UDC 616-006(05)(497.1) CODEN RDIUA 4 YU ISSN 0485-893X

RADIOLOGIA IUGOSLAVICA

ANNO 24 1990 FASC 3

PROPRIETARII IDEMQUE EDITORES: SOCIETAS RADIOLOGORUM IUGOSLAVIAE AC SOCIETAS MEDICINAE NUCLEARIS IN FOEDERATIONE SOCIALISTICA REI PUBLICAE IUGOSLAVIAE

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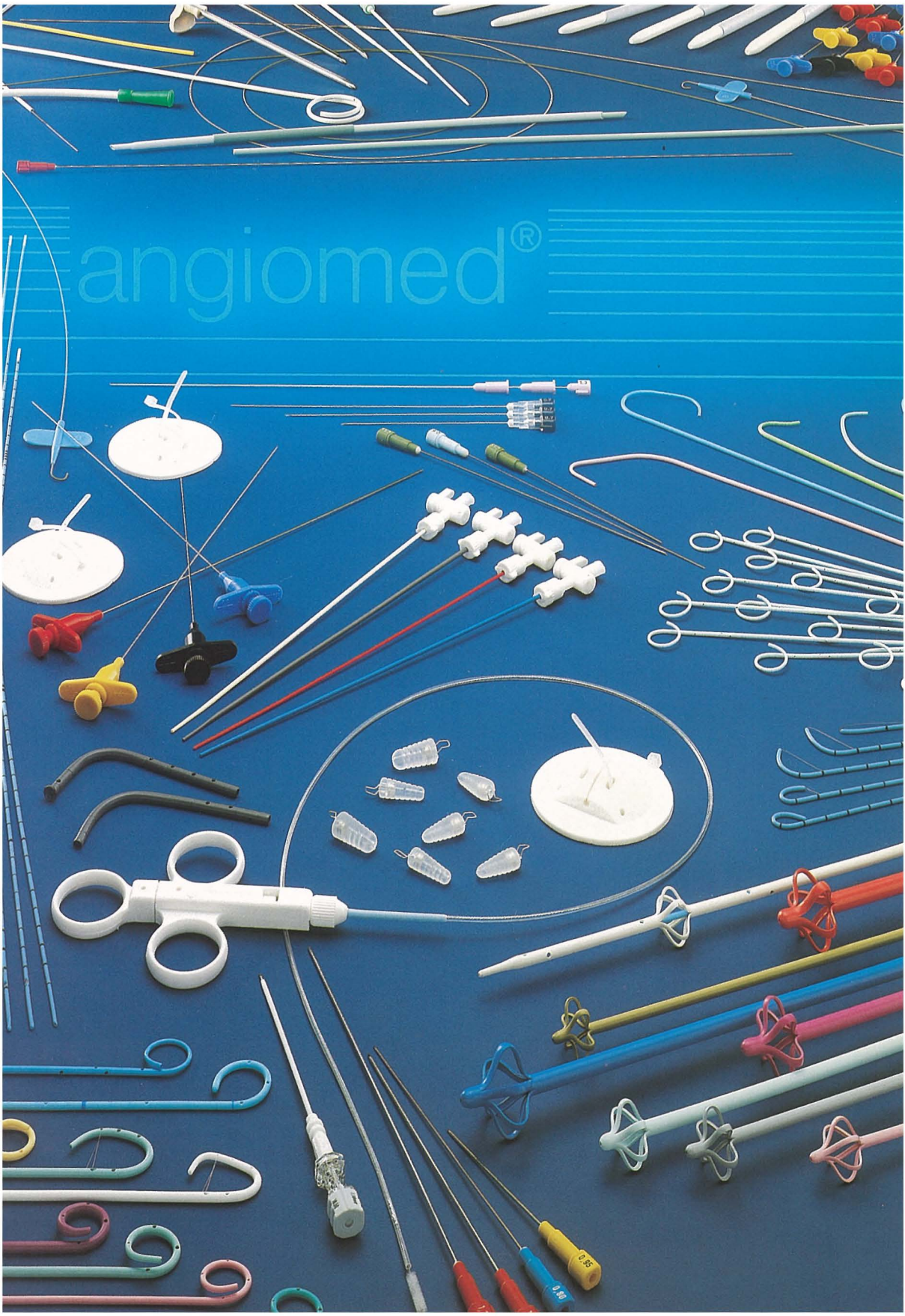
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Revija za rendgendijagnostiku, radioterapiju, onkologiju, nuklearnu medicinu, radiofiziku, radiobiologiju i zaštitu od ionizantnog zračenja – The review for radiology, radiotherapy, oncology, nuclear medicine, radiophysics, radiobiology and radiation protection.

Izdavači – Publishers:

Udruženje za radiologiju Jugoslavije i/and Udruženje za nuklearnu medicinu Jugoslavije

UDC i/and Key words:

mag. dr. Klemenčić Eva, Inštitut za biomedicinsko informatiko, Medicinska fakulteta, Univerza v Ljubljani

Tajnica redakcije – Secretary:

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Adresa redakcije – Address of Editorial Board:
Radiologia Iugoslavica

Onkološki inštitut, Zaloška cesta 2, 61000 Ljubljana
Telefon: 061/327 955 – Phone: 061/327 955

Izlazi četiri puta godišnje – Published quarterly:

Pretplata – za ustanove 1000 din, za pojedince 250 din.
Subscription rate – for institution 80 US $, individual 40 US $.
Primerak – za ustanove 300 din, za pojedince 80 din.
Single issue – for institutions 30 US $, individual 20 US $.

Broj čekovnog računa – Bank account number: 50101-678-48454
Broj deviznog računa – Foreign currency account number: 50100-620-010-257300-5180/6

LB – Gospodarska banka – Ljubljana

Reviju indeksiraju i/ili abstrahiraju – Indexed and/or abstracted by:

BIOMEDICINA IUGOSLAVICA, R.R. BOWKER ULRICH'S INTERNAT. PERIOD. DIRECTORY, CHEMICAL ABSTRACTS, EXCERPTA MEDICA, MEDICO INFORMATIONDIENSTE GmbH, PHYSICS IN MEDICINE AND BIOLOGY, SOVJETSKIJ INFORMATIVNYJ ŽURNAL

For reprint information in North America contact:
International reprint Corporation 968 Admiral Callaghan Lane, # 268
P.O. Box 12004, Vallejo, CA 94590, Tel. (707) 553-9230, Fax: (707) 552-9524.

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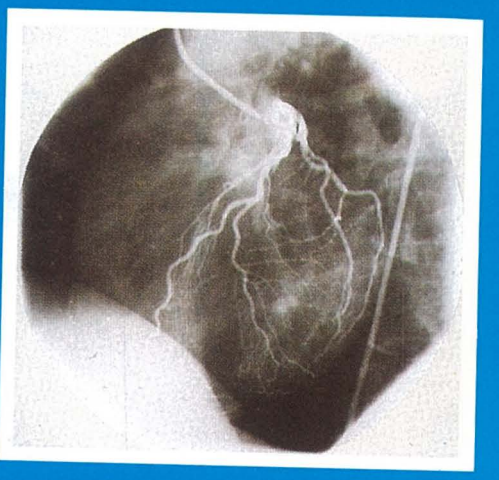

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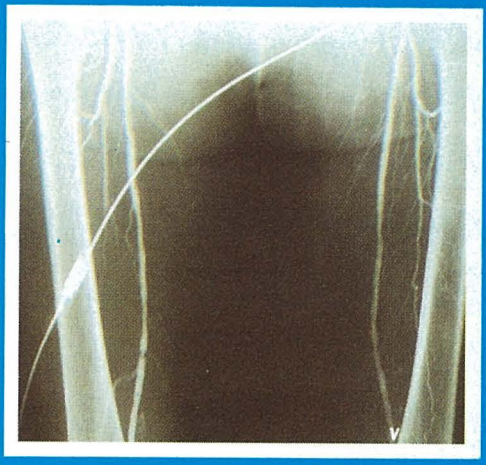

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UDC 616-006 (05) (497.1) CODEN RDIUA 4 YU ISSN 0485-893X

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ANNO 24 1990 FASC. 3

SADRŽAJ/CONTENTS

Radiološka dijagnostika – Radiological diagnostic

Radiološki prikaz trupa petog lumbalnog kralješka
Radiologic presentation of the fifth lumbar vertebra body (orig sci paper)
Miladinović K, Šećerov D, Željo-Kulenović A 209

Duplikacija žučnog mjehura
Duplication of the gall-bladder (case report)
Zamberlin R, Šmolčić S, Bedek D 215

Divertikuli rektuma
Diverticula of the rectum (case report)
Frković M, Mandić A 219

Karlica Otto-Chrobak
Otto-Chrobak pelvis (review article)
Goldner B, Dodić M, Penev B 223

Ohronoza i kalcifikati u zglobnim hrskavicima
Ochronosis and calcifications within the cartilages of the joints (case report)
Presečki V, Mihordin N 227

Iz prakse za prakso – Prikaz primera
From practice for practice – Case report (case report)
Us J 231

CT i UZ – CT and US

Approach to the stereoscopic visualisation of the real-time ultrasound images (preliminary report)
Kurbel S, Dičić M 233

Neurofibrom perikarda – Prikaz slučaja
Pericardial neurofibroma – Case report (case report)
Dalagija F, Najdanović M, Bukša M, Bešlić Š, Spasojević S 237

Nuklearna medicina – Nuclear medicine

^{99m}Tc uptake in thyroid; pinhole collimator nonuniformity correction (orig sci paper)
Lončarić S, Samaržija M, Popović S, Težak S 241

Lung scan interpretation – Comparison of different criteria (orig sci paper)
Budihna N, Milčinski M, Šuštaršič J, Grmek M, Grošelj C, Porenta M 245

^{131}I-MIBG body retention in a case of neuroblastoma – Case report (case report)
Maštrović Z, Kasal B, Ivančević V, Bajc M, Ivančević D 249

Onkologija – Oncology

Liver metastases from colorectal cancer; the impact of primary tumor removal on survival (orig sci paper)
Snoj M, Lukić F 253

Radiol Iugosl July–September, 1990; 24:203-311

Circulating Ca 15-3 and CEA values in monitoring patients with breast cancer (orig sci paper)
Vrbanec D, Cvrtila D, Bolanča A 257

Testing of the valve for controlling the excretion of faeces and stomatherapy in the experiment on dogs (orig sci paper)
Košorok P 261

Radioterapija – Radiotherapy

High dose rate Ir-192 implants in the treatment of cancer of the vocal cord (orig sci paper)
Hammer J, Hochleitner F, Seewald DH, Meindl J, Labeck W 269

Radiotherapy following quadrantectomy in stage T_1–T_2 breast cancer (orig sci paper)
Roncadin M, Candiani E, Arcicasa M, Bortolus R, Innocente R, De Paoli A, Franchin G, Trovò MG, Bassignano G, Rossi C 276

Preliminary report on radiotherapy in stage III ovarian cancer pretreated by surgery and chemotherapy (orig sci paper)
Arian-Schad KS, Hackl A, Juettner FM, Lahousen M, Pickel H 277

Treatment of the malignant germ cell tumor (orig sci paper)
Clemm Ch, Salat Ch, Ehrhart H, Wilmanns W 283

Radiofizika i zaštita – Radiofisics and protection

Local dosimetric functions and lung correction factor under ^{60}Co TBI (orig sci paper)
Vrtar M 289

^{192}Ir implantat u radioterapiji anorektalnog karcinoma: dozimetrija
^{192}Ir implant in the anorectal carcinoma radiotherapy: the dosimetry (profess paper)
Lokner V, Pokrajac B, Lokner P 297

Humic acids – Model molecules for monitoring the degree of environmental pollution (orig sci paper)
Huljev D 303

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MEDICINSKI FAKULTET SARAJEVO
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RADIOLOŠKI PRIKAZ TRUPA PETOG LUMBALNOG KRALJEŠKA

RADIOLOGIC PRESENTATION OF THE FIFTH LUMBAR VERTEBRA BODY

Miladinović K, Šećerov D, Željo-Kulenović A.

Abstract – Precise marking of the fifth lumbar vertebrae body on tomograms allows exact distinguishing of normal appearance of this part of lumbosacral dynamic segment from an affected one. Therefore, we made marking of this segment on lateral tomograms (»scout view«) in an attempt to obtain exact numerical information of its appearance.
We analysed 68 tomograms of 68 patients who were divided in two groups. Twenty-six patients had normal lumbosacral segment, without any pathologic process, and 42 patients had pathologic process on this segment. The most frequent condition was discus hernia (61%).
Analysing the pooled data, we obtained numerical information on apperance the of the fifth lumbar vertabrae body. Normal appearance of corpus of fifth lumbar vertebrae showed tendency to wedged shape. Comparing this shape between two groupes of patients, we noticed higher prevalance of wedged shape in the group of patients with pathologic processes. Significant differences showed parametars of posterior hight and inferior depth of the fifth lumbar vertebrae body on lateral tomograms. Positive Kaiser's sign was found in 20% of all examinated cases.

UDC:616.711.6-073.756.8

Key words:lumbar vertebrae-radiography, tomography

Orig sci paper

Radiol Iugosl 1990; 24:209-13.

Uvod – Varijabilni izgled trupa petog lumbalnog kralješka u domenu normalne anatomije kao i onaj čiji je izgled izmijenjen patološkim procesima pokazat će promjene na radiogramima kompjuterizirane tomografije u smislu promjenjene visine i dubine ovog dijela L/S dinamskog segmenta. Utvrđivanje numeričke informacije o izgledu ovog dijela dinamskog segmenta na radiološkom materijalu, istraživanje obima individualnih varijacija, kao i njegovog oblika u smislu eventualnog prisustva kongenitalnih anomalija omogućit će vidjanje eventualne anatomske predispozicije za nastajanje nekih patoloških procesa.

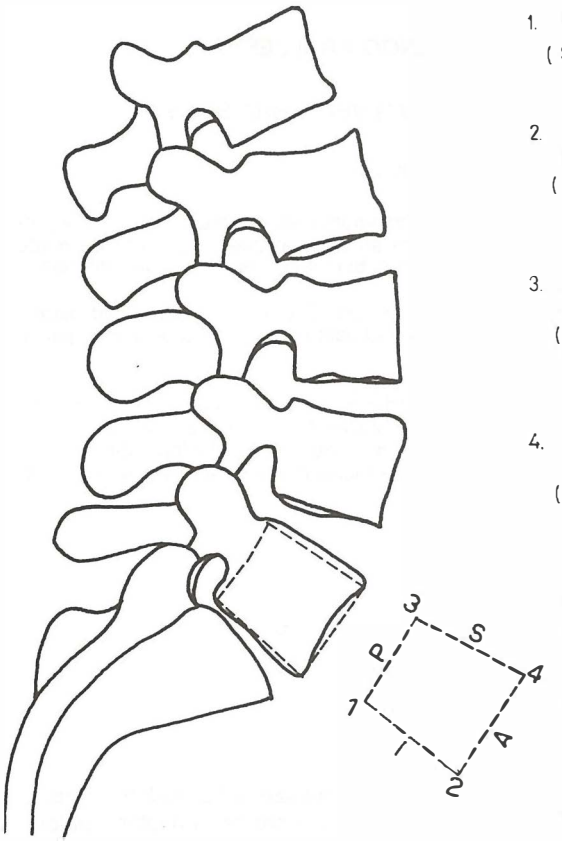
Upotrebom striktnog kriterijuma za postavljanje markera na radiogramima lumbalne kičme omogućila bi se reproducibilna mjerenja koja bi smanjila intra i interobservacijske greške.

Materijal i metode – Analizi je bilo podvrgnuto 68 tomograma pacijenata Instituta za radiologiju i onkologiju u Sarajevu, koji su pod uputnom dijagnozom došli na rendenografske i CT pretrage lumbalne kičme. Nakon obavljenog pregleda radiolog je dao dijagnozu na osnovu koje su ispitanici bili rangirani u dvije grupe. Od ukupno 68 ispitanika, 26 je nakon radiološke eksploracije imalo nalaze u fiziološkim granicama, tj. L/S segment je bio bez prisutnog patološkog procesa. Dakle, u ovoj grupi analizi je bilo podvrgnuto 26 tomograma. Druga grupa je obuhvatila 42 ispitanika sa prisutnim patološkim procesom na L/S dijelu kičmenog stuba. Od ovih ispitanika 8 je imalo deformirajuću spondilozu, 8 degenerativne promjene L/S segmenata, 13 diskus herniju L/S diskusa, 5 diskus herniju L_4/L_5 diskusa, a 8 diskus herniju i L_4/L_5 i L/S diskusa. 26 pacijenata je imalo diskus herniju, procentualno 61%.

Na početku snimanja uradi se lateralni tomogram (topogram) sa visokom rezolucijiom od 512 HE (Hounsfieldovih jedinica), što omogući vrlo dobru vizualizaciju. U novijoj literaturi ovakav radiogram nosi naziv »scout views«. Za vrijeme snimanja pacijent je u ležećem, ako je moguće, fiksiranom položaju.

Kriterijum za pozicioniranje markera je uzet iz Farfanove (2) metode. Markeri su postavljeni na ekstremnim anteriornim i posteriornim tačkama terminalnih ploha korpusa petog lumbalnog kralješka (shema 1). U statističkoj obradi i analizi podataka upotrebljeni su $\bar{x}$, $(SD)^2$, (SD), $(SD)\bar{x}$, t-test, koeficijent linearne korelacije (r) i x^2 (Hi kvadrat) test.

Received: May 18,1990 – Accepted: June 8,1990



Shema 1 – Markiranje trupa petog lumbalnog kralješka
Sheme 1 – Marking of the fifth lumbar vertebrae body

1. OBLIK PRAVOUGAONIKA
(SHAPE OF RECTANGLE)

2. UKLINJENI OBLIK SA GLAVOM KLINA PREMA NAPRIJED
(WEDGED SHAPE WITH HEAD OF WEDGE TURNED TOWARD FORWARD)

3. UKLINJENI OBLIK SA GLAVOM KLINA PREMA GORE
(WEDGED SHAPE WITH HEAD OF WEDGE TURNED TOWARD UP)

4. OBLIK SA DVOSTRUKOM UKLINJENOŠĆU
(DOUBLE WEDGED SHAPE)

Shema 2 – Oblici korpusa petog lumbalnog kralješka
Sheme 2 – The shapes of L_5 vertebrae body

Rezultati – Na osnovu vrijednosti parametara koje smo dobili konstatovali smo 4 vrste oblika korpusa petog lumbalnog kralješka (shema 2). Od 26 ispitanika bez patološkog procesa na L/S segmentu 15 je bilo sa oblikom 2 (58%), 9 sa oblikom 1 (38%) i dva sa oblikom 3 (4%). Sa oblikom 3(4%) su bila 2 ispitanika, oba u starijoj dobnoj skupini (preko 60 godina starosti).

Od 42 ispitanika sa prisutnim patološkim procesom na L/S segmentu 16 je bilo sa oblikom 2 (38%), 13 sa oblikom 1 (31%), 4 sa oblikom 3 (9%) i devet sa oblikom 4 (22%).

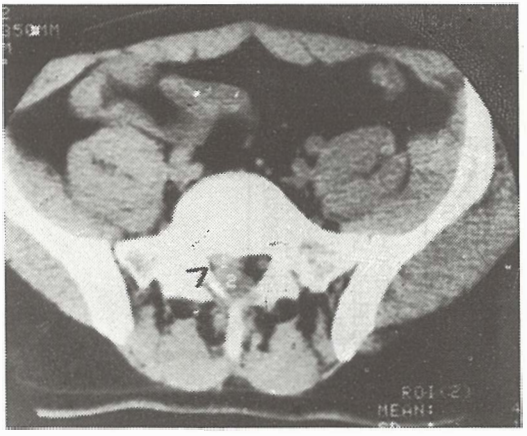
Analizirajući parametre koji su odredili oblik petog lumbalnog kralješka može se zaključiti da veličina parametra koji određuje posteriornu visinu trupa ovog kralješka igra veliku ulogu u formiranju njegovog oblika na lateralnim radiogramima. On je i pokazao signifikantne razlike na topogramima između grupa ispitanika. Njegova prosječna visina u grupi ispitanika bez patoloških procesa iznosila je 24,31 mm a u onoj sa patološkim procesom na L/S segmentu 22,44 mm. Razlika je iznosila 1,87 mm ($p<0,01$). To je bila vrijednost koja je odredila visoku signifikantnost razlika (tabela 1). Signifikantnu razliku u vrijednosti pokazao je i parametar koji je odredio inferiornu dubinu trupa L_5 kralješka. Njegova srednja vrijednost u grupi ispitanika bez patološkog procesa iznosila je 34,15 mm, a u grupi sa prisutnim patološkim procesom 32,63 mm.

U našem materijalu naišli smo na dva primjera lumbalizacije prvog sakralnog segmenta, jedan slučaj spondilolisteze, kao i na 8 slučajeva (oko 20% od ispitivanih slučajeva) defekta donjeg posteriornog ugla korpusa petog lumbalnog kralješka (»moljčev izjed«) koji su uputili na hernijaciju lumbosakralnog diskusa (slika 1, 2). Ova hernijacija je potvrđena u svim slučajevima na transverzalnim tomogramima.

Diskusija – Rezultati ovog istraživanja pokazju prevalenciju uklinjenog oblika kod ispitanika sa patološkim procesom. Dvostruko uklinjeni oblik je veoma karakterističan za ovu grupu ispitanika (22%), naročito kod onih sa degenerativnim promjenama. Također se češće pojavio i uklinjeni oblik sa glavom klinika okrenutom prema gore. Kod oba oblika je zajedničko da im je parametar koji određuje donju dubinu pršljenskog tijela manji. Signifikantne razlike između grupa ispitanika pokazao je i parametar koji definiše stražnju visinu trupa L_5 kralješka.

Witt (5) je našao da su degenerativne promjene češće uzrok bola nego prolabirani diskus

Slika 1 – Defekt donjeg posteriornog ugla korpusa L_5 kralješka
Fig. 1 – The law posterior angle defect of the fifth lumbar vertebrae corpus



Slika 2 – Hernija L/S diskusa
Fig. 2 – Hernia of L/S disc

i to na nivoima L_4/L_5 i L/S. Našao je i to da su slučajevi sa klinasto oblikovanim vertebralnim tijelima signifikantno frekventniji kod pacijenata mlađih od 40 godina starosti u grupi koja je imala bolove.

Iz biomehaničkog aspekta gledano ovi smanjeni parametri bi mogli poremetiti ravnotežu i disperziju sila u procesu prenošenja nošajne težine i na taj način više opteretiti segmente ispod sebe, intervertebralni diskus. U diskusu bi se tada stvorili uslovi za poremećenu nutriciju i nastanak degenerativnih promjena. Zbog toga bismo uklinjene oblike trupa petog lumbalnog kralješka mogli smatrati kao eventualne anatomske predispozicije za nastanak nekih patoloških procesa. CT generirani digitalni radiogram se uglavnom upotrebljava da selektira intervertebralni diskusni prostor koji treba biti ispitan, te da izabere stalni ugao za mjerodavni paralelizam presjeka i samog diskusa. Da su ovi, visoko rezoluirani, tzv. »scout views« radiogrami, generalno podcjenjeni kao dijagnostička slika, prikazao je na šest slučajeva Kaiser i sar. (3). Radilo se o novom radiološkom znaku discus herniae, koja je kasnije operativno bila potvrđena. Ovaj znak je indetificiran na visokoj rezoluciji »scout views« lumbalne kičme kao koštani defekt donjeg posteriornog ugla odgovarajućeg pršljena, i nađen je kao indikacija za postereiornu discus herniu. Najčešće se susreće na L_4/L_5 i L/S nivoima. Autori nisu mogli identificirati ovaj znak na konvencionalnim x-zračnim filmovima kod pacijenata gdje su topogrami (»scout views«) i aksijalni skenovi bili definitivno pozitivni. Stoga su zaključili da ista pojava može biti vizuelizirana standardnim radiogramima jedino u prisustvu velike rubne avulzije.

Gubitak zapremine diska pri ćemu dolazi do smanjenja njegovog vertikalnog promjera samo za 0,7 mm utiče na pojačano opterćenje u apofiznom zglobu, osobito kod osoba sa izraženom lordozom. Debevc (1) je primjetio da stopa opterećenja L/S diskusa ovisi o njegovoj inklinaciji koja uslovljava L/S lordozu. Ako je inklinacija veća manje je opterećenje diskusa.

Nagorni (4) je konstatovao da je »shear« naprezanje najveće na L/S segmentu, što je i objašnjenje za najčešće diskalne rupture kojima ne prethodi diskalna degeneracija. Diskalne rupture se mogu prevenisati povećanjem lumbalne lordoze.

Ovo su neka objašnjnja zašto se u našoj studiji susreće veća L/S lordoza kod ispitanika sa patološkim procesom. Odnosno, pošto je ravnoteža vertebralnog dinamskog segmenta kod ovih ispitanika poremećena povećano je opterećenje na

Tabela 1 – Vrijednost parametra trupa petog lumbalnog kralješnjaka na laterarnim tomogramima

Tabela 1 – Value of the fifth lumbar body parameters on lateral tomograms

ISPITIVNI PARAMETRI KOMPJUTERIZIRANE TOMOGRAFIJE (EXAMINATED PARAMETARS OF CT)	GRUPE ISPITANIKA (PATIENT'S GROUPES)	STATISTIČKI PARAMETRI (STATISTICAL PARAMETARS)				VRIJEDNOST t-TESTA I SIGNIFIKANTNOST RAZLIKA IZMEĐU GRUPA ISPITANIKA (VALUES OF t-TEST AND SIGNIFICANT DIFFERENCES BETWEN GROUPES OF PATIENTS
		BROJ ISPITANIKA (NUMBER OF PATIENTS) n	ARITMETIČKA SREDINA (MM) (ARITHMETIC MEAN (MM) $\bar{x}$	STANDARDNA DEVIJACIJA (STANDARD DEVIATION) σ	STANDARDNA GREŠKA (STANDARD ERROR) $\sigma_{\bar{x}}$	
ANTERIORNA VISINA TRUPA L_5 KRALJEŠKA (A) (ANTERIOR HEIGHT OF L_5 VERTEBRAE BODY (A))	SA PATOLOGIJOM (WITH PATHOLOGY)	42	26,88	2,82	0,44	$t = 2,0210$ RAZLIKE SU SIGNIFIKANTNE (DIFFERENCES ARE SIGNIFICANT) $(p<0,05)$
	BEZ PATOLOGIJE (WITHOUT PATHOLOGY)	26	25,58	2,14	0,42	
POSTERIORNA VISINA TRUPA L_5 KRALJEŠKA (P) (POSTERIOR HEIGHT OF L_5 VERTEBRAE BODY (P))	SA PATOLOGIJOM (WITH PATOLOGY)	41	22,44	2,81	0,44	$t = 2,8776$ RAZLIKE VISOKO SIGNIFIKANTNE (DIFFERENCES ARE HIGH SIGNIFICANT) $(p<0,01)$
	BEZ PATOLOGIJE (WITHOUT PATHOLOGY)	26	24,31	2,16	0,42	
SUPERIORNA DUBINA TRUPA L_5 KRALJEŠKA (S) (SUPERIOR DEPTH OF L_5 VERTEBRAE BODY (S))	SA PATOLOGIJOM (WITH PATHOLOGY)	42	34,45	2,80	0,43	$t = 0,3073$ RAZLIKE NISU SIGNIFIKANTNE (DIFFERENCES ARE NOT SIGNIFICANT)
	BEZ PATOLOGIJE (WITHOUT PATHOLOGY)	26	34,23	3,02	0,59	
INFERIORNA DUBINA TRUPA L_5 KRALJEŠKA (I) (INFERIOR DEPTH OF L_5 VERTEBRAE BODY (I))	SA PATOLOGIJOM (WITH PATHOLOGY)	41	32,63	3,36	0,52	$t = 1,7112$ RAZLIKE NISU SIGNIFIKANTNE ZA $p<0,05$ ALI SU SIGNIFIKANTNE ZA $p<0,10$ $(0,053<p<30,10)$ (DIFFERENCES ARE NOT SIGNIFICANT FOR $p<0,05$ BUT ARE FOR $p<0,10$)
	BEZ PATOLOGIJE (WITHOUT PATHOLOGY)	26	34,15	3,83	0,75	

sam diskus. Kompenzacionom lordozom ovakvi ispitanici će nastojati da smanje taj pritisak dovodeći L/S diskus u veću inklinaciju.

Zaključak– Striktno markiranje trupa petog lumbalnog kralješka na laterarnim tomogramima pokazalo je signifikantne razlike u veličini pojedinih parametara koji definišu izgled ovog dijela dinamskog segmenta i tako omogućilo egzaktnije razlike izgleda normalnog i aficiranog trupa petog lumbalnog kralješka. Uočila se prevalencija uklinjenog oblika kod ispitanika sa patološkim procesom. Dvostruko uklinjeni oblik je veoma karakterističan za ovu grupu (22%), naročito kod onih sa degenerativnim promjenama. Signifikantne razlike u vrijednosti između grupa ispitanika pokazali su parametri koji su odredili posteriornu visinu trupa petog lumbalnog kralješka i njegovu inferiornu dubinu. Kaiserov znak je nađen u 20% od ispitivnih slučajeva, a u svim slučajevima je potvrđena L/S discus hernia na transverzalnim tomogramima.

Sažetak

Striktno markiranje korpusa petog lumbalnog kralješka na tomogramima dozvoljava egzaktnu komparaciju normalnog izgleda ovog dijela L/S dinamskog segmenta od onog koji je aficiran. Zbog toga smo mi u ovoj studiji markirali ovaj segment na lateralnim tomogramima (topogramima) u cilju dobivanja tačne numeričke informacije o njegovom izgledu. Analizirano je 68 tomograma 68 pacijenata koji su bili podijeljeni u dvije grupe. 26 ispitanika je imalo normalni lumbosakralni segment, bez ikakvog patološkog procesa na njemu, a 42 ispitanika je imalo patološki proces na ovom segmentu. Najzastupljenija patologija je bila discus hernia (61%). Nakon statističke obrade podataka dobili smo numeričku informaciju o izgledu tijela petog lumbalnog kralješka. Normalni izgled trupa petog lumbalnog kralješka pokazao je tendenciju ka klinastom obliku. Upoređujući ovaj oblik između grupa ispitanika primjetili smo veću prevalenciju uklinjenog oblika u grupi ispitanika sa patološkim procesom. Signifikantne razlike u vrijednosti između grupa ispitanika pokazali su parametri koji su odredili posteriornu visinu trupa petog lumbalnog kralješka i njegovu inferiornu dubinu. Kaiserov znak je nađen u 20% od ispitvanih slučajeva, a u svim slučajevima je potvrđena L/S discus hernia na transverzalnim tomogramima.

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EUROPEAN SCHOOL OF ONCOLOGY
MILANO

INSTITUTE OF ONCOLOGY
LJUBLJANA

RARE TUMORS SYMPOSIUM:

BURKITT–LIKE LYMPHOMA IN CENTRAL EUROPE

OCTOBER 18–19th, 1990.

LJUBLJANA, JUGOSLAVIA

SCIENTIFIC PROGRAMME:

– EPIDEMIOLOGY AND VIROLOGY OF BURKITT–LIKE LYMPHOMA
– PATHOLOGY AND IMMUNOLOGY OF BURKITT–LIKE LYMPHOMA
– SYMPTOMATOLOGY AND DIAGNOSTICS OF BURKITT–LIKE LYPHOMA
– SPECIAL LECTURE: IMMUNITY IN MALIGNANCIES
– POSTER PRESENTATIONS AND A SERIES OF SHORT LECTURES FROM INSTITUTIONS, CLINICS AND WORKING GROUPS WITH EXPERIENCE IN DIAGNOSTICS AND TREATMENT OF BURKITT–LIKE LYMPHOMA
– CLOSING LECTURE: PRESENT STATUS AND TREATMENT OF BURKITT LIKE LYMPHOMA

Information and registration: BLL Organizing Committee, Ms. Olga Shrestha, Institute of Oncology, Zaloška 2, 61000 Ljubljana, Yugoslavia. Tel 061–327 955

KLINIČKA BOLNICA »DR M STOJANOVIĆ«, ZAGREB
ZAVOD ZA RADIOLOGIJU I ONKOLOGIJU

DUPLIKACIJA ŽUČNOG MJEHURA

DUPLICATION OF THE GALL–BLADDER

Zamberlin R, Smolčić S, Bedek D

Abstract – The authors report on a new case of gall-bladder duplication and their experiences in the diagnosis of gall-bladder anomalies (double gall-bladder and duplication) so far. The double gall-bladder anomalies and duplications were researched at our institution from June 1951 to June 1988. In that period 39000 patients were examined. Totally, 16 anomalies of the gall-bladder were diagnosed (10 double gall-bladders and 6 duplications), i. e. 1 per 2500, or 0.04%. In the literature the rate of 1 per 4000, or 0.02% is stated.
The data show that the frequency of these anomalies is twice as large as that described by other authors.

UDC: 616.366–007.256

Key words: gallbladder-abnormalities

Case report

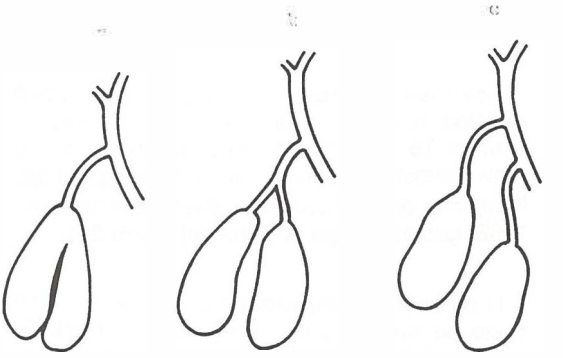
Radiol Iugosl 1990; 24:215-7.

Uvod – Anomalije dvostrukog žučnog mjehura i duplikacije su rijetke kongenitalne anomalije kod ljudi. Prvu duplikaciju žučnog mjehura opisao je Plinije 31. godine prije naše ere, a holecistografski ju je dijagnosticirao i opisao Climan 1929. godine. 1956. godine Antoine sa suradnicima opisuje 97 slučajeva, a najnoviji podaci u stranoj literaturi spominju 150 slučajeva dvostrukih holecista (1,2,3).

Patoanatomske i kirurške statistike utvrđenih dvostrukih žučnih mjehura su znatno skromnije od gore spomenutih zbirnih podataka, i iznose svega 32 slučaja ove anomalije.

U našoj litetaturi malo je pisano o ovim anomalijama. Naš patolog Knežević je na 22 – godišnjem patoanatomskom materijalu opisao svega jedan slučaj. 1960. godine Softić u statističkoj obradi anomalija žučnog mjehura navodi dva slučaja dvostruke holeciste (4). Do ovog najnovijeg slučaja na našem Zavodu je do sada dijagnosticirano ukupno 15 slučajeva ovih anomalija (2,3).

Disproporcije u zbirnim te patoanatomskim i kirurškim statistikama dosad objavljenih slučajeva uvjetovane su neslaganjem autora u nazivu anomalija. Boyden duplikaciju žučnog mjehura svrstava u dvostruke holeciste i dijeli ih u tri skupine (slika 1).

