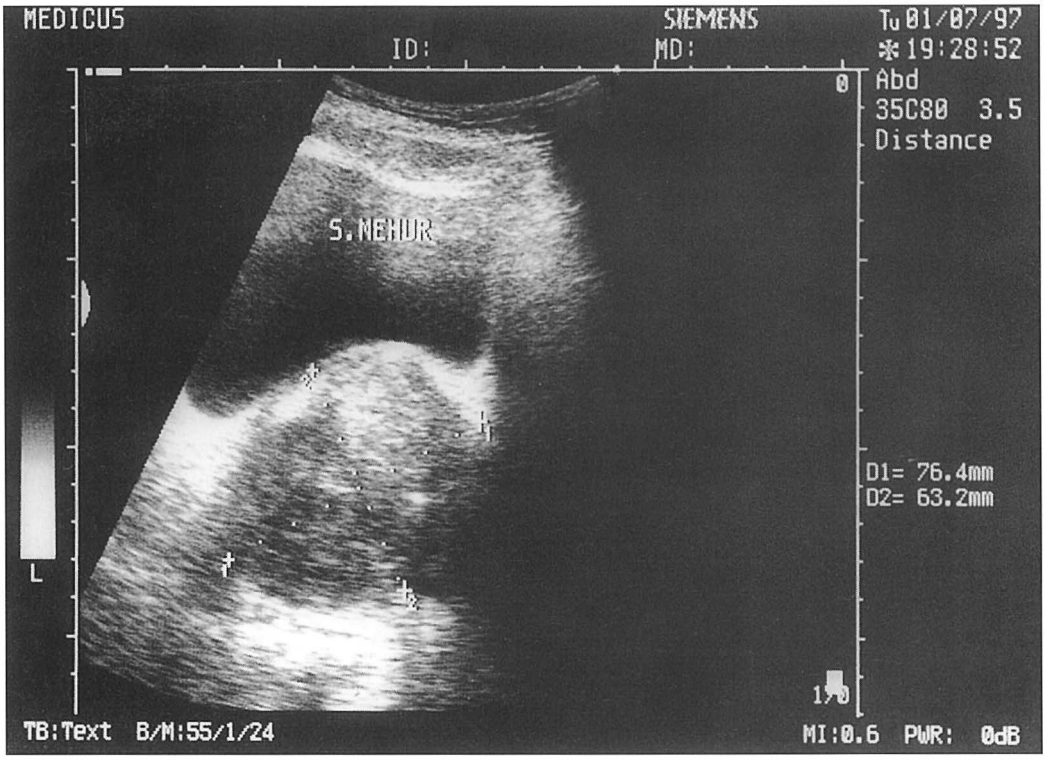

Figure 4. US visualization of echosolid tumor mass in pelvis minor.

prostatic lobe were slightly elevated. The mucous membrane of trigone was edematous. The digital examination of rectum detected a smooth and resilient formation pressing against it.

Another CT scan discovered two different kinds of masses; one was abundant solid tumor mass in between the loops of small intestine and colon, and the other granular solid tumor mass near the pelvic wall on the left and on the very place as it was the primary tumor. Both tumors were not connected to each other. Nevertheless in pelvis minor it was suspected that there was a tumor infiltration into the surrounding.

The patient was admitted to the treatment at the Institute of Oncology, Ljubljana. An US guided biopsy of the tumor in pelvis was performed and the subsequent histology findings confirmed the recurrence of the same type of tumor, as it was the primary one, i.e. small cell carcinoma corresponding to the carcinoma of kidney. The medical team at the Institute of Oncology decided to treat the patient with combined chemoimmunotherapy.

The patient received Paraplatin 3x750 mg, intravenously, in 3 weeks' interval, Vinblastin 4 mg, 24-hour infusion, in 2 weeks' interval, and Intron A 3.000.00, subcutaneously, 3 x / week. During the therapy, the patient suffered from some mild toxic effects, such as myelosuppression.

During the treatment, several US examinations were performed and two CT scans.

After the immunochemotherapy the clinical status of the patient improved. US examination also confirmed the decrease and colliquation of tumor. After a 3-month combined immunochemotherapy, the patient was referred again, if possible to operate him additionally. The CT scan showed the progression of disease with an extensive tumor masses in

the abdomen. The infiltration of tumor was observed in the surrounding tissue; particularly suspected infiltration was that one growing into the wall of rectum (Figures 5a,b). Another surgery was not possible any more, so the medical team decided for symptomatic palliative irradiation treatment. The tumor in the abdomen was pressing against the wall of rectum and for this reason the patient was obstipated. The patient received radiotherapy with TD 1800 cGy (180 cGy a day). Additionally to the radiotherapy, the patient received sensibilization treatment with Velbe 2mg in 24 hour infusion, 2 x / week. Despite the radiotherapy, progression could not be prevented.

In January 1998, the patient's condition deteriorated. At first he suffered from rectovesicle fistula followed by ileus. In March 1998, a preternatural anus was made in the transversal part of colon. The patient died in April 1998, due to a rapid progression of tumor into the abdomen.

Discussion

Despite properly selected diagnostic method and subsequent treatment modalities, we are not always in a position to influence favorably the course of disease.

Carcinoma of kidney has too often been detected by chance. The detection of this disease has become more successful when US and CT have been applied. With further improvement of diagnostic techniques we have had wider possibilities to detect tumors, even to determine their nature, as well as to distinguish between the benign and malignant one. Staging of the disease may essentially affect its treatment and prognosis. Early and accurate diagnose detected by US and CT should be strictly based on morphological criteria. The adenocarcinoma of kidney is often seen as a solid or non-homogenous accumulation and may be lobulated and clearly demarcated. Necrosis or hemorrhage often occurs in the core of tumor mass. It is important to assess the density changes in the mass after the injection of contrast medium.

CT scan is a vital diagnostic method at the detection and staging of kidney carcinoma. MR imaging is similar to CT scan, however, it is more successful in staging. It detects eventual anomalies and their extent, the veins and the surroundings of organs are more clearly perceptible.[3] CT scan cannot detect the microscopic invasion into the perirenal fatty tissue and cannot distinguish between inflammatory changes and tumor infiltration or identify small collaterals and infiltrations into the lymphatic system.[2] When defining the nature of tumor mass with an option to distinguish between the adenocarcinoma of kidney and the mesenchymal tumor on the basis of morphological changes and densitometry of CT scan, it would be more likely suspected that adenocarcinoma dominates.[4] A solitary lesion in kidney is usually the primary tumor, though the distinction between primary and secondary tumors is very complicated.[5] It is possible to observe simultaneously the renal arteries and veins, parenchyma and renal pelvis system with aid of recent technical innovations using fast sequences and contrast media during MRI. MRI can therefore be performed on any patient irrespective of age and readiness to co-operate in the examination.

It was suspected that our patient had an ectopic kidney. CT scan and MRI detected a large non-homogenous tumor mass in pelvis minor. Considering the images, restrictions and changes after the injection of contrast media, the CT scan and MRI diagnoses were malignant tumor of ectopic kidney. The T1- and T2-weighted MR images showed a tumor with a typical necrosis and hemorrhage in its core. The seminal vesicles were not seen in any MR images. Therefore, it was suspected that tumor was infiltrated into the surrounding tissue. The first CT scan did not detect another tumor which has not been removed

