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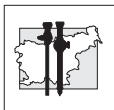
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Gordana Klun
Struška 14, 1310 Ribnica, Slovenija,
tel. 386/1/8369-450, faks. 386/1/8369-455
e-naslov: gordana.klun@siol.net
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Glavni urednik/*Editor-in-Chief*
prof. dr. Mirko Omejc, dr. med.
Klinični oddelek za abdominalno kirurgijo
Klinični center Ljubljana
Zaloška 7
1525 Ljubljana, Slovenija
tel. 386/1/522-47-88, faks. 386/1/522-22-09
e-naslov: mirko.omejc@kclj.si

Urednika/*Editors*
prof. dr. M. Veselko, dr. med.
Klinični oddelek za travmatologijo
Klinični center Ljubljana
Zaloška 7
1525 Ljubljana, Slovenija
tel. 386/1/522 21 74
faks. 386/1/522 2242
e-naslov: matjaz.veselko@kclj.si

Vladimir Mlinarič, dr. med.
Klinični oddelek za gastroenterologijo
Klinični center Ljubljana
Japljeva 2
1525 Ljubljana, Slovenija
tel. 386/1/522-22-10, faks. 386/1/433-4190

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Gordana Klun
Struška 14, 1310 Ribnica, Slovenija,
tel. 386/1/8369-450, faks. 386/1/8369-455
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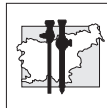
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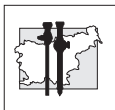
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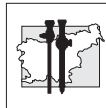
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Uvodnik

Editorial

Letos mineva slabe četrto stoletja od prve laparoskopske odstranitve žolčnika na svetu in dobrih 20 let, kar je bila opravljena prva laparoskopska holecistektomija v Sloveniji. V tem času je minimalna invazivna kirurgija doživela nesluteni razmah in to ne le v abdominalni kirurgiji, ampak v vseh operativnih strokah.

Letošnji slovenski kongres endoskopske kirurgije, že enajsti po vrsti, smo organizirali kirurgi z Oddelka za splošno in abdominalno kirurgijo Splošne bolnišnice Celje. Potekal je v Ljubljani v Cankarjevem domu od 23. do 25. marca. K sodelovanju so bili povabljeni vsi specialisti in specializanti operativnih strok, da prikažejo svoje delo in izkušnje, ki so si jih pridobili v preteklih dveh letih od zadnjega kongresa v Portorožu. Povzetki prispevkov, ki so bili predstavljeni na kongresu, so objavljeni v tej številki Endoskopske revije brez redakcijskih posegov, zato tudi niso lektorirani.

Strokovni del programa je zajemal prispevke iz abdominalne kirurgije, ginekologije, nevrokirurgije in travmatologije z ortopedijo, poslušali pa smo tudi predavanja anesteziologov, urologov, žilnih in torakalnih kirurgov. Tokrat ni bilo predavanj s področja otorinolaringologije, plastične kirurgije in okulistike.

Druženje zdravnikov različnih specialnosti, ki se ukvarjajo z endoskopsko kirurgijo, je namenjeno zlasti prikazu novosti v diagnosticiranju in zdravljenju bolezni, ki so primerna za minimalni kirurški poseg. Prikažejo se rezultati zdravljenja z novimi ali izboljšanimi operativnimi pristopi, ki zahtevajo daljše obdobje spremljanja in se šele po temeljiti analizi uvrsti med rutinske posege.

Na področju abdominalne kirurgije se v zadnjem času kažejo prvi rezultati presejalnega programa SVIT. Povsod poročajo o povečanem številu bolnikov z odkrito boleznijo debelega črevesa in danke.

Naraslo je število odkritih benignih bolezni, ki niso primerne za zdravljenje s kolonoskopom in je potreben radikalnejši kirurški poseg. Za takšne

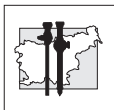
Nearly a quarter of a century has passed since the first laparoscopic removal of the gallbladder in the world, and it has been 20 years since the first laparoscopic cholecystectomy was performed in Slovenia. Since then, minimally invasive techniques have made an impressive progress, not only in the field of abdominal surgery but also in all other surgical disciplines.

This year, the organization of the 11th Congress of Endoscopic Surgery of Slovenia was taken over by surgeons of the Department of General and Abdominal Surgery of the Celje General Hospital. The venue of the congress, held from 12 to 25 March 2011, was the Cultural and Congress Centre Cankarjev dom in Ljubljana. All surgical specialists and specialist trainees were invited to participate and share their clinical achievements and experience, gained during a two-year period since the last congress in Portorož. This issue of the Endoscopic Review brings abstracts of papers presented at this Congress.