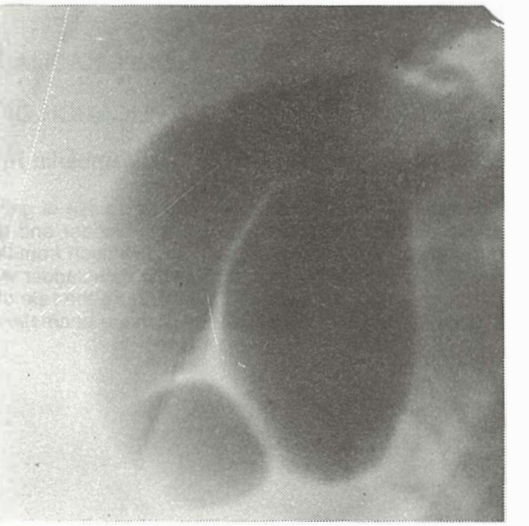


Slika 1 – Duplikacije žučnog mjehura prema Boydenu
a – Duplikacija žučnog mjehura – 1 cistikus
b – Dvostruki žučni mjehur – 2 cistikusa s spajaju u formi slova Y pred utjecanjem u holedokus
c – Dvostruki žučni mjehur – 2 cistikusa se odvojeno ulijevaju u holedokus u formi slova H

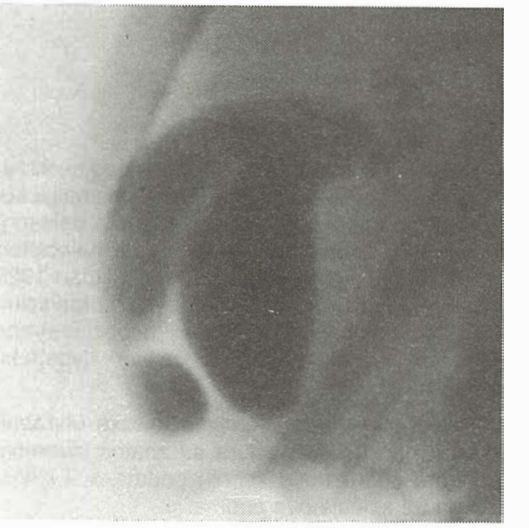
Fig. 1 – Gall–bladder duplication according to Boyden
a – Gall–bladder duplication – one cystic duct
b – Double gall–bladder – two cystic ducts are forming Y before pouring into the bile duct
c – Double gall–bladder – two cystic ducts pourig into the bile duct separately, forming H

Received: December 16, 1988 – Accepted: March 29, 1990

U skupinu a Boyden u dvostruku holecistu uključuje duplikaciju žučnog mjehura, gdje ne dolazi do kompletine podjele holeciste na dvije odvojene žučne vrećice. U ovim slučajevima žučni mjehur je podijeljen longitudinarnim septumom. Septum može zahvatiti samo fundus – parcijalna podjela – ili holecistu do njenog vrata – potpuna podjela –, u oba slučaja jedan cistikus se ulijeva u holedokus. Boyden razlikuje dvije vrste potpuno odvojenog žučnog mjehura: tip Y (slika 1b), kada se dva cistikusa spajaju poput slova Y pred utok u holedokus, i tip H (slika 1c), kod kojeg se cistikusi odvojeno ulijevaju u holedokus (1,2). Autori koji se ne slažu sa Boydenom (Ramberg, Katunarić) duplikaciju žučnog mjehura nazivaju holecista bilobata, duplikacija žučnog mjehura ili lažna dvostruka holecista, a kao prave dvostruke holeciste smatraju one gdje postoje dva potpuno odvojena žučna mjehura sa odvojenim cistikusima (2,3).



Materijal i metode – U tridesetsedmogodišnjem razdoblju izvršili smo 39000 pregleda što iznosi oko 1050 pregleda godišnje. Naša dijagnostika zasnivala se na rentgenskim metodama pretrage, peroralne holecistografije i intravenske i infuzijske holangioholecistografije. Pretrage smo radili kod odraslih osoba uz primjenu optimalnih položaja pacijenta sa slikanjem pod kontrolom TV – ekrana.

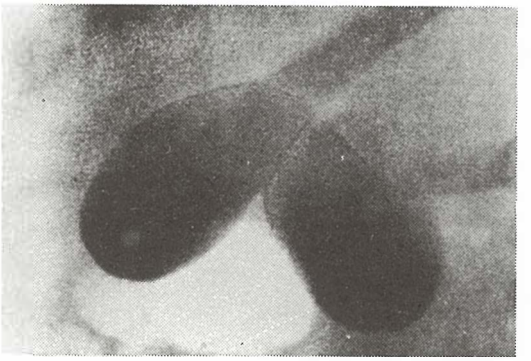


Slika 2 – Naš slučaj duplikacije žučnog mjehura
a – Žučni mjehur prije podražajnog obroka
b – Žučni mjehur nakon podražajnog obroka
Fig. 2 – Our case of gall–bladder duplication
a – Gall–bladder before excitatory meal
b – Gall–bladder after excitatory meal

Rezultati i diskusija – Napravljeno je 39000 radioloških pregleda bilijarnog trakta i nađeno ukupno 16 anomalija žučnog mjehura, i to 10 pravih dvostrukih žučnih mjehura i 6 duplikacija. Posljednji slučaj duplikacije dijagnosticirali smo 1988. godine i njega prikazujemo (slika 2a).

U opisanim anomalijama žučnog mjehura vrlo često se mogu naći konkrementi, a Alfredo je opisao slučaj sa nađenim parazitom oxiurisom (1,2). Stijenka žučnog mjehura kod ovih anomalija može biti obložena vapnom (porcelanski žučni mjehur), u pravilu kod ovih anomalija nalazimo i hipokinetsku diskineziju (slika 2b). Simptomatologija dvostruke holeciste ovisi o popratnim pojavama i eventualnim udruženim malformacijama. U diferencijalnoj dijagnozi dolaze u obzir divertikli žučnog mjehura, višestruki septumi, a ova anomalija se najčešće zamjenjuje sa presavijenim žučnim mjehurom (slika 3).

Zaključak – Dvostruke holeciste i duplikacije žučnog mjehura su vrlo rijetke anomalije kod čovjeka. Na našem Zavodu smo do sada dijagnosticirali ukupno 16 ovih anomalija, od toga 10 pravih dvostrukih žučnih mjehura i 6 duplikacija, što iznosi 0,04% s omjerom 1:2500 a što je



Slika 3 – Presavijenbi žučni mjehur koji imitira duplikaciju, a u kome se vidi manji konkrement
Fig. 3 – Bent gall–bladder that imitates duplication, with a minor gall–stone in it

skoro dvostruko više od statističkih podataka iznesenih u dostupnoj literaturi od 0,02% s omjerom 1:4000.

Dijagnostiku duplikacija i dvostrukog žučnog mjehura izvodili smo rentgenskim metodama pretrage, pregledanim i ciljanim snimkama u različitim položajima te tomografskom obradom.

Ove rijetke anomalije imaju kliničko i praktično značenje, jer su redovito popraćene ili predstavljaju podlogu za druge patološke promjene žučnog mjehura, diskinezije, konkremente, porcelanski žučni mjehur itd, a mogu biti udružene sa drugim kongenitalnim anomalijama.

Sažetak

Autori iznose novi slučaj duplikacije žučnog mjehura, te iskustva u dosadašnjoj dijagnostici anomalija žučnog mjehura (dvostruke holeciste i duplikacije). Anomalije dvostruke holeciste i duplikacije prate se na našem Zavodu od lipnja 1951. godine do lipnja 1988. godine. U tom razdoblju pregledano je 39000 pacijenata i dijagnosticirano ukupno 16 anomalija (10 dvostrukih žučnih mjehura i 6 dupliakcija), što iznosi 1 anomalija na 2500 pacijenata ili 0,04% a u literaturi je naveden podatak od 1 slučaj na 4000 pacijenata ili 0,02%.

Ovi podaci nam govore da su anomalije žučnog mjehura (dvostruke holeciste i duplikacije) skoro dvostruko učestalije kod pregledanih na našem Zavodu, nego u opisu drugih autora.

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II. SIMPOZIJ PEDIJATRIJSKE JUGOSLAVENSKE RADIOLOGIJE BEOGRAD, 2–3. XI 1990 god.

Obaveštavamo Vas, da će se u Beogradu održati u Institutu za majku i dete SR Srbije, Radoje Dakića 6, na Novom Beogradu 11070, sa početkom u 9,30^{h}, Simpozij čija je vodeća tema:

1. *DIGESTIVNI TRAKT NOVOROĐENE BEBE, PREDŠKOLSKOG I ŠKOLSKOG DETETA*
2. *Slobodne teme mogu obuhvatiti sva područja dečje radiologije u trajanju od 8 min.*
3. *DISKUSIJA OKO OKRUGLOG STOLA:*
   Kakav je kvalitet rendgenskog filma potreban da bi dete dobilo minimalnu zračnu dozu, kao i snimak dobrog kvaliteta?

Mole se učesnici da se za sve informacije obrate sekretaru Pedijatrijsko radiološke sekcije Jugoslavije (tel. 011-603-022, lok. 38, Doc. Dr Pravdoljub Komar, Dečja radiologija).

Sa kolegijalnim pozdravom
Predsednik Sekcije za Jugoslovensku pedijatrijsku radiologiju

Prof. Dr Nada Grivčeva–Janošević, dr med.

Sekretar Sekcije
Doc. Dr Pravdoljub Komar, dr med.

SPONZOR: EI NIŠ

KLINIČKI BOLNIČKI CENTAR – REBRO
MEDICINSKI FAKULTET U ZAGREBU
ZAVOD ZA RADIOLOGIJU

DIVERTIKULI REKTUMA

DIVERTICULA OF THE RECTUM

Frković M, Mandić A

Abstract – Rectal diverticula are rare. We have found them in three patients (0.95%) with diverticular disease of the colon. Rectal diverticula are not of great clinical importance, except in the cases when complicated with inflammation, perforation or malignant alteration. In such cases rectal diverticula can cause some differential diagnostic problems. Irigoradiography with double contrast is the diagnostic method of choice in the demonstration of rectal diverticula.

UDC: 616.351–007.64

Key words: diverticulosis colonic, rectal diseases

Case report

Radiol Iugosl 1990; 24:219-22.

Uvod – Iako prvi opisi divertikuloze kolona potječu od Littrea i Frienda (3) s početka 18. stoljeća, tek u zadnja tri desetljeća javljaju se prvi prikazi slučajeva rektalne divertikuloze (1,3,5,9). No, još uvijek neki autori (4,7) tvrde da se divertikuli rektuma nikad ne javljaju.

O etiologiji divertikula rektuma postoje različite pretpostavke. Smatra se da najvjerojatnije nastaju kao posljedica prirođene insuficijencije stijenke rektuma uz moguće dodatne činitelje, kao što su atrofija mišićnih dijelova stijenke, odsutnost potpornih struktura (coccigis), fokalno postupalno ili posttraumatsko slabljenje stijenke rektuma, nepravilnosti intraluminalnog tlaka (1,9).

Nalaz divertikula rektuma relativno je malog kliničkog značenja, izuzev ako se komplicira upalom, perforacijom ili mogućom malignom alteracijom. I tada su eventualne komplikacije manje rizične od komplikacija divertikula intraperitonealnih dijelova kolona. Jedini opis bolesnika s perforacijom divertikula rektuma dao je Kürten 1971. godine (2).

Metoda i bolesnici – U razdoblju od 1986. do 1989. godine metodom irigoradiografije s dvostrukim kontrastom pregledali smo 2292 bolesnika. Među njima identificirali smo 316 (13,8 %) bolesnika s divertikuloznom bolešću kolona, i to 159 (50,3 %) žena i 141 (49,7 %) muškaraca u dobi od 19 do 86 godina.

U troje (0,95 %) bolesnika s divertikuloznom bolešću kolona našli smo divertikule rektuma.

A.F., muškarac, 63 godine. Na irigoradiografiju je upućen zbog recidivirajućih, povremeno grčevitih bolova u donjem lijevom hemiabdomenu. Zbog duodenalnog ulkusa liječi se već 7 godina, a pati od kronične opstipacije. Oskudne tragove krvi u stolici primijetio je u dva navrata u skorije vrijeme. Na rektosigmoidoskopiji evidentirana je divertikulozna bolest, nema posebnog osvrta na divertikule rektuma. Pri irigoradiografiji prikazan je rektum u cijelosti uži, a na njegovoj ventralnoj i lijevoj lateralnoj konturi vide se kontrastom ispunjeni divertikuli promjera 25 do 30 mm (slika 1 a, 1 b). Brojni divertikuli, naznačeno suženje lumena, haustreole, vidljivi su u području sigme, a nekoliko divertikula veličine do 15 mm nalazi se i u proksimalnim dijelovima kolona.

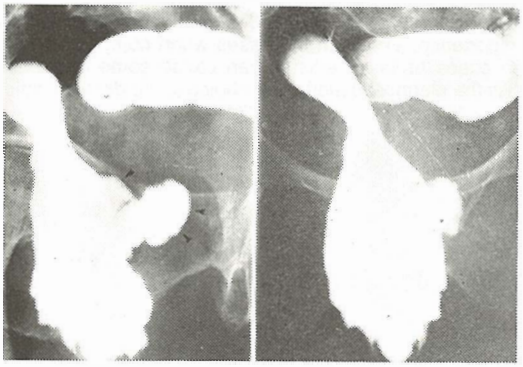
Ž.K., muškarac, 57 godina. U anamnezi nema simptoma za bolesti debelog crijeva. Na irigoradiografiju je upućen s ciljem da se nađe lokalizacija primarnog malignog procesa, budući da su ultrazvukom i kompjutoriziranom tomografijom jetre identificirani multipli hipoehogeni, odnosno

Received: March 29, 1990 – Accepted: June 1, 1990

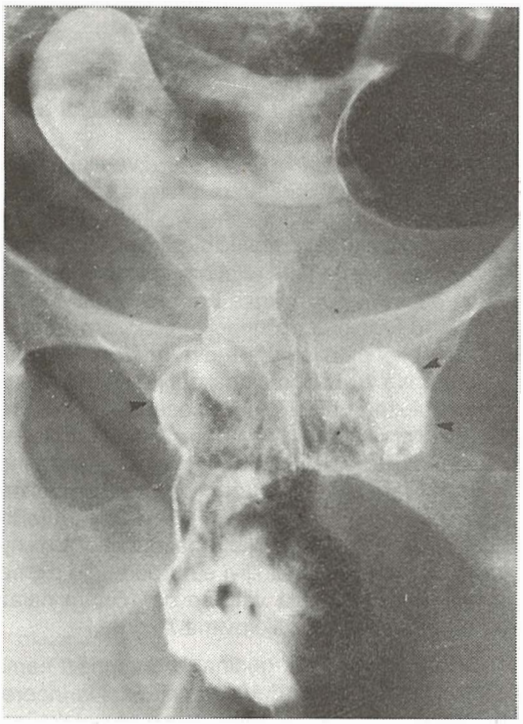
hopodenzni, žarišni procesi, metastaze.

Irigografskim pregledom evidentira se divertikulozna bolest sigme i prikaže divertikul na desnoj konturi rektuma veličine 15 mm (slika 2). Nije nađen maligni proces kolona.

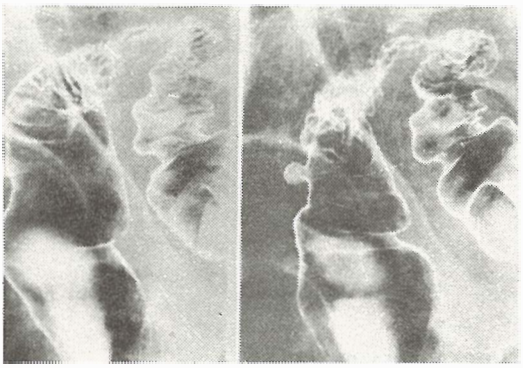
V.B., žena, 49 godina. Zbog upala dermoidnih cista sakralne regije operirana je 1977. i 1986. godine. U veljači 1989. godine operirana je zbog ciste desnog ovarija. Osam mjeseci potom dolazi zbog boli uz rektum, posebno intenzivnih prilikom



Slika 1 a – Pri pregledu bariievom kontrastnom klizmom prikazala su se dva rektalna divertikula
Fig 1 a – Barium enema film demonstrates two rectal diverticula



Slika 1 b – Divertikuli rektuma bolje se prikazuju metodom dvostrukog kontrasta
Fig 1 b – Rectal diverticula are beeter seen on double contrast films



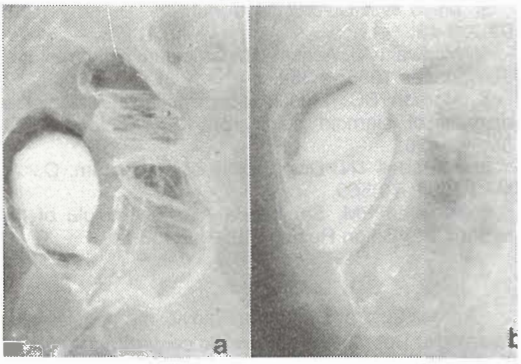
Slika 2 – Divertikul rektuma
Fig 2 – Diverticulum of the rectum

sjedenja uz povremene septične temperature. U fizikalnom nalazu dominira opsežno, inflamirano područje sakrokokcigealne regije s obilnom seropurulentnom sekrecijom. Digitorektalni je pregled bolan, a u Douglasovu prostoru pipa se tvorba veličine muške šake.

Na rendgenogramu sakrokokcigealnog segmenta kralješnice vidljiva je demineralizacija do gotovo potpunog brisanja koštane strukture kokcigisa. Kompjutorizirana tomografija opisuje cističnu ekspanziju ovarija koja imprimira rektum sprijeda (!).

Rektroskopski se na 2 cm od anokutane granice, na 12 sati, vidi otvor promjera 1 cm kroz koji se može ući u retrorektalnu cističnu šupljinu. Endoskopičar smatra da je ovaj nalaz posljedica jatrogene fenestracije retrorektalne ciste. Nema znakova upalne reakcije sluznice rektuma (!?). Irigografski je nalaz impresivan. Neposredno iznad analnog kanala, kroz vrat širine oko 2 cm u kojem se prate sluznički nabori, kontrastnom klizmom puni se orijaški divertikul, promjera oko 7 cm. On je utisnut u retrorektalnom prostoru i rektum potiskuje ventralno. Konture su divertikula pravilne, a njegova se veličina mijenja pri promjeni intraabdominalnog tlaka (slika 3 a, b).

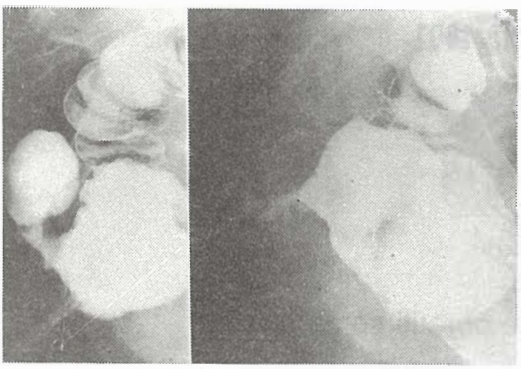
Zbog neadekvatnog odgovora na konzervativnu terapiju ponovno je indiciran operativni zahvat inflamiranih dermoidnih cista sakrokokcigealne regije. U ranom postoperativnom toku u



Slika 3 – Orijaški divertikul rektuma čija se veličina mijenja pri promjeni intraabdominalnog tlaka
a) u maksimalnom ekspiriju
b) u maksimalnom inspiriju
Fig 3 – Gigantic diverticulum of the rectum whose size alters with change of the intraabdominal pressure
a) on max. expiration
b) on max. inspiration

operativnom polju pojavila se sterkoralna fistula. Potvrđena je kontrolnom irigoradiografijom kao komunikacijama između stražnjeg zida divertikula rektuma i interglutealne regije–jatrogena lezija (slika 4). Bolesnica je u daljnjem kirurškom tretmanu.

Rasprava i zaključak – Da su divertikuli rektuma doista rijetki, govori podatak da u literaturi nalazimo malo izvještaja o njihovom pojavljivanju (1,3,6,9). Dapače, neki autori iznose posve oprečnu tvrdnju: da se divertikuli rektuma nikad ne javljaju (4,7). S posljednjim se teško možemo



Slika 4 – Jatrogena lezija rektalnog divertikula pri operaciji dermoidne ciste sakrokokcigealne regije
Fig 4 – Iatrogenic lesion of the rectal diverticulum during the operation of a dermoid cyst in sacrococcygeal region

složiti budući da smo u vlastitoj praksi našli tri bolesnika s divertikulima rektuma i njih smo prikazali u ovom radu. Ova tri bolesnika čine približno 1 % u grupi bolesnika u kojih smo evidentirali diveretikuloznu bolest kolona, odnosno 0,13 % svih bolesnika kojima smo učinili irigografiju. Ispitivanjima na slično definiranom uzorku bolesnika Walstad (9) prezentira rezultate da se divertikuli rektuma javljaju u približno 0,08 % bolesnika kojima je učinjena irigografija, odnosno u 2 % bolesnika s divertikuloznom bolešću crijeva. Isti autor daje prikaz bolesnika s dvama divertikulima rektuma, dosad, prema dostupnoj nam literaturi, jedini takav slučaj. Naš bolesnik A. F. ima dva divertikula rektuma.

Rezultate slične Walstadovim, da je učestalost rektalnih divertikula 2,4 % (prikaz 4 slučaja), dali su još 1927. godine Spriggs i Marxer (9).

Kolika je stvarna incidencija divertikula rektuma, teško je utvrditi, budući da se najčešće radi o sporadičnim, pojedinačnim slučajevima ili o vrlo malom uzorku bolesnika, bez zakonitosti u pojavljivanju. Stoga, u naprijed iznesenim podacima vidljive manje statističke razlike ne smatramo signifikantnima. Također, u ovako malom uzorku neprimjereno je govoriti o distribuciji bolesnika po spolu. S obzirom na dob bolesnika, 49 – 63 godine, možemo napomenuti da su sva tri naša bolesnika u dobi kada je i inače najveća incidencija divertikulozne bolesti kolona.

Divertikuli rektuma najčešće su pravi (1), redovito veći od divertikula na proksimalnim dijelovima kolona, a kao etiološki uzrok njihovog nastanka možemo smatrati sve one činitelje koji dovode do slabljenja stijenke rektuma.

U radiološkoj dijagnostici divertikuli rektuma, ako nisu komplicirani upalom, krvarenjem ili eventualnom malignom alteracijom (2,3,8) ne čine značajnijih diferencijalnodijagnostičkih poteškoća. Osim spomenutih mogućih komplikacija, dodajemo i vlastitu iskustvenu implikaciju – valja paziti da se divertikul rektuma ne zamijeni eventualnom cistom ili apscesom spontano ili jatrogeno fenestriranim u rektum.

Smatramo da je metoda izbora u dijagnostici rektalnih divertikula, kao i uopće u dijagnostici patoloških stanja kolona, korektno izvedena irigoradiografija s dvostrukim kontrastom.

Sažetak

Divertikuli rektuma su rijetki. Našli smo ih u tri (0,95%) bolesnika s divertikuloznom bolešću kolona. Nemaju veće kliničko značenje, izuzev u slučajevima kada se kompliciraju upalom, perforacijom ili malignom alteraci-

jom. Tada mogu uzrokovati i veće ili manje diferencijalnodijagnostičke poteškoće. U pravilu se dokazuju irigoradiografijom, metodom dvostrukog kontrasta.

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INSTITUT ZA ENDOKRINOLOGIJU, DIJABETES I BOLESTI METABOLIZMA
KLINIČKO-BOLNIČKI CENTAR ZEMUN
ODELJENJE ZA RENDGENOLOŠKU DIJAGNOSTIKU
MEDICINSKI CENTAR BOSILEGRAD
RENDGENOLOŠKA SLUŽBA

KARLICA OTTO–CHROBAK

OTTO–CHROBAK PELVIS

Goldner B, Dodić M, Penev B

Abstract – The term Otto–Chrobak pelvis was first used to describe bilateral acetabular protrusion as a late complication of the rheumatoid arthritis. However, this type of pelvic deformity may be a congenital or developmental abnormality, and may be encountered in numerous acquired diseases such as: acute or chronic osteoarthritis, deforming osteoarthrosis, ankylosing spondylitis, osteomalatia and rickets, Paget's disease, involutive osteoporosis or may be of traumatic origin.
Hyperthyroidism and hemophilia could also be added to the present list of possible causes of this condition. Pertinent radiographic findings of some diseases, including two new causes which may be responsibile for bilateral acetabular protrusion, are rewieved.

Key words: acetabulum, osteoarthritis hip

UDC:616.718.16-007.57

Review article

Radiol Iugosl 1990; 24:223-5.

Uvod – Obostrana protruzija acetabuluma je retka urođena ili stečena deformacija kukova, koja nastaje zbog različitih patoloških procesa čije je primarno sedište u acetabulumu ili njegovoj okolini (1,2,3).

Prvobitan opis obostrane protruzije acetabuluma koji se odnosio na komplikaciju reumatoidnog artritisa poznatu kao karlice Otto–Chrobak ili arthocatadysis, vremenom je proširen na niz patoloških stanja i oboljenja koja u osnovi menjaju strukturu acetabuluma i susednih kostiju. Do sada su u literaturi opisani: akutni i hronični osteoartritis, deformišuća osteoartroza, ankilozirajući spondilitis, osteomalacija i rahit, Pagetova bolest, involutivna osteoporoza i traume (1,3).

Cilj ovog saopštenja je rendgenografski prikaz nekih patoloških procesa, od kojih se primarni hiperparatiroidzam i hemofilija po prvi put uključuju kao mogući uzroci obostrane protruzije.

Materijal i metode – U toku višegodišnjeg bavljenja koštanozglobnom patologijom, izdvajani su i klasifikovani rendgenogrami pojedinih manje ili više zastupljenih entiteta iz raznovrsne političko–stacionare populacije bolesnika. Odatle potiču i rendgenski snimci patoloških karlica tipa Otto–Chrobak koje u ovom radu prikazujemo.

Rezultati – Od brojnih rendgenskih snimaka karlica, na kojima se uz osnovnu, najčešće prepoznatljivu bolest nalazi i obostrana protruzija acetabuluma, zbog skučenosti prostora prikazujemo samo četiri slučaja ređih patoloških promena koje za ishod imaju karlicu Otto–Chrobak.

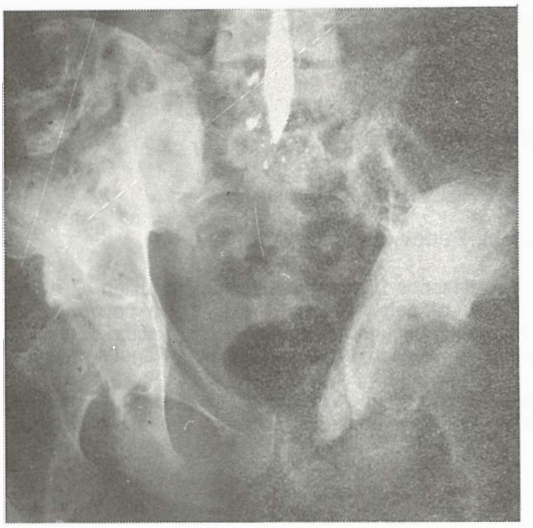
Morbus Paget sa karakterističnim distrofičnim promenama na karličnim kostima u kojima se prepliću polja poroze, hipertrofične atrofije i skleroze, zbog razmekšanja i patološke pregradnje, ima za posledicu obostranu protruziju acetabuluma (slika 1).

U osteomalaciji karlica trpi najveće promene, pa je uz generalizovanu demineralizaciju kostura u celini, čest nalaz deformisane karlice tipa Otto–Chrobak (slika 2).

Primarni hiperparatiroidizam slično kao kod osteomalacije strukturalno menja i deformiše karlicu. Pored nalaza izmenjenog oblika karlice sa slikom »srca u kartama« moguća je protruzija acetabuluma sa glavama butnih kostiju (slika 3).

Osteoarthrosis haemophilica takođe može da bude uzrok obostrane protruzije acetabuluma, bilo da su promene samo u zglobovima kukova

Received: May 15, 1989 – Accepted: April 16, 1990

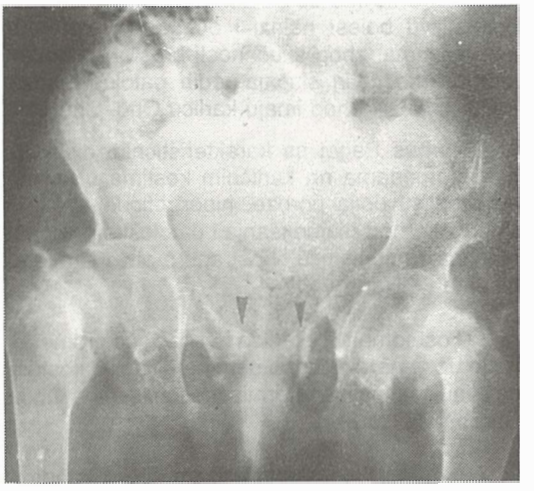


Slika 1 – Deformisana karlica u Pagetovoj bolesti. Obostarna protruzija acetabulama i superacetabularno polje sklerotične kosti. Ostaci kontrastnog sredstva u spinalnom kanalu posle mijelografije

Fig. 1 – Deformed pelvis in Paget's disease. Bilateral acetabular protrusion and supraacetabular areas of osseous sclerosis. The remnants of contrast medium in the spinal channel after a myelography

Slika 3 – Snimak karlice u bolesnika sa primarnim hiperparatiroidizmom. Asimetrična, deformisana karlica sa izrazitom osteoporozom, obostranom protruzijom acetabulama i patološkim frakturama na ishijadičnim kostima

Fig.3 – An X-ray film of the pelvis in a patient with primary hyperparathyroidism. Asimmetrical and deformed pelvis with severe osteoporosis, bilateral acetabular protrusion and pathological fractures in the ischiadic bones

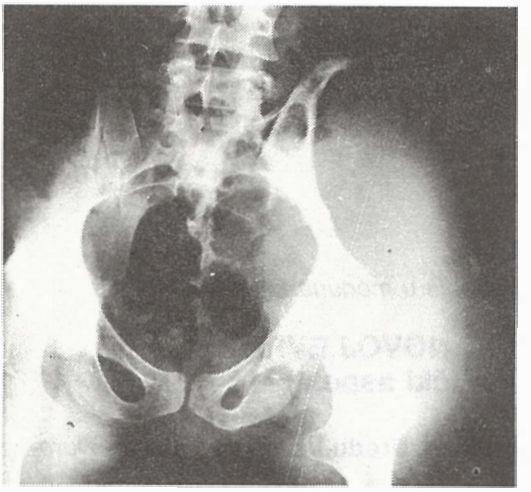


Slika 2 – Osteomalatična karlica sa obostranom protruzijom acetabulama, simetričnim pseudofrakturama (Looserove zone) na gornjim granama pubičnih kostiju i pubično–ishijadičnim spojevima (strelice)

Fig. 2 – Osteomalatic pelvis with bilateral acetabular protrusion and symmetrical pseudofractures (Looser's zones) in the superior public ramus and ischio–public junctions (arrows)

ili da se uz njih nalaze opsežna razaranja u susednim delovima karlice (slika 4).

Diskusija – Prikazani snimci patološko izmenjenih karlica ukazuju na promene koje su uslovile obostranu protruziju acetabuluma, a čiji je zajednički supstrat: gubitak koštane mase i strukturne promene u acetabulumu i susednim kostima karlice. Primarni proces postupno razara koštano dno acetabuluma a potom i polumesečastu zglobnu hrskavicu u njemu. Koštano dno acetabuluma nestaje, a glave butnih kostiju gubeći čvrsto uporište se utiskuju u zaostalu vezivnu opnu dna put unutra u šupljinu karlice. Acetabulum se ne širi već produbljuje pomerajući granicu preko terminalne linije. Na utisnutoj vezivnoj opni se stvara nova kost oblikujući novi acetabulum sklerotičnog dna. Köhlerova figura suze ili kapi koja se sa dna normalnog acetabuluma pruža medijalno i kaudalno kao ovoidna transparencija, kod protruzije se deformiše i gubi (3). Na spoljnjem rubu acetabuluma se stvaraju osteofiti. Zglobni prostor kuka se sužava i deformiše. Glave butnih kostiju mogu da izmene oblik,



Slika 4 – Karlica Otto-Chrobak u bolesnika sa hemofilijom A. Obostrana protruzija acetabuluma i koštane ankiloze koksofemoralnih zglobova. Opsežan hemofilični pseudotumor u levom glutealnom delu prouzrokovao je ekstenzivnu osteolizu leve ilijačne kosti.

Fig. 4 – Otto–Chrobak pelvis in a patient with hemophilia A. Bilateral acetabular protrusion and osseous ankylosis in the coxofemoral joints. A voluminous gluteal hemophylic pseudotumor with extensive osteolysis of left iliac bone.

da se spljošte bilo zbog opšte razmekšalosti skeleta i mehaničkog pritiska ili zbog uzura na zglobnoj površini glave (4). Ankiloza nije pravilo, s napomenom da se kod reumatoidnog artritisa nikada ne razvija. Vratovi butnih kostiju mogu da slede promene u glavama, acetabulima i susednim kostima karlice ili da se deformišu zbog gubitka mineralnog sadržaja a u sklopu osnovne bolesti. Oni se svijaju i poprečno postavljaju gradeći sa glavama butnih kostiju poznatu sliku »pastirskih štapova«.

Obostrana protruzija acetabuluma je retko posledica traume. Češći je jednostrani nalaz tzv. centralne luksacione frakture kod koje glava femura probije dno acetabuluma i zadje u karlicu. Anamnezni podaci o traumi rešavaju dijagnozu.

Sažetak

Naziv karlice Otto–Chrobak prvi je put upotrebljen da označi obostranu protruziju acetabulama i glava femura u karlicu kod slučajeva sa hroničnim reumatoidnim artritisom. Međutim, ovakav tip deformacije karlice može da bude urođen ili razvojni poremećaj, da se nađe u brojnim stečenim oboljenjima kao: akutni ili hronični osteoartritis, deformirajuća osteoartroza,ankilozirajući spondilitis, osteomalacija i rahit, Pagetova bolest, involutivna osteoporoza ili da je traumatskog porekla. Postojećoj listi bolesti mogli bismo da pridodamo još primarni hiperparatiroidizam i hemofiliju kao moguće uzroke. Rendgenografski nalazi koji se odnose na ovakav tip deformacija karlice, uključujući i dva nova uzroka koja mogu da budu odgovorna za obostranu protruziju acetabulama, prikazani su u ovom radu.

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OHRONOZA I KALCIFIKATI U ZGLOBNIM HRSKAVICAMA

OCHRONOSIS AND CALCIFICATIONS WITHIN THE CARTILAGES OF THE JOINTS

Presečki V, Mihordin N

Abstract – A patient with severe skeletal ochronosis is reported. On radiographic examination there was a linear density surrouonding the knee joints. Calcifications within the cartilages and the menisci of the knee joints, as well as cartilages of shoulder, carpal and other joints and intervertebral discs were found.
Pigmentary deposits in the skin of the hand and sclerae were seen. Homogentisuria was verified.

UDC: 616.72-018.3-003.84

Key words: ochronosis, cartilage articular, chondrocalcinosis

Case report

Radiol Iugosl 1990; 24:227-30.

Uvod – Ohronoza je kliničko stanje u kojem dolazi do odlaganja modro–crnog pigmenta u hrskavice, tetive i tkiva u građi kojih prevladava kolagen (1, 2). Poremećen je katabolizam tirozina i fenilalanina u nivou homogentizinske kiseline (HK) (1, 2, 3). Defekt katabolizma je potpun, količina HK izlučene u mokraći je u relaciji s količinom razgrađenih proteina u organizmu. Tkivo jetre bolesnika od ohronoze ne sadrži oksidazu homogentizinske kiseline pa se HK ne katabolizira (1, 2). Dio HK se izluči mokraćom a dio se polimerizira i odlaže irverzibilno u kolagen (1, 2, 3). Ta mjesta u histološkom preparatu oboje se oker smeđe pa otuda potječe ime ohronoza (2, 4). HK prisutna je u mokraći od rođenja.

Ohronoza je kompleks simptoma skeletne i ekstraskeletne manifestacije. Klinički nalaze se sivo–plavkaste mrlje po bjeloočnicama, nepravilne pigmentacije kože (češće dijelovi izloženi svijetlu) a vidljive tetive plavkasto prosijavaju kao i hrskavice uške i nosa.

Odlaganje polimerizirane homogentizinske kiseline (PHK) izraženije je u fibrozne prstenove intervertebralnih prostora, sinhondroze, hrskavice zglobova, traheje i rebara, tetive mišića, ligamente i zglobne kapsule (2, 3, 5, 6).

MacKenzie i suradnici našli su histokemijski odlaganje kalcium pirofosfata u ekscidiranim tetivama bolesnika od ohronoze na mjestima gdje je odložena PHK (6). Odlaganje kalcija u periartikularne strukture i fibrozne prstenove intervertebralnih prostora smatraju kao pokušaj reparacije degenerativne lezije (2, 7, 8).

Prikaz bolesnika – Bolesnica J.M. rođena 1924. godine, M.br. 8116/88. Otac je sa 30 godina bolovao od »vode u koljenima«, teže se kretao zbog bolova u kukovima i kičmi, umro je u 54. godini života od bolesti želuca. Bolesnica unatrag 10 godina pati od bolova u koljenima koja joj povremeno otiču, teže se kreće. Traume velikih zglobova i kostiju negira.