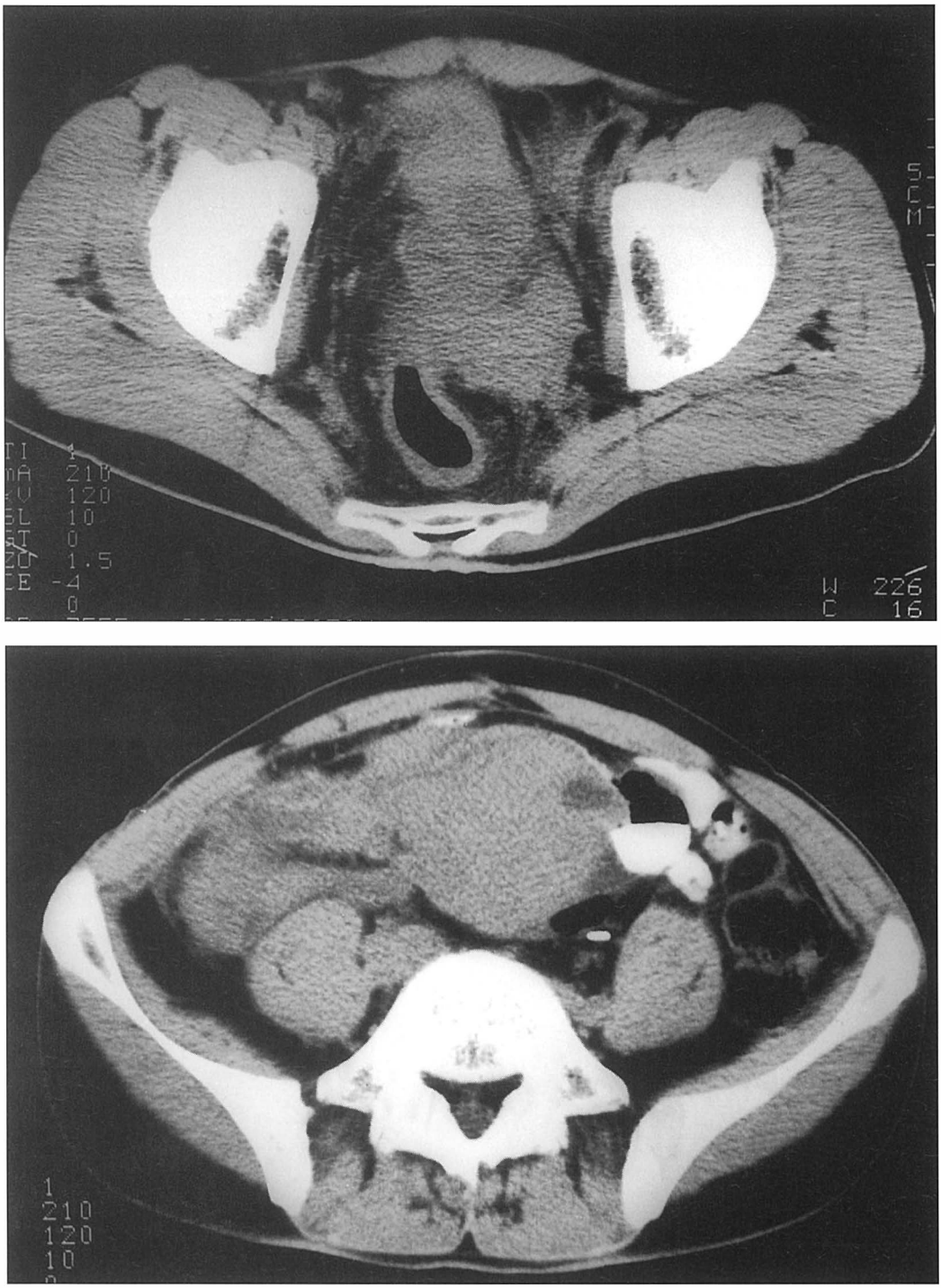

Figure 5. (a) CT visualization of tumor residuum in pelvis minor. (b) CT visualization of soft-tissue tumor in between the intestinal loops.

during the first operation was detected in between the intestinal loops. That tumor could have had the metastatic spread into the pelvis. Another differential diagnostic option was presence of the tumor of different etiology. The histologic findings of surgically removed tumor as well as cytological biopsy of residual tumor and/or its recurrence confirmed the adenocarcinoma of ectopic kidney.

Another review of the images of the first CT scan and MRI did not provide us with any additional data. Neither renal artery nor vein of the ectopic kidney could be seen on those images. The margins between the tumor and the surrounding organs with suspected infiltrations were better seen on MR images. There was no enlargement of lymph nodes detected on any of those images. Unfortunately, all the subsequent CT scans after the operation and during the therapy confirmed only a rapid progression of the disease.

A tumor localized in an ectopic kidney has been rarely reported in literature. Our case report confirms that despite current potential diagnostics, surgical treatment, choice of chemoimmunotherapy and radiotherapy it was not possible to slow down or to prevent from the progression of disease.

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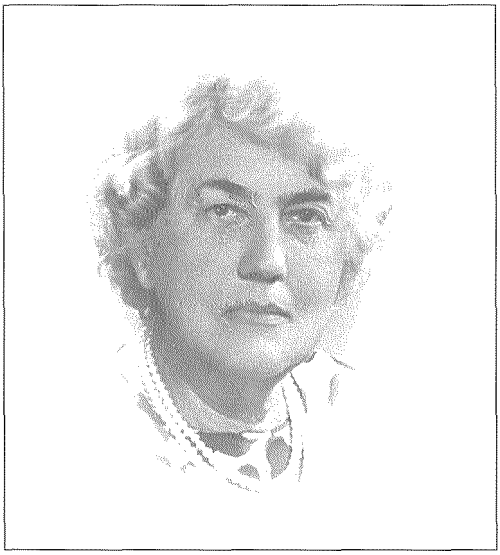
Prof. Mira Vurnik-Žumer, M.D., Ph.D. (1916-1998)



Professor Mira Vurnik-Žumer, a prominent radiologist and teacher of several generations of medical students and radiologists in Slovenia, died on August 8, 1998 at the age of 82 years.

Professor Mira Vurnik-Žumer was born in Vienna on September 28, 1916. She completed her pre-university education in Ljubljana, and graduated in 1935. She pursued her study of medicine at the Faculties of Medicine in Ljubljana and in Zagreb, and graduated M.D. from the latter in April 1942. She did her preregistration year in the Ljubljana General Hospital, and worked as a volunteer physician at the Department of Internal Medicine for two years.

She entered the specialist training in radiology quite early, and in 1950 began to work at the Institute of Radiology in Ljubljana. She passed the final speciality examination in June 1954. After presenting her work on the modern classification of primary bone tumours she was appointed Teaching Assistant of Radiology at the Faculty of Medicine in Ljubljana on June 6, 1956. She was the first woman to occupy this position in the history of Slovene radiology. In 1965 she defended her thesis "Diagnosis of gastric carcinoma" and was advanced to the rank of Assistant Professor. In 1973 she maintained her doctor's thesis entitled " Cine- and radiographic studies of the gastroesophageal region in the diagnosis of hiatus hernia in adults". The status of Associate Professor of Radiology was conferred on her one year later. Her teaching activities involved lectures, tutorials and seminars for medical and dental students. She was also a member of the board of examiners conducting final speciality examinations. Since 1955 she held a teaching post at the College for Radiographers Assistants in Ljubljana.

She took an active part in numerous meetings of the Slovene Section of Radiology and Nuclear Medicine, as well as in many postgraduate courses of surgery, postgraduate seminars for dental surgeons, gastroenterology symposiums, the Tavčar Days postgraduate courses, Slovene-Croatian intersectional meetings and congresses of Yugoslav radiologists.

In recognition of her contributions made to the field of radiology, Professor Vurnik-Žumer was elected President of the Slovene Section of Radiology and Nuclear Medicine for the periods 1956-1957 and 1962-1964.

Her hospital appointments included a post of the supervising physician at the radiological out-patient unit of the Institute of Radio-

logy in Ljubljana and that of the chief of the Institute's service of gastroenterologic radiology (both since 1966). In addition, she provided radiological services for the Izola and Trbovlje general hospitals.

Her chief areas of interest included radiological diagnosis of skull pathologies, musculoskeletal conditions - particularly of bone tumours, and intraabdominal pathological processes. During the second part of her career, Professor Vurnik-Žumer devoted most of her time and energy to the radiological diagnosis of gastroenterological diseases, paving the way for this new subspecialty.

She introduced two important diagnostic methods - conventional tomography of the skull and hypotonic duodenography - in the routine radiological practice in Slovenia.

Professor Vurnik-Žumer published a number of papers about the above mentioned topics, most of them dealing with radiological diagnosis of the digestive system.

Her lectures on the "Radiology of the Digestive System" published in 1976, were an indispensable manual for medical undergraduates for many years. This text, together with contributions by other faculty teachers, served as the basis for the first textbook of radiology in the Slovene language.

She retired in 1976.

Professor Vurnik-Žumer will always be remembered as an outstanding teacher by many generations of medical and dental students, radiological engineers and postgraduate trainees. She pioneered modern radiological diagnosis of gastroeneterologic disorders, and was one of the founders of the Ljubljana Institute of Radiology as we know it today. She has set a fine example to us all, and the outstanding contribution she made to the Slovene radiology will never be forgotten.

Vladimir Jevtič

Radiol Oncol 2000; 34(2): 85-91.

Defekografija: poročilo o 35 primerih

Jamar B, Šurlan K

Izhodišča. Namen raziskave je bil oceniti indikacije pri bolnikih, poslanih na preiskavo na Inštitut za radiologijo Kliničnega centra v Ljubljani od oktobra 1996 do decembra 1999.
Bolniki in metode. Na Inštitut je bilo v navedenem času napotenih na defekografijo 35 bolnikov (31 žensk in 4 moški, s povprečno starostjo 56,5 oz. 34,5 let) s težavami pri defekaciji, ki so trajale od 1 meseca do 17 let. Z raznimi napotnimi diagnozami je iz proktoloških ambulant prišlo 26 bolnikov, 9 pa iz gastroenterooloških ambulant. Defekografija je funkcijska rentgenska preiskava: bolniku napolnimo rektum z gosto barijevo pasto, ga posedemo na posebno oblikovano komodo in v stranski projekciji delamo ciljane posnetke rektoanalnega predela v raznih fazah defekacije.
Rezultati. Rektokelo smo našli v 21 primerih, 9 v povezavi z rektorektalno intususcepcijo, 3 z rektoanalno intususcepcijo in 2 s herniacijo v ishiorektalno foso. Našli smo še prolaps (2 primera), rektorektalno intususcepcijo (4), rektoanalno intususcepcijo (1) in 3 fistule. Funkcionalne motnje smo dokazali v 3 primerih in le en izvid preiskave je bil ocenjen kot normalen. Pri 11 ženskah so se motnje defekacije začele po ginekološki operaciji, pri 6 po porodu. Osem žensk si je za začetek ali olajšanje defekacije moralo pomagati z roko.
Zaključki. Defekografija je preprosta rentgenska preiskava, s katero je v večini primerov mogoče pokazati patološkoanatomski ali funkcijski vzrok težav z defekacijo.