The scientific part of the programme featured papers addressing the fields of abdominal surgery, gynaecology, neurosurgery, traumatology and orthopaedic surgery. Also, lectures were delivered by anaesthesiologists, urologists, vascular surgeons and thoracic surgeons. There were, however, no contributions from specialists in otorhinolaryngology, plastic surgery and eye surgery.

Experts of different surgical specialties come together to discuss the latest advances in the diagnosis and treatment of diseases that are conducive to the management by minimally invasive surgery. They present the results of refined state-of-the-art operative techniques, which can be offered as routine procedures only after long-term follow up and accurate analysis of the results.

In the field of abdominal surgery, the SVIT screening programme has yielded the first results; the number of patients with colorectal



bolnike je laparoskopski pristop metoda izbire, saj je dokončni rezultat zdravljenja primerljiv s klasičnim pristopom, pooperativni potek pa je za bolnika neprimerno ugodnejši, manj boleč, pot do končne ozdravitve pa bistveno krajša.

S programom SVIT se odkrije tudi več malignomov debelega črevesa in danke v zgodnjem obdobju bolezni. Skepsa glede možnosti laparoskopskega operiranja po onkoloških načelih se je postopno premagala, saj rezultati, temelječi na daljšem spremljanju poteka bolezni, kažejo, da sta obolevnost in umrljivost po laparoskopskem oziroma klasičnem odprtem zdravljenju primerljivi. Tako postaja laparoskopski pristop k malignim boleznim črevesa in danke standard v vseh slovenskih bolnišnicah.

Še eno področje minimalno invazivne kirurgije je v obdobju med dvema kongresoma doživelo viden napredek. To je urologija z robotsko asistiranim pristopom k operaciji prostate. V začetku lanskega leta smo v Splošni bolnišnici Celje kupili Da Vincijev robot in tako belo liso področij, kjer v Evropi še ne operirajo z robotsko asistenco, zmanjšali. Od maja lani, ko je bila narejena prva robotsko asistirana radikalna prostatektomija, je bilo doslej opravljenih že prek sto takšnih posegov. Rezultati so zelo dobri in za bolnika mnogo ugodnejši kot pri klasični odprti prostatektomiji. Pričeli smo tudi uporabljati robot pri laparoskopskih operacijah na debelem črevesu in danki, v kratkem pa predvidevamo uporabo robotske asistencije tudi na področju ginekologije in žilne kirurgije. Upam, da bodo lahko spodbudni rezultati prikazani že na naslednjem kongresu endoskopske kirurgije, ki ga bodo čez dve leti organizirali kolegi iz Ljubljane.

prim. mag. Bogdan Fludernik, dr. med.

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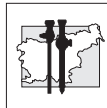
diseases has been widely reported to have increased. There has been an increase in the rate of benign lesions that are not manageable by endoscopic resection during colonoscopy and require a more radical surgical approach. Laparoscopic surgery is the method of choice in these patients for the following reasons: the final outcome of treatment is comparable to that in open surgery, it is associated with less discomfort and less pain during the postoperative course, and affords faster recovery.

Also, through the SVIT screening programme a greater number of early-stage malignant lesions of the colon and rectum have been detected. Scepticism concerning the feasibility of laparoscopic procedures following oncologic principles was ultimately overcome: long-term follow up results indicate that open surgery and laparoscopic surgery are associated with comparable morbidity and mortality rates. As a result, laparoscopic treatment of colorectal cancer is being introduced as a gold-standard treatment in all hospitals in Slovenia.

In the interval between the two congresses, great advances have also been made in minimally invasive urologic surgery. Robotic-assisted prostatic cancer surgery was introduced in the Celje General Hospital at the beginning of 2010 with a purchase of the Da Vinci robot. Thereby a "white spot" was covered on the map of European countries which have not yet initiated this surgical technique. The first robot-assisted radical prostatectomy in Slovenia was accomplished in May 2010 and since then it has been successfully performed in more than 100 patients. The procedure offers many benefits to the patient and has proved superior to conventional open prostatectomy. We began using robotic technology in laparoscopic colorectal surgery and it will soon be applied to the fields of gynaecology and vascular surgery. Hopefully, promising results of these procedures will be presented in two years' time, at the next congress of endoscopic surgery, which will be organized by our colleagues from Ljubljana.

Bogdan Fludernik, MD, MSc

President of the Organizing Committee
11th Congress of Endoscopic Surgery of
Slovenia



Članki

Articles

Endoscopic endonasal approach to pituitary adenoma with invasion to the cavernous sinus

Endoskopska endonazalna odstranitev hipofiznega adenoma s širjenjem v kavernozi sinus

Roman Bošnjak, Mitja Benedičič

Department of Neurosurgery, University Medical Centre Ljubljana

Avtor za dopisovanje (*Correspondence to*):

prof. Roman Bošnjak, M.D., Ph.D.; Department of Neurosurgery, Surgical Clinic,
University Hospital Centre Ljubljana, Zaloška 7, Slovenia; e-mail: roman.bosnjak@kclj.si

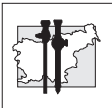
Abstract

Introduction. Transsphenoidal removal is the first-choice treatment for pituitary adenoma. Endoscopic view and dedicated instruments allow for removal of invasive adenomas from different cavernous sinus compartments.