Iz statusa: na dorzumu obih šaka vidljive su sivo–plavkaste mrlje promjera oko 4 cm, koje postoje dulje od tri godine. Mrlje (pigmentacije) slične boje, promjera 2-3 mm vide se po bjeloočnicama u okolini rožnice. Uške su sivo–plavkaste. Desno koljeno je otečeno, patela balotira što upućuje na tekućinu u zglobu koljena.

Received: January 30, 1989 – Accepted April 12, 1990

Učinjeni su radiogrami: torakalnih organa, oba ramena, oba lakta, oba ručna zgloba, kičmenog stuba, oba zgloba kuka, oba koljena i skočnih zglobova.

Na radiogramima viđeno je:

– kalcificirane hrskavice traheja i glavnih bronha, okoštavanje rebranih hrskavica.

– mrljaste sjene tvrdoće vapna uz rub cirkumferencije glave humerusa i glenoida skapule (u hrskavici) obostrano, manifestnije lijevo.

– mrljaste sjene tvrdoće vapna u meniscima oba koljena, uz rub kondila lijevog femura te prugaste sjene u mekim čestima poplitealne fose (zglobna kapsula ?).

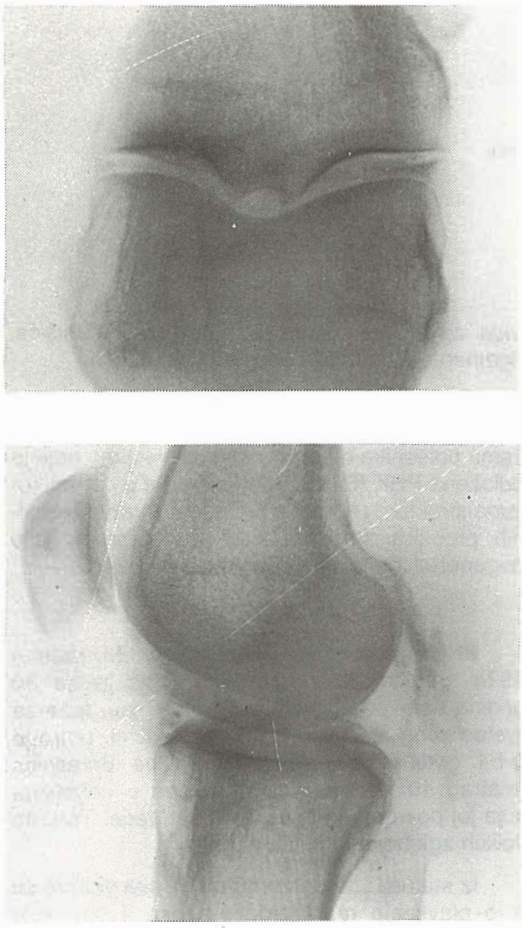
– mrljaste sjene tvrdoće vapna uz cirkumferencije glave oba femura, manifestnije lijevo te u sinhondrozi simfize.

– na kostima kralješnice viđene su promjene deformirajuće spondiloze sa suženim intervertebralnim prostorima. U dva intervertebralna prostora lumbalne kralješnice viđen je vakuum fenomen. Mrljasto odlaganje vapna u intervertebralnim prostorima svih kralješaka.

– mrljaste sjene tvrdoće vapna u hrskavicama oba ručna zgloba

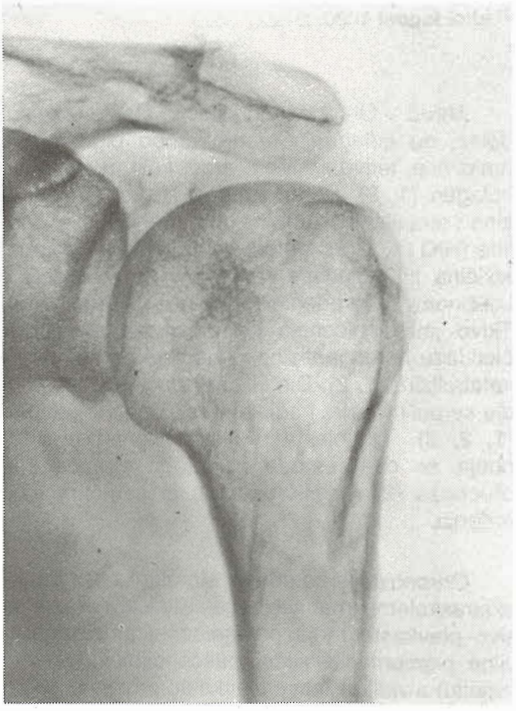
– artrotske promjene, manje ili više izražene su i na ostalim zglobovima sa manjim odlaganjem vapna u zglobne hrskavice.

U urinu poslanom u biokemijski laboratorij KBC-a potvrđena je prisutnost homogentizinske kiseline i time je potvrđena dijagnoza ohronoze.



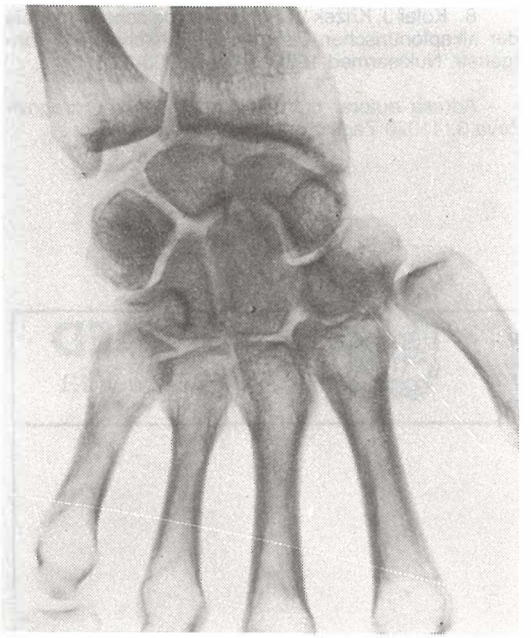
Slika 1a i 1b – Kalcifikacije u meniscima koljena i poplitealnoj fosi

Fig. 1a and 1b – Calcifications within the knee joint menisci and popliteal fossa



Slika 2 – Kalcifikacije u hrskavicama ramenog zgloba

Fig. 2 – Calcifications within the cartilages of the shoulder joint



Slika 3 – Kalcifikacije u hrskavicama karpalnih zglobova
Fig. 3 – Calcifications within the cartilages of the carpal joints

Diskusija – Bolest je dominantno nasljedna s slabom ekspresijom gena (2, 4) pa je klinička manifestacija od slučaja do slučaja različita, skeletna i ekstraskeletna. Bolest tijekom života ne pravi smetnje i dijagnosticira se slučajno ili pak kada nastupe komplikacije zbog odlaganja PHK i naglašenog razvoja degenerativnih promjena zglobova i kičmenog stupa u četvrtom ili petom deceniju života.

Nije nam namjera da prikazujemo klasičnu radiološku simptomatologiju već da ukažemo na prisutnost kalcija u hrskavicama zglobova i sinhondrozama koji kao radiološki znak nije opisivan. Odlaganje vapna u zglobne hrskavice i meniske koljena »opisuje samo Pomeranz 1941. dok drugi autori ne spominju ...« citat je O'Brien i suradnika iz pregleda svjetske literature (1584-1962) (2).

Intenzivno kalcificirane traheobronhalne hrskavice i hrskavice rebara u drugom i trećem deceniju života našli su u 9 od 11 bolesnika od ohronoze Kolař i suradnici (8). Odlaganje vapna u intervertebralne prostore i periartikularne vezivne srukture neki smatraju kao značajne za radiološku dijagnostiku ohronoze (2, 7, 8).

Prisutnost kalcija (kao radiološki relevantan znak) na mjestima gdje se odlaže PHK ima opravdanje u histokemijskom dokazu kalcijum pirofosfata kako su utvrdili MacKenzie i suradnici (6) kod bolesnika od ohronoze.

Kod naše bolesnice vjerojatno je ekspresija gena snažna, pa je simptomatologija, skeletna i ekstraskeletna, dobro izražena, osobito odlaganje kalcija u hrskavice i vezivo gdje se deponira PHK.

Zaključak – Odlaganje polimerizirane homogentizinske kiseline u kolagen tjelesnih i zglobnih hrskavica, meniske koljena, tetive, zglobne kapsule i fibrozne strukture intervertebralnih prostora dovodi do degenerativnih promjena. Odlaganje kalcijum pirofosfata u područje deponirane polimerizirane homogentizinske kiseline, za pretpostaviti je, pretstavlja primarni radiološki znak skeletne ohronoze. Naglašene artrotske promjene zglobova, suženi intervertebralni prostori i jača manifestna spondiloza najvjerojatnije su sekundarni.

Definitivno postavljanje dijagnoze ohronoze neosporno je dokaz prisutnosti homogentizinske kiseline u mokraći bolesnika.

Sažetak

Prikazana je bolesnica sa manifestnom skeletnom ohronozom. Radiografskom metodom pregleda nađene su linearne tvrđe sjene u okolini koljenih zglobova. Kalcifikacije u hrskavicama i meniscima zglobova koljena, kao i u hrskavicama ramenih, ručnih i drugih zglobova te intervertebralnim prostorima. Zapaženo je odlaganje pigmenta u kožu šaka i bjeloočnice. Homogentizurija je bila dokazana.

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IZ PRAKSE ZA PRAKSU

KVIZ Br. 2

PRIKAZ PRIMERA

Bolesnica: 47 godina
Zanimanje: ekonomski tehničar
Iz istorije bolesti – odpusno pismo, koje donosi sa sobom:

Primljena u bolnicu zbog bolova u predelu slabina, malaksalosti i povišene temperature. Tegobe su počele dve nedelje pre prijema, kada je osjetila jake bolove u slabinama, više desno, groznicu, drhtavicu, temperatutu 37,5° C.

Preležala je dječje bolesti, pre 20 godina operacija vanmaterične trudnoće. Od 1974 g. hipertenzija. Pre jedne godine operacija žuči.

Anamneza po sistemima: osećala je malaksalnost i gubitak apetita. Imala je česte i veoma jake glavobolje »da gubi svest od bolova«. Nije kašljala i nije imala tegobe sa disanjem. Povremeno je osećala bolove u predelu srca, »preskakanje« srca. Stolica uredna. Pušač. Nije uzimala alkohol. Negira porodična oboljenja.

Objektivni nalaz: bolesnica je savestna, orjentisana. Aktivno pokretna, pravilne ostemuskularne gradnje. Temperatura 37,8° C. Glava, vrat, grudni koš, kičmeni stub uredni. Abdomen: vidljiv ožiljak po laparotomiji. Bubrežne lože osetljive na grubu perkusiju i bimanuelnu palpaciju. Edema nema.
TA do 22,6/16,0

Laboratorijski nalazi:
EKG levogram, sinusni ritam, fr. 65 u min. sa znacima opterećenja levog srca.
Urin 1–2L, sveži erit., bel. 1., pH 5.
KKR uredna
Kostna srž: jako hipercelularna usred hiperplazije eritrocitne loze, koja je normoblastna slabije sat. Hgb. Na ćelijama granulocitne loze se viđaju displastične promene dok je maturacija očuvana. Megakariociti su u dovoljnom broju. Mieloperoksidaza je pozitivna u ćelijama granulocitne loze. LE ćel. fenomen neg.
C3c = 1,62g/L, C4 = 0,62g/L
SE 94/126
Holesterol, urea, ukupni proteini, albumini, ŠUK, bilirubin, alkalna fosfataza, kisela fosfataza, fibrinogen, elektroliti, SGOT, SGPT sve u granicama normalnog.

Radiorenogram: insufiniencija desnog bubrega, izražene drenažne smetnje levog bubrega. Urografija, uredna.

CT bubrega: desno između aorte i v. cavae vidljiva okruglasta mekotkivna senka, gustine oko 40 HU, koja ispred sebe pomera v. renalis a potiskuje i aortu i v. cavu. Posle davanja kontrasta formacija se samo ivično obojava kontrastom, a centralno pokazuje zrakast hipodenzitet.
Diagnoza: TU retroperitonealis lat. dex. (Lymphangioma).

Scintigrafija limfnih čvorova: nalaz je suspektan na zahvatanje paraaortalnih limfonodusa patološkim procesom.

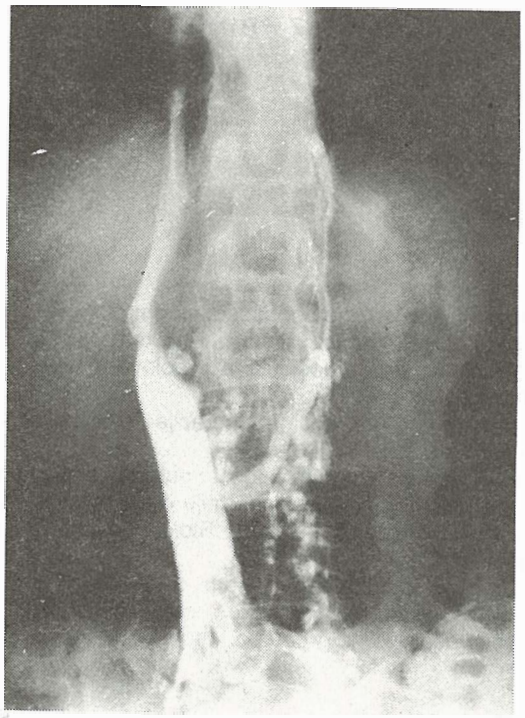
Limfografija: nalaz prikazanih limfnih čvorova uredan do visine L 2. Desno na visini L 1 pršljena izgleda, da postoji ekspanzivna formacija, koja sprečava daljni prodor limfe.

Ponovni CT pregled – stanje nepromenjljivo.

Pod diagnozom Infiltratio reg. retroperitonealis. Anem. sec. Hypertrnsio arterialis. Cor hypertensivum comp., premeštena na daljnu obradu.

Obavljene dodatne pretrage

Kavografija: vidi sliku 1



Aspiracijka biopsija vodžena sa CT: neadekvatni material.

Mišljenje :

daljnje pretrage? Koje?

Postupak lečenja?

Odgovor : vidi stranu 307

GENERAL HOSPITAL OSIJEK
DEPARTMENT OF ONCOLOGY AND RADIOTHERAPY

APPROACH TO THE STEREOSCOPIC VISUALISATION OF THE REAL – TIME ULTRASOUND IMAGES

Kurbel S, Dičić M

Abstract – The short theoretical paper deals with the possible use of stereoscopy as an optional display mode in a real time ultrasound. The proposed concept consists of:
a/a special probe with two arrays crossed in the middle under an acute angle for generating left and right ultrasound images
b/a monitor that alternatively displays left and right images in sequence
c/ liquid crystal spectacles of controlled alternative transparency that allows images to be seen only by the coresponding eye.
The 'b' and 'c' components are alredy available as parts of the commercial stereoscopic video equipment.

UDC: 534-8:611-018.06

Key words: ultrasonic diagnosis, biometry

Preliminary report

Radiol Iugosl 1990; 24:233-5.

Introduction – Attempts to improve the real – time ultrasound visualisation are numerous and different (1-4). A possible new approach might be to try to generate a true stereoscopic ultrasound image that might improve the impression of depth.

Stereoscopic pictures are known from the beginnings of photography (5). A pair of pictures are simultaneously taken from two points that are 65 or more milimeters appart. Observed through special prismatic spectacles, two images can be mentally fused to form a single stereoscopic image with exellent impression of depth. They are used in aerial cartography, conventional radiology etc.

Historical attemps have been made to introduce stereoscopic movies. The principle was to project simultaneously left and right images on the same screen, one in red and the other in blue colour. The spectators were using coloured spectacles so that the left eye would watch only the left images and vice versa. The system was abandoned mainly because of unnatural colours and today it can be sporadically seen in computer games or experimental video.

A new system of stereoscopic video display has been recently introduced in the field of entertainment electronics. Left and right colour video images are being alternatively displayed in a fast sequence on the monitor screen. The spectator is using liquid crystal spectacles that can quickly turn dark or transparent by means of electricity. The spectacle transparency is governed by the special video recorder that allows images to be seen only by the coresponding eye.

Description of the proposed concept – Conventional real time ultrasound can display stereoscopic ultrasound images as an additional option if the built–in computer is powerful enough to display 16 or preferably more frames per second. Higher frame rate is important since each eye is watching only a half of the frames. To have real time ultrasound, each eye should receive at least 16 frames per second. Each frame can be displayed twice to reduce screen blinking in case the liquid crystal filters are able to react fast enough. The high frame rate is also a limiting factor of the image depth. It could be improved by reducing actual frame rate per second and displaying the same images trice.

Received: April 4, 1990 – Accepted: May 15, 1990

The special linear array probe for stereoscopic ultrasound display requires two narrow arrays crossed in the middle under an acute angle, as shown in Fig. 1. Convex electronic sector probes can also be used. Stereoscopic probes with two mechanical sectores would be much more complicated.

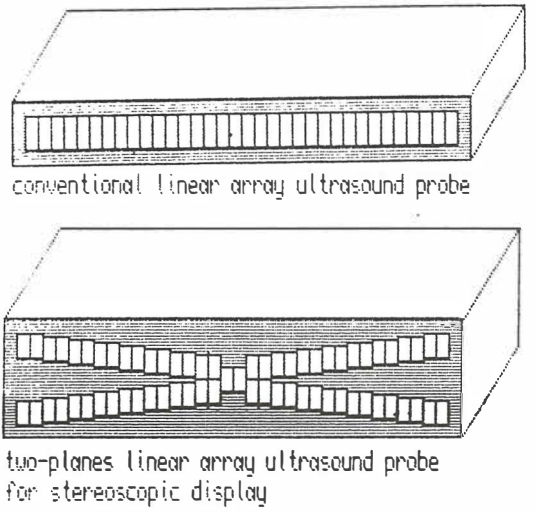


Fig. 1 – The comparison between the conventional linear array ultrasound probe (upper half) and the proposed two array probe (lower half) with arrays crossed under an acute angle

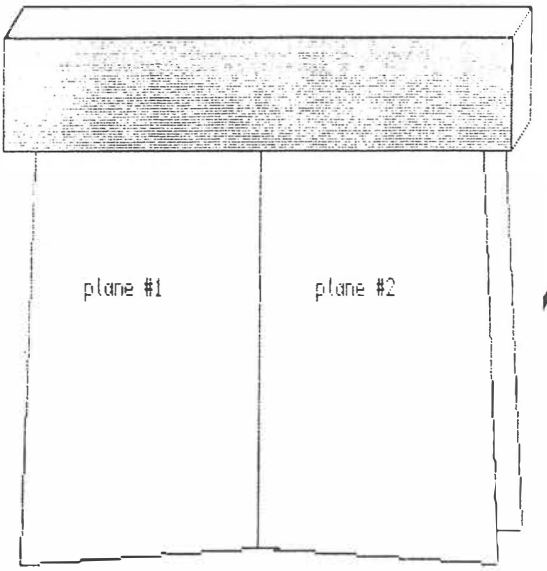


Fig. 2 – The image planes of the proposed two array ultrasound probe

The main disadvantage of the proposed probe is that it needs a larger contact surface. As we are considering stereoscopic display just as an additional option of the real time ultrasound units, intercostal and other complicated approaches can be used with the conventional linear arrays.

Two–array probe would generate two slightly different intersecting images that correspond to the planes shown in Fig. 2. The angle and differences between the images have to be sufficient to produce stereoscopic effect and also small enough to allow the same structures to be present in both planes. The distance between the lateral crystals should probably be 6 to 10 mm for a 10 cm linear array probe. The actual angle can be electronically manipulated in a manner alredy used in the convex linear arrays.

In the future, two–dimensional linear and convex arrays (for instance 600 crystals in 60 rows of 10) with dynamic beam focusing in all planes can be expected. The proposed two array probe might be the first step in that direction.

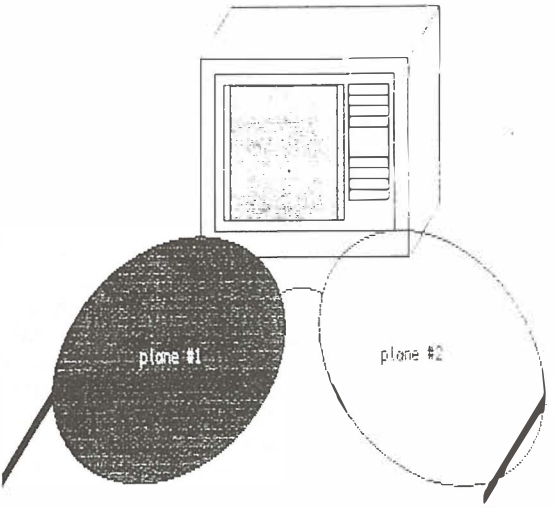


Fig. 3 – Scheme of a monitor that displays left and right images on the same screen observed through liquid crystal spectacles of electrically controlled alternative transparency

Stereoscopic ultrasound images can be displayed on a monitor and observed through liquid crystal spectacles, as shown in Fig. 3. Alternative sequence of left and right images would be displayed on the same screen. The sonographer watching through the spectacles of alternative

transparency is able to fuse left and right image into a single stereoscopic picture.

Sažetak

STEREOSKOPSKI NAČIN ULTRAZVUČNOG PRIKAZA

Kratki teoretski članak se bavi mogućom upotrebom stereoskopije kao mogućeg načina ultrazvučnog prikaza. Predloženo rješenje se sastoji iz:

a) posebna ultrazvučna sonda s dva linearna sektora koji se pod oštrim kutom križaju u sredini (u obliku oštrog x) za dobivanje lijevih i desnih ultrazvučnih prikaza

b) monitor koji naizmjence prikazuje lijeve i desne prikaze u nizu

c) naočare s tekućim kristalima kontrolirane alternativne transparentcije koje omogućuju da pojedini prikaz vidi samo odgovarajuće oko.

Komponente navedene pod 'b' i 'c' se mogu nabaviti na tržištu kao dijelovi komercijalne video opreme.

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JUGOSLOVENSKO DRUŠTVO ZA ZAŠTITU OD ZRAČENJA

DRUŠTVO ZA ZAŠTITU OD ZRAČENJA
SR SRBIJE

PRIRODNO MATEMATIČKI FAKULTET
KRAGUJEVAC

ORGANIZUJU

treće Savetovanje sekcije JDZZ
za prirodnu radioaktivnost sa temom

IZLAGANJE POJEDINACA I STANOVNIŠTVA ZRAČENJU KOJE POTIČE OD RADONA, RADONOVIH POTOMAKA I DRUGIH RADIONUKLIDA U ŽIVOTNOJ SREDINI

Vrnjačka Banja
15, 16. i 17. oktobra 1990

Informacije

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UNIVERZITETSKO MEDICINSKI CENTAR U SARAJEVU
INSTITUT ZA RADIOLOGIJU I ONKOLOGIJU

NEUROFIBOM PERIKARDA – PRIKAZ SLUČAJA

PERICARDIAL NEUROFIBROMA – CASE REPORT

Dalagija F, Najdanović M, Bukša M, Bešlić Š, Spasojević S

Abstract – The authors have presented a case of 49–year old male without clinical symptoms, with occasional radiologic finding of cardiomegaly and suspicion for echinococcus cyst. Preoperativelly, all avilable diagnostic methods, including computed tomography (CT) were performed. Although the echocardiographic finding was accurate in localization and relation to the surrounding structures, it was inaccurate in definition of tissue consistency. CT accurately presented an oval tumorous mass with 10x12 cm diameter, solid tissue density, intrapericardially, next to the left cardiac ventricle.
Operatively, the pericardial (epicardial) tumor was extracted completely with pathohistologically confirmed neurofibroma.
The value of CT and difficulties in diagnosis of pericardial tumoros were discussed.

UDC: 616.11-006.38.03

Key words: pericardium, neurofibroma

Case report

Radiol Iugosl 1990; 24:237-40.

Uvod – Primarni tumori srca su, kao što je poznato, općenito rijetki, a primarni tumori perikarda rijeđi od intrakardijalnih tumora. Od benignih tumora perikarda sreću se: lejomiomi, hemangiomi, lipomi, a najčešće teratomi i interperikardijalne bronhogene ciste. Utvrđeno je da više od polovine primarnih tumora perikarda čine maligni tumori, predominantno mezoteliomi i sarkomi (fibrosarkomi), dok su od svih tumora koji zahvataju perikard najčešći metastatski tumori (1, 2, 3, 4, 5).

Benigni tumori perikarda se većinom prezentiraju bez simptoma kao neobjašnjiva kardiomegalija. Ako su simptomi prisutni, oni ovise od veličine i lokalizacije tumora, kao i stepana kompresije srca i velikih krvnih žila (2, 5, 6).

Postojećim brojnim dijagnostičkim metodama kao što su kliničko–laboratorijske, konvencionalne radiološke metode, ehokardiografija itd., u posljednjih desetak godina pridružila se i kompjuterizirana tomografija (CT).

Kao superiorna nad konvencionalnim radiološkim dijagnostičkim metodama, ona se pokazala veoma korisnom i u dijagnostici tumora srca, odnosno perikarda (1, 5, 7, 8, 9, 10, 11, 12, 13).

Prikaz slučaja – Radi se o 49-godišnjem muškarcu bez kliničkih simptoma, kod koga je na ambulantno učinjenoj standardnoj radiografiji pluća i srca slučajno otkrivena kardiomegalija. Zbog sumnje na ehinokoknu cistu, a u cilju daljnje dijagnostičke obrade i eventualne operativne intervencije, pacijent je upućen u kliniku za grudnu hirurgiju.

Kod prijema, svi laboratorijski nalazi, kao i krvni pritisak, bili su u granicama normale, Auskultatorno srčana akcija je bila ritmična, usporena, prvi ton tmuo. EKG je pokazao sinusnu bradikardiju frekvence oko 55 u minuti sa znacima ishemije lijeve komore.

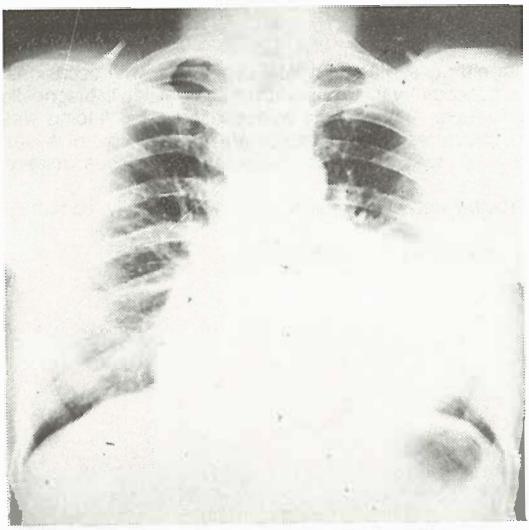
Standardna radiografija pluća i srca (postero–anteriorna i profilna projekcija) kao i radioskopija potvrdile su izraženu kardiomegaliju na račun lijeve srčane komore (slika 1).

Ehokardiografija je ukazala na postojanje eho strukture, moguće ciste, dužine do 10 cm, koja dijelom potiskuje zid i smanjuje šupljinu lijeve komore (slika 2).

Kompjuterizirana tomografija (CT) je jasno prikazala ovalnu tumorsku masu, promjera 10x12 cm, vizuelno izodenzne strukture, stepena gustoće solidnog tkiva, ali nešto nižih vrijednosti.

Received: April 9, 1990 – Accepted: May 9, 1990

Ista je smještena intraperikardijalno, lijevo, sa impresijom lijeve komore, ali bez potiskivanja srca u cjelini (slika 3). Nakon aplikacije kontrastnog sredstva u vidu »bolusa« masa se nešto intenzivnije opacificirala.

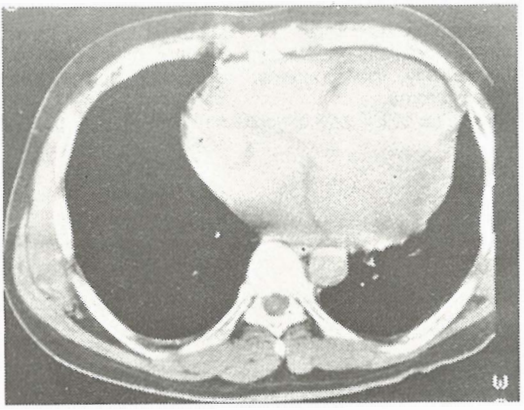


Slika 1 – PA radiogram pluća i srca: izražena kardiomegalija

Fig. 1 – PA chest roentgenogram: expressed cardiomegaly

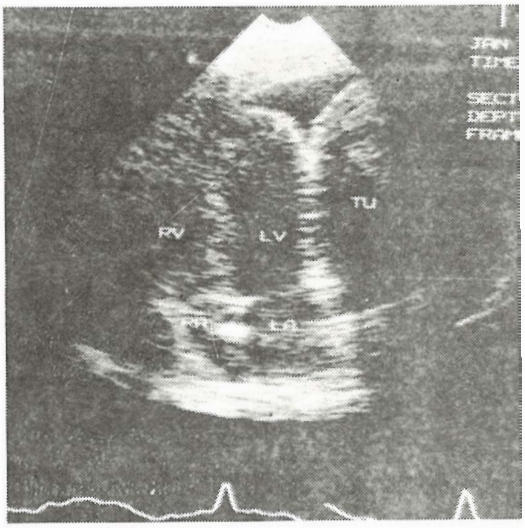
Intravenozna digitalna subtrakciona angiografija je pokazala smanjenje i impresiju lijeve srčane komore prema kaudalno (slika 4).

Preoperativno su učinjene i desna kateterizacija srca, lijeva pneumoaniografija i lijeva ventrikulografija, čiji su nalazi bili uglavnom u granicama normale. Sinekoronarografija je otkrila atipičan tok dijagonalnih grana koje su bile »nategnute i izravnate«. Postojeća tumorska masa je



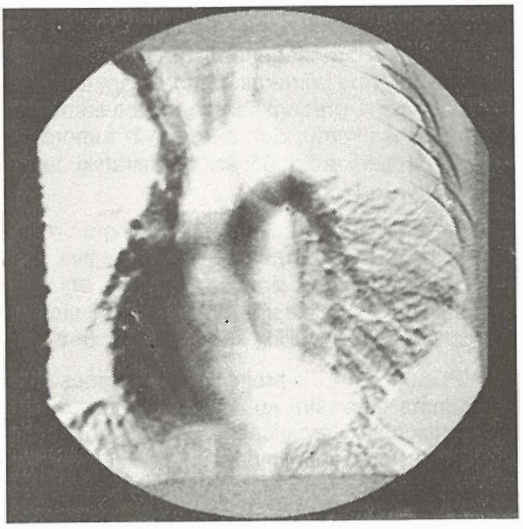
Slika 3 – Kompjutertomogram: voluminozna tumorska masa gustoće solidnog tkiva, intraperikardijalno lijevo

Fig. 3 – CT scan of the chest: voluminous, tumorous mass of solid tissue density, intrapericardially left



Slika 2 – Ehokardiogram: voluminozna ehostruktura uz lijevu komoru, moguće cista

Fig. 2 – Ultrasonogram: a voluminous echo–structure next to the left ventricle, possible cyst



Slika 4 – D.S. angiogram: izraženo smanjenje i impresija lijeve komore

Fig. 4 – D.S. aniogram: expressed decrease and impression of the left ventricle

hipovaskularizirana od grana ramus interventrikularis anterior, koje su iregularnog lumena i kružnog toka na području od preko 2/3 prednjeg zida.

Operativno je u cjelini odstranjen perikardijalni (epikardijalni) tumor »poput veće muške pesnice«. Patohistološki je utvrđeno da se radi o neurofibromu. Postoperativni tok je bio produžen zbog nakupljanja tećnosti u perikardijalnoj šupljini, pa je izvršena i perikardijalna punkcija.

Kod otpusta iz bolnice, nalazi kontrolne radiografije, ehokardiografije i CT, sem mjestimičnih znakova perikardijalnih priraslica, ne pokazuju drugih patomorfoloških promjena. Srčana sjena odgovarajuće veličine.

Diskusija – Klinička slika benignih tumora perikarda, kao što je već unaprijed navedeno, nije karakteristična. Stoga se oni često otkrivaju slučajno na standardnoj radiografiji. Diferencijalno dijagnostički dolaze u obzir tumori medijastinuma kao što su: struma štitne žljezde, dermoidna cista, timom, ehinokokna cista medijastinuma ili perikarda, aneurizma aorte ili srca itd.

Tvrdi se da je do pojave kompjuterizirane tomografije (CT) evaluacija kardijalnih i perikardijalnih tumora pomoću radiografije, radioskopije, konvencionalne tomografije, angiografije i ehokardiografije bila veoma otežana, a preoperativna dijagnoza specifičnih entiteta većinom i nemoguća (2, 5, 13, 14).

Transverzalnim prikazom bez superpozicije, CT obezbjeđuje tačno utvrđivanje lokalizacije i odnosa lezije prema okolnim strukturama. Sposobnošću preciznijeg diferenciranja apsorpcionih razlika, ona omogućuje i karakterizaciju intraperikardijalnih masa na bazi njihove radiografske gustoće. Stoga je ona superiorna nad konvencionalnim radiološkim dijagnostičkim metodama u procjeni njihove tkivne konzistencije bilo da se radi o tečnom sadržaju, solidnom ili masnom tkivu, kalciju, koštanim ili dentalnim strukturama, a osobito kod neuspješnog ili nesigurnog ehokardiografskog pregleda (2, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17). Gore navedeno potvrđeno je i u prezentiranom primjeru. Dok je nalaz ehokardiografije bio nesiguran, CT je riješila dilemu o eventualnoj cističnoj prirodi lezije. Jasno je pokazala da se radi o tumorskoj masi gustoće solidnog tkiva. Uz dobar prikaz forme i veličine, točno je definisala njenu intraperikardijalnu lokalizaciju, kao i odnos prema srcu u cjelini i lijevoj komori posebno. Konačno, intenzivnija opacifikacija nakon aplikacije kontrastnog sredstva ukazala je na njenu prokrvljenost (dokaz više protiv njene cistične prirode). Svi navedeni podaci potvrđeni su operativno.

Ipak upozoreno je i na teškoće, pa i greške u dijagnostici pojedinih bronhogenih i drugih medijastinalnih, kao i perikardijalnih cista na osnovu CT gustoće. Ove ciste mogu biti ispunjene gustim mukoidnim sadržajem koji daje visoke CT vrijednosti gustoće, sugerišući solidnu masu. Stoga, visoki CT brojevi ne isključuju benignu perikardijalnu cistu (15, 18, 19, 20).

Zaključak – Nalaz kompjuterizirane tomografije (CT) u prezentiranom slučaju, koji je operativno potvrđen, u skladu je sa iskustvima stranih autora o vrijednosti CT u dijagnostici perikardijalnih tumora.

Uz ostale vrijedne dijagnostičke metode, ona komplementarno, a često i odlučujuće doprinosi njihovoj tačnijoj evaluaciji.

Sažetak

U radu je prezentiran slučaj 49-godišnjeg muškarca bez kliničkih simptoma sa slučajnim radiografskim nalazom kardiomegalije i sumnjom na ehinokoknu cistu. Peoperativno su izvršene sve raspoložive dijagnostičke metode uključujući i kompjuteriziranu tomografiju (CT).

Mada je u pogledu lokalizacije i odnosa lezije prema okolini, nalaz ehokardiografije bio tačan, u pogledu njene tkivne konzistencije bio je nesiguran. CT je, međutim, jasno prikazala ovalnu tumorsku masu, promjera 10x12 cm, stepena gustoće solidnog tkiva, intraperikardijalno uz lijevu srčanu komoru. Operativno je u cjelini odstranjen perikardijalni (epikardijalni) tumor, a patohistološki utvrđen neurofibrom.

Diskutovano je o vrijednosti CT, kao i određenim teškoćama u dijagnostici perikardijalnih tumora.

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^{99m}Tc UPTAKE IN THYROID; PINHOLE COLLIMATOR NONUNIFORMITY CORRECTION

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Abstract – In order to determine thyroid structure and function simultaneously, we have developed a method that uses ^{99m}Tc pertechnetate, gamma camera and computer. 130 MBq (3.5 mCi) of ^{99m}Tc Pertechnetate is intravenously injected to the patient and 20 minutes later a scintigram is acquired with pinhole collimator positioned at optimal distance over the patient's neck. Tc–uptake in thyroid is calculated by FORTRAN program that makes all corrections necessar for pinhole nonuniformity, isotope decay and extrathyroidal activity. Method was also tested by the thyroid phantom that imitates real conditions in the human neck, and on the group of 56 patients. The developed method with pinhole planer non–uniformity correction enables us to examine gland as a whole and also regionally. All relevant data about thyroid structure and function can be obtained within 40 minutes after clinical examination.