Radiol Oncol 2000; 34(2): 93-9.

Trasjugularni intrahepatalni protosistemski šant (TIPS)

Šurlan M, Jereb J

Izhodišča. Avtorji prikazujejo indikacije in kontraindikacije za trasjugularni intrahepatalni portosistemski šant, ki jih delimo na absolutne in relativne. Absolutne indikacije so sveža in ponovna krvavitev iz varic požiralnika in trdovratni ascites. Relativne indikacije so splenomegalija s hipersplenizmom, Budd-Chiariev sindrom, preprečevanje zapletov pred presaditvijo jeter in hepatorenalni sindrom. Absolutni kontraindikaciji sta huda okvara jeter in odpoved desnega srca, relativne pa so policistična degeneracija jeter, novotvorbe, zapora portalne vene in hujša lokalna ali sistemska okužba. Pred posegom določimo stopnjo okvare jeter, desnega srca in ledvic, naredimo biokemične in krvne preiskave s testi koagulacije ter določimo koncentracijo amoniaka v serumu in preverimo prehodnost portalne vene. Natančno je opisana izvedba posega, skrb za bolnika in njegovo spremljanje po posegu. Posega je uspešen v 93-100 %, smrtnost znotraj 30 dni zaradi transjugularnega intrahepatalnega portosistemskega šanta je 1-3 %. Krvavitev ustavimo v 95-100%, ascites se izboljša v 87-92 % in ledvično delovanje v 81 %, pri hipersplenizmu se trombocitopenija izboljša pri 75 % in levkopenija pri 50 % bolnikov. Zapletov ob posegu je relativno malo, več jih je kasneje zaradi zožitev in zapor šanta. Po dveh letih je šant prehoden pri 50 % bolnikov. V naši skupini 29 bolnikov, zdravljenih v obdobju štirih let, s povprečnim časom opazovanja 2 leti je še živih 22 (75,9 %) bolnikov, umrlo jih je 7 (24,1 %). Šest umrlih bolnikov je imelo alkoholno cirozo jeter, pri dveh bolnikih pa vzrok smrti ni bil povezan s transjugularnim intrahepatalnim portosistemskim šantom oziroma cirozo jeter.

Zaključki. TIPS je zlasti učinkovita metoda za ustavljanje svežih varikoznih karvavitev. Uporabljamo jo pri krvavitvah, kjer nismo bili uspešni z medikamentoznim zdravljenjem ali endoskopsko sklerozacijo. To je tudi najbolj učinkovita metoda za zniževanje portalnega pritiska pred presaditvijo jeter in znatno izboljša uspehe tahšnih presaditev.

Radiol Oncol 2000; 34(2): 101-6.

Slikovna diagnostika, indikacije in meritve za premostitev anevrizme aorte z endoprotezo

Šurlan Š, Salapura V, Kunst T

Izhodišča. Avtorji prikazujejo slikovno diagnostiko anevrizme aort, indikacije, splošne kontraindikacije in meritve za izdelavo ali izbiro aortne endoproteze. Preiskava z ultrazvokom je najbolj priročna in ekonomsko upravičena metoda za odkrivanje anevrizme aort, spremljanje asimptomatskih anevrizem ter bolnikov po zdravljenju z operacijo ali endoprotezo. Naslednji preiskavi za prikaz anevrizme aorte sta računalniška tomografija brez kontrastnega sredstva in z njim. Načrt zdravljenja z endoprotezo naredimo s pomočjo digitalne substrakcijske angiografije, spiralne računalniške tomografske angiografije in/ali magnetne resonance in angiografije. Z digitalno subtrakcijsko angiografijo dobro prikažemo svetlino anevrizme in aorte ter spremembe v njej, velike arterije v bližini anevrizme in stanje medeničnih arterij za izbiro pristopa. Spiralna računalniška tomografska angiografija in magnetnoresonančna angiografija v dvo- in trodimenzionalni reprodukciji v več smereh nam omogočata natančno izmero velikosti anevrizme, premera aorte nad in pod anevrizmo ter presodita kakovost njene stene.

Zaključki. Indikacijski področji za endoprotezo sta anevrizma trebušne aorte in descedentnega dela prsne aorte. Zdravljenje z endoprotezo kot manj invazivna metoda je indicirano pri bolnikih, pri katerih ima kirurško zdravljenje veliko zapletov in visoko smrtnost. Endoproteza je zgrajena iz kovinske opornice in proteze. Opornica pritrdi endoprotezo na neprizadeti del aorte nad in pod anevrizmo, razpre protezo in ji daje oporo. Proteza je sintetična tkanina dakron, ki ima za ta namen primerne lastnosti, kot so majhna podajnost, poroznost, prepustnost in razteznost. Endoprotezo uvajamo v aorto skozi kateterski dovodni sistem. Vhodno mesto je kirurško odprta skupna stegnenična ali medenična arterija.

Radiol Oncol 2000; 34(2): 107-13.

Premostitev anevrizme aorte z endoprotezo

Šurlan M, Salapura V

Aortne endoproteze delimo po obliki, mestu aplikacije in po materialu, iz katerega so zgrajene. Po obliki so tubularne ali razcepiščne. Prve uporabljamo za premoščanje anevrizem prsne aorte in redkeje trebušne aorte. Anevrizme trebušne aorte večinoma premoščamo z razcepiščno endoprotezno. Aortne endoproteze so zgrajene iz opornega kovinskega dela in proteze. Oporni del je narejen iz nerjavečega jekla ali nitinola. Proteza je iz tkanine dakrona ali politetrafluoretilena. Oporni del pritrdi protezo na neprizadeti del aorte nad in pod anevrizmo namesto šivov. Protezo razpre in ji daje oporo. Natančno je opisan postopek uvajanja endoproteze in premoščanja anevrizme prsne in trebušne aorte. Prikazani so možni zapleti in natančno je opisan mehanizem notranjega puščanja in njegovo ugotavljanje. V naši ustanovi smo z aortno endoprotezo uspešno premostili anevrizmo aorte trem bolnikom. Pri dveh v področju descedentnega dela prsne aorte in tretjemu v področju trebušne aorte, nižje od ledvic. Prvemu bolniku smo premostili psevdoanevrizmo, ki je povzročala hripavost, drugemu zaradi drugega poznega zapleta z deformacijo endoproteze z notranjim puščanjem po dvakratnem zdravljenju z endoprotezo v tujini. Tretji bolnik se je za endovaskularno zdravljenje z endoprotezo kot manj invazivno opcijo odločil zaradi prestalih operacij na odprtem srcu. V zaključku smo na osnovi naših izkušenj in obljavljenih rezultatov poskušali oceniti vrednost metode.

Radiol Oncol 2000; 34(2): 115-22.

Ultrazvočno vodena aspiracijska biopsija prikritih področnih zasevkov karcinoma glave in vratu

Višnar-Perovič A[1], Aničin A[2], Zupančič Ž[1], Černelč B[1], Šmid L[2], Vidmar DB[1], Gorenc M[1]

Izhodišča. Študije v katerih obravnavajo kombinirano rabo ultrazvoka (UZ) in ultrazvočno vodene aspiracijske biopsije (UZVAB) pri ugotavljanju prikritih področnih zasevkov ploščatoceličnega karcinoma glave in vratu so obetavne, vendar maloštevilne. V novejšem času, pri odločanju za UZVAB, avtorji povdarjajo pomen parametrov velikosti bezgavk. Želeli smo oceniti zanesljivost UZ-UZVAB in parametrov velikosti bezgavk pri ugotavljanju prikritih področnih zasevkov ploščatoceličnega karcinoma glave in vratu.

Bolniki in metode. Pri 77 bolnikih s ploščatoceličnimi karcinomi glave in vratu smo z UZ pregledali 121 strani vratu brez tipnih zasevkov. Glede na rezultate smo na 64 straneh vratu opravili še UZVAB. Pooperativno smo rezultate UZ-UZVAB primerjali s histološkim pregledom pri disekciji odstranjenih bezgavk.

Rezultati. V raziskavi smo dosegli 77 % občutljivost in 100 % specifičnost za UZ in UZVAB skupaj, medtem ko je bila natančnost 95 %. Negativna napovedna veljavnost je bila 94 %, pozitivna pa 100%. Najboljši parameter pri napovedovanju prisotnosti zasevkov v bezgavkah je bilo razmerje prečni / vzdolžni premer.

Zaključki. Menimo, da je metoda UZVAB primerna za diagnostiko prikritih področnih zasevkov na vratu in jo kaže uvrstiti med rutinske preiskave za oceno razsežnosti karcinomov glave in vratu.

Radiol Oncol 2000; 34(2): 123-36.