UDC: 616.441-073:539.163

Key words: thyroid gland–radionuclide imaging, technetium

Orig sci paper

Radiol Iugosl 1990; 24:241-4.

Introduction – It has been shown (1, 2, 3, 4, 5, 6, 7) that ^{99m}Tc Pertechnetate can be used to measure thyroid function, and that owing to its physical characteristics it provides high quality scintigrams.

The main problem of technetium method is low, nonselective thyroid uptake. Thyroid accumulates only 2% of applied dose, what makes only 40-50% of total counts seen by whole gamma camera field of view. Because of so high extrathyroidal activity, and hence necessary background correction, technetium fixation cannot be measured by usual scintillation uptake set that is normally used for 131-I uptake measurement. Gamma camera and computer are needed. In that way extrathyroidal activity can be subtracted and all necessary corrections can be done to get accurate value for ^{99m}Tc uptake in thyroid. We make corrections for nonuniformity of the pinhole collimator, isotope decay and distance of collimator from the patient's neck; correction for attenuation by neck tissue is not made.

Materials and methods – For measurement and calculation of ^{99m}Tc uptake in thyroid we use gamma camera PHO/GAMMA V with pinhole collimator with 5 mm aperture, and PDP-11 computer with GAMMA-11 system. Method consists of four parts. The first part is acquisition of the scintigram of the syringe that contains 130 MBq ^{99m}Tc in volume of 1 ml. The distance from the collimator is 10 cm and preset count is 100000. Because of the heavy distance dependence of the counting efficiency for pinhole collimator (8,9), we carefully determine distance with cardboard pieces of precise lenght. The second part is preparation and imaging of the patient. Activity is injected intravenously and 20 minutes later, when thyroid activity reaches plateau, the scintigram is acquired. Plateau persists from the 15th to the 30th minute after injection. Again, preset count is 100 000 counts. Patient is in supine position, and collimator is positioned at optimal distance from the neck. That is usually 5-10 cm and depends upon the thyroid size. Thyroid has to be positioned inside the field of view of camera in such a way that representative extrathyroidal area can be easily determined. The third part is imaging of the used syringe to determine the amount of activity left after injection. Distance from collimator is 10 cm and preset time is one minute. The fourth part consists of image uniformity corrections, definition of

Recived: April 24, 1990 – Accepted: May 3, 1990

target and background regions of interest, and running the developed FORTRAN program for uptake calculation.

Corrections and calibration – Response or geometric efficiency of a pinhole collimator for a point source is nonuniform and given by (10)

$$G = \frac{d^2 \cdot \sin^3(\theta)}{16 \cdot b^2}$$

d – effective aperture of the collimator,
b – distance from aperture to the source of activity,
θ – the ray angle.

During the measurement of ^{99m}Tc uptake 50% of total count within the field of view are from extrathyroidal activity. Therefore, it is necessary to subtract activity of overlaing and underlaing structures to get net thyroidal activity. Thyroid is positioned in the image center, and the background area near it (what means toward periphery), so it is very important to correct the image for collimator nonuniformity. In fact the same reasoning apply equally well for every pixel or the part of the thyroid. We make corrections in the following way:

We take a flood study of 57-Co flood source with 3 000 000 preset count. Afterwards, every scintigram is corrected with standard GAMMA-11 flood correction command (»FCD #«).

From flood study GAMMA-11 creates correction matrix that increases the low–response areas and decreases the high–response areas. Then, by multiplying each patient image by the correction matrix, one can compensate for the irregularities in the image due to poor camera response or, as in our case, for severe collimator nonuniformity. GAMMA-11 creates a flood–correction matrix in the following manner.

1. All cells whose counts lie outside the display thresholds are zeroed.
2. The average cell count AVO of the remaining nonzero cells is computed.
3. All cells below the cutoff m, that is, with counts smaller than m% of AVO, are zeroed. A new average cell count AV of the nonzero cells now remaining is calculated.
4. Each of these remaining nonzero cells is converted into a flood–correction factor by replacing its contents with the value AV/CT, where CT is the original number of counts in the cell.

In that way we equalized the weight of every matrix element in the scintigram. Thyroid and background can be positioned anywhere within the field of view. Some authors (8) have tried to solve the problem of nonuniformity by calibrating for the thyroid size. Strictly speaking such a procedure is not completely correct with respect to the position of the thyroid within the field of view and regarding to correction for the overlyng structures. To be able to quantify ^{99m}Tc uptake in thyroid we have calibrated our system with »Searle« neck phantom with known activity. In phantom we have put plastic tube with 2% of previously measured activity and contained in 5 ml volume. It has been imaged at distances 5-10 cm from collimator, and calibration factors has been calculated (Fig. 1). It was easy to calculate calibration factors for every distance, because we have known that tube in the neck phantom had exactly 2% uptake.

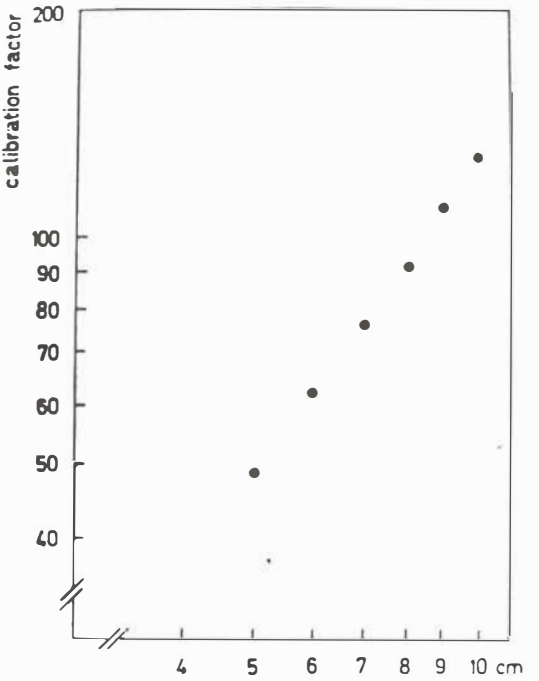

Fig. 1 – Calibration factors which are collimator–neck distance dependent

$$F = \frac{D \cdot P}{U}$$

F – calibration factor,
P – per cent of accumulation
D – injected activity
U – accumulated activity.

The second degree polynomial has been fitted to the obtained set of distance dependent factors. For background subtraction, and distance and decay corrections we have written FORTRAN program. Distance calibration factors for particular distance is calculated by fitted polynomial.

Results – Algorithm correctness has been checked by measuring and calculating various activities in the neck phantom. We got high correspodence for whole range 0.5-5% of the applied dose. Also, program has been tested under the real, strictly controlled, conditions on the phantom we have made to imitate real situation in the human neck. That is plastic bowl, whose diameter is 15 cm, filled with water that contains activity corresponding to the extrathyroidal activity.

The pair of syringes simulating thyroid have been immersed in the bowl. Measurements have been done for various volumes (10-100 ml). All data have been analyzed twice. With uniformity correction and without it.

Table 1 shows exellent results for corrected data, while noncorrected data gave results that differ considerably from the true value of 2% and depends on volume of simulated thyroid.

Table 1 – Results of uptake measurement in our phantom for various thyroid volumes and different modes of calculation

VOLUME (ml)	99m-Tc UPTAKE (%) UNCORRECTED	CORRECTED
10	2.56	2.15
20	2.40	2.04
40	2.23	2.01
60	2.09	1.84
100	1.87	1.92
MEAN ± S.D.	2.23 ± 0.06	1.99 ± 0.01

Method was also applied to the group of 56 patients (Table 2). In the euthyroid group of patients the mean value of ^{99m}Tc pertechnetate thyroid uptake is 1.99±0.07% (X±S.D.). The normal range defined as X±2S.D. is 0.3-3.73%.

The method separates very well euthyroid patients from patients with hypo or hyper thyroid function.

Table 2 – ^{99m}Tc uptake in euthyroid, hyperthyroid and hypothyroid patients

GROUP	RANGE
EUTHYROID	(n=40) 0,3 - 3,7 % ($\bar{x} \pm 2$ SD)
HYPERTHYROID	(n= 8) 4,3 - 11,8% (apsolute range)
HYPOTHYROID	(n= 8) 0,02 - 0,14% (apsolute range)

Discussion – The thyroid size and position within a camera field of view does not influence the calculated value for Tc uptake when all of the acquired pictures are corrected for the pinhole collimator non–uniformity (Table 1). On the other hand, correction for the neck distance makes possible to get closer to the thyroid which means to obtain high quality scintigrams with well delineated thyroid structures, while at the same time not effecting the uptake measurement . Only one pictures is necessary in contrast to Atkins (12) where two acquisitions are nedded for complete procedure.

The evaluation of described computer program for pinhole non–uniformity correction indicates that pinhole collimator can be used for quantitative thyroide imaging as well as specially designed collimator thyroid imaging proposed by German Association of Nuclear Medicine (7).

The metod described in this article can be made more practical for routine work by measuring filled and empty syringe in the dosecalibrator. It is only necessary to establish transfer factor between that instrument and gamma camera.

Developed method for evaluation of thyroid function by the use of ^{99m}Tc, tested on the phantoms and the group of patients, gave very satisfactory results. Hence, this work should be continued further for wider group of euthyroid and especially pathological cases. Because of successful uniformity correction and hence ability to measure regional uptake, we extended our study to this direction.

Sažetak

UPOTREBA ^{99m}Tc PERTEHNETATA, GAMA KAMERE I KOMPJUTERA U ODREĐIVANJU STRUKTURE I FUNKCIJE ŠTITNJAČE.

U nastojanju da istovremeno odredimo strukturu i funkciju štitnjače razvili smo metodu koja koristi ^{99m}Tc pertehnetat, gama-kameru i kompjuter. Ispitaniku se intravenski injicira 130 MBq (3.5 mCi) ^{99m}Tc, a tiroidna aktivnost snima se nakon 20 minuta pomoću gama–kamere i »pinhole« kolimatora koji su postavljeni na optimalnoj udaljenosti. Stupanj akumulaciji u štitnjači određuje se kompjuterski pomoću FORTRAN-skog programa koji vrši neophodne korekcije za neuniformnost »pinhole« kolimatora, vrijeme poluraspada izotopa i

aktivnost okolnih struktura vrata. Metoda je provjerena na fantomu vrata i štitnjače koji oponaša realne uvjete u organizmu te na grupi od 56 ispitanika. Svi relevantni podaci o strukturi i funkciji štitnjače dobivaju se 40 minuta poslije kliničkog pregleda. Razvijena metoda omogućava određivenje stupnja akumulacije ^{99m}Tc kako u cijelom organu tako i u pojedinim dijelovima štitnjače.

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LUNG SCAN INTERPRETATION – COMPARISON OF DIFFERENT CRITERIA

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Abastract – Authors reevaluated lung perfusion scans performed for suspected pulmonary embolism in 1988 and 1989 using new criteria proposed by international prospective study for pulmonary embolism diagnosis (PIOPED (5)).
The difference between the first reading and the reevaluation was found in 200 (25,35%) of patients examined by lung perfusion scaning using 99mTc–macro–aggregated albumin (99mTc–MAA). The probability of lung embolism increased in 185 (92,5%) of patients where the disagreement between the first and the second reading was found. The degree of discordance is low in the patients under 30 years of age (9,59%) and in the interpretation of normal lung perfusion scan (2,14%).
Ventilation lung scanning by 99mTc–diethylenetriaminepentaacetate aerosol (99mTc – DTPA), which was performed after perfusion lung scanning in 59 patients, influenced the diagnosis in 14 (23,72 %) of patients by lowering the predicted probability of lung embolism as assessed by perfusion scanning alone.
The systematic two–observer approach to lung perfusion scan analysis using PIOPED criteria is more sensitive for the diagnosis of pulmonary embolism than single–observer method. Ventilation scanning helps to avoid overdiagnosis of lung embolism specially in intermediate and high probability of pulmonary embolism.

UDC: 616.24-005.7:539.163

Key words: pulmonary embolism–radionuclide imaging

Orig sci paper

Radiol Iugosl 1990; 24:245-8.

Introduction – Diagnosis of pulmonary embolism (PE) is difficult if only clinical and biochemical criteria are considered. Lung scintigraphy is one of the most important noninvasive imaging techniques. The interpretation of lung scans is liable to errors. As it has been proven with prospective studies, the systematic aproach is most succesful in the correct diagnosis of PE (1, 2, 3, 4). Since the systematic aproach has not been accepted in our laboratory before, we compared the results of nonsystematic lung scan interpretation to the aproach suggested by National Heart, Lung and Blood Institute in USA (5).

Patients and methods – Lung perfusion scanning was performed in 789 patients (pts) because of clinically suspected pulmonary embolism (PE) in the period of two years (from 1988 to 1989). The pts were from 10 to 90 years old, 448 (57,5%) were females.

Lung perfusion scanning was performed with a large view field gamma camera after intravenous application of 99mTc-human serum albumin macroaggregates (99mTc-MAA). During the injection the pts were supine, but the scans were taken in the sitting position whenever there were no serious contraindications. The scans were performed mostly in four projections: anterior, posterior, left and right posterior oblique. Few pts had scans taken only in anterior and both anterior oblique projections.

Ventilation lung scanning by 99mTc–diethylenetriaminepentaacetate aerosol (99mTc-DTPA) was performed after perfusion lung scanning in 59 patients in the same positions as perfusion scanning.

At the first diangnostic reading the scans were evaluated by several nuclear medicine physicians (sometimes they were less experienced) without strict criteria for lung scan interpretation. When ventilation lung scanning was not available, a recent thorax radiograph was compared to the lung scan serving as an estimation of the lung ventilation in the pts.

On reevaluation PIOPED criteria were used (Table 1). These are essentially modified Biello's criteria, known as PIOPED (prospective study of pulmonary embolism diagnosis (5)).According to them, the scans were assessed by two observers as normal, concordant with low, intermediate or high probability of lung embolism.

Received: May 14, 1990 – Accepted: May 21, 1990

Table 1 – PIOPED criteria for diagnostic reading of lung perfusion scans

PROBABILITY OF PE	PIOPED CRITERIA
NORMAL	NORMAL PERFUSION
LOW	(1) SMALL Q DEFECTS REGARDLESS OF NUMBER, V OR CXR FINDINGS (2) Q DEFECT SUBSTANTIALLY SMALLER THAN CXR DEFECT (V IRRELEVANT) (3) V-Q MATCH IN ≤ 50% ONE LUNG OR ≤ 75% OF ONE LUNG ZONE CXR NORMAL OR NEARLY NORMAL (4) SINGLE MODERATE Q WITH NORMAL CXR (V IRRELEVANT) (5) NONSEGMENTAL Q DEFECT
INTERMEDIATE	(1) ABNORMALITY THAT IS NOT DEFINED BY EITHER »HIGH« OR »LOW«
HIGH	(1) TWO OR MORE LARGE Q. V AND CXR NORMAL (2) TWO OR MORE LARGE Q IN WHICH Q IS SUBSTANTIALLY LARGER THAN EITHER MATCHING V OR CXR (3) TWO OR MORE MODERATE Q AND ONE LARGE Q. V AND CXR NORMAL (4) FOUR OR MORE MODERATE Q. V AND CXR NORMAL

Legend: Q = perfusion, V = ventilation, CXR = chest X ray (chest roentgenogram)

Table 2 – The degree of discordance between the first and the second interpretation of lung perfusion of lung perfusion scans according to the age of the patients

AGE (YEARS)	No OF PTS	No OF DISCORDANT INTERPRETATIONS	% OF DISCORDANCE
≤29	73	7	9.59
30 - 39	83	22	26.51
40 - 49	119	28	23.54
50 - 59	136	37	27.21
60 - 69	189	50	26.46
≥ 70	189	56	29.63
ALL	789	200	25.35

Table 3 – The degree of discordance between the first and the second interpretation of lung perfusion scans according to the scintigraphic probability of pulmonary embolism

SCAN RESULT	No OF PTS	No OF DISCORDANT INTERPRETATIONS	PER CENT DISCORDANCE
NORMAL SCAN	140	3	2.14 %
LOW PROBABILITY OF PE	213	35	16.43 %
INTERMEDIATE PRO-BIBILITY OF PE	181	92	50.83 %
HIGH PROBABILITY OF PE	255	70	27.45 %
ALL	789	200	25.35 %

Results – The disagreement between the first interpretation of lung perfusion scans and the reevaluation by two observers was found in 200 (25,35%) dof 789 patients. The probability of lung embolism increased in 185 (92,5%) of patients where the disagreement between the first and the second reading was found. The degree of discordance is low in the patients under 30 years of age (9,59% (Table 2)) and in the interpretation of normal lung perfusion scan (2,14%), (Table 3).

Ventilation lung scanning by 99mTc-diethylenetriaminepentaacetate aerosol (99mTc-DTPA), which was performed after perfusion lung scanning in 59 patients, influenced the diagnosis in 14 (23,72%) of patients by lowering the predicted probability of lung embolism as assessed by perfusion scanning alone.

Discussion – Disagreement in repeated readings of diagnostic pictues was first studied in radiology. According to Smith (7), following double reading of 300 consecutive radiologic examinations, diagnostic disagreements occur in about one-third of all filmreadings and about two-thirds of all errors are found by modified dual-reading techniques.

In our study, lung scintigrams performed in last two years were reevaluated by two experienced nuclear medicine physicians using PIOPED criteria and compared to the results of random aproach of several individual, sometimes less experienced, nuclear medicine physicians who were not strictly using special criteria for lung scan interpretation. The percent of discordance between the first and the second reading of the scans in our study was comparable to the results published by Smith. An important difference was found in some of the patients in whom repeated reading increased the probability of lung embolism from low to intermediate or from intermediate to high. In the latter group, the disagreement was partly due to illdefining of larger than segmental defects composed of several juxtaposed segments thus overlaying the anatomic borders. Further, problems have arisen as already noted by Sullivan (6), in the definition of the size of the subsegmental defects. The multiobserver aproach is of great value in these cases.

In our pts the ventilation scans mostly decreased the probability of lung embolism estimated on the basis of perfusion scans only. Unfortunately they were not performed frequently enough in all patients.

We conclude that the systematic applying of PIOPED criteria, especially with multiobserver aproach, surpasses the nonsystematic scan analysis particularly in the borderline scans. Substantial experience is necessary for interpreters. Ventilation scan is peremptory in the cases of intermediate and high probability of lung embolism estimated on the base of perfusion scan, to avoid the scintigraphic overdiagnosis of high probability of lung embolism.

Povzetek

PONOVNA OCENA SCINTIGRAMOV PLJUČ BOLNIKOV S SUMOM NA PLJUČNO EMBOLIJO

Avtorji poročajo o ponovni oceni scintigramov pljuč pri 789 bolnikih, ki so jih preiskovali v letih 1988 in 1989 zaradi kliničnega suma na pljučno embolijo. Pri vseh bolnikih je bila izvedena perfuzijska scintigrafija pljuč z 99mTc–albuminskim makroagregatom (99mTc-MAA). Ventilacijsko scintigrafijo pljuč z aerosolom (99m Tc-dietilentriaminopentaacetata (99mTc-DTPA) so izvedli po perfuzijski scintigrafiji 59 bolnikom.

Pri ponovnem ocenjevanju scintigramov avtorji uporabljajo merila priporočena v mednarodni prospektivni študiji za diagnostiko pljučnih embolizmov (PIOPED (5)).

Pri 200 (25,35%) bolnikih od 789 se razlikujejo rezultati prvega in drugega odčitanja perfuzijskih scintigramov pljuč. Stopnja neskladja je najmanjša pri bolnikih mlajših od 30 let (9,59%) in pri normalnih scintigramih pljuč (2,14%). Z uporabo kriterijev PIOPED se pri 185 (92, 5%) bolnikih od 200 poveča verjetnost pljučnih embolizmov.

Pri 14 (23,72%) bolnikih od 59 rezultat dodatne ventilacijske scintigrafije pljuč zmanjša verjetnost obstoja pljučnih embolizmov.

Interpretacija scintigramov pljuč z dvema odčitovalcema,ki uporabljata merila PIOPED, poveča občutljivost (in s tem možnost lažno patoloških rezultatov) perfuzijske scintigrafije v diagnostiki pljučnih embolizmov v primerjavi s tehniko z enim odčitovalcem. Ventilacijska scintigrafija pljuč, ki sledi perfuzijski scintigrafiji, zmanjša število lažno patoloških rezultatov perfuzijske scintigrafije, posebno tistih, ki kažejo srednjo in visoko verjetnost pljučnih embolizmov.

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^{131}I-MIBG BODY RETENTION IN A CASE OF NEUROBLASTOMA – CASE REPORT

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Abstract – The case of a little girl with neuroblastoma of the left hemithorax is presented. Surgery was performed at the age of 26 months. There was clinical evidence of diffuse bone marrow infiltration, and the disease progressed in spite of heavy chemotherapy. At the age of 30 months scintigraphy with 131-I-meta-iodobenzyl-guanidine (131-I-MIBG) was performed. Pathological accumulations could be seen in the left hemithorax, the entire bone marrow and in the evident metastases in the skull and oral cavity. Urinary and fecal activity in napkins and underwear were measured daily for 96 hours. A monoexponential retention curve having a T(1/2) of 18.5 h with an additional body retention constant of about 51 % was found.
Due to the measuring protocol, a faster, also urinary component, described by other authors, could not be identified.

UDC: 616-006.487:539.163

Key Words: neuroblastoma – radionuclide imaging, iodine radioisotopes

Case report

Radiol Iugosl 1990; 24: 249–52.

Case report – A 26-month-old girl was hospitalized on suspicion of skull base fracture and a tumor in the left hemithorax. One month before hospitalization the girl began to lose weight. There were periods of febrility up to 38.5 C° which were ascribed to respiratory infectons. A haematoma occurred under her left eye. Two days before hospitalization the girl fell on the head after which moderate orbital haematomas developed around both eyes. Consequently, a skull X-ray was performed which was suspicious of scull base fracture. At the same time a through pediatric examination revealed a pathological lung X-ray, hepatosplenomegaly, hypochromic anaemia and slightly elevated hepatic enzymes and ESR. Liver and spleen ultrasound scan excluded the presence of focal lesions.

A posterolateral thoracotomy of the left hemithorax was performed and tumor was found originating from the paravertebral sulcus and extending into the thorax, thus completely infiltrating the fifth and largely the fourth rib.

Therefore, an »en bloc« resection was performed. Also a minor metastatic dissemination into the parietal pleura and paravertebral sulcus was found, the lung being intact. Pathology verified a neuroblastoma. From the local city hospital the child was referred to the hematological and oncological ward of our University paediatric clinic. In spite of a very aggresive chemotherapy and numerous transfusions, the disease progressed and the child died at the age of 33 months. A 133-I-MIBG whole body scan was done at the age of 30 months, the girl already being very weak. She was conscious but immobile, cachectic and extremely pale with purple rings around the eyes and exophthalomos (Fig. 1). Numerous metastatic tumors were visible on the head and a red-brown necrotic, bleeding and fetid tumorous mass jutted out of the mouth. The nose was also filled with tumorous masses. Inspection of the body revealed the surgical cut extending from the left anterior chest wall to the left scapula. Congested subcutaneous veins could also be seen. The abdomen was tense and painful, the liver and spleen markedly enlarged. The lower half of the left thigh showed a spindle-shaped tumor.

The thyroid was blocked with sodium perchlorate 24 hours prior to and for seven subsequent days after the injection of 4.44 MBq (120 μCi) of 131-I-MIBG. Static scintigrams, 50 kcounts each, of the head, trunk and thigs were

Received: May 22, 1990 – Accepted: June 27,1990

Fig. 1 – Numerous metastases disfiguring the patient's head and causing exophthalmos and protrusion of the tongue

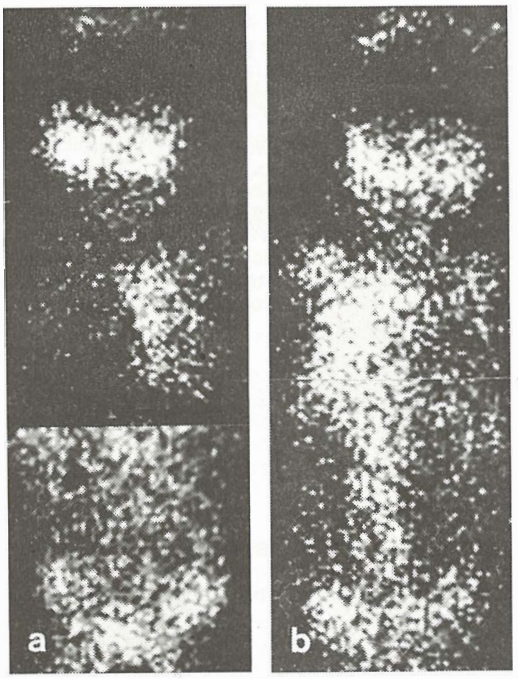

Fig. 2 – 131–I–MIBG whole body scan:
a) anterior view: metastases in the skull, mouth, left hemithorax and pelvis
b) posterior view: in addition to described pathology also infiltration of the head of left humerus and entire vertebra

taken on a GE Maxicamera 400T linked to a PDP 11/34 computer. Numerous metastases were found in the skull, the entire skeleton and left hemithorax (Fig. 2a and b).

At the same time all the girl's excreta together with napkins, underwear and sheets were collected for 96 hours. The activity of the excreta was measured on a daily basis. We insisted on measuring the retention for several days because of wide-spread metastases for which we expected an elimination dynamics different from cases in which a normal body retention predominates.

For our measurements the opposite probes of a dual detector whole body scanner »Elscint« were used Na1(T1) crystals of 5x2 inches, without collimator). The samples were packed in equally dimensioned, hermetically sealed plastic containers and measured in well defined fixed geometry. A calibration source of 185 kBq (μCi) 131-I dilluted in 300 ml of water and spilled over clean napkins was measured under equal geometric and other experimental conditions. Uncontaminated underwear was measured as background. Each sample activity was calculated as the geometric mean of the upper and lower detector measurements.

131-I-MIBG whole body retention, expressed in % of administered activity, is presented as a monoexponential curve with a biological half-life of 18.5 hours with an additional body retention constant of about 51 % (Fig. 3).

Discussion – After Wieland et al 1980 (1) published a study on 131-I-iodobenzyl-guanidine, a newly synthetized radiopharmaceutical, for the imaging of adrenergic tissue, several authors (2, 3, 4, 5) reported on the clinical value of 131-I-MIBG in the diagnosis of tumors of the suprarenal gland. Furter investigations showed that 131-I-MIBG could be used in the diagnosis of other endocrine and neuroendocrine tumors, e.g. medullary carcinoma of the thyroid (6, 7), carcinoids (8, 9) and neuroblastomas (10, 11, 12). A of this radiopharmaceutical (12). MIBG elimination blood is described in the sparse literature referring specifically to the kinetics and biodistribution of this radiopharmaceutical (12). MIBG elimination

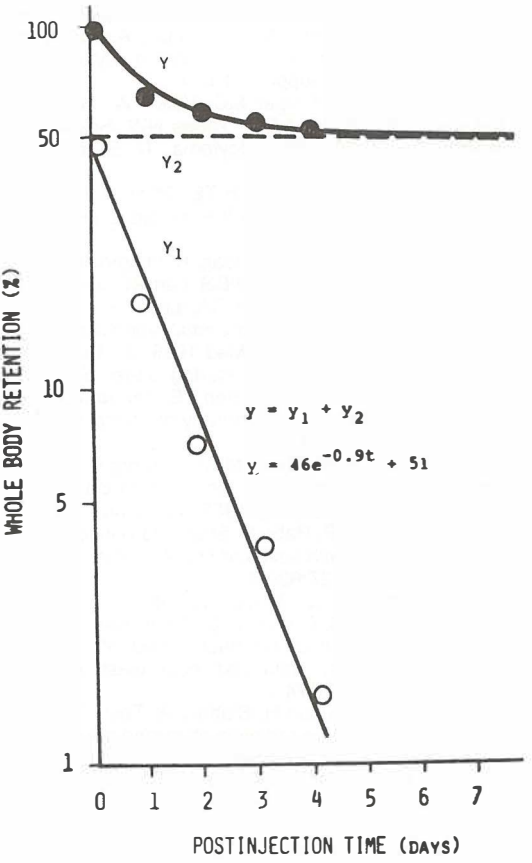

Fig. 3 – Whole body retention curve (y), expressed as a percentage of administered 131-I.MIBG activity: Exponential component (y_1), having a biological half-life of 18.5 h with an additional body retention constant (y_2) of about 51 %

from the body is described as being accomplished by urinary excretion and also following a two-exponential model (5, 12). Owing to the fast excretion at the beginning the authors measured the rate of the second component of urinary excretion only, which, according to Lashford (12), amounts to 19–45 hours (mean 35 hours). Retention measurement in an 11-year-old boy with suspicion of pheochromocytoma or adrenomedullar hyperplasia (13) showed a three-exponential MIBG retention consisting of component with half-lives of 0.35, 1.3 and 5.9 days. Simultaneously measuring the thyroid activity, these authors calculated the thyroid to whole body activity ratio of 0.001, although the thyroid had been blocked. In our study we did not measure the activity accumulation of the thyroid, but scintigrams in the anterior projecton did not show any visible accumulaton of 131-I. Thus, any faint activity in this region seems to be largely due to metastases in the cervical vertebra. Obviously, with such a high 131-I-MIBG retention in the girl's body, the contribution of unbound 131-I is negligible.

In our study we investigeted the cummulative 131-I-MIBG excretion in a two and a half-year-old child for four days. Because of the child's age it was impossible to measure urine and faces separately and the elimination could not be mesaured any longer for technical reasons. On account of this and the way of elimination we could not record the fastest component with an expected biological half-life of few minutes (12). Our four-day retention curve with a half-life of 18.5 hours (fig. 3) is in agreement with Lashford's results (12). The still hypothetical fast component of urinary elimination cannot be identified with such an investigation setting. We assume that this component contributes to a higher MIBG elimination in the first 24 hours, and therefore the first dot in the retention curve has a relatively low value as compared to the following days. Also, the sum of the values of the exponential component and the constant body retention does not reach 100 %, possibly because part of the eliminated activity may belong to the fastest component which we could not measure directly. A certain measurement error has to be considered also. The constant 131-I-MIBG body retention of 51 % is puzzling. A high body accumulation can be explained with a large tumor mass and active MIBG uptake.

However, some long term elimination of 131-I-MIBG or 131-I can be expected because of in vivo 131-I-MIBG elution or 131-I dissociation from the complex, in spite of the changed biochemistry in the tumor in comparison to normal tissues with catecholaminic activity. As our measurements merely extended over four days, it seems possible that we did not identify the 131-I-MIBG elution from tumor tissue or 131-I dissociation, if either process was very slow. The patient received cytostatic therapy which could also influence the kinetics of 131-I-MIBG in tumors. Most important for tumor therapy with 131-I-MIBG, beside tumor mass estimation, is knowing the retention cuvre is influenced by the various factors mentioned and can be defined accurately only by individual measuring.

Sažetak

RETENCIJA ^{131}I-MIBG-a U BOLESNIKA S NEUROBLASTOMOM – PRIKAZ SLUČAJA

Prikazan je slučaj djevojčice s neuroblastomom lijevog hemitoraksa. U dobi od 26 mjeseci izvršena je operacija. Postojali su klinički znaci difuzne infiltracije koštane srži i, unatoč intenzivnoj kemoterapiji, bolest je progredirala. U dobi od 30 mjeseci učinjena je scintigrafija s ^{131} I-meta-iodobenzyl-guanidineom (^{131} I-MIBG). Nađena je patološka akumulacija u lijevom himitoraksu, cijeloj koštanoj srži i vidljivim metastazama u lubanji i usnoj šupljini. Tijekom 96 sati mjerena je urinarna i fekalna aktivnost pelena. Nađena je monoeksponencijalna retenciona krivulja s $T_{(1/2)}$ 18.5 sati i tjelesna retenciona konstanta od oko 51 %. Radi načina mjerenja brža, također urinarna komponenta, koju su opisali drugi autori nije se mogla identificirati.

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LIVER METASTASES FROM COLORECTAL CANCER; THE IMPACT OF PRIMARY TUMOR REMOVAL ON SURVIVAL

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Abstract – Presented work is aimed at showing some survival characteristic of colorectal cancer patients with liver metastases. We have reviewed 736 record of patients who had histologically verified colorectal cancer. Nearly 70% of these were rectal primaries, whereas in almost 30% the malignacy was localized in the rest of the colon. Patients were divided in two groups. In the first nonresectable liver metastases were present on admission. In this group diversion colostomy was performed and primary tumor was not removed. We had 121 such patients. Liver metastases could have been treated by systemic 5-FU regimen or liver irradiation. Median survival was 7,3 months. The second group comprised patients that we treated radically by surgery. We had 83 such patients. In 27 liver metastases appeared after some period. These were treated by the same means as the first group. Median survival after discovery of metastases was 6,2 months. The difference in survival in these two groups was not statistically significant ($\chi^2 = 0,35$; $p<0,1$). The removal of primary tumor seemed to have no impact on survival if nonresectable liver metestases were present.

UDC: 616.36-006.6:616.351/.352-006.6

Key words: Liver neoplasms-secondary, colonic neoplasms, rectal neoplasms

Orig sci paper

Radiol Iugosl 1990; 24:253-5.

Introduction – Colorectal cancer (CRC) metastases in the liver are the object of long term research. In the last time especially, many researches have paid their attention to this subject, as by improved surgical techniques of primary tumor removal (1) metastatic disease came into focus.

Liver metastases could be treated either by chemotherapy, irradiation or liver resection. It seems that only liver resection gives some chances for cure of at least improves the survival (2, 3, 4, 5). Unfortunately, only about 5% of CRC patients with liver metastates are suitable for resection (2). The rest of the patients are treated only with palliative intent. In these patients the treatment should be oriented to improving the quality of life and therefore overtreatment should be avoided.

That is why we try to throw the light on the question whether the primary tumor resection in patients with hepatic metastases is justified or not.

Patients and methods – In the research 736 records of patients with CRC were reviewed. All patients had histologically verified carcinoma. They were treated between the years 1971 - 1981, almost 70% had rectal carcinoma, whereas in approximately 30% the disease was localized in other parts of the colon (Table 1). There were 261 patients with metastatic disease on admission. These were discovered and confirmed during the operation or on liver scintigraphy. Of 163 surgically treated patients, 83 had radical surgery where as the rest were treated with palliative intent.

Patients were divided in two groups. In the first liver metastases were present on admission.

Table 1 – Primary tumor site

SITE	%
Rectum	70,5
C. sigmoideus	13,3
C. ascendens	4,5
Caecum	3,3
C. transversum	2,2
Fl. hepatica	1,9
C. descendens	1,8
Anorectum	1,4
Fl. lienalis	1,1
Total	100,0

Received: May 3, 1990 – Accepted: June 2, 1990

These were considered nonresectable in principle. In these patients only derivation colostomy was done. In about a quarter of patients liver metastases were treated by systemic 5-FU regimen and/or liver irradiation.

In the second group there were 83 patients treated by radical primary tumor removal. They had no liver metastases on admission. In 27 liver metastases appeared after some period. A few of them were treated by the same means as the first group. Statistical significance was assessed by nonparametric Chi-square test.

Results – In the first group of patients (those with metastases on admission) median surival was 7.3 months, whereas in the second group (patients with colorectal metastases in the liver appearing after a time interval following primary cancer treatment) the median survival from the detection of hepatic metastases was 6.2 months (Table 2). Difference in median survival was not statistically significant ($p<0.1$; $\chi^2 = 0.35$). It seemed that primary tumor removal had no impact on the survival if liver metastases were present.

Table 2 – Median survival in patients with hepatic metastases from colorectal cancer

Group	No. of patients	Median survival (months)	Range (months)
1	121	7.3	1 - 45
2	27	6.2	1 - 25

Discussion – We have retrospectively reviewed the files of CRC patients with liver metastases, treated at the Institute of Oncology between years 1971-1981. It has been found that there was no statistically significant difference in survival between those who primary tumor removed and those who had not.

The patients that we treated had in principle surgically non resectable metastases. In those years we belived thart liver metastases from CRC could not be treated surgically, unless they were solitary, superficial and small. We had no such cases in our study. Some of the patients had liver irradiation (up to 2000 RAD), whereas others received systemic 5-FU. It was proved, that these two modalities had no influence on the survival, although they often resulted in on objective response (6, 7). Therefore we did not try to elicit that fact in our study. There was no intraarterial application of the drugs. The question whether it improves the survival or not has not been solved yet (8). No patient underwent liver resecion. The opinions about importance of this method are diverging. Most authors agree that it could be performed for a solitary liver metastasis (2, 3, 4), however some recent results (9) suggest that up to four metastases could be resected.

Median survival of our patients was 7.3 or 6.2 months. Patients with CRC metastases in the liver have longer survival than those who had gastric, pancreatic or biliary carcinoma (7). The same author reports a similar survival than that obtained in our study, i.e. 160 days; the patients with colostomy and those with resection of primary tumor had the same survival. Wood (4) reported survival of 7.7 months after discovery of liver metastases that were not treated. The patients with disease limited to one segment of the liver and those with solitary metastases had longer survival.

Patients with liver metastases from CRC have bad prognosis and according to our results, their survival is not influenced by primary tumor removal. We think that in the case of nonresectable liver metastases, the removal of primary tumor is not indicated unless the tumor is so symptomatic (pain, bleeding, destruction etc.) tha its removal would result in a significant symptomatic improvement. In these cases only palliative approach should be intended (derivation colostomy, laser destruction, irradiation).

On the other hand, the concepts of treating liver metastases from CRC has changed. With the development of liver surgery and introducing of intraoperative ultrasound in to clinical practice, the resectability of hepatic metastases has increased considerably (10). The only factors that might themselves be considered contraindications for liver resection are the presence of positive nodes, the presence of resectable extrahepatic metastases, or the presence of four or more metastases (9).

It seems that nowdays the outlook for the patients with hepatic metastases from CRC is promising, so more and more patients could be treated with curative intent.

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CIRCULATING CA 15-3 AND CEA VALUES IN MONITORING PATIENTS WITH BREAST CANCER

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Abstract – Serum concentrations of CA 15-3 and carcinoembryonic antigen (CEA) were measured in 277 patients with breast cancer. Metastatic disease was detected in 74 of them. Three hundred and thirty–nine healthy subjects provided our normal CA 15-3 reference value. The upper limits of normal range for CA 15-3 and CEA were found to be 26.4 U/ml and 2.5 ng/ml, respectively. Both CA 15-3 and CEA values were higher in patients with metastases. Significantly more patients had elevated levels of CA 15-3 than CEA (67,1% versus 47,3%, $p<0.05$) as measured at various stages of the disesase. Concentrations of CA 15-3 and CEA varied significantly with the stage of disease, but also in the relation to treatment response. However, CA 15-3 is more closely associated with the clinical status assessed in the follow–up period.

UDC: 618.19-006.6-074-097

Key words:antigens tumors-associated, carbohydrate, carcinoembryonic antigen, breast neoplasms

Orig sci paper

Radiol Iugosl 1990; 24: 257–60.

Introduction – Since tumor markers like carcinoembryonic antigen (CEA), tissue polypeptide antigen (TPA), mucin–like carcinoma associated antigen (MCA) and CA 15-3 have been available, an attempt has been made to incorporate serum determinations of these markers in the monitoring of breast cancer patients (1, 2, 3, 4). CEA, the most widely used cancer marker, has been shown to be of value for monitoring the response to treatment in about 60% of advanced metastatic breast cancer but lacks the sensitivity and specificity to detect small tumor burdens (5). The proliferation antigen TPA also shows the same sensitivity. However, in numerous benign, respiratory inflamatory diseases nonspecific titer of CEA and TPA can be found. Carbohydrate antigen 15-3 (CA 15-3) is recently described breast cancer associated antigen (6, 7), defined by two different monoclonal antibodies. One antibody (DF3) was produced by Kufe et al. (8) against a with membranes enriched fraction of human breast cancer metastases. This concerns an antigen with a molecular weight of 260 KD. The other antibody (115 D8) was developed against human milk fat globule membranes. Antibody 115 D8 recognizes a glycoprotein (MAM 6) antigen with a higher molecular weight, which is usually present in cases with cancer of the breast.

This study was done to determine the significance of both these tumor markers in the diagnosis and in the oncological follow–up in a group of subjects with breast cancer.

Material and methods – Two hundred and seventy–seven patients with breast cancer were included in this study (622 serum samples were analyzed). Metastatic disease was detected in 74 patients. Breast cancer was histologically confirmed for all these patients. The age of patients ranged from 29 to 84 years (mean value 57.6 years; median value 59 years). The patients were divided up into 2 group:

1. Patients with detectable metastases resp. recidivation ($n = 74$). The involed metastatic sites are given in Table 1.

2. Patients, who at the time of these results had no detectable distant metastases resp. recidivation ($n = 203$).

Metastatic lesions were monitored using x-ray examinations, scintigraphy and in certain cases computed tomography. Patients with metastatic disease were treated with local (irradiation) and/or systemic therapy (CMFVP; adriamycin combinations and/or hormonal manipulations).

Received: March 9, 1990 – Accepted: April 16, 1990

Table 1 – Number of involved metastatic sites

Skeletal	46
Lung	15
Liver	6
Skin	3
Cerebral	2
Combination	7

Table 2 – Serum concentrations (mean ±S.D.) of CA 15-3 and CEA in patients with breast cancer

	Patients with metastatic disease	Patients free of metastases
CA 15 - 3 (U/mL)	131.2 ± 17.8	20.2 ± 7.3
CEA (ng/mL)	19.3 ± 8.1	1.5 ± 1.7

In the control group we examined 339 presumably healthy person aged from 17 to 76 years (mean value 38.9 years; median value 39.5 years).

CA 15-3 and CEA levels were measured simultaneously in specimens of serum collected during either outpatient visits or hospitalization and frozen at–20°C until assayed.

CA 15-3 was measured by immunoradiometric assay (obtained from CIS, France) and CEA was determined using IRMA–MAT CEA Kit (obtained from Byk–Sangtec Diagnostica, FR Germany). CEA values above 2.5 ng/mL were considered elevated.

The results were expressed by a mean value and a median value were appropriate. Chi–square test with the correction for continuity in 2x2 tables was used to evaluate the significance of variables. The P values < 0.05 were considered significant.

Results – In our control group CA 15-3 values were in the range from 3.5 to 39.9 U/mL (mean value 15.6 U/mL, median value 15.0 U/mL). Cut–off value was set at 26.4 U/mL, i.e., at 95th percentile. CA 15-3 was elevated in 44 out of 203 patients (21.7%), and CEA was elevated in 31 out of 203 patients (15.2%) who had no evidence of metastases (chi–square 2.355, $P<0.2$).

CA 15-3 and CEA values were statistically higher in patients with metastases (Table 2).

Significantly more patients with metastatic diseases had elevated circulating levels of CA 15-3 than CEA (49/74 patients, 67,1% and 29/74 patients, 47.3%, respectively; chi–square 9.785, $p<0.002$). Using CA 15-3 and CEA in combination, sensitivity (ei. at least one marker is elevated) can be increased, depending on the clinical stage of the disease. CA 15-3 serum levels in 74 patients with progresivve breast cancer in accordance to the localisation of metastases are shown in Figure 1.

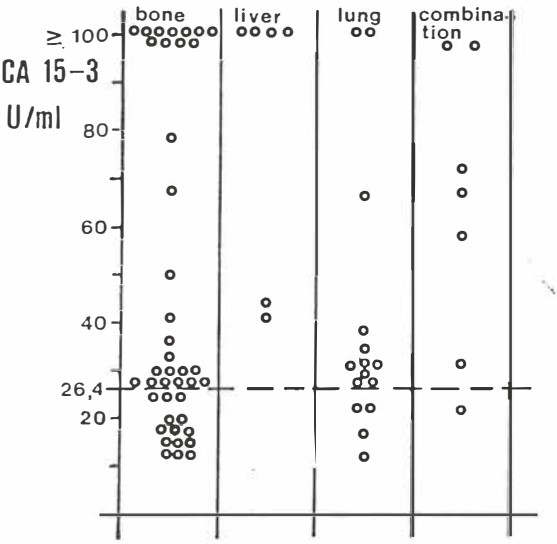

Fig. 1 – CA 15-3 levels in patients with metastatic breast cancer (sites of metastatic involvement)

CEA serum levels in patients with metastases in accordance to the localisation of metastases are shown in Figure 2.

Concentration of CA 15-3 and CEA varied significantly with the stage of the disease but also in the relation to the treatment. In three patients who developed local recurencce there was no significant change of CEA and CA 15-3 levels between when they are tumor free and had evidence of local recurrence.

Figure 3 shows the response of CA 15-3 and CEA serum levels to endocrine or citotoxic therapy in one patient with metastatic cancer. This patients had her breast removed 2 weeks before the beginning of the study. The receptor status was unknown. At the beginning of the study there was metastatic bone disease proven by scintigraphy and x-ray investigation. The patients was treated with combined chemotherapy (CMFVP protokol) and tamoxifen. There was no therapy between 13-22 months because there was clinically stable disease. After month 22 there was clinical evidence of progressive disease, and the therapy was changed to medroxyp-

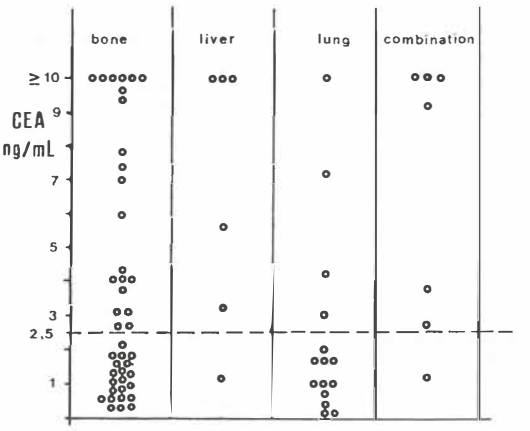

Fig. 2 – CEA levels in patients with metastatic breast cancer (sites of metastatic involvement)

rogesteron. This therapy caused a clinical improvement of the patient and there was an drop of the CEA and CA 15-3 levels.

Discussion – This study confirm and amplify some previous reports concerning the usefulness of tumor markers in breast cancer (9, 10, 11). Among other tumor markers, CA 15-3 have been described as clinically useful laboratory tool in monitoring patients with breast cancer. The use of CEA in the follow up of patients with breast cancer is controversial. While it was initially suggested as being a useful marker for breast cancer, not all authors agree (12, 13, 14, 15, 16). In our patients we found the sensitivity of CEA to be poor, and therefore it is not itself very useful for detecting occult metastases.

The present investigation makes it clear that high frequencies of elevated serum CA 15-3 and

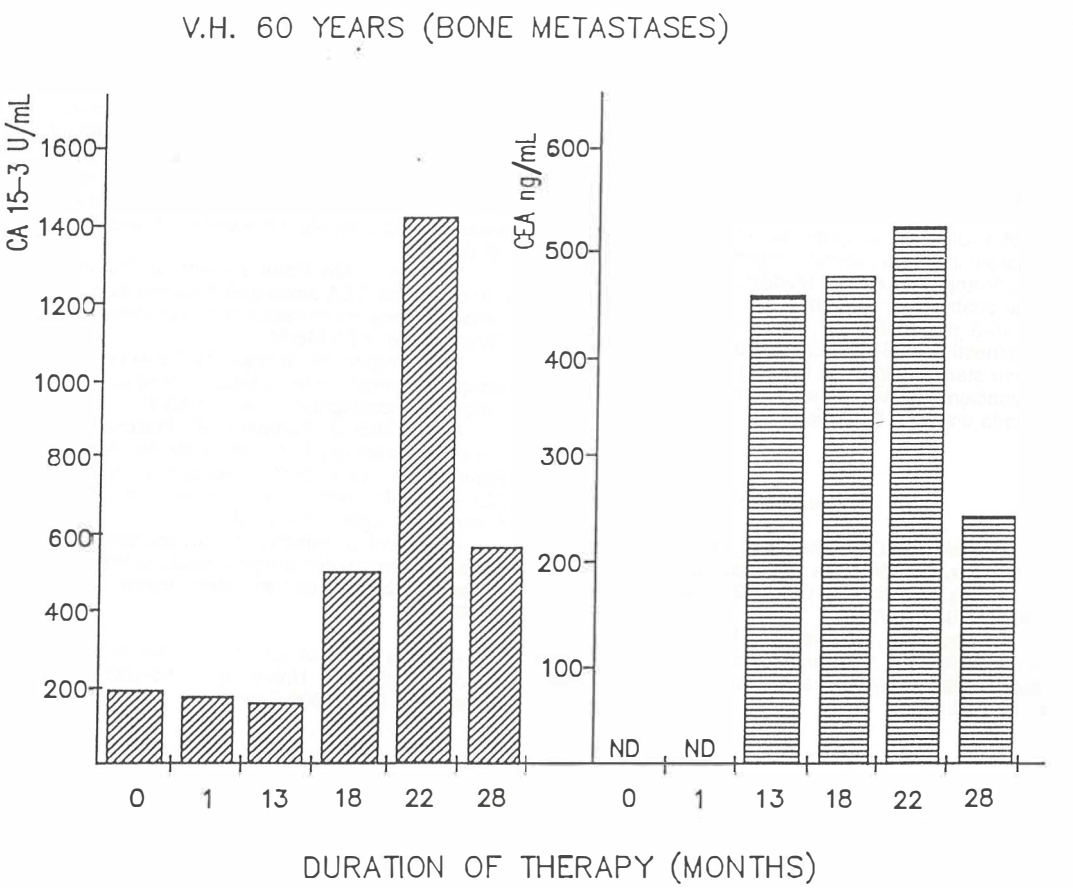

Fig. 3 – The relationship between treatment response and changes in tumor marker values. Between 0 and 13 months of the follow–up period, CMFVP protocol was used. There was no therapy between 13 and 22 months, and at 22nd month medroxyprogesteron (Depo Provera) was induced.

CEA concentration in breast cancer patients were seen only in cases of a disseminated disease. This finding may be used in the follow–up of patients, especially for early detection of recurrences and progression of disease and in monitoring of treatment success. The results also show that in patients with metastatic breast cancer, CA 15-3 levels were elevated more often than CEA levels. Thus, CA 15-3 levels were more useful than CEA for monitoring clinical course of patients undergoing treatment for metastatic breast cancer. Our results agree with those reported by others, i.e. that CA 15-3 appears to be a more sensitive marker compared with CEA for following breast cancer patients.

Sažetak

VRIJEDNOST CA 15-3 I CEA U PRAĆENJU BOLESNICA S KARCINOMOM DOJKE

U serumu 277 bolesnica s karcinomom dojke određivane su vrijednosti CA 15-3 i karcinoembrionskog antigena (CEA). 74 bolesnice imalo je metastatski tumor. Naše normale za CA 15-3 određivali smo iz skupine koju je sačinjavalo 339 zdravih osoba. Gornja granica normalnih vrijednosti za CA 15-3 i CEA iznosila je 26.4 U/ml i 2.5 ng/ml. Bolesnice s metastatskim tumorom imale su povišene vrijednosti CA 15-3 i CEA. Određivanje u različitim stadijima bolesti pokazalo je da je znatno veći broj bolesnica imalo više vrijednosti CA 15-3 nego CEA (67,1% prema 47,3%, $p<0.05$). Vrijednosti CA 15-3 i CEA značajno su se razlikovale prema stadiju bolesti, ali i u toku terapije. CA 15-3 bio je značajnije povezan s kliničkim statusom tijekom perioda praćenja bolesnica.

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UNIVERSITY DEPARTMENT OF GASTREONTEROLOGIC SURGERY

TESTING OF THE VALVE FOR CONTROLLING THE EXCRETION OF FAECES AND STOMATHERAPY IN THE EXPERIMENT ON DOGS

Košorok P

Abstract– A valve for controling the axcretion of faeces and stomatherapy of diverted bowel has been developed on the dog. The valve is installed in the terminally diverted flexure of the sigmoid colon. The inner elastic ring is inserted into the bowel and expands in the lumen of the bowel at the inner side of the abdominal wall. The greatest diameter of the inserted ring has been 55 mm, and it has been possible to continously keep the prosthesis in place for up to one week. The bowel has not been damaged by the inserted prosthesis. In the dog the prosthesis can be changed without anaesthesia. So far the need for a new surgical technique does not appear necessary; the simple terminal diversion of the bowel is sufficient.
The success of this experiment on dogs makes it appear that the valve has been developed to a stage where it could be experimentally used in human patients with rectal carcinoma who have undergone the amputation of the rectal sigmoid and require the application of anus praeter.

UDC: 616.352-089.844-092.9

Key words: colostomy – methods, prosthesis, feces, dogs

Orig sci paper

Radiol Iugosl 1990; 24:261-5.

Introduction – Patients with rectosigmoid carcinoma who have had to undergo the amputation of the rectum and installation of a diverted bowel into the abdomen (anus praeter) require special post–operative rehabilitation. Hitherto used means for such treatment have comprised self–adhesive collecting appliances with or without the skin barrier, made either in the form of a closed pouch or a pouch with an outlet. One method of post–operative care, which also enables good rehabilitation, is irrigation (self–clystering through the diverted bowel). This method is feasible at the terminally divertted sigmoid colon. According to the type and behaviour of the diverted bowel, various means are being constructed.

Yet, none of these treatments is perfect. Patients need to be informed about different types of treatment, since they are supposed to choose the appropriate sort according to various conditions, changes of the season, as well as periodic changes in digestion.

It was decided to test a new appliance which is not intended to be fastened to the skin. It is, rather, inserted through the diverted bowel into the very lumen of the bowel, in such a way that the inner elastic ring is attached to the inner side of the abdominal wall. We wanted to avoid damange to the skin, since the skin is exposed to the strongest burdening in the hitherto mentioned manners of enterostomal therapy. The anchoring of the prosthesis in the classical treatment depends on the strenght of the adhesive area and on the condition of skin. In case of skin inflammation, the adhesiveness is questionable, which causes danger of leakage of faeces to the surrounding skin, missing the pouch. Another difficulty is that the pouch may become detached; if it falls off it allows the uncontrolled leakage of faeces out of the diverted bowel.

We are suggesting a new means of enterostomal therapy consisting of a valve with an inner elastic ring which can be inserted into the lumen of the bowel. After installation, the elastic ring again expands into the bowel. The abdominal pressure attaches it against the inner side of the abdominal wall. Since the diameter of the inserted ring is larger than that of the bowel, the ring cannot fall out. In this manner, the inner anchoring of the prosthesis is achieved – thus avoiding the severe burdening of the skin which was one of the worst problems in the types of therapy used so far. In the past, the skin has been damaged by the mechanical burdening of

Received: May 13, 1990 – Accepted: May 24, 1990

the weight of the appliance, frequent stripping off the applances with strongly adhesive surface and, in the classical self–adhesive appliance, also by the steam closure, which is disables the skin to breathe.

Materials and methods – In the experiment on dogs we applied the surgical technique of terminal diversion of the distal colon. The distal part of the bowel is blind ended.

According to the plan, we utilized the prostheses with growing diameters of the inner ring. We tried various external parts of the prosthesis, used for the retention – prevention of the slipping of prosthesis into the abdomen (Fig. 1). The external part of the prosthesis can be prolonged by an additional piece with an open bottom, thus achieving the leading away of the faeces to the furthest possible distance from the animal (Fig. 2). To prevent the animal from biting off the prosthesis from the artificial anus, a safety basket was attached to its collar.

During the whole period of the experiment, the experimantal animal was fed with food containing no thick residues.

The experiment was performed on four animals; in the years 1982 and 1983 on two dogs (German shepherds), and in 1987, one experiment on a German shepherd and the other on a karst shepherd.

The experiments were carried out at the Clinic for Carnivorous Animals at the Veterinary Faculty in Ljubljana (Department of Veterinary Hospital, Cesta v Mestni log 40, Ljubljana), in collaboration with M. Sc. Zlatko Pavlica, veterinarian.

In human patients, the sigmoid stoma is applied in cases of rectal cancer, after amputation of the complete rectal sigmoid.

In the experiment on a dog, the colon was discontinued at the level of the sigmoid colon, the distal part blindly sutured, and the stump left in the abdominal cavity. The terminal sigmoid colon was diverted through the trephine hole of the abdominal wall in the left lower quadrant of the abdomen. The sugery resembles the Hartman type of resection in human patients.

Results – Surgical diversion of the terminal sigmoid, as applied in patients with rectal carcinoma in which the amputation of rectosigma is necessary, was experimentally carried out in four dogs.

Fig. 1 – Different forms of the prosthetis; demonstration of the longitudinal elasticity of the rubber tube

Fig. 2 – Torsion of the elastic tube – emphasis on the small bulge of the rubber tube, which connects both pieces

In the first dog (German shepherd), the diversion of the sigmoid was performed in an already sacrificed animal in order to study the anatomy and the surgical technique.

In the recently sacrificed dog the colon was discontinued in the sigmoid level and the sigmoid stoma diverted through the trephine hole in the left lower quadrant of the abdomen. The distal stump of the colon was sutured in two layers and left in situ, as in the Hartman procedure (Fig. 3).

In the order dog, the identical procedure was carried out under endotracheal anaesthesia. The animal recovered in a few days; in three week's time we started testing the prosthesis. Here, we ran across unexpected trouble. The animal pulled out the prosthesis with its teeth; the prosthesis had to be reinstalled. During the installation, the animal was (intraveneously) sedated by an injection of Combelen.

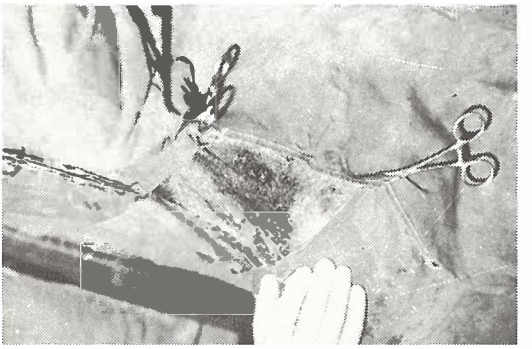

Fig. 3 – Experimental terminal sigmoid anus in a dog

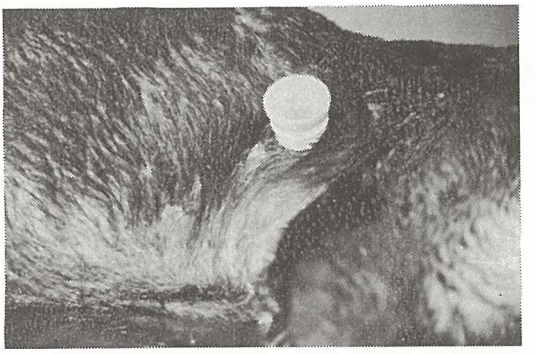

Fig. 4 – Valve inserted into a diverted bowel

Since the dog continued removing the prosthesis, we decided to fix the external part of the prosthesis to the skin. The operation was performed in premedication with Combelene and under barbiturate anasthesia (Nesdonal). The external tube of the prosthesis (Fig. 4) was fixed with polidec stitches.

The animal now tolerated the prosthesis because it was sutured onto the skin and its removal would cause pain. The prosthesis remained in place for a week. Later, though, the dog managed to bite through the sutures and eliminate the prosthesis.

The third dog, a mongrel – German shepherd, was somewhat smaller. For that reason we tried to expand the terminal part of the sigmoid with a few cuttings and a surgical transformation. Unfortunately, the animal was unsufficiently purged before surgery. This provoked leakage and peritonitis owing to which the animal survived for only two days after the surgery.

The second dog – the karst shepherd was of suitable proportions, whereupon we decided to carry out a simple discontinuance of the sigmoid and a terminal sigmoid stoma. The opreration was successful. After three weeks it was possible to insert the valve as in the primary version (from the years 1982 and 1983), and to suture the external ring onto the skin. It turned out that the inner ring of the valve was too small (35 mm). This provoked the leaked of faeces to the area around the valve. The valve remained positioned for 3 to 4 days; later the animal managed to remove and destroy it without trace.

In further experiments we installed a number of valves. The insertion was done without suturing, mainly in order to alow the attachment of the inner ring against the inner abdominal wall. A negative effect appared when the prosthesis was sutured to the skin because it was then not possible to adjust the length of the rubber tube. The prosthesis was attached to the skin while the inner ring floated loose in the lumen of the bowel. This caused leakage of faeces at the side of the inner ring. At the changing of the prosthesis, the diameter of the largest one was 55 mm, which was double the width of the lumen of the bowel in the experimental animal.

In one case the symptoms of ileus were observed. The animal vomited after feeding, yet appeared lively during the later walk.

Clinically, no symptoms of peritonitis could be observed. We removed the prosthesis and palpated the distal bowel. In the lumen of the bowel we could find a few lumps of faeces mixed with hay, which literally obturated approximately 10 cm of the terminal bowel. The extraction of the prosthesis, digital evacuation of the hay lumps and the revised insertion was performed without any problems. The animal became lively again. With the exception of this short interruption, the 55 mm prosthesis remained installed for another day (totalling 4 days). Later, the prosthesis repeatedly fell out and was reinserted. Al together, the total period that the prosthesis was installed was one week. Finally the prosthesis fell out and could not be found any more.

Discussion – The experiment showed that the terminally diverted colon successfully witstood the dilation with the elastic ring for up to the lenght which twice exceeded the width of the bowel. It was found unnecessary to enlarge the prosthesis over the double diameter of the lumen of the bowel, as the satisfactory inner anchoring could be achieved at smaller diameters.

Suturing of the external retention ring on the skin gave negative consequences. Not only did

this method damage the animal, it also suppressed the genuine fitting of the inner ring. Noticeable leakage of faeces at the side of the inner ring was observed.

In other prostheses which were not sutured on the skin, the leakage of faeces was not observed. Nevertheless, minor leakage might be presumed, this being impossible to estimate owing to poorer hygienic conditions. A number of external retention rings had been applied – from the simplest thin ring to the 5 cm tube. The longer tube was adequate for the adjustment of the prolongation and for the regulation of stretching of the tube. Yet, at the same time it provoke negative effects – it worked as a lever which luxated the prosthesis out of the bowel in case the animal lay on it.

The external prolongation, as used in our experiment, enabled the excretion of faeces in the furthest possible distance from the animal, thus avoiding dirtyng of the animal. The negative side was that it was within easy reach for the animal to pull it out with its teeth. Such a removal of the prosthesis was quite successfully avoided by installing the safety basket on the animal's collar.

A number of intresting conclusions were derived from the phase of the experiment in which ileus occurred. The obturation of the prosthesis with the hay lumps provoked a stronger dilation of the bowel than usual. The increased pressure inside the bowel pressed the ring against the abdominal wall even harder, thus raising the possibility for the forming of pressure sore necrosis. The latter had been considered the worst danger for the use of the prosthesis. The ileus lasted approximately one day. The distension of the bowel additionally aggravated the blood circulation in the inestinal wall. In spite of all this, the bowel was not damaged at the place where the prosthesis was inserted.

From this incident we gain more insight into the experiment. The prosthesis could easily be extracted without sedative (Combelen) or anaesthetic (Nesdonal). The hey lumps were easly digitally removed from the lumen of the bowel. This brought us to the conclusion that the insertion and changing of the prosthesis was not an axtraordinarily painful and disagreeble procedure for the experimental animal; it could be expected that this would be true also in human patients.

The obstruction of the prosthesis with the lumps implies another favourable possibillity for human patients. The complete tightening up of the prosthesis could be desirable as a possibe way of assuring complete continence of the artificial anus.

Considering the fact that the most appropriate place for the diversion of the bowel in

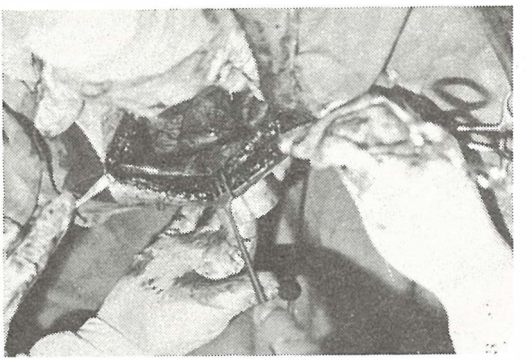

Fig. 5 – Demonstration of anchoring of the inner ring

Fig. 6 – Inserted prosthesis with the collecting pouch. The pull stresses the firmness of installation of the inner ring.

human patients is the left lower quadrant of the abdomen, we used the same location in dogs. In our opinion, a more suitable location when the operation is repeated would be in the median line, perhaps involving the excision of the umbilicus. So far, no need for a new surgical technique has been observed.

The performance of the prosthesis, applied hitherto (Fig. 5, 6) satisfied the set goals. It appears reasonable to pass on to the experimental use of this prosthesis in human patients. Only their observations and feelings could give us the necessary feed–back information and guidance for further adjustments, or changes of the primary construction of the prosthesis.

Only one published source which deals with the application of a similar prosthesis could be found in the literature. It is manufactured by the firm Johnson–Johnson(1). In the national literature, the installation of the rumen fistula in a calf, which was in use at the Institute of Psyhology of the VeterinaryFaculty in Ljubljana, for the study of digestion in the calf, should be mentioned (2).

The commercial prosthesis for the rumen fistula with the valve, used experimentally for studying the digestion in the calf is known as well. It can be installed for an optional period of time (3). When studying the animal digestion the permanent intestinal canilas (Brueggemann–Jovanović type) (4) in open fistulas are used. Generally, the analysis of the literature which was available to the author showed no attempts to control the excretion of faeces at the diverted bowel in a similar way (MEDLARS register, Koeln).

Povzetek

PREISKUS ZAKLOPKE ZA KONTROLO IZLOČANJA BLATA IN NEGO IZPELJANEGA ČREVESA V EKSPERIMENTU NA PSU

V poskusu je bila uporabljena vrsta zaklopk za kontrolo izločenja blata pri izpeljanem črevesu, ki smo jih vstavljali v svetlino črevesa. Želeli smo preiskusiti ali notranji elastični obroč more povzročiti dekubitalno okvaro črevesne stene. Črevo je ostalo nepoškodovano tudi v slučajno nastalem ileusu. Menimo, da ta izvedba proteze ne okvarja črevesa. Predpostavljamo, da bi enak tip proteze lahko poskusno uporabili tudi pri bolnikih, ki bi nam lahko dali koristne povratne informacije. Te bi nam služile pri daljnjem razvoju proteze. Slučajno nastali ileus zaradi začepljenja proteze nakazuje še drugo možnost, ki bi bila pri bolnikih z anus praetrom zaželjena. S poklopcem na zunanjem nastavku bi dosegli kontinenco anus praetra.

Menimo, da je v tem eksperimentu zaklopka že razvita do stopnje, ko jo je možno uporabiti pri bolnikih s karcinomom rektuma, ki imajo amputirano rektosigmo in narejen anus praeter.

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OCTOBER 3–5, 1991

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The official language of the Congress will be English

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Dilemmas in HPB Surgery and Medicine

Topics: HPB trauma
liver metastases
HPB malignancies
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chronic pancreatitis
tumors of biliary tract
transplantations
will be presented and discussed in:

PLENARY SESSIONS, with pro and contra lectures, round table discussion and free papers

VIDEO SESSIONS, presenting surgical and nonsurgical techniques,

POSTER SESSIONS, where the posters of the above mentioned topics will be discussed and prizes will be awarded to the best posters.

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Reception an the Town Hall
Concerts
Tours of lake Bled, Postojna Caves, Lipica

ACCOMMODATION

A number of rooms – single and double – will be reserved for the Congress Participants and their Accompanying Guests at hotels in Ljubljana, all within walking distance from the Congress venue.

EXHIBITION

An exhibition of pharmaceutical and surgical equipment will be held at Cankarjev dom.

DEPARTMENT OF RADIOTHERAPY[1], ENT – DEPARTMENT[2]
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HIGH DOSE RATE Ir–192 IMPLANTS IN THE TREATMENT OF CANCER OF THE VOCAL CORD

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Abstract – Since September 1986 an Ir-192 source with a high dose rate has been used for interstitial boosting of the tumor–bearing vocal cord in the organ–preserving management of larynx carcinoma. So far 6 patients with 8 vocal cord tumors have been treated. 5 patients presented with a T1 tumor, 2 of them with an in situ carcinoma in the contralateral vocal cord, and 1 patient presented with a T2 stage. All patients except 1 underwent local tumor removal. The treatment method included external radiotherapy with a dose of 5000 cGy to the larynx. The patient who refused surgery was treated with 6000 cGy. 1 to 2 weeks after external radiotherapy an interstitial implant into the vocal cord was performed. Using two needles per cord a boost dose of 1000 cGy was given to the tumor area. The method of implantation and the needle set–up will be described. The median follow–up time is 34 months (range 44-20, calculated May 1990). So far no local or regional failures occured. None of the patient had intra–or postoperative complications. All patients have preserved their voice, 2 of them present with a mild hoarsness. Concerning the late effects, 1 patient developed a mild submental edema, 1 patient presents with teleangiectasia on the treated vocal cord. The number of patients is very low, but the psycho–social aspects of preserving the ability to speak is of high value.

UDC: 616.22-006.6:615.849.2

Key words: laryngeal neoplasms–radiotherapy, vocal cords, brachytherapy, iridium radioistopes

Orig sci paper

Radiol Iugosl 1990; 24: 269–72.

Introduction – In the first half of our century vocal cord carcinomas were treated with Radium implantations (1, 2, 3, 4) and this method has been preferred by some radiation expert in the last 3 or 4 decades (5, 6, 7). Brachytherapy has been replaced by the introduction of teletherapy and in part by surgical procedures. Recently brachytherapy has come back into use, using mainly the isotope Iridium-192. Most centers use wires with a low dose rate source. Usually radiation treatment is the initial treatment prescribed for early lesions, with operation reserved for salvage of irradiation failures. While chordectomy or hemilaryngectomy will produce comparable cure rates for selected T1 and T2 vocal cord lesions, irradiation is the preferred initial therapy. The major advantage of irradiation compared to chordectomy or hemilaryngectomy is that the voice quality is likely to be better. The voice after hemilaryngectomy remains hoarse. After successfull irradiation the voice is usually better than before therapy, a worsening of voice quality is uncommon. Hemilaryngectomy may be used as a salvage operation in suitable cases after irradiation failure. Complete stripping of the mucosa of the cord is sometimes curative for lesions variously classified as leukoplakia, dysplasia or carcinoma in situ. In these patients early use of irradiation means a better chance of preserving a good voice. The difficulties in differentiating of carcinoma in situ from microinvasion tend to put the decision towards radiation.

There is an increasing use of the laser surgery in removing benign lesions and very early carcinomas involving the true vocal cords (8).

Preservation of the voice and quality of life should be considered before deciding on the treatment method (9). Occasionally radiation therapy leads to a permanent hoarsness (10, 11), but in general after surgery – even after conservation of the vocal cord – a considerable reduction of the voice quality is to be expected (12). The reduction of speechability and the quality of voice results in a reduction of life quality (13, 14, 15). The results after laryngectomy and the complete loss of voice are well known: The patient retreats from his social surrounding, from his workplace as well as from the family. Often these circumstances results in

The material was presented on Synposium: »New arhievements in radiotherapy«, Ljubljana, October, 1989.

Received: June 26, 1990 – Accepted: July 17, 1990

chronic alcoholism. Many patients are not able to continue with the treatment or to cooperate because of their low social status. After laryngectomy only a small percentage of patients are able to use the offered help, e.g. to learn the socalled esophagus speech', or to use electronic aids.

Patients and Method – Since December 1986 an Iridium 192 source has been used for interstitial boosting of the tumor – bearing vocal cord in the organ preserving management of larynx carcinoma. Until September 1988 6 patients with 8 vocal cord tumors have been treated: 2 patients presented with tumors on both cords and were treated simultaneously. 5 patients presented with a T1 tumor, 2 of them with an in situ carcinoma in the contralateral vocal cord, and 1 patient with a T2 stage. All except 1 T1 patient underwent tumor excision or cord stripping. Irradiation for early vocal cord cancer is delivered by small portals, covering only the primary lesion. Tretment fields for T1 and T2 tumors usually extend from the thyroid notch superiorly to the inferior border of the cricoid. The posterior border depends on the posterior extension of the tumour. The field size ranges from 4x4 cm to 6x6 cm. The incidence of lymp node involment is so small (0% - 1%), that elective irradiation of nodes usually is recommended only for T3 or T4 lesions, or for T2 lesions with poorly differentiated histology (16). Our treatment method included percutaneous radiotherapy with a dose of 5000 cGy to the larynx with 2 treatment portals in the size of 5*5 or 6*6 cm using wedge filters. The patient who refused surgery was treated with a dose of 6000 cGy. 1 to 2 weeks after external radiotherapy an interstitial implant into the vocal cord has been performed. Using 2 needles per cord a boost dose of 1000 cGy was given to the tumour area by means of a high dose rate Ir-192 source. Its maximum activity is 8 Ci. The procedure is performed under general anesthesia of the patient. Using a Kleinsasser or Weerda device the needles were inserted by the ENT–surgeon under direct view of the cord. The distance between the needles is 10 mm in the range of 7 to 12 mm. The dose of 1000 cGy is calculated to that isodose which covers the entire area of the primary lesion. Fig. 1 shows the combied isodose–plot of external and interstitial radiotherapy. An interoperative prednisolone i.v.–dose prevents the patients from major edemas. The treatment time per needle depends on the actual activity of the Ir–source and is usually in the range of 1 to 2 minutes. The Ir–source oscillates inside the needle and the lenght of oscillation can be adjusted from 1 to 4 cm by mechanical disk. Using the 4 cm oscillation path the tratment volume, this is the 1000 cGy isodose shell, shows a size of about 1 to 2 to 4 cm.