Računalniško tomografska angiografija pri intrakranialnih žilnih boleznih

Miloševič Z

Izhodišča. Uvedba spiralnega načina računalniško tomografskega slikanja je omogočila natančnejši prikaz žilja tudi z računalniško tomografsko angiografijo (CTA). Ker je metoda minimalno invazivna, so jo hitro sprejeli radiologi in kliniki. V začetku devedesetih let se je tudi na področju nevroradioloških preiskav intrakranialnih žilnih bolezni CTA pridružila konvencionalni intraarterijski angiografiji in magnetnoresonančni angiografiji (MRA). CTA uporabljamo v okviru odkrivanja in evaluacije intrakranialnih anevrizem, žilnih malformacij, stenozantnih in okluzivnih bolezni intrakranialnih arterij in patoloških procesov na venskih sinusih. Pri odkrivanju intrakranialnih anevrizem ima CTA v primerjavi z konvencionalno intraarterijsko angiografijo - kot zlatim standardom - visoko občutljivost, specifičnost in diagnostično zanesljivost. Na področju žilnih malformacij je CTA uporabna pri odkrivanju in pri pred- in pooperativni evaluaciji arteriovenskih malformacij. S CTA lahko dobro prikažemo venske angiome in se tako izognemo bolj invazivni konvencionalni angiografiji. Stenozantne in okluzivne spremebe intrakranialnih arterij lahko odkrijemo in natančneje opredelimo pri bolnikih z vazospazmom intrakranialnih arterij, pri bolnikih, ki imajo akutno možgansko kap, in pri bolnikih s kroničnimi stenozantnimi in okluzivnimi spremembami intrakranialnih arterij.

Zaključki. CTA je zanesljiva metoda v diagnostiki okluzivnih in stenozantnih sprememb venskih sinusov. CT angiografiji daje dodatno vrednost možnost ustvarjanja tridimenzionalnih rekonstrukcij, ki omogočajo lažjo oceno anatomskih odnosov pri intrakranialnih žilnih boleznih. Slabša resolucija glede na konvencionalno angiografijo je poglavitna slabost CTA, s posodabljanjem spiralne računalniške tomografije in delovnih postaj pa se povečuje, tako da ima CTA velike možnosti razvoja in vse širše uporabe na področju intrakranialnih žilnih bolezni.

Radiol Oncol 2000; 34(2): 137-43.

Računalniškotomografska angiografija

Kunst T, Berden P

Izhodišča. Uporabo špiralnega CT skenerja v kombinaciji z žilnim kontrastnim medijem imenujemo računalniškotomografska angiografija (CT angiografija). Ker je metoda minimalno invazivna, je bila hitro sprejeta v slikovno diagnostiko, podobno kot Dopplerjev ultrazvok, angiografija z magnetno resonanco, transezofagealni ultrazvok itd. Na področju kardiovaskularne radiologije CT angiografijo uporabljamo predvsem za diagnosticiranje patoloških sprememb ascendentne in descendentne aorte, kot so aneurizma, disekcija, traumatska ruptura ali kongenitalne anomalije. Zelo koristno jo uporabljamo tudi pred- in pooperativno kot preiskavo pri vzstavitvi žilne endoproteze v aorto. Tako v zadnjih letih priskava močno vpliva na predoperativne odločitve, po posegu pa jasno kaže postoperativne anatomske spremembe in tudi zaplete.
Zaključki. CT angiografija je v tem kontekstu primerljiva z intraarterielno angiografijo in ima celo nekatere prednosti. Edina pomanjkljivost je nekoliko slabša prostorska ločljivost in daljši čas procesiranja, vendar lahko s posebnimi skenerji z več žarkovnimi snopi (multi-slice skenerji) in zmogljivejšimi delovnimi postajami omenjeno pomanjkljivost močno zmanjšamo.

Radiol Oncol 2000; 34(2): 145-50.

Magnetnoresonančna artrografija ramenskega sklepa

Jevtič V, Praprotnik A

Izhodišča. Namen študije je bil ugotoviti vrednost nativnega slikanja z magnetno resonanco (MRI) in direktne magnetnoresonančne artrografije (MRA) s paramagnetnim kontrastnim sredstvom (Gd-DTPA) pri diagnostični opredelitvi posttravmatskih sprememb ramenskega sklepa.
Bolniki in metode. Direktna magnetnoresonančna artrografija je bila narejena na 27 bolnikih s težjo poškodbo ramenskega sklepa, pri katerih MRI ni omogočila zanesljive diagnoze. Po intraartikularni aplikaciji Gd-DTPA v fiziološki raztopini (koncentracija 0.2 mmol/l) je bilo narejeno slikanje s spin echo in gradient eho tehniko. Primerjali smo rezultate obeh preiskav.
Rezultati. MRA je pokazala strgano rotatorno manšeto pri 5 bolnikih, lezije labruma v 7 primerih, 4 osteohondralne poškodbe in prosto telo v sklepu, posttravmatske spremembe, ki jih MRI ni odkrila. Vsi rezultati MRA so bili potrjeni artroskopsko ali z operativnim posegom.
Zaključki. V naši študiji se je MRA v primerjavi z MRI pokazala kot občutljivejša tehnika za prikaz klinično pomembnih posttravmatskih intraartikularnih sprememb ramenskega sklepa.

Radiol Oncol 2000; 34(2): 151-8.

Magnetna rezonanca tumorjev in netumorskih mas v srcu

Berden P

Tumorji srca so redki in jih je potrebno ločiti od netumorskih mas v srcu, saj je zdravljenje različno. V ta namen se pri slikanju z magnetno rezonanco (MR) uporabljata spin-echo (SE) in gradient-echo (GE) tehnika. Prva omogoča prikaz anatomije srca in ugotavljanje sestave tkiva, druga nudi informacije o dinamiki - pretoku krvi in srčnih kontrakcijah. Miksom srca ločimo od tromba s pomočjo intravenske aplikacije paramagnetnega kontrastnega sredstva. Z GE tehniko ocenjujemo njegovo premičnost. Lipom in subakutna krvavitev imata enako, visoko intenziteto signala na T1-uravnoteženi sliki, zato za njuno razpoznavo uporabimo tehniko maščobne supresije. MR uporabljamo za oceno reakcije malignega tumorja na kemoterapijo. GE MR je koristna pri ločevanju tromba in počasnega pretoka, intravenska aplikacija gadolinija pa za ločitev tromba od tumorja. Ehokardiografija je prva metoda izbire pri bolnikih s sumom na tumor v srcu. MR uporabimo za potrditev ehokariografskega izvida, za natančnejšo opredelitev lokalizacije in razširjenosti tumorja, za ugotavljanje sestave tumorskega tkiva, za spremljanje bolnikov med zdravljenjem in za zgodnje odkrivanje morebitne ponovne tumorske rasti.

Radiol Oncol 2000; 34(2): 159-64.

Magnetna resonanca pri obolenjih torakalne aorte

Berden P

Običajna, z EKG vodena spin-echo (SE) magnetna rezonanca (MR) in magnetno rezonančna angiografija (MRA) sta odlični slikovni metodi v diagnostiki obolenj torakalne aorte. SE nudi dobro prostorsko ločljivost, ki omogoča prikaz anatomije aorte in odnos do okolnih tkiv. MRA pokaže pretok, vendar je ločljivost slabša od običajne MR. 3D (tri dimenzionalna) MRA s kontrastnim sredstvom je zelo zanesljiva pri prikazu aortne anatomije, predvsem pa pri ugotavljanju nepravilnosti njenih vej. Občutljivost in specifičnost ugotavljanja aortne disekcije se gibljeta od 95 % do 100 % oziroma 94 % do 100 % in sta najvišji v primerjavi z drugimi slikovnimi tehnikami (ultrazvok, CT angiografija-CTA). MR jasno pokaže celoten premer aortne anevrizme, velikost tromba v njej in njeno širitev v trebušno votlino. Običajno je potrebna kombinacija SE in kino MRA. Enake sekvence s kontrastnim sredstvom nudijo tudi vse potrebne podatke pri prirojenih nepravilnostih aorte. MR je zelo zanesljiva pri prirojenih nepravilnostih aorte, aortnih anevrizmah in disekcijah pri hemodinamsko stabilnih bolnikih. Uporabiti jo velja pri vseh kroničnih aortnih disekcijah in pooperativnem sledenju bolnika. Nestabilni bolniki, ki potrebujejo intenziven monitoring za MR niso primerni.

Radiol Oncol 2000; 34(2): 201-10.

Radiol Oncol 2000; 34(2): 165-73.

Hidrokolonsonografija v odkrivanju bolezni širokega črevesa

Vidmar D

Izhodišča. Tekočina v lumnu izboljša preglednost prebavne cevi do te mere, da se patološke spremembe odkrivajo prej in bolj natančno. Diagnostično metodo za široko črevo, ki se po predhodnem izčiščenju retrogradno napolni z vodo, imenujemo hidrokolonsonografija (HS).
Bolniki in metode. Uspešnost metode smo testirali v skupini 56 bolnikov s primerjavo izvidov HS in kolonoskopije (KS) ali irigografije ali operativnim izvidom.
Rezultati. Celokupna točnost je bila 86 %, senzitivnost 81 %, specifičnost 92 %, pozitivna napovedna vrednost (PPV) 91 % in negativna napovedna vrednost (NPV) 82 %.
Zaključki. HS je po uspešnosti primerljiva z irigografijo razen za prikaz rektuma. Omejitev preiskave je v tem, da je zahtevna za preiskovalca, kar vpliva na njeno sprejemljivost v diagnostiki širokega črevesa.