Until May 1990 16 patients have been treated in the same method. All the statements mentioned above remain true concerning all patients.

Results – The median follow up time of these 6 patients is 32 months in a range of 18 to 42 months refferred to March 90. So far no local or regional failure ocurred. All patients are free of

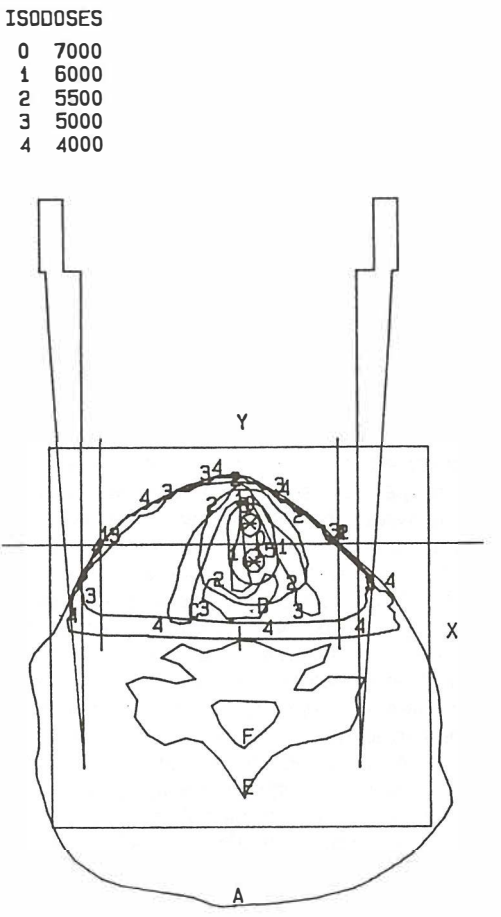

Fig. 1: Dose distribution of the combined plan of external radiation and interstitial therapy. Isodose No. 1 marks the 6000 cGy area, No. 2 5500 cGy, and No. 3 5000 cGy.

disease. None of the patients had intra – or postoperative complications. The side effects to the glottic mucosa are slight and transient. An intraoperative prednisolone i.v.–dose prevents the patients from major edemas. All patients have preserved their voice. 2 of 6 present with a mild horsness. No functional troubles in swallowing have been observed. Concerning the late effects 1 patient developed a mild submental edema, 1 patient presents with teleangiectasia on the treated vocal cord.

Discussion – In the treatment of T1-T2 tumours with radiation therapy, a high percentage of disease free survival can be expected (17). The goal of radiation therapy, on the one hand, is cure with the best functional result and the least of serious complications (18), and on the other hand, is to reduce the rate of local recurrences as much as possible, both by carefull planning of the radiation and adequant dose application (19, 20). The main advantage of radiotherapy in comparison to laryngectomy or hemilaryngectomy is the preservation of the voice (21). In case of a local recurrence surgical operation to remove the tumor can be undertaken. A decision to perform a hemilaryngectomy or a total laryngectomy depends on the extent of the tumour. A survey by Stalpers concerning the rate of local recurrences and survival shows a survival–rate of 86% after primary radiation (in the range of 80% to 91%) and of 88% after primary surgery. The rate of local recurrences after primary radiation is 30% and after surgery 20%. The possibility of salvage surgery after local recurrences is 50% in the radiation therapy group and 30% in the surgery group. After salvage surgery the rate of persistent local recurrences in the radiotherapy group therefore is 15%. In the group of patients with primary surgery (and a 20% local recurrence rate) only 6% could be considered tumour free after salvage surgery (14% unsalvaged). These are average data from different cancer centers and clinics. It is to be noted that each individual center or clinic offers different results wich could lead to different conclusions.

Some authors report a correlation of the incidence of local recurrences, on the one hand to the applied dose and to the other hand to the size of the treatment portals dependent of the tumour stage (16, 22). Some papers indicate no noticable reduction of local recurrences with increased radiation doses (23). Accelerated fractionation seems to be successfull (8, 18, 24).

Pene (25) reports about in situ carcinomas in the stage T1 and T2 showing the same rate of local recurrences as invasive tumours. He assumes that these are not true recurrences but a new tumour deriving from the primary dysplastic epithelium. It is to be considered that along with every diagnosed in situ carcinoma other invaded areas may be present.

The number of patients in our series treated with high–dose–rate Iridium implantations is very low, therefore the data are of limited value, but the psycho–social aspects of preservation of the ability to speak is of high value. The preliminary results are encouraging: so far no local or regional recurrence have occured. It remains to be seen if a boost using Iridium implantation directly into the vocal cord results in a noticable reduction of local recurrences.

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RADIOTHERAPY FOLLOWING QUADRANTECTOMY IN STAGE T1 – T2 BREAST CANCER

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Abstract – Two consecutive studies from March 1981 through November 1988, comparing quadrantectomy followed by 60 Gy/30 fractions radiotherapy delivered over 6 weeks and quadrantectomy followed by 50 Gy/25 fractions over 5 weeks in stage T1-T2 breast cancer, were carried out at our Department. Also in our experience the conservative treatment is a valid alternative to mastectomy: good-excellent cosmetic results can be obtained with an acceptable toxicity and with a good local control over disease thus improving the patients quality of life.

UDC:618.19-006.6:615.849.5

Key words: breast neoplasms–radiotherapy, radiotherapy dosage

Orig sci paper

Radiol Iugosl 1990; 24:273-6.

Introduction – In the most recent years in the U.S.A., owing to early diagnosis, about 80% of the patients with a diagnosis of breast cancer, and with cancer measuring less than 5 cm in diameter, not adjacent either to skin or to chest wall, with or without positive lymph nodes, have a stage T1-T2 at presentation.

Most of the patients are candidates for a conservative treatment (either quadrantectomy or segmental resection, followed by radiotherapy) thus improving cosmetic results with a consequent improvement in the patients quality of life (1).

As demonstrated by several clinical trials, the results obtained with the conservative treatment are comparable to those reported for radical mastectomy: a randomized trial by Fisher reported a recurrence rate of 4 and 7% respectively for the 2 groups (2, 3).

No statistically significant difference on local control and survival between the 2 groups (mastectomy versus quadrantectomy plus axillary dissection plus radiotherapy – QUART) were also reported in a randomized study on 701 patients with T1 N0 M0 breast cancer, carried out at the Istituto Nazionale Tumori in Milano (Italy) from 1973 through 1980: disease–free survival was 80% at 9 years (4, 5) (Fig. 1).

Radiotherapy following local surgery on the involved breast improves local control (reducing the rate of recurrence from 30 to about 10%) as a prophylactic treatment for either possible residual or microscopic disease (6, 7).

Patients usually receive a total dose of 50 Gy using 2 opposed tangential fields on the tumor bed. Higher doses are not advisable since they may cause fibrosis and/or retraction of the treated breast and, as a consequence, poor cosmetic results.

Patients receive irradiation over a period of 5 weeks, 5 days a week; daily doses range from 180 to 200,rad. A boost of 10-15 Gy either with fast electrons or Iridium 192 implants on the tumor bed is indicated when, at histology, resection margins are not clearly free from neoplastic infiltrations.

In presence of positive lymph nodes, the approach varies according to the chemo or monotherapy treatment (8, 9).

The material was presented on Symposium: »New achievements in radiotherapy«, Ljubljana, October, 1989.

Received: June 24, 1990 – Accepted: July 17, 1990

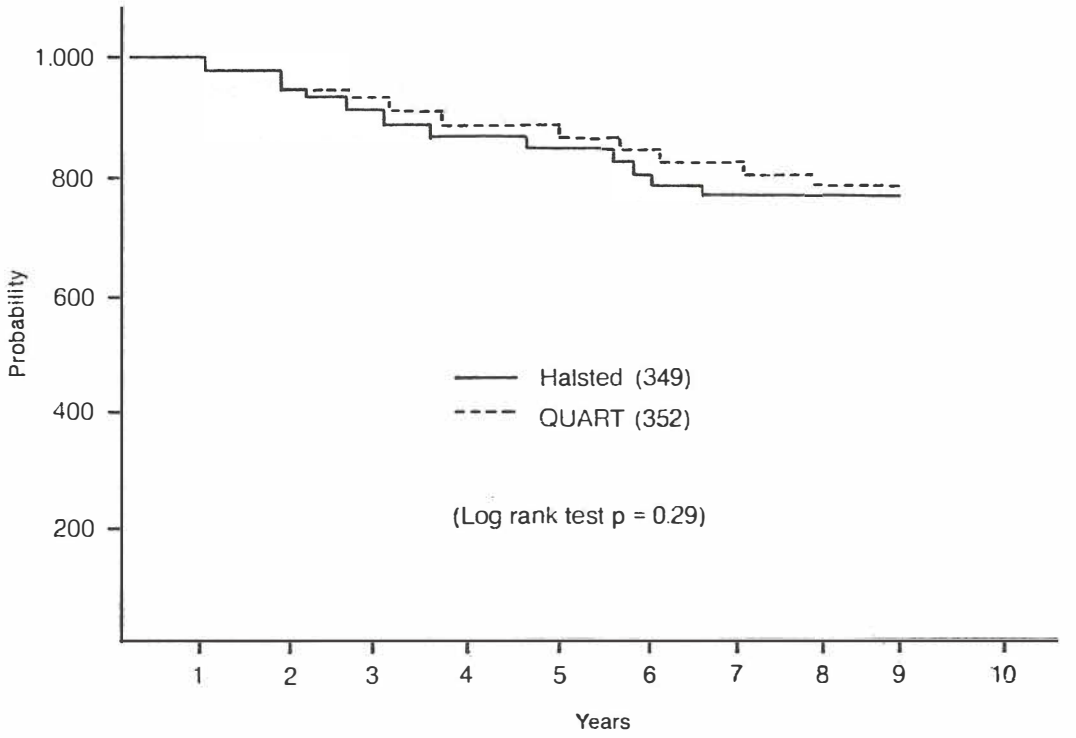

Fig 1 – Actuarial disease–free survival in patients treated with Halsted mastectomy and in patients treated with quadrantectomy plus axillary dissection and radiotherapy (QUART). From: HARRIS JR, HELLMAN S, Silen W. Conservative Management in Breast Cancer. New Surgical and Radiotherapeutic Techniques. J.B. Lippincott Company, Philadelphia, 1983.

Results and discussion – From March 1981 through June 1987, at the Radiotherapy Department of the Centro di Riferimento Oncologico (C.R.O.) in Aviano – Pordenone, 116 patients with stage T1 – T2 breast cancer, were treated with quadrantectomy plus axillary dissection and radiotherapy; 86 patients were classified as stage 1 and 30 as stage 2.

The outer upper quadrants were the most interested (56%) and, in general, the upper quadrants were more interested compared with the lower (Table 1).

After axillary dissection, 93 patients showed negative and 23 positive lymph nodes.

Treatment consisted of 50 Gy/25 fractions/5 weeks on the involved breast, delivered with a 6 MeV Linear Accelerator, using wedge filters, followed by a boost of 10 Gy/5 fractions/1 week with fast electrons (8-12 MeV) on the tumor bed.

From July 1987, the patients with a stage T1-T2 breast cancer, were scheduled to receive 50 Gy/25 fractions/5 weeks on the involved breast without the 10 Gy boost on the tumor bed.

On September 30 1989, 106 patients entered the latter study: cancer was classified as stage 1 in 98 patients and as stage 2 in 8. Also for the patients entered in the latter study the outer upper quadrants were the most involved (52%) (Table 5). Sixtysix patients had negative and 40 positive lymph nodes. Patients with positive lymph nodes were also treated with adjuvant chemo or monotherapy. The results of the 2 studies are reported in tables.

On September 30 1989, out of the 116 evaluable patients treated with 50 Gy, delivered in 25 fractions, and with a boost of 10 Gy on the tumor bed, 5 (4,3%) developed distant metastases and 3 (2,6%) locoregional recurrence. The median follow–up was 44 months (range 18,5 – 104,5) (Table 2).

Acute toxicity from radiotherapy was reversible and the late acceptable. Fifty–two (45%) patients developed epithelitis and in 8 (7%) radiological sings of rib bone changes were recorded.

Cosmetic results, according to Beadle and Danoff (10, 11), were good–exellen in 72 patients (62%) (tables 3, 4).

Table 1 – Radiotherapy following quadrantectomy in stage T1–T2 breast cancer 60 Gy/30 fractions/6 weeks (March 1981 – June 1987)

	SITE OF PRIMARY				
Right breast	: 58	27	11	3	38
Left breast	: 58		|	|	
Outer quadrants	: 69‰		– 5 –	– 8 –	
Inner quadrants	: 20%		|	|	
Quadrant borders	: 11%	9	6	3	6

Table 2 – Radiotherapy following quadrantectomy in stage T1–T2 breast cancer 60 Gy/30 fractions/6 weeks (March 1981 – June 1987)

	RESULTS
Loco–regional recurrence	: 3/116 (2,6%)
Distant metastases	: 5/116 (4,3%)
Median follow–up	: 44 months (range 18,5 – 104,5)

2 patients died of non–neoplastic causes after 14 and 31,5 months from radiotherapy

Table 3 – Radiotherapy quadrantectomy in stage T1–T2 breast cancer 60 Gy/30 fractions/6 weeks (March 1981 – June 1987)

	COSMETIC GRADING
Exellent	: Treated breast almost identical to untreated;
Good	: Minimal difference between the untreated and the treated breast;
Fair	: Obvious difference between untreated and treated but without major distortion;
Poor	: Major functional and aesthetic sequela in treated breast.

Definition of Fair to Poor cosmetic grading

Moderate or severe breast retraction
Moderate or severe breast retraction + teleangiectasia
Moderate or severe breast retraction + edema
Severe teleangiectasia

Modif. from Beadle GF et al. Cancer 1984; and Danoff et al. Int J Radiat Oncol Biol Phys 1983.

Table 4 – Radiotherapy following quadrantectomy in stage T1–T2 breast cancer 60 Gy/30 fractions/6 weeks (March 1981 – June 1987)

	COSMETIC RESULTS	
N. evaluable patients	: 116	
– Exellent	: 24	(21%)
– Good	: 48	(41%)
– Fair	: 22	(19%)
– Poor	: 22	(19%)

Table 5 – Radiotherapy following quadrantectomy in stage T1 – T2 breast cancer 50 Gy/25 fractions/5 weeks (July 1987 – November 1988)

	SITE OF PRIMARY				
Right breast	: 52	28	9	11	27
Left breast	: 54		4	1	
Outer quadrants	: 70%	– 2	–	– 1	1 3 –
Inner quadrants	: 22%		3		
Quadrant borders	: 8%	6		2	8

Table 6 – Radiotherapy following quadrantectomy in stage T1 – T2 breast cancer 50 Gy/25 fractions/5 weeks (July 1987 – November 1988)

RESULTS		
Loco–regional recurrence	:	1/106 (1%)
Distant metastases	:	1/106 (1%)
– 1 patient (p T1 N0 M0 G3 pre–menopausal): pelvis – 4,5 months after radiotherapy		
Median follow–up	:	21,5 months (range 10 – 36)

Table 7 – Radiotherapy following quadrantectomy in stage T1 – T2 breast cancer 50 Gy/25 fractions/5 weeks (July 1987 – November 1988)

COSMETICS RESULTS			
N. evaluable patients	:	106	
– Exelent	:	58	(55%)
– Good	:	34	(32%)
– Fair	:	12	(11%)
– Poor	:	2	(2%)

On September 30 1989, out of the 106 patients entered into the study employing quadrantectomy plus radiotherapy without the final boost on the tumor bed, 1 patient developed distant metastases and 1 loco–regional recurrence. The median follow–up in this group of patients was 21,5 months (range 10 – 36) (Table 6) with an acceptable toxicity (40% reversible epithelitis and no radiological signs of rib bone changes).

Cosmetic results were good–exellent in 92 patients (87%) (Table 7) (10, 11).

Also in our experience, in early stage breast cancer, quadrantectomy plus axillary dissection followed by radiotherapy is a valid alternative to mastectomy; good–exellent cometic results can be obtained thus improving the patients quality of life.

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PRELIMINARY REPORT ON RADIOTHERAPY IN STAGE III OVARIAN CANCER PRETREATED BY SURGERY AND CHEMOTHERAPY

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Abstract – Twenty patients with FIGO stage III epithelial ovarian cancer were treated by radiation therapy (whole abdominial radiation with 30 Gy, followed by a subdiaphragmatic/paraaortic boost with 12 Gy and a field to the true pelvis up to a total dose of 51.5 Gy) after aggressive surgery and combination chemotherapy. Second–look laparotomy was not performed in this patient series. Seventeen patients completed the full course of radiation. Two patients had to be abandonned from further radiotherapy due to acute hematologic toxicity, and one patient refused treatment. Transient hematologic toxicity occurred in 5 patients (29%), necessitating treatment breaks ranging from 8 to 16 days (median 12 days). Seven patients relapsed within the abdomen, 2 patients presented with extraabdominal lymph node metastases as sole site of failure. The overall and relapse–free survival at 3 years was 69% and 47%, respectively, with a median follow–up of 24 months (mean 27.5 months). A correlation with overall and disease–free survival among various factors evaluated (including histologic subtype, tumor grade, amount of residual disease after surgery and lymph node involvement) showed that only the extent of residual tumor left at surgery was predictive for the ultimate course of disease ($p < 0.01$). Radiation was well tolerated with only one serious complication requiring surgical intervention due to bowel obstruction. Preliminary results suggest that combined surgery and chemo–radiotherapy has an impact on disease–free survival only for patients with microscopic or minimal disease after surgery.

UDC:618.11-006.6:615.849.19

Key words: ovarian neoplasms–radiotherapy

Orig sci paper

Radiol Iugosl 1990; 24: 277–81.

Introduction – Combined effort has been directed to improve the survival rates for patients with advanced stage ovarian cancer. Inspite of more aggresive surgery the use of different drug combinations (1, 2, 3, 4, 5), and the delivery of high dose radiation for consolidation (2, 3, 4, 6, 7, 8, 9, 10, 11) the results have remained poor.

Although several prognostic indicators such as stage, histological subtype, grade, and residual disease have been indentified and were found to be of significance, the differing therapeutic approaches in the past make it difficult to campare the results of the various studies performed (4, 12, 13, 14).

Former investigations have suggested the potential benefit of radiation as first line therapy after surgery in a certain subgroup of patients (15, 16, 17, 18, 19), the operative procedures in these patient series, however, vary greatly and for some the staging procedures might appear inadequate today.

A more recent approach, combining maximum cytoreductive surgery with combination chemotherapy utilizing cis–platinum, subsequently followed by high–dose radiation, has demonstrated poor tolerance to large field irradiation with significant hematologic toxicity and a high percentage of serious complications (7, 18, 20, 21).

In an attemt to evaluate pretreatment and treatment factors predictive of recurrent disease and to assess the sites of failure as well as treatment related toxicity, a prospective study was initiated in cooperation with the University Clinic of Gynecology and the Division of Radiotherapy in Graz utilizing a trimodality tratment approach in patients with stage III ovarian cancer.

Patients and methods – Since May 1985, 20 patients with FIGO stage III epithelial ovarian cancer, aged 43-68 years (median 59 years) have been treated with maximum cytoreductive surgery followed by multidrug chemotherapy and high dose radiation.

Patient selection criteria were: age less than 70 years, Karnofsky performance status > 80 %, no radiological evidence of distant metastases, normal renal and hepatic function, no history of

The material was presented on Symposium »New achievements in radiotherapy«, Ljubljana, October, 1989.

Received: April 30, 1990 – Accepted: May 17, 1990

malignant disease aside from basal cell carcinoma and no severe concomitant medical illness.

Preoperative radiological work–up consisted of chest x-ray, CT scan of the abdomen and pelvis, and intravenous pyelogram (IVP). If indicated, ultrasound of the liver was performed in addition to help rule out hepatic metastases.

The surgical procedure was aggressive and included hysterectomy, bilateral oophorectomy, omentectomy and attempted radical lymph node dissection of both the pelvic and paraaortic nodes. If tumor showed involement of adjacent organs or structures, either partial cystectomy, appendectomy, abdominoperineal resection or resection of parts of the intestinum were performed. Exploration of the diaphragmatic surface and peritoneal washings were carried out routinely.

Postoperatively the complete surgical specimen was examined to determine stage, lymph node involvement, tumor subtype and grade.

Two to 3 weeks after surgery systemic therapy was initiated with the aim to deliver 6 cycles of a multidrug regimen containing cis–platinum (PAC).

Subseqent to the completion of chemotherapy a complete clinical and radiological restaging was performed. If blood counts showed at least 3000/mm^3 leukocytes and 100 000/mm^3 platelets, respectively, radiation therapy was initiated.

The treatment fields were planned using a CT–aided planning system. The radiation technique chosen was similar to the technique described by Schray et al. (21) with minor modifications with regard to blocking of the kidneys and liver, an enlarged width of the subdiaphragmatic boost field and the simultaneous treatment of abdominal lymph nodes and the true pelvis. First, an open abdominal AP/PA field (WAP) encompassing the entire peritoneal cavity was applied up to a total dose of 30 Gy (1.5 single fraction per day,5 days a week). After a 2-week rest a subdiaphragmatic boost field with 12 Gy was added in cases with negative paraaortic nodes. If involvement of these nodes had been assessed histologically the field was extended to cover the entire subdiaphragmatic and paraaortic lymph node region.

Simultaneously, the true pelvis was treated in all patients up to a total dose of 51.6 Gy with a single fraction of 1.8 Gy per through AP/PA shaped fields.

Blood counts were performed once a week or more often if indicated. Follow–up exams were scheduled on a 3-month basis and included physical examination, blood chemistry, assessment of tumor markers, and radiological work–up.

Statistical analysis – Survival was measured from the onset of surgical therapy and the onset of radiation utilizing the Kaplan–Maier product limit method (22). The Cox proportional hazard model was used for the determination of prognostic factors correlating with overall or disease–free survival (DFS). The statistical differences between the various factors were assessed by the Mantel–Haenszel test; those included: exent of residual disease at the time of surgery (none visible vs $\leq$ 2 cm vs $>$ 2 cm), histologic subtype, tumor grade, lymph node involvement of the pelvis, paraaortic region or both.

Results – Maximum cytoreductive surgery was performed in all but 2 patients, in whom praaortic lymph node sampling was performed only. In one case partial bladder resection was done and in two cases parts of the intestinum had to be removed because of tumor infiltration into these organs.

Chemotherapy was given to all patients ranging from 4-10 cycles (median, 6 cycles). Dose reduction in the last cycle of chemotherapy was necessitated in 6 cases, which was due to acute hematologic toxicity in 5 patients and hepatitis in one patient.

All cases presented with FIGO stage III carcinoma based on the presence of widespread and bulky intraabdominal disease.

In addition, histopatological staging revealed nodal involvement in 75% of cases. In 3 patients positive findings were restriced to pelvic nodes, in one case paraaortic involvement without concomitant pelvic disease was diagnosed and in 11 (55%) patients involvements of both lymph node regions were noted.

Histopatological assessment of tumor subtypes revealed 12 serous, 3 endometroid, 2 mucinous, 2 clear–cell and one undifferentiated adenocarcinoma. Grading of the tumors was almost equally distributed by 5 well, 7 poorly, and one undifferentiated carcinoma.

Maximum debulking with no macroscopic disease visible in the abdomen was achieved in 8/20 (40%), in 3/20 (15%) tumor of equal or less than 2 cm, and in 9/20 (45%) more than 2 cm had to be left in the peritoneal cavity.

The radiation treatment was well tolerated aside from the expected side–effects of WAP

radiation such as inapetence, diarrhea, general fatique and nausea. In one patient treatment was interrupted on request because of vomiting, in two others the course of radiation was not completed due to prolonged bone marrow depletion after 10 and 12.5 Gy, respectively. Five patients (29%) required treatment breaks ranging from 8 to 16 days (median 12 days) because of transient leukocytopenia or thrombocytopenia, of whom all were finally able to receive the prescribed dose.

Overall and DFS at 3 years from date of surgery for the patients who completed the full course of radiation was 69% and 47%, respectively, with a follow–up for overall survival ranging from 19 to 53 months. Overall survival and DFS from initiation of radiotherapy was 71% and 23.8% (follow–up: 10 to 45 months).

The time to recurrence was 17 to 37 months (median, 20) and 9 to 29 months after surgery or onset of radiation, respectively.

Seven patients (41%) recurred in the abdomen alone, one failed in the left supraclavicular lymph node and another patient relapsed in both supraclavicular nodes at 20 and 38 months, as sole sites of disease. Thus, the overall relapse rate was 53% in the patients who had completed the trimodality approach.

The sites of failure were located at the dome of the diaphragm in 3 cases, paraortic and paracaval lymph nodes in 1 case and the pelvis in two cases. One patient developed recurrent disease at the diaphragm and in the pelvis simultaneously. Recurrences in the abdomen were diagnosed at a median time of 23 months (range: 17-25 months). The interval from detection of recurrent tumor and death was short, ranging from 1 to 8 months (median 3 months).

Statistical analysis showed that among all factors evaluated only the amount of residual mass left after surgery significantly influenced DFS and overall survival (none vs < 2 cm or $>$ 2 cm, $p < 0.001$). Correlation with the amount of residual disease at surgery over time showed that survival was 100% for patients with no visible disease, 66. 7% for < 2 cm residual and only 26.7% for patients with more than 2 cm residual mass. The 3-year intraabdominal DFS after surgery was 54.4%, respectively.

Discussion – The lack of uniformity in the treatment of advanced ovarian carcinoma makes it difficult to compare the various treatment modalities described in literature (2, 3, 4, 8, 9, 10, 11, 15, 16, 17, 19, 20, 23, 24). This refers to more or less aggressive surgical approaches, the number of cycles and the differing drug combinations applied, the performance of pathological or clinical restaging for the evaluation of response to chemotherapy, and the differing doses and treatment techniques chosen for radiation therapy.

Prospective trials randomizing postoperative chemotherapy to primary radiotherapy are lacking and little is known about the optimum sequence of the various modalities employed so far.

Although the number of patients in our series is small the feasibility of combining a maximum debulking surgery with combination chemotherapy and high–dose radiation with acceptable toxicity has been shown. The comparatively low rate of acute hematologic toxicity and severe complications with regard to bowel injury might be related to the relatively low number of chemotherapy cycles employed and the renunciation of second–look laparotomy (2, 7, 9, 18, 21).

Careful attention was paid to selection criteria for the patients treated with this protocol. All patients presented with bulky abdominal disease and were not classified as stage III based on positive nodal involvement only. Prospectively radical dissection of both pelvic and paraaortic nodes was attempted in order to minimize possible residual tumor in the peritoneal cavity and to determine the percentage of paraaortic lymph node involvement. Inspite or aggressive surgery, however, residual disease of > 2 cm in 45% and less than 2 cm in 15% of cases could not be completely removed. This was particulary true when tumor was located at the right diaphragmatic surface, which occurred in 9 of 20 patients in our series.

The efficacy of chemotherapy in eradicating macroscopic residual disease has been demonstrated with clinical response rates of 90% with regimens containing cis–platinum – the pathologically confirmed complete responses (pCR), however, revealed that only 30-40% of patients were free of tumor on second–look laparotomy. Despite of histopathologically verified tumor control, up to 50% of patients have been shown to relapse (2, 3, 8, 10, 14, 25, 26). Thus, the potential benefit of adjuvant radiotherapy for consolidation of response in this subgroup of patients warrants further investigation.

The role of second–look laparotomy (SLL) is controversial. SLL has proven useful in assessing the response to different chemotherapy protocols and was considered helpful in selecting subgroups of patients, in whom adjunctive treatment might be indicated (2, 3, 4, 9, 13, 19, 20).

For nonresponders, however, second line treatments showed poor results. In an attempt to alter the course of disease, secondary debulking at SLL was suggested, but the impact of such procedure also seems unclear. Rizel et al. (8) reported on 12 patients with secondary complete removal of the tumor, of which only 4 patients remained free of disease. Ho et al. (26) failed to demonstrate an impact on survival comparing two groups of patients with and without SLL.

The analysis of pattern of failures in our patient series showed, that all patients recurred at sites of initial macroscopic residual mass. This is in agreement with other reports, which showed that the exent of residual disease left in the abdomen does correlate significantly with survival (2, 3). The specific role that either chemotherapy or radiotherapy contributed in our series still remains unclear. In agreement with other studies, however, it seems that maximum debulking at the initial operative procedure is predictive in terms of overall and DFS regardless of aggressive adjuvant therapies available at that time (2, 25, 27).

Conclusion – This study demonstrated that high dose radiation is well tolerated inspite of preceding radical surgery and multidrug chemotherapy. Based upon the relatively low number of chemotherapy cycles employed as compared to other studies in literature, and the omission of SLL, acute toxicity was moderate and serious complications were restriced to one patient in our series.

The 3-year overall and DFS rates of 69% and 47%, respectively, compare favorably to those reported in previous studies, particulary considering that only patients with widespread intrabdominal disease were included into this protocol.

However, this approach seems to be of value only for patients with no or minimal disease after surgery. A randomized study is warranted to verify the benefit of adjuvant radiation in this particular subgroup of patients.

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TREATMENT OF THE MALIGNANT GERM CELL TUMOR

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Abstract – In the past 10 years the treatment results for nonseminomatous germ cell tumor (NSGCT) improved dramatically. Two factors are important: the introduction of cisplatinum in the 1970s in polychemotherapy and the cooperation between surgeons, pathologists, oncologists, urologists, radiologists, and endrocrinologists. Improved cat scan and tumor marker methods also played an important role. We report our Munich experience with 250 patients. Diagnosing NSGCT, we differentiate between seminoma, teratoma and combination tumors by means of histology and tumor markers. After clinical staging, treatment strategy is discussed, consisting of polychemotherapy and secondary surgery. Side effects and follow–up are also taken into consideration.

UDC: 616-006.2-07-08

Key words: dysgerminoma–pathology, teratoma–pathology, antineoplastic agents, combined

Orig sci paper

Radiol Iugosl 1990; 24:283-7.

Introduction – Now a days interdisciplinary treatment concepts have taken the place of previously one–sided and uncoordinated therapeutic treatment. As a results, the treatment of malignant testicular tumors with curative intent now takes place from the start with the help of interdisciplinary measures. The strategy of treatment of the malignant germ cell tumor is based on new perceptions of histological classification, clinical staging and surgical as well as radiological methods. In the therapeutic concept, the use of cytostatic drugs has established itself in a central position (1, 2).

The malignant germ cell tumor of the male is rare (1-2% of all tumor incidences), yet in the age group of 20-30 years old men it is the most frequently found tumor. Whereas in 1960 more than 95% of all patients with malignant germ cell tumor died, today more than 90% of these patients with stages I-IIA and more than 50% with higher stages can reach a long term cure rate. This positive development is due to two factors: the interdisciplinary cooperation of pathologists, urologists, radiologists, medical oncologists, endocrinologists and surgeons has led to improved diagnosis and more effective therapy regimens. On the other hand, the new achivements in the field of chemotherapy – especially the introduction of platinum compounds in polychemotherapy in the 1970s have markedly improved the chances of cure in patients suffering from this malignant disease. Yet, in spite of all the success, a complete reduction of failure rate and errors in treatment has not yet come true. In 1979, eg., 372 patients in the FRG died of malignant germ cell tumor, and in 1988 the number was still 200. This shows that theoretically possible healing chances have not been fully used, for the remission rates in recent studies show a much lower death rate (3).

In this paper, various aspects of diagnosis, therapy and side effects and the equally important topic of follow–up are discussed.

Diagnosis – The cancer of the testis is a palpable and usually painless swelling, yet out of negligance or embarassment, patients are often reluctant to seek medical advice. When a physician is finally consulted, other possible diseases such as epididymitis are often considered. Thus

The material was presented on Symposium »New achievements in radiotherapy«, Ljubljana, October, 1989.

Received: April 20, 1990 – Accepted: May 25, 1990

28% of our patients in advanced stage of disease had a record of more than one year case history. In addition to recommending regular self–eximination, each routine check–up by a physician should include examination of the testes. In differential diagnosis, epididymitis is the most frequent, followed by hydrocele, varicocele, trauma or testis torsion. In case of doubt as to the genesis of the infection, histological tools and sonography should be used no later than 10-14 days after antibiotic treatment.

Histology – If a surgical inspection of the testis shows the possibility of a tumor, a high inguinal semicastration should be carried out. Next to the histological subclassification in seminoma, teratoma or combination tumor (seminoma/teratoma), the exent of primary tumor must be defined using TNM–classification.

In our histological classification we follow the recommendations of the British Tumor Panel (Table 1). An immunohistological examination using specific tumor antibodies is often helpful in the histological evaluation. Against human chorion gonadotropin (hCG) and alphafetoprotein (AFP) special antibodies have been developed. While hCG can be detected in seminoma patients, the presence of AFP is always connected with non–seminomatous tumor mass. But both AFP and hCG are found also in the serum of the patient, not only in the histological section. Thus it is important to obtain blood serum before a planned operation to determine the tumor markers, especially since the following therapy can be determined by the tumor markers as well as the diagnostic findings.

Table 1 – Histology of germ cell tumors (British Tumor Panel/Pugh)

Seminoma		S
Teratoma	differentiated	TD
	undifferentiated	MTU
	intermediate	MI
	trophoblastic	MTT
Combined tumors seminoma/teratoma		

Staging – Apart from the histological staging of the primary tumor, there is clinical staging according to tumor stages. Stage I is limted to the testis, stage II includes lymph node metastases below, stage III above the diaphragm and stage IV visceral metastases. (Table 2) Stage II is furthermore subdivided into stages IIA, IIB, IIC, depending on the size of the lymphnode metastases.

Table 2 – Staging of the testicular tumor

I	Testis only
II	Lymph nodes below the renal arteries
IIA	Lymph nodes smaller than 2 cm
IIB	Lymph nodes diameter smaller than 5 cm
IIC	Lymph nodes diameter larger than 5 cm
III	Lymph nodes above the renal arteries (mediastinal or supraclavicular)
IV	Organ metastases
E	Primary extragonadal tumor

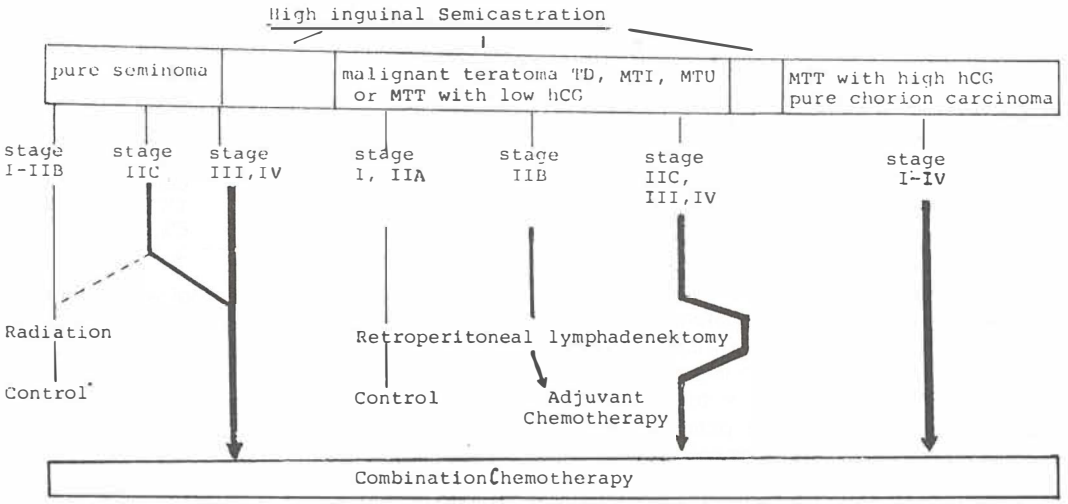
Risk factors – Since both the type of therapy as well as the intensity depend on the type of tumor involved, studies have been made concerning primary risk factors. Hereby it was discovered that when there is an unfavorable response to therapy initially, later intensifications does not lead to the desired results. In the case of existing risk factors, intensifications of therapy is necessary from the start. This is especally important in the case of »bulky« tumor with large tumor mass (4).