Radiol Oncol 2000; 34(2): 175-84.

Zožitev moške sečnice: Pravilna izvedba in vrednotenje radiografske in ultrazvočne uretrografije, da se izognemo napakam

Babnik Peskar D, Perovič Višnar A

Izhodišče. Natančna ocena mesta, dolžine, globine in sestave zožitve sečnice so pogoj za pravilno odločitev o zravljenju, da preprečimo recidive. Odločitev o dilataciji, interni uretrotomiji ali odprtem kirurškem posegu zavisi od endoskopske, radiouretrografske in v zadnjem času tudi ultrazvočne ocene po Mc Anninch-u. Dodatna informacija ultrazvoka je neposredna ocena globine in sestave spongiofibroze. V predhodnih objavah ugotovljena radiografska podcenitev dolžine, v primerjavi z ultrazvokom in endoskopijo, je možen razlog nepravilnega izbora zdravljenja in recidivom. V prispevku smo ocenili novo ultrazvočno diagnostično možnost pri zožitvah sečnice. Opisali smo obe slikovni metodi v diagnostiki zožitev sečnice važnih za izbor zdravljenja, skupaj z običajnimi napakami v izvedbi in vrednotenju, ki so po našem prepričanju vzrok napačnim izmeram in predhodno objavljeni radiografski pocenitvi dolžine.
Bolniki in metode. V obdobju 20 mesecev smo, pri 51/130 moških s sumom na zožitev sečnice, ocenili ultrazvočno uretrografijo v primerjavi z radiouretrografijo in endoskopijo.
Rezultati. V primerjavi z RUG je bil ultrazvok 92-odstotno pravilen v odkrivanju zožitev. Ultrazvočno izmerjene dolžine striktur so bile v povprečju za 22% krajše od radiografskih izmer, kar lahko razložimo z radiografsko povečavo, ki smo jo dokazali z merilno žico postavljeno na penis. Ob upoštevanju radiografske povečave, drugih bistvenih razlik v večini meritev nismo našli. V naši primerjavi RUG, SUG in endoskopije nismo našli predhodno objavljene radiografske podcenitve dolžine.
Zaključek. Kombinacija obeh slikovnih metod nam zagotavlja optimalne podatke o anatomiji zožitve sečnice. Iz naših rezultatov sklepamo, da je objavljena radiografska podcenitev dolžine samo napaka v oceni. Zato poudarjamo, kako pomembna je za primerno terapijo pravilna izvedba in ocena slikovnih preiskav , da se izognemo napakam v izvedbi, vrednotenju, nepravilni primerjavi in napačnim zaključkom. Za radiouretrografijo priporočamo dinamično uretrografijo po Mc Callumu.

Radiol Oncol 2000; 34(2): 201-10.

Radiol Oncol 2000; 34(2): 185-90.

Ultrazvočno ocenjevanje hrbteničnega kanala pri otrocih

Zupančič Ž

Izhodišča. Z ultrazvokom lahko pri pregledu hrbteničnega kanala dobro prikažemo anatomsko strukturo kanala kot tudi strukturo okoljnih tkiv. V prispevku opišem tehniko pregledovanja in podam pregled anatomije in najpogostejših prirojenih anomalij, primerjavo diagnostičnosti ultrazvoka z magnetnoresonančnim slikanjem ter vlogo in mesto ultrazvoka pri ocenjevanju hrbteničnega kanala.
Zaključki. Ultrazvok priporočamo kot primarno slikovno diagnostično metodo za ocenjevanje okultnega hrbteničnega disrafizma pri dojenčkih in majhnih otrocih.

Radiol Oncol 2000; 34(2): 191-8.

Adenokarcinom v ektopični ledvici - možnosti diagnoze in zdravljenja tumorja ledvice: prikaz primera

Brenčič E, Stanovnik M, Glušič M

Izhodišča. Široka uporaba ultrazvoka in računalniške tomografije je prispevala k zgodnjemu odkrivanju tumorjev ledvic, saj vemo, da so velikokrat odkriti slučajno. Magnetna resonanca nam omogoča ne samo prikaz tumorja, odločitev glede narave tumorske mase, temveč nam poda odgovor na vprašanje infiltracije v okolico ter prisotnosti sprememb v žilah.
Prikaz primera. Prikazan je primer bolnika z adenokarcinom v ektopični ledvici. Ultrazvočna, računalniško tomografska preiskava in magnetna resonanca so pokazale veliko, nehomogeno tumorsko maso v mali medenici. Kljub sumu o ektopiji ene izmed ledvic se je postavila možnost prisotnosti patološkega procesa druge etiologije, zlasti, ker je bila prisotna tudi druga tumorska masa med črevesnimi vijugami. Po neradikalni operaciji adenokarcinoma v ektopični ledvici je po dveh mesecih prišlo do povečanja ostanka tumorja v mali medenici in tumorja med vijugami črevesja, ki ni bil odstranjen pri operaciji. Bolnik je bil zdravljen s kemoimunoterapijo in lokalnim obsevanjem.
Zaključek. Po podatkih v literaturi, ki nam je dostopna, je lokalizacije tumorja v ektopični ledvici zelo redka. Postavlja se vprašanje, ali so bile izčrpane vse diagnostične možnosti in zdravljenje tumorja v ektopični ledvici, kar je bil tudi namen prikaza tega zanimivega primera.

Notices

Notices submitted for publication should contain a mailing address, phone and/or fax number and/or e-mail of a Contact person or department.

Computed tomography

July 20-23, 2000

The "8th Annual Advanced Topics in CT Scanning: The 2000 Edition" will take place in Lake Tahoe, NV, USA.

Contact Office of Continuing Medical Education, John Hopkins University School of Medicine, Turner 20, 720 Rutland Avenue, Baltimore, Maryland 21205-2195, USA; or call +1 410 955 2959; or fax +1 410 955 0807; or e-mail cmenet@jhmi.edu; or see Internet http://www.med.jhu.edu/cme

Radiotherapy

August 18-22, 2000

The ESTRO teaching course "Evidence-Based Radiation Oncology" will take place in Singapore.

Contact ESTRO office, Av. E. Mounier, 83/4, B-1200 Brussels, Belgium; or call +32 7759340; or fax +32 2 7795494; or e-mail info@estro.be; or see Internet http://www.estro.be

Radiotherapy

August 26 - September 2, 2000

The 2nd International Summer School on Experimental and Clinical Oncology for Medical Students will take place in Vienna, Austria.

Contact Prof. Dr. Huber and R. Potter; call +43 1 40400 4429; or fax +43 1 40400 4451.

Radiotherapy

August 27-29, 2000

The 3rd Workshop on brachytherapy in Head and Neck Cancer will take place in Kiel, Germany.

E-mail kovacs@onco.uni-kiel.de

Radiophysics

August 27-31, 2000

The ESTRO teaching course on "Physics for Clinical Radiotherapy" will take place in Leuven, Belgium.

Contact ESTRO office, Av. E. Mounier, 83/4, B-1200 Brussels, Belgium; or call +32 7759340; or fax +32 2 7795494; or e-mail info@estro.be; or see Internet http://www.estro.be

Radiology

September 4-8, 2000

The 21st International Congress of Radiology and 20th Interamerican Congress of Radiology will take place in Buenos Aires, Argentina.

Contact Executive Secretariat; Tucuman 2075, 1050 Buenos Aires, Republica Argentina; or fax +54 11 4374 6487; or e-mail info@icr2000.0rg.ar

Pathology

September 6-10, 2000

The ESO postgraduate course in "Theoretical and Diagnostic Histopathology - PCTDH - (Part III), Systemic Pathology" will be offered in Alexandroupolis, Greece.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Lung cancer

September 11-15, 2000

The "9th World Conference on Lung Cancer" will be offered in Tokyo, Japan.

Contact Dr. Yoshihiro Hayata, The 9th World Conference on Lung Cancer, Tokyo Medical College Cancer Center, 6-7-1 Nishishinjuku, Shinjuku-ku, Tokyo 160-0023, Japan; or fax +81 3 3342 0893

Oncology

September 14-16, 2000

The "2nd International Symposium on Organ Sparing Treatment in Oncology" will take place in Bled, Slovenia.

Contact Ms. Natalija Bah, Cankarjev dom - Cultural and Symposium Centre, Prešernova 10, SI-1000 Ljubljana; or call +386 61 1767 132; or fax +386 61 217 431; or e-mail: natalija.bah@cd-cc.si

Myelodysplastic and marrow failure syndromes

September 15-17, 2000

The ESO training course will take place in Olympia, Greece.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Radiation therapy

September 19-23, 2000

The 19th Annual ESTRO Meeting will take place in Istanbul, Turkey.

Contact ESTRO office, Av. E. Mounier, 83/4, B-1200 Brussels, Belgium; or call +32 7759340; or fax +32 2 7795494; or e-mail info@estro.be; web: http://www.estro.be

Breast and colorectal cancer

September 21-23, 2000

The ESO training course will take place in Thessaloniki, Greece.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Breast cancer

September 26-30, 2000

The 2nd European Breast Cancer Conference will be held in Brussels, Belgium.