Therapy planning – The strategy of therapy is in accordance with the staging. Seminoma, previously a domain of the radiologist, is more and more successfully being treated by polychemotherapy (Table 3). In the case of teratoma, we differentiate between aggressive tumor entities with high hCG levels and trophoblastic tumor specimens that are initially treated by chemotherapy. Other types of teratoma (undifferentiated, differentiated and intermediate teratoma) will often be treated surgically in the case of small and operable lymphnodes. If the size of lymph nodes exceedes 5 cm, a chemotherapy should be carried out before surgery. New therapeutic strategies recommed this when lymphnodes exceed 2 cm (5).

While there is still discussion about the time of indication for chemotherapy, there is absolutely no doubt as to its value and necessity where the advanced stage of disease is concerned. Even when lung metastases are already widely spread, combination chemotherapy can lead to impressive results. This therapy regimen consists of cisplatinum, etoposide and bleomycin (PEB) and is carried out with constant hyperhydration of 6 l/24 hrs to counteract the neprohrotoxicity of cisplatinum.

Cisplatinum	20 mg/m^2	days 1-5
Etoposide	100 mg/^{2}	days 1-5
Bleomycin	30 mg	days 1,8,15

Table 3 – Treatment strategy for malignant germ cell tumor



Vinblastine was substituted by etoposide to avoid the polyneuropathy induced by vinca alkaloids (6). Some studies recommend total renunciation of bleomycin when there is minimal or slight tumor mass and reduce the combination polychemotherapy to cistplatinum and etoposide (7).

When dealing with an extended tumor mass in the sence of »bulky« disease, therapy has to be highly intensive from the start. Here we have had very good results with a regimen of etoposide, cisplatinum, bleomycin and cyclophosphamide (ECBC). Even in very advanced stages of disease, we managed to obtain more than 60% complete remissions. In the case of brain metastases, the prognosis is no longer fatal. Here the extent of cerebral metastases is as important as the extent of lung metastases and their ability to respond to therapy. Brain metastases of the malignant grem cell tumor react well to total brain irradiation of 60 Gy. With 3 patients in this advanced stage of disease we achieved a long term complete remission with no evidence of disease that has now been lasting for more than 3 years. There is an indication for surgery only in the case of solitary brain metastases. Apart from the radiation of brain metastases, radiation remains the therapy of choice when pure seminoma is classified. Even when metastases are 5 cm in diameter, cure with radiation therapy of a total of 30 (to 40) Gy is possible. Only when the lymph nodes exceed 10 cm in diameter, are the results not convincing when radiation alone is implemented.Where nodes are between 5 cm and 10 cm in size, the question of curative radiotherapy is heavily discussed. In the Munich Tumor Center we have agreed on recommending primary chemotherapy for all cases where lymph nodes exceed 5 cm in diameter (8, 9). After obtaining good results with teratoma patients, we advise a combination chemotherapy for seminoma patients consisting of

Cisplatinum	20 mg/m^2	days 1-5
Ifosfamide	1,2 g/m^2	days 1-5
Etoposide	75 mg/m^2	days 1-5

Carboplatinum is less nephrotoxical than cisplatinum, but more toxic to the bone marrow. When used as a monotherapy for seminoma, it achieves good results, but these must be further documented in additional studies (10).

Results of therapy – Our table (Table 4) shows the results of therapy in 250 patients with malignant germ cell tumor who were treated at our Center between 1979 and 1989. The 222 teratoma patients were subdivided into 167 histologically pure teratomas, the remaining 55 patients showed a combination of teratoma and seminoma (25%). While the pure seminoma patients showed a remission rate of 90% (28/32 patients) even in advanced stage of disease IIC-IV after having received chemotherapy, teratoma patients show a stage–dependent complete remission rate of 50-100%. In the unfavorable subgroups (IIC-IV) with advanced visceral and cerebral metastases, it is possible to achieve complete remission only for a few patients.

Secondary surgery – After completion of chemotherapy in the case of patients with »bulky« disease, i.e. large tumor mass, secondary surgery is indicated when remains of tumor are evident. Hereby retroperitoneal lymphmetastases remains are radically removed and histologically examined, after diagnosis in the cat scan. Remaining uni–or bilateral lung metastases can be removed radically by thoractomy. From 1979-1989, 82 of our patients underwent either retroperitoneal lymphadenectomy or thoracotomy, totalling 103 operations.

Secondary surgery brought to light 3 types of histology – malignant undifferentiated teratoma (MTU) in 12 cases, diferentiated teratoma (TD) in 46 cases, and necrotic tissue in 45 cases. Of all 82 patients, 70 remained tumor–free after secondary surgery. Twelve patients achieved only partial remission and relapsed in the months following surgery. Therapy depends on the histological results. If vital tumor remains are evident, »salvage« chemotherapy with etoposide, ifosfamide and cisplatinum (EIP) is necessary.

Unwanted effects of chemotherapy and operation – In addition to the acute toxicity – especially to bone marrow – and nephrotoxicity with cisplatinum, chronic toxic side effects due to chemotherapy or surgery have to be taken into consideration. Bone marrow toxicity, e. g., is the major factor leading to dosage reduction of cisplatinum, etoposide and ifosfamide. Bleomycin is not toxic to bone marrow, but has pulmonary toxicity dependent on the dosage. If this exceeds a total of 400 mg irreversible lung fibrosis can occur as a result (11). Thus it is advisable to substitute bleomycin with ifosfamide in cases with a large dosage or in older patients or those having received prior radiotherapy. With older seminoma patients, ifosfamide should be given.

Vinca alkaloids have been replaced by etoposide because of their ability to induce polyneuropathy. It still remains unclear whether carboplatinum can be used entirely as a substitute for cisplatinum, because while reducing the oto– and nephrotoxic side effects, it is highly toxic to bone marrow. Here it is also important to note that its therapeutic value in the case of nonseminoma as compared with cisplatinum still remains to be proven.

When judging long–term side effects, two factors must be taken into account: testicular cancer patients are usually young and often wish to have children. Here the question of gonadotoxicity must play an important role in the choice of therapy. While resection of the testis is without influence on the endocrinological function and the production of semen in the contralateral testis, retroperitoneal lymphnode resection often impairs ejaculation reflexes. Due to the severance of the L2/L3 ganglion on both sides, a retrograde ejaculation can take place. Here it helps already to limit the operation to one testis and use standardized and modified operating techniques in lieu of radical retroperitoneal lymphadenectomy. The sides effects of chemotherapy are often reversible. There remains the possibility of prior kryoconservation of sperm, but here one must consider the fact that in about 50% of patients a greatly reduced sperm production exists at the time of diagnosis (oligo/azoospermia).

Table 4 – Treatment results in testicular cancer

	Stage	Number of patients	complete remission
Seminoma	IIC-IV	28/32	88%
Teratoma	I	37/40	93%
	IIA	23/24	96%
	IIB	38/38	100%
	IIC Bulky	7/14	50%
	II (A-C)	68/76	89%
	III	12/19	63%
	IV A/B	53/37	61%

The second question that arises here is whether intensive chemotherapy induces secondary tumors. After more than 10 years of studies, single cases of patients with a secondary tumor are reported, yet this low rate cannot serve as a reason for restricting adjuvant chemotherapy. Yet, of course, all new results should be closely studied (12, 13).

Follow up – In order to quantify the effects of therapy, patients have to be controlled at regular intervals. The most important effect of a careful follow–up programme with compliance on the part of the patient is the posibility of early detection of a relapse. This occurs in the case of prior chemotherapy in about 10% of our patients. Most of these relapses occur within the first two years following treatment (90%), which documents the importance of close follow–up schedules. After this period, patients should be checked at least for 5, better for 10 years in order to detect late relapses (14).

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LOCAL DOSIMETRIC FUNCTIONS AND LUNG CORECTION FACTOR UNDER ^{60}Co TBI

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Abstract – The points where the absorber doses in a phantom under ^{60}Co TBI conditions have to be determined, are equally important regardless their being in central or off-axis position, but the basic dosimetric functions, such as TAR and PDD, refer only to the central ray measurments. Therefore, we introduced the local dosimetric functions which depended on the specific distribution of the scattering centers around the location of interest. It means that the location became a center of an effective field. For the purpose of measurments an anatomic–cuboidal water phantom, representing the man lying on his side, was constructed.Further, a theoretical model, based on sector integration method, adapted for TBI, was established. The agreement between experiment and theory for the local TAR was better than 2% for the depths of AP/2 on average, for all investigated locations. In this model the lung's correction factor depends on the local TAR in water, contours of the lungs and TBI phantom at a certain depth, density of inhomogeneity and dose distribution of the primary beam. The experimental values of the correction factor differ from the theoretical ones for 3.3% on average, for all depths. The correlation to the literature data was discussed.

UDC: 616.24-006.6:615.849.2

Key words: lung neoplasms–radiotherapy, radiotherapy dosage

Orig sci paper

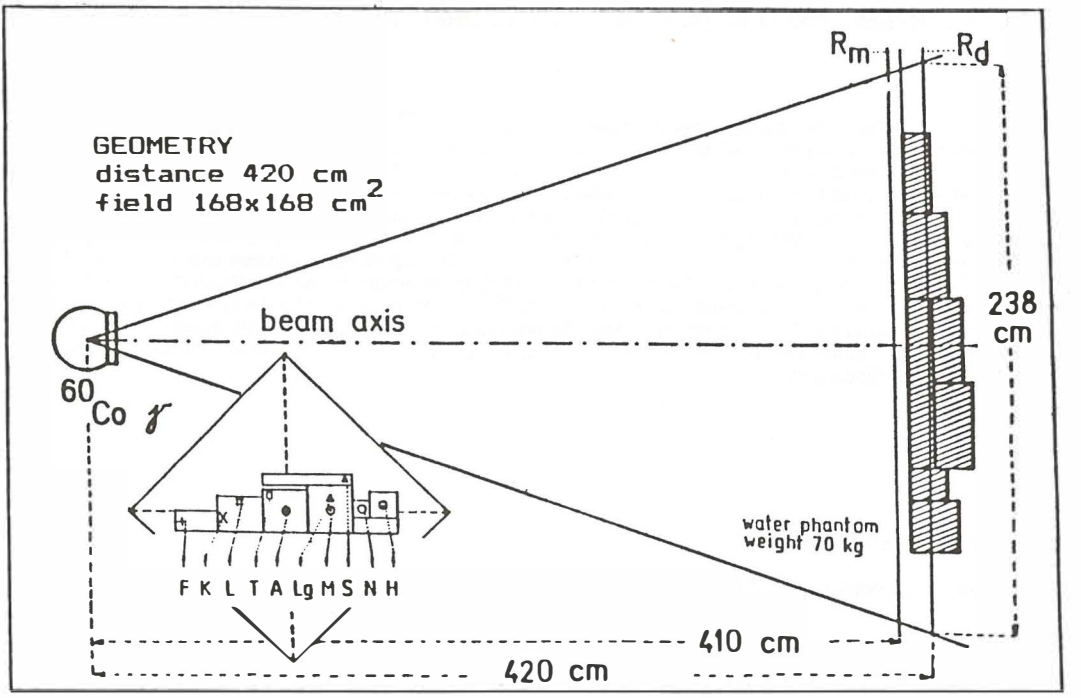
Radiol Iugosl 1990; 24; 289–96.

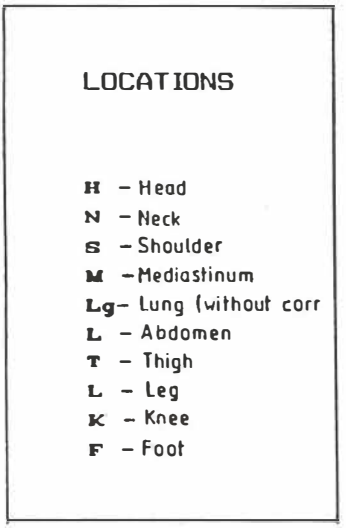
Introduction – In TBI (Total Body Irradiation) the whole patient is situated in a large field which extends beyond the body's limit, so that only the central part of the body (abdomen) is near to the axis, the others are situated in off–axis regions, even in the corners of the field.

Up to date it was usual to use the central axis data, for example TAR (Tissue Air Ratio) values, in TBI conditions, but eventually extrapolated for large fields and corrected for »finite« phantom thickness, as by Van Dyk (1). However, except for the primary component, the specific distribution of the scattering centers around the point on the beam axis, where the dose is determined, contribute to TAR owing to the secondary or higher scattered photons in a certain amount. To take into account all these contributions from the surroundings to the point on beam axis, some methods were established for TBI phantoms. For example, the peak scatter factor by Podgorsak (2) or the beam–zone method by Quast (3). But, all the points in TBI phantom are equally important in dosimetric sense, regerdless of being in central axis or off–axis position. It follows that the conventional dosimetric functions must be modified under TBI conditions. Also, the human body, or the suitable shaped phantom, has the characteristic dimension and mass arrangement of the constituent parts, so TAR must be volume dependent (4). It means that there appears a need to define the local dosimetric functions for any off – axis point (location) in TBI phantom.

Material and methods – Experimental techniques : for the purpose of measurement, in order to establish conditions as similar to real situation as possible, an anatomic–cubical phantom was constructed. It represented the patient lying on his side, as in parallel opposite AP-PA irradiation technique. The TBI phantom consisted of 8 basins with thickness of 0.5 cm polystyrene, opened from above and filled with water. In this way it was possible to move continously the dosimetric system. Lung's inhomogneity was represented by cork (0.27g/cm^3). The position of the phantom in ^{60}Co beam is given in Figure 1. The radiation field analysis was performed with a combination of RFA-3 dosimetry system (which was adapted for measurements in TBI phantom) and DPD-5 dosimeter connected with a special n-type Si detector (all Therados). The detector was produced exclusively for our measurements under TBI conditions in ^{60}Co field, that is in the case of low dose rate, where the signal

Received: May 8, 1990 – Accepted: May 22, 1990





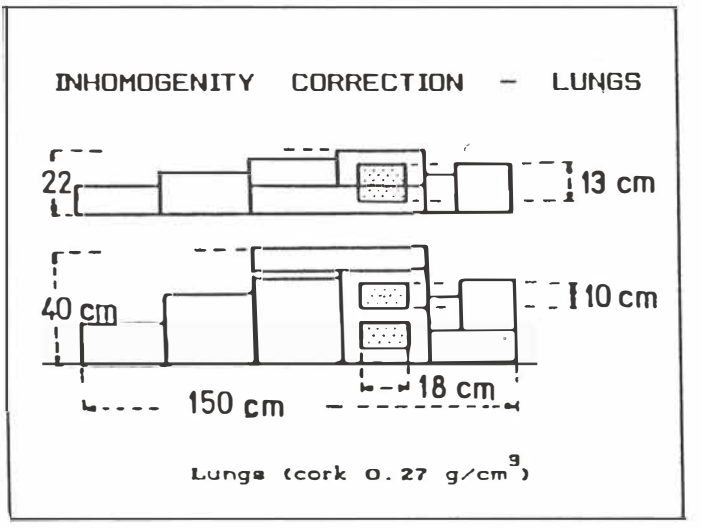


Fig. 1 – TBI model

was very weak. The sensitivity of the sermiconductor detector was 10 times greater in relation to the standard p-type (1200 nC/Gy). The analysis of the detector (Figure 2) shows that due to increased sensitivity (by increasing the volume), the statistical noise was reduced. This is in accordance with the statements by Rikner (5). In addition, the spatial resolution in TBI is not of the same importance as in standard radiotherapy. Also, the 1 mm Pb shielding of the detector sides reduces the overrespond to the low energies.

Theoretical model : The absorbed dose

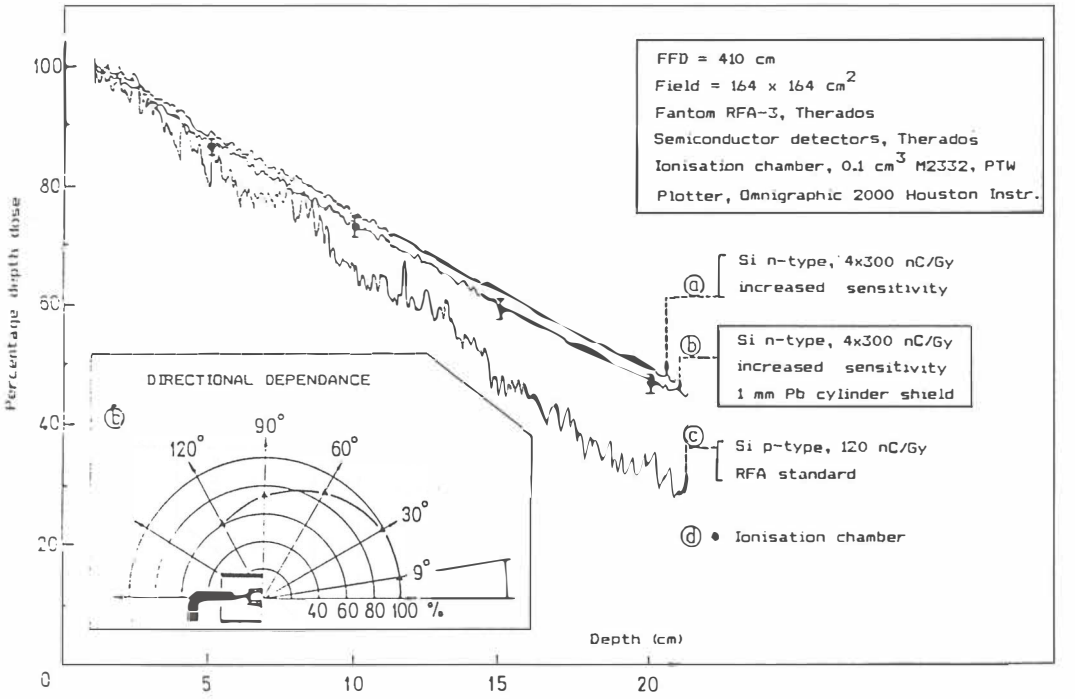


Fig. 2 – Comparison of measurments with different detectors in 60-Co TBI conditions

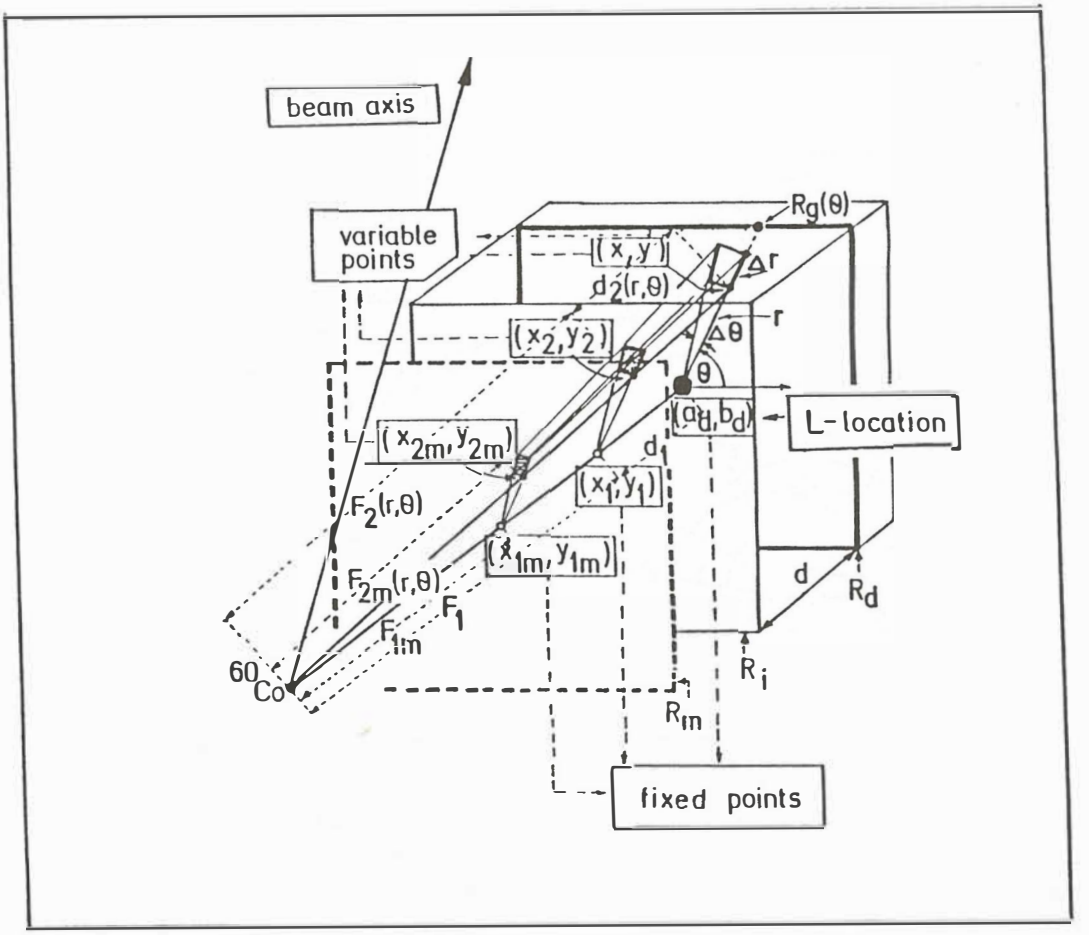
calculation in TBI was performed by the use of adapted sector integration method, enlarged with some assumptions. These are: introduction of the local dosimetric function, knowledge of the phantom contour at a depth of consideration and taking into account the dose reduction factor because of the finite local phantom width in the neighborhood of each location where the effective field was determined. We used the earlier results for the reduction of TAR (1), but an interpolation had to be performed to describe the local field defined by the range of scattered radiation contributions. Therefore, we define in any location (a_d, b_d) (Figure 3) in TBI phantom, local TAR

$$TAR^{L}_{TBI}(d) = \frac{D^{L}_{d}}{D^{L}_{d,air}} (RF)^{L}_{d} \qquad (1)$$

Here D^{L}_{d} is the total absorbed dose at depth d in the fixed point (a_d, b_d), $D^{L}_{d,\,air}$ is the in–air dose in the same point, and $(RF)^{L}_{d}$ is the reduction factor. We must take into account the known in–air dose distribution $f(x_m, y_m)$ of ^{60}Co beam, (measured in reference plane R_m), and the fact that D^{L}_{d} can be separated to the primary and scattered component. Also, the simple geometry connects the surface elements r Δ r Δθ situated in the varible point (x, y) in the plane of dose determination R_d and its projections to R_m. It follows

Sar (Scatter Air Ratio), was represented by its analytical form, valid in the case of extended fields by Habic (6), and in accordance with a range of scattering contributions for ^{60}Co irradiation up to 50 cm (7). f(i) is an abbrevation for

$$TAR^{L}_{TBI}(d) = (RF)^{L}_{d}\left[TAR\,(0, d_1) + \sum_{\theta=0}^{2\pi} \sum_{r=0}^{Rg(\theta)} \frac{f(2)}{f(1)}\, \Delta SAR\,(r, d_2)\, \frac{\Delta\theta}{2\pi} \right] \qquad (2)$$



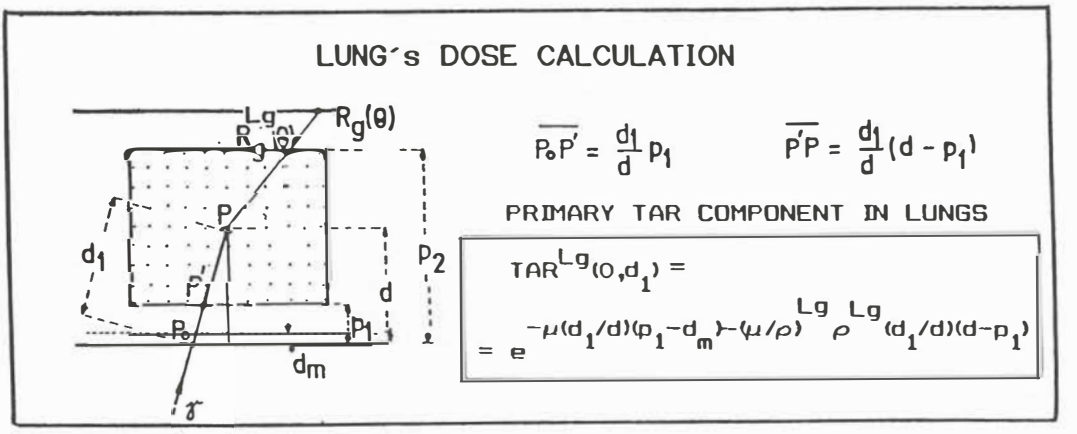


Fig. 3 – Geometry for absorbed dose calculation in ^{60}Co TBI

$f(x_{im}, y_{im})$ and $\Delta SAR\ (r, d) = SAR\ (r + \Delta r, d\ (r + \Delta r)) - SAR\ (r, d\ (r))$. It depends on polar coordinates r, $\theta \cdot R_g(\theta)$ is the limiting value of r, lying on the contour line in depth d, while for monoenergic ^{60}Co, TAR, $(0, d_1) = \exp(-\mu\ (d-d_m))$. For local PDD we have

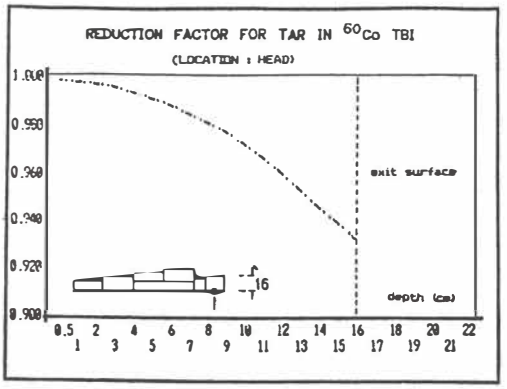
$$PDD^{L}_{TBI}(d) = 100 \left[\frac{F_1}{F_1 + d_1}\right]^2 \frac{TAR^{L}_{TBI}(d)}{TAR^{L}_{TBI}(d_m)} \qquad (3)$$

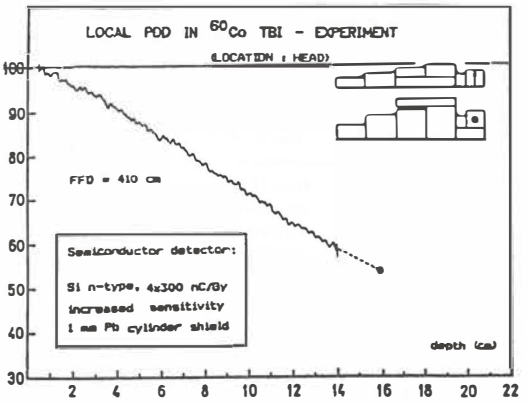
The contrabution of ^{60}Co primary beam to the dose in the lungs is determined by an exponential function, consisting of two parts as presented in Figure 3. The mass attenuation coefficient for lung tissue can be found from: data concering the composition of body tissues (8), calculation of mass attenuation coefficient for a mixture of elements (9) and CT determined values for lung density (10). So the value $(\mu/\varrho)^{Lg} = 0.06352\ cm^2/g$ was determined (for water, we have $0.06410\ cm^2/g$). The correction factor in the lungs is

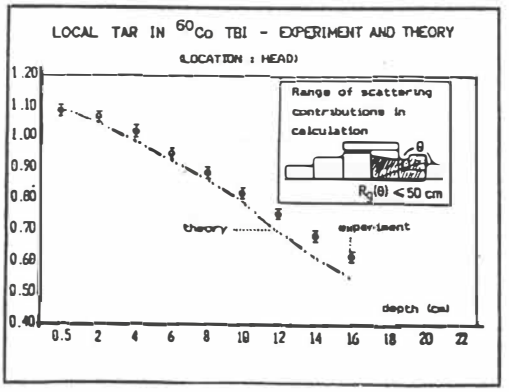
$$CF(d) = \frac{D^{Lg}_d(r)}{D_d(r)} = \frac{TAR^{Lg}(r,d)}{TAR(r,d)} \qquad (4)$$

and after some easier calculations

$$CF(d) = \frac{f(1)\ TAR^{Lg}(0,d_1) - \sum_{\theta=0}^{2\pi} \left[\sum_{r=0}^{R^{Lg}_g(\theta)} f(2)\ \Delta TAR^{Lg}(0,d_2) + \sum_{r=R^{Lg}_g(\theta)}^{Rg(\theta)} f(2)\ \Delta TAR\ (0,d_2) \right] \frac{\Delta\theta}{2\pi}}{f(1)\ TAR\ (d) - \sum_{\theta=0}^{2\pi} \sum_{r=0}^{Rg(\theta)} f(2)[\Delta SAR\ (r,d_2) + \Delta TAR\ (0,d_2)]\ (RF)^{Lg}_d\ \frac{\Delta\theta}{2\pi}} \qquad (5)$$







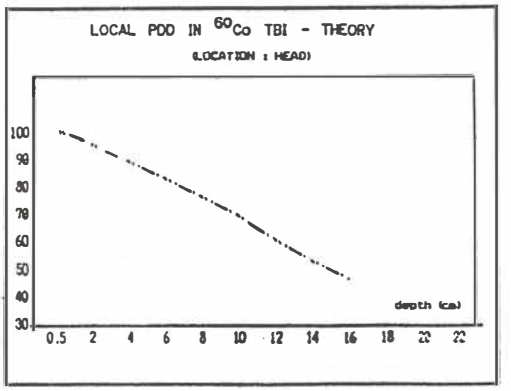


Fig. 4 – Local dosimetric functions. An example of results: location head

Results – The local TAR values, which are important for TBI, were measured in 10 locations by the previously described dosimetric equipment. However, there is no reason to do it for any other point. The calculation was performed by the computer program applied to the expression (2). As an example of results we present the local TAR^{H}_{TBI} and PDD^{H}_{TBI}, (i.e. for head, experiment and theory), together with the reduction factor $(RF)^{H}_{d}$, in Figure 4. The other locations can be presented in the same way, differing in their values from each other due to the position in TBI phantom and its surroundings which contribute the scattered irradiation in a different way.

In the case of inhomogenieties (cork model of the lungs) the local dosimetric functions for the lungs were measured for a number of depths, while the theoretical approach was established according to the relation (5) concerning the correction factor CF(d). This is given in Tables 1 and 2. Also, the experimental and theoretical results of CF(d) (for density 0.27 g/cm^3) were presented in Figure 5. A comparison of the correction factor in local TAR method and modified equiavalent TAR (11), can be found there too. The cited reference was pointed out because the similarities of shape and density in the region of lung inhomogenities were the closest to our

Table 1 – Local TAR and PDD values in the lungs (60-Co TBI, density 0.27 g/cm^3)

depth (cm)	experiment		theory	
	TAR	PDD	TAR	PDD
0.5	1.082	100.0	1.117	100.0
2	1.073	97.5	1.075	95.5
4	1.030	91.7	1.023	90.0
6	1.029	90.5	1.040	90.6
8	1.042	91.5	1.064	91.9
10	1.053	91.5	1.077	92.1
12	1.059	90.0	1.052	89.1
14	1.046	88.3	1.033	86.7
16	1.005	85.0	1.007	83.7
18	0.942	79.5	0.941	77.5
20	0.855	72.3	0.852	69.4
22	0.765	65.0	0.745	60.3

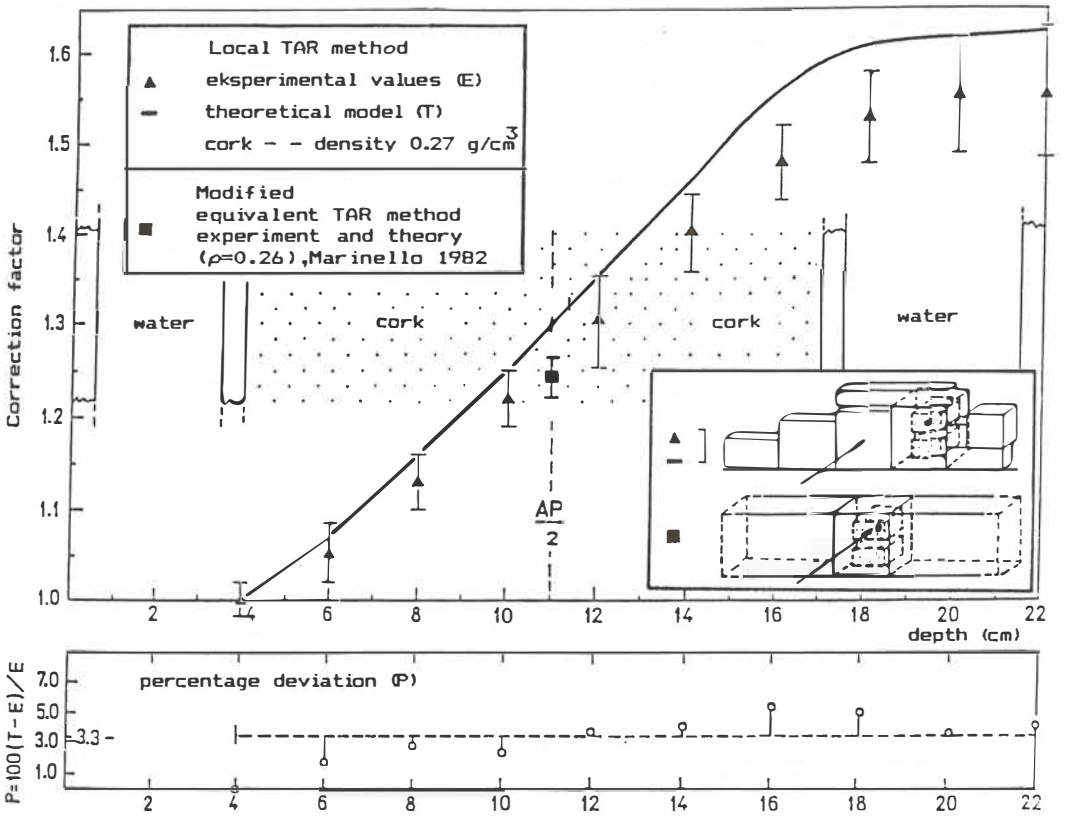


Fig. 5 – Correction factor for dose in the lungs in ^{60}Co TBI

Table 2 – Correction factor for dose in the lungs (theoretical values)

depth (cm)	density (g/cm^3) 0.17	0.23	0.27	0.31	0.37
4	1.000	1.000	1.000	1.000	1.000
6	1.082	1.075	1.071	1.066	1.060
8	1.185	1.170	1.162	1.148	1.136
10	1.291	1.266	1.250	1.231	1.212
12	1.416	1.380	1.356	1.327	1.299
14	1.543	1.493	1.461	1.422	1.385
16	1.668	1.604	1.563	1.513	1.466
18	1.727	1.656	1.611	1.565	1.502
20	1.731	1.660	1.615	1.568	1.506
22	1.743	1.671	1.624	1.576	1.513

model, while the other details and principles (beam axis TAR method, infinite dimensions of the phantom cross section and the field size in calculation) were different.

Discussion – The measured values of the local TAR differ from the calculated ones not more than 1-3%, for the depths less than AP/2, and the agreement is better than 2% in the case of d=AP/2, on average for all locations. The local PDD, as measured in the »automatic scanning system mode« and, alternatively, in »manual mode« with 2 cm steps, showed only small deviations from the theoretical approach (eq. 3). The average differences, up to 10 cm of depth, were less than 3%..It means thet the concept of the local TAR is consistent. On the other side, if we compare the local TAR with, for example, the values corresponding to the central axis data for ^{60}Co 50x50 cm^2, even reduced for the finite phantom thickness (1), there is an evident difference in TAR (4). In the reference (1), the dimensions of the field agree with the equivalent square field of our TBI phantom. The values of the local TAR are strictly dependent on the applied location in TBI phantom, as they would in a real patient too. Considering the corection factor for the dose in the lungs CF(d), an agreement of theory and experiment was 3,3% on avarage for all depths, being better for depths up to AP/2. Comparing these results with CF(d) by Marinello (11) (where the mean value was 1.24), it follows that local TAR method gives slightly higher values. The reason is that decreasing of the volume of water surrounding the lung model increases CF(d). Namely, our TBI phantom is not of a simple cubic type, but adapted to anatomic shape, so that there exists some missing volume (compared to (11)) near to location Lg.