Contact FECS Conference Unit, Av. E. Mounier, 83, B-1200 Brussels, Belgium; or call +32 7750202; or fax +32 2 7750200; or e-mail EBCC-2@fecs.be; or see Internet http://www.fecs.be

Oncology

September 28-30, 2000

The ESO training course on "Monoclonal Antibodies, Cytokines and Growth Factors in Oncology" will take place in Patras, Greece.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Lymphoma

October, 2000

The ESO postgraduate course will take place in Izmir, Turkey.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Radiation therapy

October 2-6, 2000

The 9th International Symposium on Neutron Capture Therapy for Cancer will take place in Osaka, Japan.

E-mail igcong@po.iijnet.or.jp

Oncology

October 4-6, 2000

The 4th National Congress of Federation of Spanish Societies of Oncology (F.E.S.E.O.) will be offered in La Caruna, Spain.

Contact Technical Secretariat, Orzan Congres, S.L.; call +34 981 169 855; or fax +34 981 247 908

Oncology

October 6-7, 2000

The ESO course on "Fatigue/Exhausting in Cancer Patients" will take place in Milan, Italy.

Contact ESO Office, Viale Beatrice d'Este 37, 20122 Milan, Italy; or call +39 0258317850; or fax +39 0258321266: or e-mail esomi@tin.it

Surgical oncology

October 6-7, 2000

The ESO training course will take place in Herakleion, Greece.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Radiation oncology

October 8-12, 2000

The ESTRO teaching course on "Evidence-Based Radiation Oncology: Principles and Methods" will be offered in Lleida, Spain.

Contact ESTRO office, Av. E. Mounier, 83/4, B-1200 Brussels, Belgium; or call +32 7759340; or fax +32 2 7795494; or e-mail info@estro.be; or see Internet http://www.estro.be

Radiobiology

October8-12, 2000

The ESTRO teaching course on "Basic Clinical Radiobiology" will be offered in Bratislava, Slovakia.

Contact ESTRO office, Av. E. Mounier, 83/4, B-1200 Brussels, Belgium; or call +32 7759340; or fax +32 2 7795494; or e-mail info@estro.be; or see Internet http://www.estro.be

Radiation oncology

October 8-12, 2000

The Joint Meeting DEGRO-OGRO-DGMP will be offered in Munchen, Germany.

See Internet http://www.degro.org

Bioelectromagnetism

October8-12, 2000

The "3rd International Conference on Bioelectromagnetism" and "1st Slovenian-Croatian Meeting on Biomedical Engineering" will be offered in Bled, Slovenia.

Contact Prof. Damijan Miklavčič - president, Faculty of Electrical Engineering, University of Ljubljana, Tržaška 25, SI-1000 Ljubljana, Slovenia; or call +386 61 1768 264; or fax +386 61 1264 658; or e-mail 3rdICBEM@svarun.fe.uni-lj.si; or see Internet http://www.albatros-bled-sp.si

Oncology

October 12-14, 2000

The ESO training course on "Oncology through the Ages: Historical, Philosophical and Ethical Aspects" will take place in Athens, Greece.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Medical oncology

October 13-17, 2000

The 25th ESMO Congress will take place in Hamburg, Germany.

Contact ESMO Congress Secretariat, Via Soldino 22, CH-6900 Lugano, Switzerland; or call +41 91 950 0781 or fax +41 91 950 0782; or e-mail esmo@dial.eunet.ch; or see Internet http:/www.esmo.org

Radiation therapy

October 22-25, 2000

ASTRO Annual meeting will be held in Boston, Massachusetts, USA.

Contact American Society for Therapeutic Radiology and Oncology Office, 1891 Preston White Drive, Reston, VA 20191, USA; web site: www.astro.org

Soft tissue sarcomas and bone tumours

October 26-28, 2000

The ESO training course will take place in Ankara, Turkey.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Oncology

October 27-29, 2000

The ESO training course on "Angiogenesis: Indications in the Prognosis and Treatment of Cancer" will take place in Alexandroupolis, Greece.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Thoracic tumours

November, 2000

The ESO training course will take place in Nicosia, Cyprus.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Ovarian cancer

November 2-3, 2000

The ESO training course will take place in Athens, Greece.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Colorectal carcinoma

November 3-5, 2000

The ESO training course will take place in Ankara, Turkey.

Contact ESO office for Balkans and Middle East, N. Pavlidis, E. Andreopoulou Medical School, Department of Medical Oncology, University Hospital of Ioannina, 45110 Ioannina, Greece; or call +30 651 99394 or +30 953 91083; or fax +30 651 97505

Medical physics

November 5-9, 2000

EPSM 2000, The Annual Conference of Engineering and the Physical Sciences in Medicine in Australasia will be offered in Newcastle, Australia.

E-mail phtk@cc.newcastle.edu.au

Radiophysics

November 9-12, 2000

The International Workshop on Monte Carlo Treatment Planning will be offered in Stanford, USA.

E-mail cma@reyes.stanford.edu; or see Internet http://www-radonc.stanford.edu/

Oncology

November 10-11, 2000

The ESO course on "Anemia and Cancer Therapy" will take place in Milan, Italy.

Contact ESO Office, Viale Beatrice d'Este 37, 20122 Milan, Italy; or call +39 0258317850; or fax +39 0258321266: or e-mail esomi@tin.it

Radiation oncology

November 11-14, 2000

The 10th International Brachytherapy Conference will be offered in Madrid, Spain.

E-mail congress@nucletron.nl

Paediatric oncology

November 12-18, 2000

The training course under the auspices of the International Society of Paediatric Oncology will be held in Chandigahr, India.

Contact P.A. Voute, call +31 20 5665655; or fax +31 20 6912231

Paediatric oncology

November 16-20, 2000

The training course under the auspices of the International Society of Paediatric Oncology will be held in Sao Paulo, Brazil.

Contact P.A. Voute, call +31 20 5665655; or fax +31 20 6912231

Medical physics

November 20-22, 2000

The Topical Meeting on Physics and Engineering will be offered in Lisbon, Portugal.

See Internet http://www.newton.itn.pt/itn/Meetings/MeRPE/default.html

Radiotherapy

November 23-24, 2000

The Kiel Teaching Course on Prostate Cancer Brachytherapy (LDR and HDR) will take place in Kiel, Germany.

E-mail kovacs@onco.uni-kiel.de

Radiation oncology

November 23-24, 2000

The 11th SFRO Meeting be offered in Paris, France.

Contact SOCFI, 14 rue Mandar, 75002 Paris, France; or call +33 1 44 882 525; or fax +33 1 40 260 444.

Neck surgery

November 27-29, 2000

The ESO master course will take place in Milan, Italy.

Contact ESO Office, Viale Beatrice d'Este 37, 20122 Milan, Italy; or call +39 0258317850; or fax +39 0258321266: or e-mail esomi@tin.it

Organising secretariat: P. Lonati; phone +39 0257 489 490; fax + 39 0257 589 491; e-mail head&neck@ieo.it

Pediatric oncology

November 30 - December 2, 2000

The ESO conference will take place in Rome, Italy.

Contact ESO Office, Viale Beatrice d'Este 37, 20122 Milan, Italy; or call +39 0258317850; or fax +39 0258321266: or e-mail esomi@tin.it

Oncology

December 4-8, 2000

The "World Assembly on Tobacco Counters Health WATCH-2000" will take place in New Delhi, India.

Contact Vimal Arora Conference Secretariat, WATCH 2000, 509-B, Sarita Vihar, New Delhi-110044, India; or call +91 11 694 4551; or fax +91 11 694 4472; or e-mail varora@ndf.vsnl.net.in ; or see Internet http://www.watch-2000.org

Radiation morbidity

December 10-12, 2000

The ESTRO workshop on radiation morbidity will be held in Brussels, Belgium.

Contact ESTRO office, Av. E. Mounier, 83/4, B-1200 Brussels, Belgium; or call +32 7759340; or fax +32 2 7795494; or e-mail info@estro.be; or see Internet http://www.estro.be

As a service to our readers, notices of meetings or courses will be inserted free of charge.

Please sent information to the Editorial office, Radiology and Oncology, Vrazov trg 4, SI-1000 Ljubljana, Slovenia.

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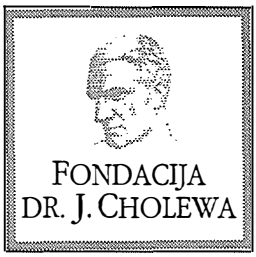

Activity of "Dr. J. Cholewa" Foundation for Cancer Research and Education - A Report for the First Quarter of 2000

The activity of the Foundation in the year 1999 was finally assessed in the first weeks of the year 2000. It was agreed that in general it is becoming increasingly difficult to entice individuals and other business subjects to contribute to the special type of charities, as is the activity of the "Dr. J. Cholewa" Foundation. Fortunately, there are some of the donors from Slovenia and abroad who tirelessly continue to try to support it, and the members of the Foundation and its Executive and Supervisory Committees feel obliged to express their gratitude to all who understand the importance of its goals and activities to reach them.