Sažetak

LOKALNE DOZIMETRIJSKE FUNKCIJE I KOREKCIJSKI FAKTOR ZA DOZU U PLUĆIMA U ^{60}Co TBI

Točke u fantomu, koji se nalazi u ^{60}Co snopu u uvjetima ozračivanja cijelog tijela (TBI), podjednako su značajne za dozimetriju bez obzira nalaze li se u području središnje zrake snopa ili izvan nje. Osnovne dozimetrijeske funkcije, kao što su TAR i PDD, odnose se na mjerenja u osi snopa. Zbog toga, uveli smo lokalne douimetrijske funkcije koje uzimaju u obzir specifičnu raspodjelu centara raspršenja u okolini bilo koje točke (lokacije) od interesa. To znači da lokacija postaje centrom efektivnog polja. Za potrebe mjerenja konstruiran je anatomsko–kubični fantom, koji oblikom i položajem predstavlja čovjeka koji leži na boku (kao pri AP–PA metodi TBI). Nadalje, teorijski model osniva se na metodi integracije po sektorima, koja je prilagođena TBI uvjetima. Podudaranje eksperimenta i teorije za dubine od AP/2 bilo je u okviru 2%, uzevši u obzir sve važne lokacije. Korekcijski faktor za dozu u plućima, u okviru ove metode, ovisi o vrijednostima lokalnog TAR–a u vodi, konturama pluća i TBI fantoma na određenoj dubini, gustoći nehomogenosti i raspodjeli doza primarnog snopa. Eksperimentalni rezultati razlikuju se od teorijskih prosječno 3,3%, uzevši u obzir sve dubine. Diskutirana je veza s literaturnim podacima.

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^{192}Ir IMPLANTAT U RADIOTERAPIJI ANOREKTALNOG KARCINOMA: DOZIMETRIJA

^{192}Ir IMPLANT IN THE ANORECTAL CARCINOMA RADIOTHERAPY: THE DOSIMETRY

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Abstract – Radiotherapy is the only choice of primary treatment for a particular group of anorectal carcinoma patients. Dosimetric control of interstitial circular implant with ^{192}Ir wires is analysed. Manual afterloading technique is used. The implant delivers a boost dose to the target volume as supplement to the external beam irradiation of the pelvis. Regular setting of courses as well as their parallel positioning is secured by means of metallic guides. Syed type of template is used for transperineal introduction of guides in the tissue. In the central plane of the implant a pattern of 18 courses is formed by equilateral triangles and squares. This arrangement violates one of the strict rules of Paris system dosimetry. For a geometrically ideal implant built from the sources of 7 cm lenght and 4.44 MBq/mm linear activity, with 14 mm distance in unite cells, the spatial distribution of dose rate is analysed. It could be seen that homogeneity of the dose rate within Syed type of the implant is so good that deviation from Paris rules is only formal. For the circular implant formed with Syed type of template, dosimetry control could be done using concept of Paris system reference dose.

UDC: 616.351/.352-006.6:615.849.2

Key words: anus neoplasms–radiotherapy, rectal neoplasms–radiotherapy, brachitherapy, iridium radioisotopes

Profess paper

Radiol Iugosl 1990; 24: 297–302.

Uvod – Pokazano je kako zračenje kao primarna terapija (posebno ako se ograniči jedino na vanjske izvore) ne daje dobre rezultate u liječenju anorektalnog karcinoma, kako u lokalnoj kontroli tumora tako i u petogodišnjem preživljavanju. Kombinacija radioterapije i palijativnog kirurškog tretmana bolji je pristup bolesti (1, 2, 3). Za jedan broj bolesnika s anorektalnim karcinomom radioterapija je, ipak, jedini tretman s ciljem ostvarenja barem djelomične lokalne kontrole. To su bolesnici visokog rizika, oni koji odbijaju abdominoperinealnu resekciju te oni koji imaju primarni ili rekurentni karcinom sa ekstenzivnim metastazama ili su u stanju koje je toliko uznapredovalo da se ne može resecirati. Za njih je radioterapija palijacija uz prihvatljivi stupanj komplikacija (4,5). Radioterapija s tim ciljem obično se ostvaruje kao kombinacija brahiradioterapije i vanjskog zračenja kako bi se dobila što homogenija lokalna raspodjela doze.

Iza nas je pozitivno iskustvo u kliničkoj primjeni tehnike ručnog afterloadinga sa žicama iridija (^{192}Ir) u intersticijalnoj radioterapiji glave, vrata i dojke (6). Istu tehniku implatacije, s nekim modifikacijama, sada koristimo u radioterapiji karcinoma anorektuma. Implantat homogeno predaje ciljnom volumenu udarnu dozu zračenja tako da njezini efekti budu nadopuna vanjskom zračenju zdjelice.

Uvjeti perinealne regije diktiraju naročiti oblik implantata i posebna rješenja u tehnici uvođenja izvora što je povezano s teškoćama u dozimetrijskoj kontroli. Terapijski raspored ^{192}Ir izvora postavljamo u kružni implantat transperinealno, koristeći vodilice i Syedovu šablonu za njihovo uvođenje u tkivo (7, 8). Ovaj rad ispituje primjenjivost jednostavnog dozimetrijskog opisa implantata Pariskim sistemom dozimetrije.

Pariski sistem prostornog rasporeda linearnih izvora zračenja i dozimetrije ^{192}Ir implantata pokazao se klinički uspješnim (9). Ovdje ćemo pobrojati samo neke osnovne definicije: detaljni pregled čitalac će pronaći u radu Pierquina (10). U Pariskom sistemu idealni planarni implantat oblikuje se redanjem ravnih i paralelnih izvora zračenja, jednake linearne aktivnosti i jednake udaljenosti između susjeda. Volumni se implantat slaže iz dva ili više paralelna planarna implantata čija se međusobna, i za sve susjedne ravnine ista, udaljenost odabire tako da svaki izvor zračenja bude podjednako udaljen od svih svojih prvih susjeda. Ravnina koja je okomita na izvore zračenja i dijeli ih na polovicu, naziva se centralna

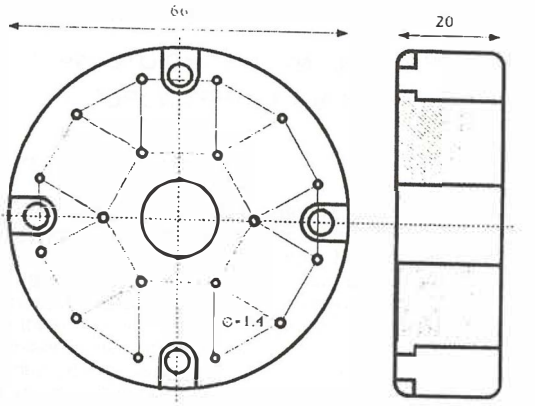
Received April 4, 1990 – Accepted May 15, 1990

ravnina (CR). Točke presjeka CR s izvorima nalaze se u vrhovima ili istostraničnih trokuta ili kvadrata, kao posljedica definiranih pravila o udaljenostima. Ispravno oblikovan volumni implantat je u CR predstavljen skupom samo jedne vrste osnovnih geometrijskih ćelija. Dozimetrijski se implantat opisuje samo u CR. Izračunava se bazalna doza (BD) definira tako da bude srednja vrijednost minimalnih doza unutar implantata, koje se geometrijski pridružene središtime ćelija. Referentnom dozom (RD) koja se izvodi kao 85% BD kontrolira se trajanje radioterapije. Sve se definicije temelje na pretpostavci o tome kako izodozna ploha vrijednosti RD (tretirani volumen) obuhvaća u potpunosti ciljni volumen kojeg čine tumor i ono okolno tkivo koje treba da primi najmanje propisanu dozu. Dimenzije ćelija, kao i duljina izvora, podložni su empirijskim ograničenjima kako bi se smanjila područja unutar implantata s brzinama doze značajno iznad ili ispod RD. RD se koristi kao numerička mjera u kontroli terapije budući da se smatra reprezentativnom za ozračeni volumen kao cjelinu.

Ciljni su volumen ovakve udarne radioterapije duboko infiltrirane lezije u anorektumu ili analnom kanalu, s ne više od 5 cm promjera. Lezije nisu više od 8 cm od anokutane granice, s biopsijom koja ukazuje na adenokarcinom ili karcinom epitelnih stanica.

Materijal i dozimetrija – Raspored izvora zračenja vezan je uz oblik ciljnog volumena, a treba da ostvari što homogeniju raspodjelu doze. Izvori su obično podjednake duljine, paralelni i, promatrano u proizvoljnoj ravnini okomitoj na izvore, pravilno geometrijski raspoređeni. Implantat od žica ^{192}Ir postavlja se u tretirani volumen uz pomoć šupljih metalnih vodilica. Vodilice uvodimo korištenjem šablone kako bi se impalantat što više približio svom idealnom obliku.

Šablona koju koristimo vlastite je izrade, a oslanja se na raspored otvora Syedove šablone za implantaciju ^{192}Ir izvora (Sl. 1). Kružni oblik i središnji otvor na šabloni odražavaju zahtjeve lokalne anatomije i implantacijske tehnike. Za neke posebne slučajeve središnji se otvor koristi za dodatno uvođenje standardnog intrakavitarnog ^{137}Cs aplikatora ili usisne cijevi za drenažu. Krute šupljine vodilice od nehrđajućeg čelika, unutrašnjeg promjera 1 mm, zaoštrene su na jednom kraju, a učvršćuju se mehanički, deformiranjem krajnika. ^{192}Ir žicu promjera 0.3 mm s platinskom oblogom nabavljamo u obliku 500 mm dugog namotaja s nominalnom srednjom linearnom aktivnosti od 4.44 MBq/mm (120 μCi/



Slika 1 – 2 cm debela pločica od akrilika služi kao šablona za transperinealno paralelno uvođenje šupljih vodilica raspoređenih na Syedov način. Izvori se ručno ulažu u vodilice i oblikuju kružni implantat.
Fig. 1 – 2 cm thick acrylic plate is used as a template for transperineal parallel introduction of hollow guides in Syed type of pattern. The sources are manually entered in the guides to form a circular implant.

mm). Žica se, zbog lakšeg rukovanja, ulaže u plastičnu cjevčicu i reže na komade pogodne duljine (50-120mm) koji se mogu višestruko koristiti.

Postavljanje vodilica radi se u općoj anesteziji za litotomiju. Šablona se učvršćuje za perinealnu kožu sa 4 šava kroz lateralne otvore, a zatim se transperinealno uvode vodilice. Oblikuje se implantat pravilnog rasporeda 18 paralelnih izvora, od kojih je svaki jednako (14 mm) udaljen od svih svojih prvih susjeda. Raspored vodilica kontrolira se radiografski. Tek kada su sve vodilice ispravno postavljene i pacijent se nalazi u sobi, ručno se ulažu prethodno pripremljeni ^{192}Ir izvori i fiksiraju olovnim kapicama ili ljepljivom trakom. Ova manualna afterloading tehnika postave dozvoljava razumnu točnost u pozicioniranju izvora.

Opisujući dozimetrijski implantat, žicu ^{192}Ir aproksimiramo linearnim izvorom koji prolazi sredinom šuplje vodilice. Brzina apsorbirane doze A_T u nekoj točki T implantata izračunavana je tako da su u obzir uzeti efekti atenuacije zračenja; u žici i sloju platinske ovojnice zračenje se filtrira, dok se u metalnoj vodilici i tkivu zračenje raspršuje i apsorbira. Račun je proveden u diskretnom obliku za n izvora gdje se za svakog od njih dodatno smatra da je podjeljen u skup od m segmenata duljine l koji, u ovoj aproksimaciji, zrače kao točkasti izvori. Brzina apsorbirane doze je:

$$A_T = \sum_{i=1}^{n} \sum_{j=1}^{m} \Gamma \frac{l\alpha}{r_{ij}^2} f(\theta_{ij})\, g(\theta_{ij})\, h(r_{ij}) \quad [Gy/h],$$

gdje je r_{ij} udaljenost središta ij-tog segmenta i točke T; Γ je specifična konstanta za gama zračenje ^{192}Ir; α je linearna gustoća izvora; θ_{ij} je kut što ga r_{ij} zatvara s okomicom na dulju os izvora; $f(\theta_{ij})$ je faktor kose filtracije u iridijskoj žici i platinskoj ovojnici; $g(\theta_{ij})$ je faktor koji opisuje raspršenje i apsorpciju u vodilici; $h(r_{ij})$ je faktor koji opisuje raspršenje i apsorpciju u tkivu. $f(\theta_{ij})$ je:

$$f(\theta_{ij}) = e^{-\frac{\mu_l d}{2\sin\theta_{ij}}(1-\sin\theta_{ij})}$$

gdje je u μ_l efektivni linearni atenuacijski koeficijent izvora (μ_l=0.43 mm^{-1} za Ir–Pt kombinaciju), a d je njezin ukupni promjer (11, 12, 13). Apsorpcija i raspršenje u stijenki vodilice (debljina 0.2 mm), opisani faktorom $g(\theta_{ij})$, mogu se izračunati kao klasična kosa atenuacija ($\mu_V \approx 0.79$ mm^{-1} za Fe). $g(\theta_{ij})$ ne utječe kritično na brzinu apsorbirane doze u točki T; atenuacija je općenito ispod 4%, osim za vrlo male kutove θ_{ij}. Atenuacija u tkivu aproksimirana je onom za vodu. Korišten je faktor $h(r_{ij})$ za homogeno tkivo:

$$h(r_{ij}) = 0.98342 + 1.7536\times10^{-3} r_{ij} - 2.2054\times10^{-5} r_{ij}^2$$

izveden iz Monte Carlo simulacija za dozu u vodi koja okružuje točkasti izvor s izotropnom emisijom (14, 15). Izračunavanje doze u proizvoljnoj točki implantata, implementirano je na personalnom kompjuteru.

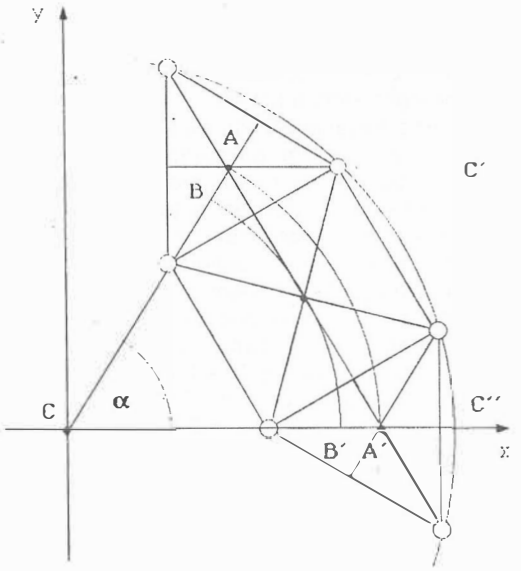
Rezultati – Implantat postavljen Syedovom šablonom ne zadovoljava uvjete Pariskog sistema; raspored izvora zračenja poštuje sva pravila i ograničenja osim onog o ne mješanju različitih osnovnih ćelija u CR. U prstenu kružnog implantata izmjenjuju se i istostranični trokutovi i kvadrati. Zbog toga, formalno, nije moguća jednostavna dozimetrijska karakterizacija implantata s RD. Ovo odstupanje od Pariskog sistema, međutim, nije značajno. Zbog specifičnog rasporeda izvora prostorna je homogenost brzine doze u ravnini koja bi odgovarala CR implantata takva da se Pariski sistem dozimetrije ipak može primjeniti.

Da bismo to potvrdili, analizirat ćemo primjer prostorne raspodjele doze za potpuni idealni kružni implantat postavljen Syedovom šablonom sa 18 izvora duljine7 cm i linearne gustoće 4.44 MBq/mm (120 μCi/mm). Veličina osnovne ćelije je 14 mm. Ove vrijednosti opisuju implantat koji se standardno klinički koristi.

U izračunavanju BD Pariski sistem polazi od brzina doza u nekim geometrijski definiranim točkama implantata. To su središta osnovnih (istovrsnih) ćelija, budući da su to točke lokalnih minimuma brzine doze unutar implantata. Kako je implantat simetričan, dovoljno je promatrati samo jedan njegov segment od 60°. Za prikaz odabrati ćemo ravninu koje je CR implantata. Promjene brzine doza u implantatu pratimo presjecima duž dva pravca **C – C''** te **C – C'** koji prolaze središtem implantata C i duž dva luka koji povezuju točke **A' – A** i **B' – B** (Sl. 2). Ovi presjeci prolaze kroz dvije, za Pariski sistem dozimetrije najinteresantnije, točke implantata: središte jednakostraničnig trokuta i središte kvadrata.

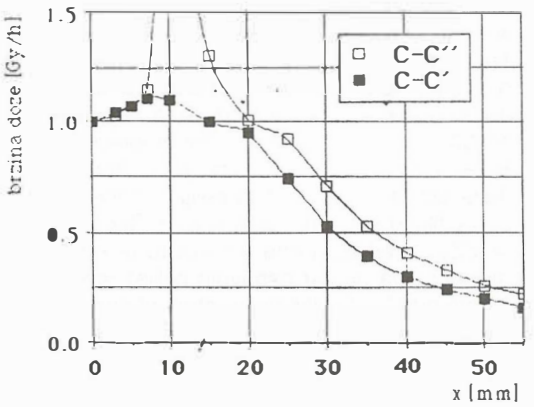
Dva vrlo povoljna svojstva karakteriziraju implantat: dobra prostorna homogenost doze unutar implantata i njezino vrlo brzo opadanje izvan granica (Sl. 3). Osim neposredno uz izvor, brzina se doze slabo mijenja u CR. Ako promatramo onaj dio implantata koji je omeđen spojnicama izvora u vanjskom prstenu (12-trokut s opisanom kružnicom polumjera ~ 27 mm) i isključimo cirkularne zone promjera 5-8 mm oko izvora, razlika je među ekstremalnim odstupanjima ~ 10% srednje brzine doze, za taj dio ravnine. Za sve cirkularne zone oko izvora ispunjen je empirijski zahtjev Pariskog sistema da izodoza vrijednosti 200% one koja se koristi u kontroli terapije nema promjer veći od 10 mm (16). Izvan granica 12-trokuta doza pada naglo; na udaljenosti 35 mm od središta implantata doza je polovica one u središtu, a na udaljenosti od 50 mm tek četvrtina. Lučni presjeci **A' – A** i **B' – B** kroz implantat ukazuju na homogenost doze unutar elementarnih ćelija; brzine doza se ne razlikuju više od ~ 6% (Sl. 4). Brzina doze u središtu kvadrata i one u središtu trokuta (minimumi brzina unutar osnovnih ćelija) razlikuju se manje od 1%. Ovako visoki stupanj homogenosti potpunog kružnog implantata dozvoljava da se definicije BD i RD Pariskog sistema mogu bez ikakvih ograničenja primjeniti. (Za usporedbu, prostorni implantat od 10 izvora, uz istu veličinu izvora i njihov razmak kao i razmatrani kružni implantat, postavljen strogo u skladu s zahtjevima Pariskog sistema u 5 kvadratičnih ćelija, pokazuje razliku u središtima ćelija od gotovo 10%).

Za razmatrani transplantat BD je 1.00 Gy/h, čemu odgovara RD od 0.85 Gy/h.



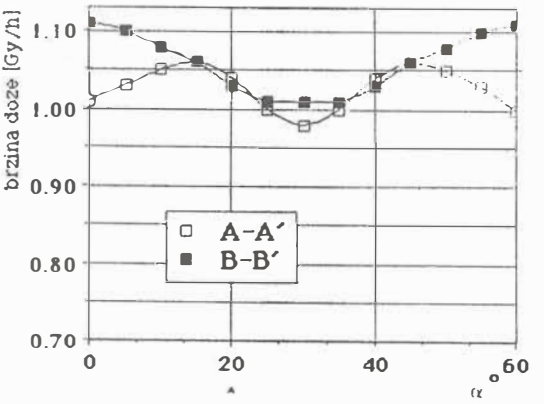
Slika 2 – Idealni raspored ^{192}Ir izvora u centralnoj ravnini. Označene su za Pariski sistem dozimetrije važne točke. Izračunati ćemo raspodjelu doze duž dva pravca (**C-C''** i **C-C'**) i dva luka (**A-A'** i **B-B'**). Zbog simetrije dovoljno je razmatrati samo šestinu implantata.

Fig. 2 – Ideal distribution of ^{192}Ir sources in the central plane. Relevant points for Paris System dosimetry are marked. The dose distribution along two lines (**C-C''** and **C-C'**) and two arcs (**A-A'** and **B-B'**) will be calculated. Because of the symmetry it is sufficient to analyze one sixth of the implant.



Slika 3 – **C-C''** i **C-C'** presjeci kroz raspodjelu brzina doza u implantatu. Ishodište se podudara sa središtem implantata.

Fig. 3 – The dose rate distribution along **C-C''** and **C-C'** lines. The origin corresponds to the center of the implant.

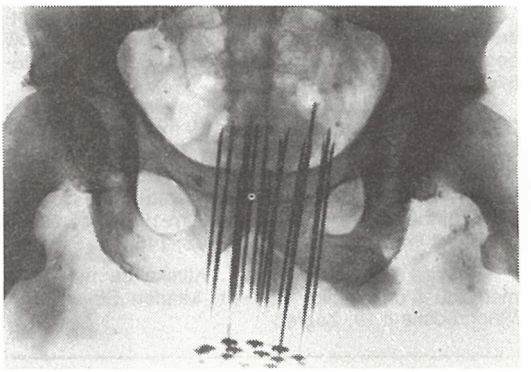


Slika 4 – Raspodjela brzina doza duž **A-A'** i **B-B'** lukova. Kut od 30° odgovara središtu kvadrata, a 0° središtu istostraničnog trokuta.

Fig. 4 – The dose rate distribution along **A-A'** and **B-B'** arcs. 30° angle corresponds to the center of the square and 0° to the center of the equilateral triangle.

Diskusija – Rezultati analize homogenosti odnose se na geometrijski implantat u smislu zahtjeva Pariskog sistema. U stvarnosti, idealni oblik implantata teško je ostvariti posebno kada se, kao u slučaju kružnog implantata, radi s većim brojem izvora. Korištenje šablona i vodilice omogućava da se raspored izvora približi idealnome, odnosno, da odstupanja od paralelnosti i/ili pravilnog oblika osnovnih ćelija u CR budu minimalna (Sl. 5). Primjena šablone Syedovog tipa dozvoljava jednostavnu postavu i točno oblikovanje kružnog ^{192}Ir implantata kojeg se, zbog homogenosti prostorne raspodjele brzine doze, može opisati Pariskim sistemom dozimetrije. Opadanje brzine doze s udaljenošću od središta štedi okolno tkivo i kritične strukture (mjehur/rektum) na način kojeg nije moguće ostvariti zračenjem uz upotrebu samo vanjskog snopa.

Udarnu dozu od 20 Gy kružnim implantatom u ciljni volumen, koristimo kao nadopunu vanjskom zračenju zdjelice. Vanjskim se zračenjem predaje doza do 50 Gy farakcionirano, u 4-5 tjedana. Promjenom veličine osnovnih ćelija na šabloni ili izborom drugih linearnih gustoća ^{192}Ir izvora (do 11.1 MBq/mm (300 μCi/mm)) vrijeme trajanja udarne terapije kružnim implantatom moguće je mijenjati. Kraća vremena terapije povoljnija su za pacijenta, premda se moraju kretati u okvirima preporučenih brzina od 8-12 Gy na dan koje su vezane uz dobru toleranciju tkiva, s minimalnim akutnim ili odloženim komplikacijama. Isto tako, osnovne ćelije ne mogu biti veće od 20 mm budući da promjer izodoza definiranih



Slika 5 – Rendgenska snimka implantata. Šablona omogućava postavu gotovo paralelnih izvora i minimalna odstupanja od idealnog implantata.
Fig. 5 – X-ray of the implant. The template enables almost parallel setting of the sources with the minimal deviation from the ideal implant.

kao 200% RD prelazi spomenuti dozvoljeni maksimum od 10 mm.

Valja naglasiti tri osnovne slabosti koje karakteriziraju sve iridijske implantate postavljene Pariskim sistemom: prvo, neidealnost geometrije implantata povlači (posebno kod duljih izvora) naglašene deformacije RD izodozne plohe u toj mjeri da se javljaju džepovi u kojima može doći do poddoziranja ciljnog volumena; drugo, postava izvora koja dobro zatvara ciljni volumen obično značajno zrači kožu; i treće, obično nepravilni ciljni volumen teško je homogeno zračiti pravilnim implantatom. Dva dodatna problema utječu na točnost dozimetrijskog opisa iridijumskih implantata; stvarna linearna gustoća izvora može se razlikovati i do 10% od nominalne, a nehomogenosti duž izvora mmogu iznositi od 10-12% od srednje gustoće. Ovo može promjeniti vrijednost brzine doze u nekoj točki implantata do 10% (17). Zbog kratkog poluživota ^{192}Ir korisni život izvora obično ne prekazi 60 dana.

Djelomično postavljen kružni implantat (primjerice poluprsten od 9 izvora) još uvijek ima toliko homogenu raspodjelu brzine doze unutar osnovnih ćelija da se i na njega mogu primjeniti zaključci ovog rada u potpunom implantatu. Isti način dozimetrijske kontrole implantata može biti primjenjen i na šablonu Syed/Nablettovog tipa koja je razvijena za primjenu ^{192}Ir u radioterapiji prostate, a dijelom se, u konstrukciji, razlikuje od Syedove šablone.

Dobra dozimetrijska kontrola kružnih implantata s pravilno raspoređenim izvorima može se postići pažljivim izvorom ciljnog volumena, korištenjem šablone za točno oblikovanje implantata i primjenom koncepta Pariskog sistema dozimetrije.

Sažetak

Radioterapija je jedini izbor primarnog tretmana za jednu grupu pacijenata s anorektalnim karcinomom. Ovaj rad analizira dozimetrijsku kontrolu intersticijalnog kružnog implantata sa ^{192}Ir žicama. Koristi se tehnika ručnog afterloadinga. Implantat predaje udarnu dozu ciljnom volumenu tako da bude nadopuna zračenju zdjelice vanjskim snopom. Pravilnu postavu izvora, kao i njihovu paralelnost, osiguravamo korištenjem metalnih vodilica. Koristi se Syedov tip šablone za transperinealno uvođenje vodilica u tkivo. U centralnoj ravnini implantata pravilan raspored 18 izvora oblikuju jednakostranični trokutovi i kvadrati. Ovaj raspored narušava jedno od strogih pravila dozimetrije u Pariskom sistemu. Analizirana je prostorna raspodjela doze za geometrijski idealan implantat izgrađen od izvora duljine 7 cm te linearane aktivnosti 4.44 MBq/mm sa međusobnom udaljenošću od 14 mm u osnovnoj ćeliji. Može se vidjeti kako je homogenost brzine doze unutar implantata Syedovog tipa toliko dobra da su odstupanja od Pariskog pravila samo formalna. Dozimetrijska kontrola kružnog implantata oblikovanog Syedovom šablonom može se provesti koristeći koncept referentne doze Pariskog sistema.

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HUMIC ACIDS – MODEL MOLECULES FOR MONITORING THE DEGREE OF ENVIRONMENTAL POLLUTION

Huljev D

Abstract – Humic acids (HA) have been isolated from soils affected by varying degrees of pollution, and totally hydrolyzed. The metals present in HAs and their hydrolysates were determined by neutron activation analysis (NAA). As shown by the experiments, HA molecules obtained from intensively fertilized soils and close to major settlements contain significantly elevated quantities of Cs and Co (Se reduced). Similarly, hydrolysates of HAs isolated from contaminated soils contain a higher percentage of phenols. The main HA components include amino acids, aromatics, phenols and sugars (carbohvdrates). As shown by analyses, HAs isolated from contamined soils contain elevated level of metals (except Se) and organic fractions (phenols) belonging to pollutants. Because of this HA molecules can be used as markers of environmental pollution by heavy metals and organic compounds.

UDC:

Key words: environmental pollution–analysis, humic acids

Orig sci paper

Radiol Iugosl 1990; 24: 303–5.

Introduction – The purpose of this paper has been to present HA as a macromolecule which can be used as a model molecule in monitoring environmental pollution by heavy metals and organic pollutants.

HA molecules contain $-NH_2$; –OH; –COOH; $-NO_2$; $-CONH_2$; –SH; $-OCH_3$; =CO; and other functional groups. Because of this they can bind metals from their environment and from different compounds (1). HA molecules contain 2-15% of phenol. Under specific conditions HAs may bind phenols from their environment (2). Certain phenols are indicators of industrial soil and stream pollution. HA molecules obtained from different geographical sites contain different levels of phenols, amino acids, aromatics and sugars (3). The first attempts to totally hydrolyze HA can be traced back to quite a few years ago (4). In general, only specific compounds have been isolated from HA hydrolysates, but total hydrolysis of this important natural macromolecule has also been carried out recently (5).

Because of its specific chemical compound content, the humic acid molecule can serve as a model substance for the study of many biochemical reactions occurring in live organisms (6).

Received: June 14, 1990 – Accepted: June 30, 1990

Materials and Methods – HAs may be isolated by a number of methods. In this case the method described earlier has been used (7). The same reference describes the NAA procedure. Soil samples were taken from four different sites according to the degree of soil pollution. Part of the isolated HAs was analyzed (NAA), and the remainder drastically hydrolyzed. Figure 1 illustrated an abridged scheme of total HA hydrolysis.

Results – The results obtained by NAA of HAs obtained from different sites (Zagreb, Karlovac, Banja Luka, Varaždin) are reviewed in Table 1. Due note should be paid to Cs and Co level data. Cs is a typical nonessential metal, whereas Co is a trace element. Both can be used as indicators of environmental pollution.

Table 2 reviews the results of crude hydrolysis of HAs obtained trom the above mentioned sites. Phenol is considered to be an indicator substance which can be used to measure the degree of environmental pollution by organic substances (e.g., woodpulp industry).

Discussion – Because of their functional groups, HAs may contain and bind quite a few metals. Distinction should be made between

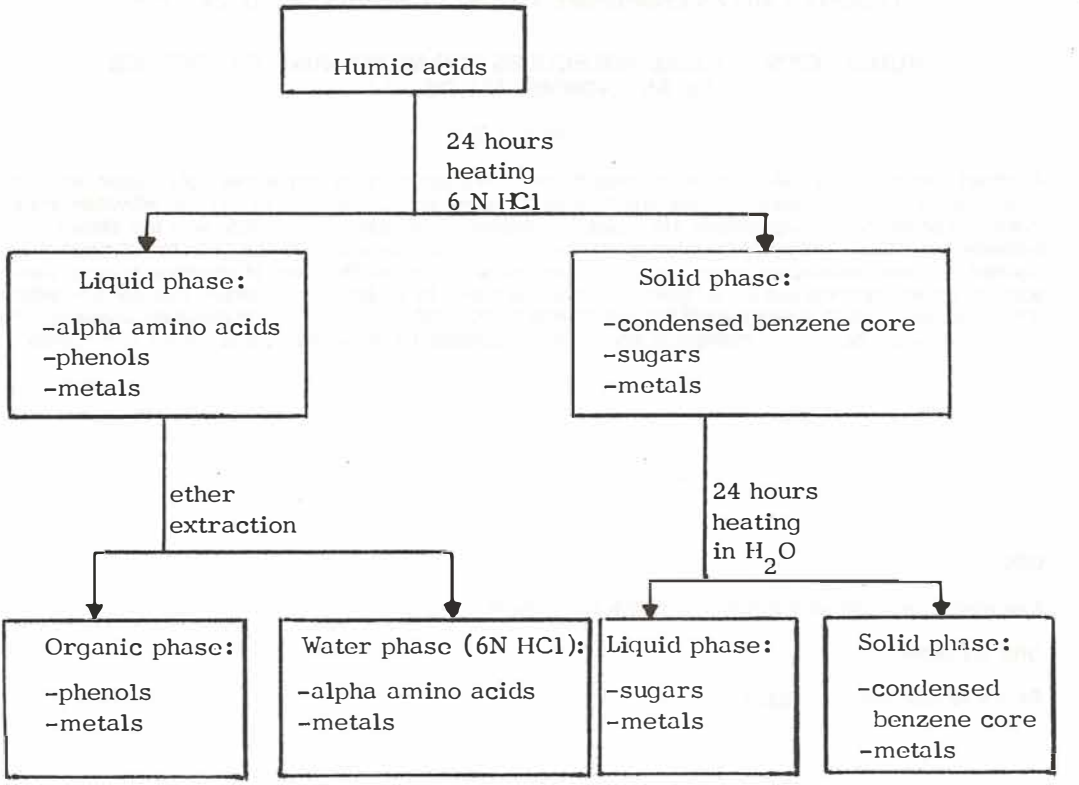

Fig. 1 – Abridge sheme of the experimental procedure for total hydrolysis of humic acids

Table 1 – Neutron activation analysis of humic acids (HAs) from four different localities. The data are given in μg/g (ppm) of dry weight.

Locations	Metals (μg/g) ppm								
	Cs	Co	Ag	Eu	Fe	Sb	Sc	Se	Sr
Zagreb	16.0	6.0	0.4	0.4	2000	11	1.4	0.1	200
Karlovac	10.0	5.0	0.3	0.3	2500	30	1.0	0.1	400
Banja Luka	1.0	0.7	0.2	0.2	3000	20	2.0	1.0	100
Varaždin	0.5	0.3	0.1	0.1	1500	17	3.0	0.9	150

Table 2 – Results obtained by total hydrolisis of humic acid molecules from four different localites. The data are given in percentages of each organic fraction within the humic acid molecule.

Locations	Organic compounds (percentages, %)			
	Phenols	Sugars	Amino acids	Aromatics
Zagreb	10	2	40	48
Karlovac	5	3	37	55
Banja Luka	12	2	46	40
Varaždin	3	3	55	39

metals originating from a clean and balanced environment, and those due to human activity (modern agriculture, industrial development, etc.). The latter are called pollutants. Hence, metals are also an important part of the structure of the HA molecule. NAA is required in order to gain knowledge on the fine structure of these macromolecules.

Because of organic molecules present in its basic structure, and specific makeup, HAs can bind and exchange identical organic compounds from its environment. Distinction should be made between organic compounds due to the normal decomposition of live matter (natural resources), and those due to environmental pollution produced by human activity (artifical resources). Hence the interest in total HA molecule hydrolysis in terms of compound groups. Of course, HAs isolated from both clean and polluted sites (soils) have to be analyzed for the purpose.

Table 1 warrants the conclusion that the soil (HAs) in the Zagreb and Karlovac areas is more polluted by heavy metals than in the Varaždin and Banja Luka areas. The Cs and Co levels in the former areas were found to be 10-30 and 7-20, respectively, as high as in the letter. The soil (HAs) samples found in the areas of Banja Luka and Varaždin contains 9-10 times much Se as the samples from Zagreb and Karlovac (intensively fertilized soils).

The data listed in Table 2 allow for the assumption that the Zagreb and Banja Luka areas are more polluted by organic industrial waste than the areas of Karlovac and Varaždin. Phenol is the marker of such pollution. the phenol level was found to be 2-4 times as high in the Zagreb and Banja Luka areas, as compared with Karlovac and Varaždin.

Sažetak

HUMUSNE KISELINE – MODEL ZA PRIKAZ STUPNJA ZAGAĐENOSTI OKOLINE

Humusne kiseline (HKs) izolirane su iz tla vrlo različitog stupnja zagađenosti. Načinjena je totalna hidroliza HKs. Metodom neutronske aktivacijske analize (NAA) određeni su metali prisutni u HKs i njezinim hidrolizatima. Rezultati eksperimenata pokazuju da HKs iz tla koje se intenzivno obrađuje umjetnim gnojivima i koi se nalaze u blizini velikih naselja sadrže u svojim molekulama signifikantno povišene koncentracije Cs i Co (Se je snižen). Također HKs izolirane iz kontaminiranih zemljišta sadrže u svojim hidrolizatima veći postotak fenola. Glavne komponente HKs su: aminokiseline, aromati, fenoli i šećeri. Analize pokazuju da HKs izoirane iz kontamininiranih tla sadrže povišene koncentracije metala (osim Se) i organskih frakcija (fenola) koje spadaju u kontaminate. Zbog toga HKs mogu poslužiti kao markeri zagađenja našeg okoliša teškim metalima i organskim spojevima.

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