The summary of the activities of the Foundation in the year 1999 makes a complex and interesting reading. The Foundation helped to finance the Annual Conference of the International Breast Cancer Study Group in Bled, Slovenia; the International Conference on Cancer in Opatija, Croatia; and the Plečnik Memorial Meeting in Ljubljana, Slovenia. Furthermore, a public invitation for research grants in the field of oncology was published in "Dnevnik" and "Večer" daily newspapers in Slovenia, in "Radiology and Oncology" international oncology journal, published in Ljubljana, Slovenia, and in "ISIS", the journal of the Medical Chamber of Slovenia, Ljubljana, Slovenia. Surprisingly, the response to this invitation was rather lukewarm. It is planned the invitation will be publicly issued again this year with the aim to provide grants for MSc, PhD and post-doctoral studies. A "14th Oncological Weekend" meeting with the themes concerning lung and thyroid cancers was also organised with the help of the Foundation, and the Proceedings of this meeting were published in a special publication. In addition, several grants for participation on various international congresses and symposia were provided for the applicants from Ljubljana and different regions of Slovenia.

The Foundation continued to support the regular publication of "Radiology and Oncology" international scientific journal, and the regular publication of the "Challenge ESO Newsletter" in 1999. Both medical journals are edited, published and printed in Ljubljana, Slovenia. In the past year the Foundation also contributed support for the publication of the Slovenian Dictionary of Medical Terminology, and for the Proceedings of two meetings organised by the Nursing Association of Slovenia, and dedicated to the problems in oncology.

The Foundation will in the year 2000 strive to concentrate its activities to further facilitate the access to oncology research and education to as many interested individuals and institutions in the various regions of Slovenia as possible. Several new approaches and ways to achieve the enhancement of the knowledge in cancer prevention and early detection all over the country will have to be evaluated. In addition, special attention will be given to the requests coming from the regions of Slovenia outside Ljubljana to provide grants for the participation of Slovenian oncologists and others on various educational meetings in the country and abroad.

On behalf of the Foundation a special award was presented to Mr. Miloš Kovačič, MSc, one of its founding members and a long-time supporter of its activity. Mr. Kovačič is the director of the "KRKA" pharmaceutical company, and as such is a well known and highly respected personality in Slovenia and one of its foremost business leaders. It is safe to say that his activity in the pharmaceutical industry in Slovenia and its branches elsewhere represents an essential part of its success. His support and help in the functioning of the Foundation are therefore extremely valuable and should be viewed in the context of his precious time and high level day-to-day responsibilities.

On the more sombre note, the Foundation gravely feels the loss of Dr Srečko Rainer, Professor of gynaecology at the Medical Faculty of the University of Ljubljana. Professor Rainer was one of the founding members of the Foundation and was always ready to help in improving the quality of its activities. His sharp mind and wit will be greatly missed.

Andrej Plesničar, MD
Tomaž Benulič, MD
Borut Štabuc, MD, PhD

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Portorož, 19. - 21. oktober 2000

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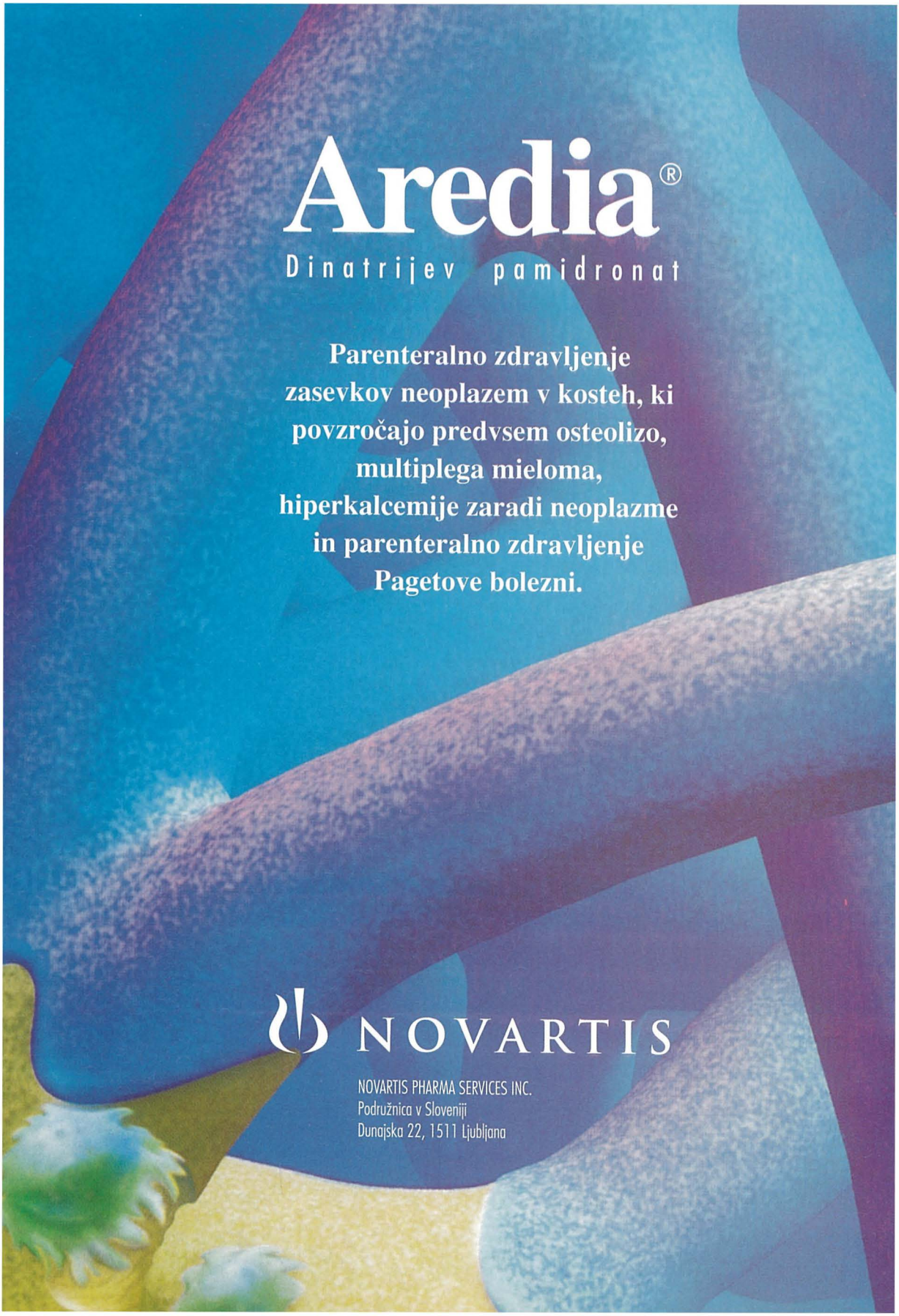
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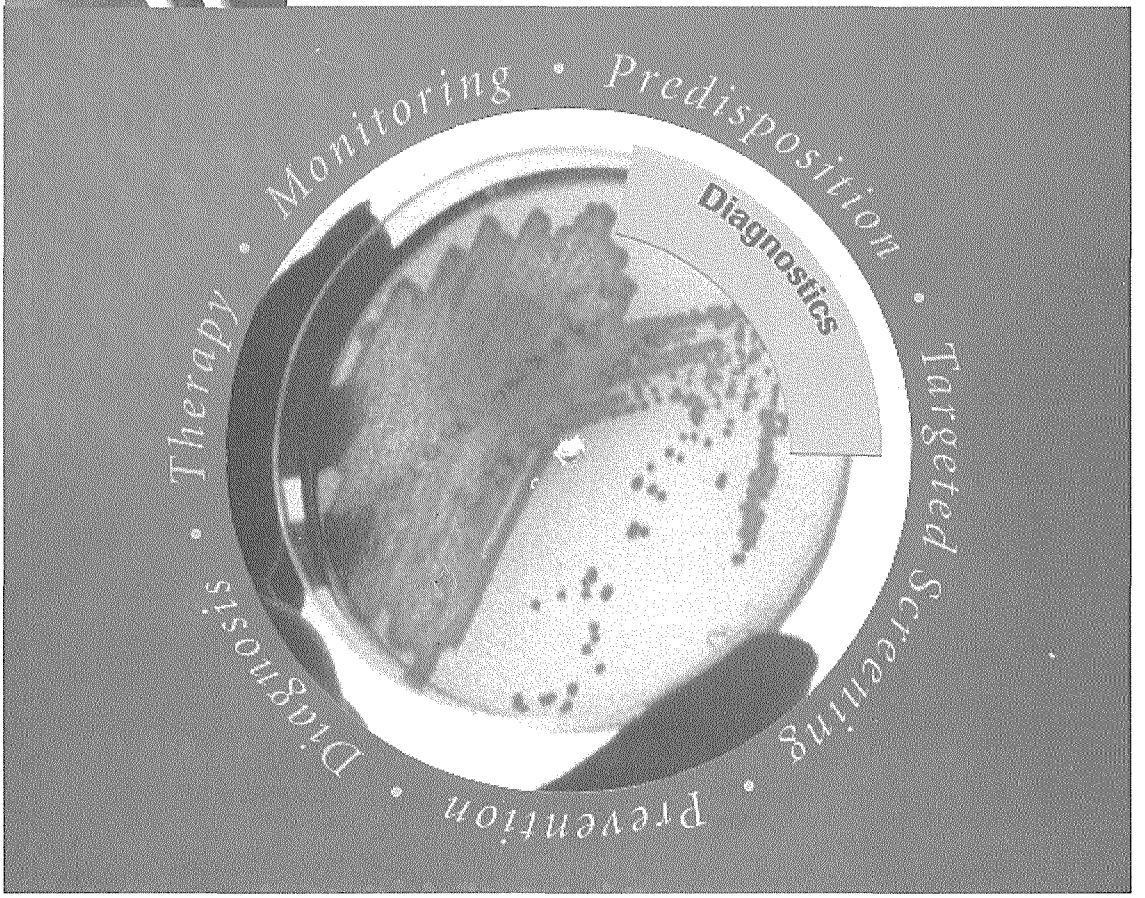

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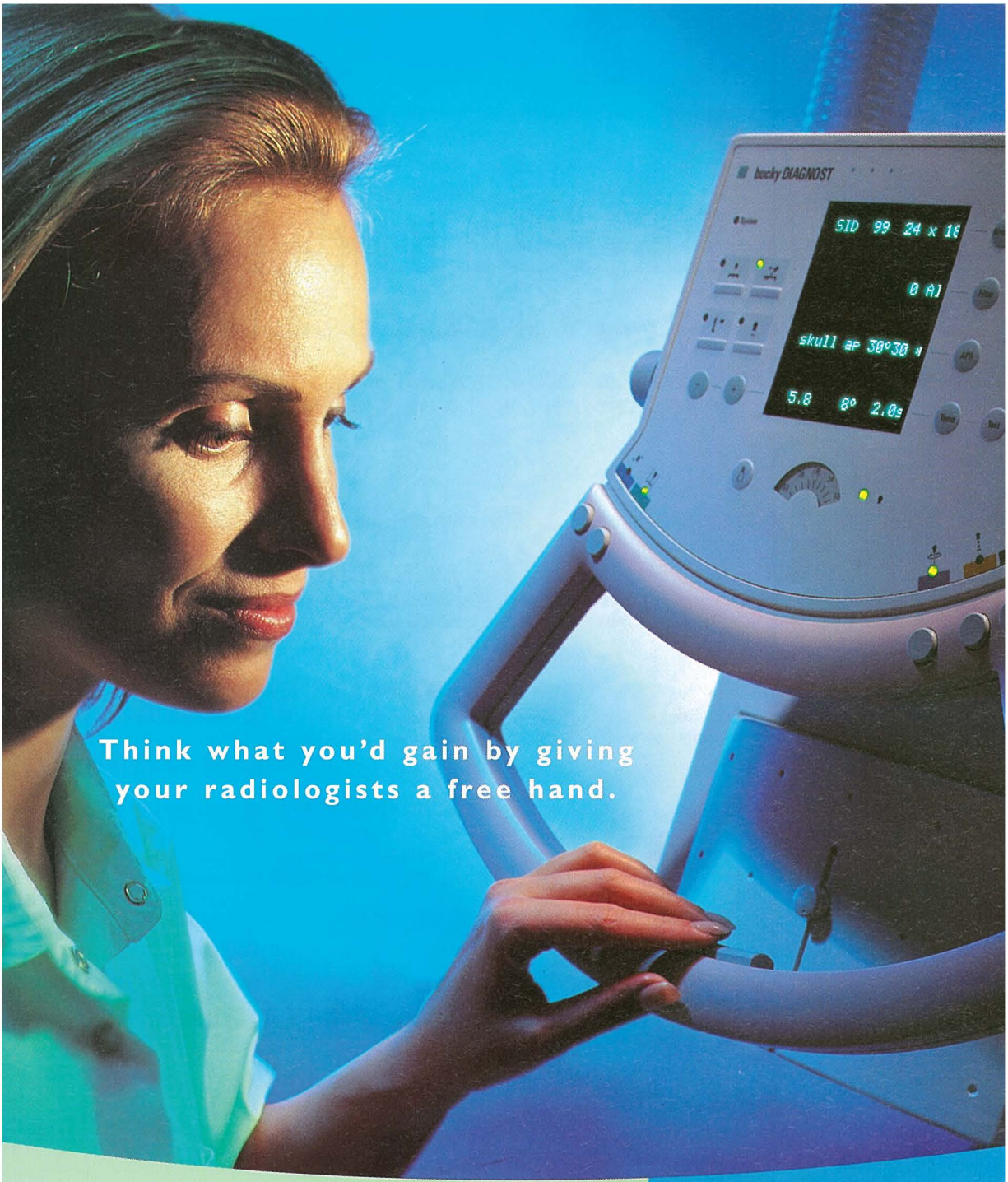

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Manuscript written in English should be submitted to the Editorial Office in triplicate (the original and two copies), including the illustrations: *Radiology and Oncology*, Institute of Oncology, Vrazov trg 4, SI-1000 Ljubljana, Slovenia; (Phone: +386 61 132 00 68, Tel./Fax: +386 61 133 74 10, E-mail: gsersa@onko-i.si). Authors are also asked to submit their manuscripts on a 3.5" 1.44 Mb formatted diskette. The type of computer and word-processing package should be specified (Word for Windows is preferred).

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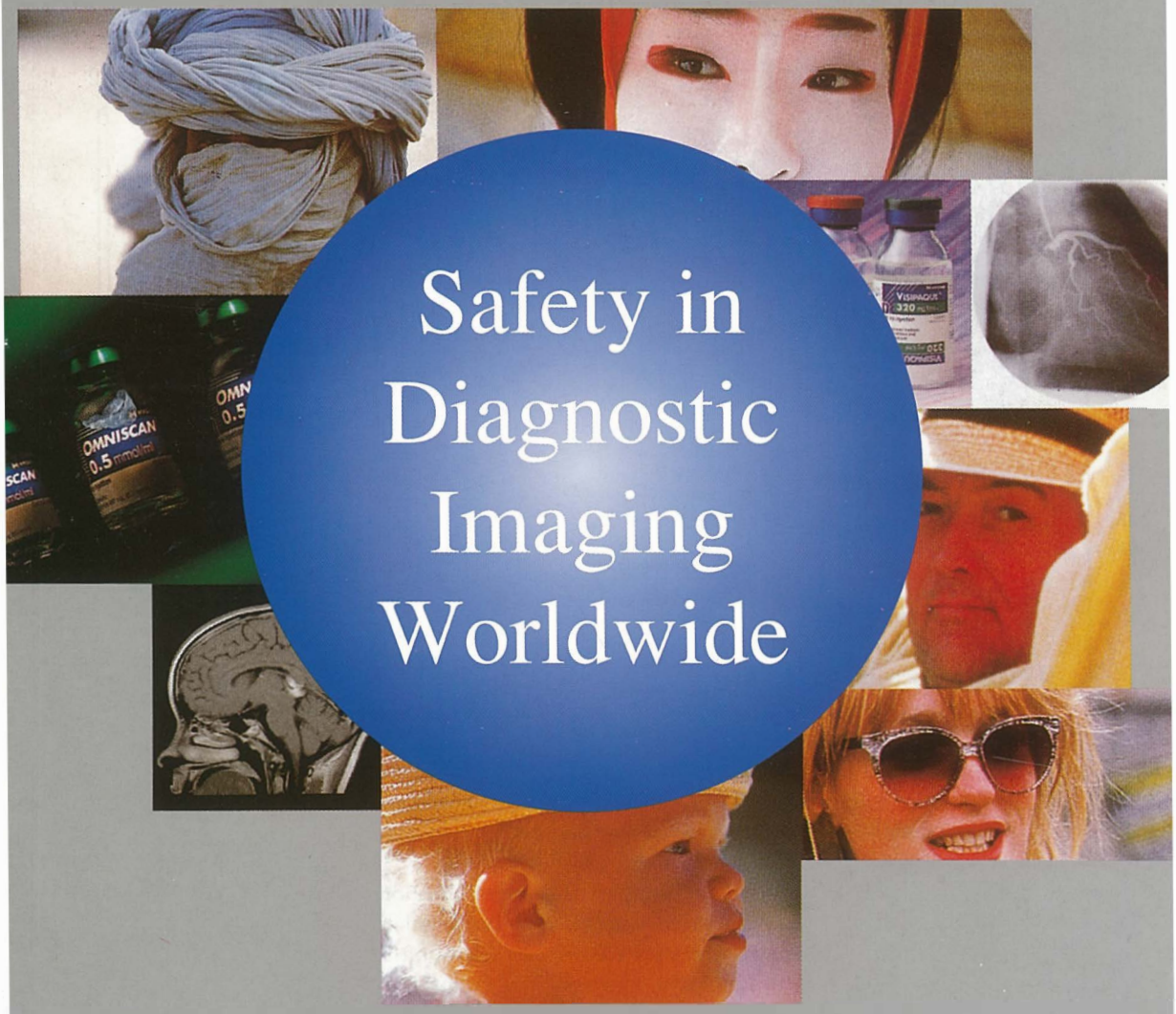

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