Patients and methods. Thirteen patients with intraoperatively confirmed pituitary adenoma invading the cavernous sinus were enrolled in the study. Middle turbinectomy and posterior ethmoidectomy permitted maximal anterior sphenoidotomy and lateral exposure of the sphenoid sinus, and allowed drilling of the lateral wall of sphenoid toward the orbital apex and unroofing of the superior orbital fissure and foramen rotundum. A neuronavigational system was used for surgical planning.

Results. The patients were followed up for 14.6 months (range 3-40 months).

Vision improved in 4/13 patients; in the rest it remained normal or was as good as before surgery. Small residual tumors were seen or suspected in 5/13 patients (subtotal removal > 90%). The pre-operative level of pituitary function was preserved in 11/13 cases. All secretory adenomas were either cured or controlled with pharmacological agents.



Conclusions. Detailed preoperative evaluation, adequate exposure of the inferior wall of the cavernous sinus, avoidance of blind curettage and control of venous bleeding make extended endonasal approach to the cavernous sinus a safe and effective procedure, associated with minimal or no morbidity.

Key words. Endoscopic, endonasal, transsphenoidal, adenoma, cavernous sinus.

Povzetek

Uvod. Transsfenoidna odstranitev hipofiznega adenoma je metoda prve izbire. Endoskopski pogled in ustrezni instrumenti omogočajo odstranitev invazivnega adenoma iz različnih predelov kavernoznega sinusa.

Bolniki in metode. V študijo je bilo vključenih 13 bolnikov z dokazanim širjenjem v kavernozi sinus med operacijo. Odstranitev srednje nosne školjke in zadajšnjih etmoidnih celic je bilo potrebno za čim večjo sprednjo sfenotomijo in prikaz lateralne stene sfenoidnega sinusa. Slednjo smo pobrusili proti vrhu orbite in odprli zgornjo orbitalno fisuro ter foramen rotundum. Nevronavigacijski sistem smo uporabili tudi za načrtovanje operacije.

Rezultati. Bolnike smo spremljali 14,6 mesecev (3-40 mesecev). Vid se je izboljšal pri 4/13 bolnikih, pri ostalih je ostal normalen ali enak tudi po operaciji. Manjši ostanek tumorja ali sum na ostanek tumorja je bil prisoten pri 5/13 bolnikih (subtotalna odstranitev > 90 %). Delovanje preostanka hipofize je bilo ohranjeno v enaki meri pri 11/13 bolnikih. Pri vseh sekrecijskih adenomih smo po operaciji dosegli ozdravitev ali nadzor nad boleznijo z zdravili.

Zaključki. Natančno predoperativno načrtovanje, zadostno razgaljenje spodnje stene kavernoznega sinusa, izogibanje slepi kiretaži in nadzorovanje venske krvavitve so pogoj za varno in učinkovito izvajanje razširjenega endonazalnega pristopa z najmanjšo možno obolevnostjo.

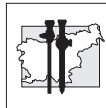
Ključne besede. Endoskopsko, endonazalno, trans-sfenoidno, adenom, kavernozi sinus.

Introduction

Transsphenoidal removal is the first-choice treatment of pituitary adenoma. Radiosurgery is generally used for residual or recurrent parasellar adenomas. However, extended endoscopic approach, neuronavigation and dedicated instruments permit sufficient exposure of different compartments of the cavernous sinus (CS) and safe biopsy, debulking or even total removal of soft intracavernous adenoma. The extent of removal is limited and more risky in hard non-adenomatous tumors and tumors invading the

ICA wall. The only procedures recommended in these tumors include biopsy and minor debulking that should be reserved for well-selected cases and performed by an experienced surgeon.

Laws reported the first microscopic transsphenoidal treatment of carotico-cavernous fistula in 1979 (1). In the microscopic era, several modifications of the classical transsphenoidal approach were used to enlarge the lateral extrasellar exposure, the most widely used being posterior ethmoidectomy.



Alfieri and Jho undertook a detailed endoscopic transsphenoidal anatomical study and suggested paraseptal, middle turbinectomy and middle meatal approaches for progressive lateral exposure of the entire lateral wall of the sphenoidal sinus (2,3).

Haris and Rhoton classified four CS compartments in relation to the ICA: ventral, dorsal, medial and lateral (4).

Knosp proposed a 4-grade system according to MRI features, such as tumor crossing the medial, median or lateral intercarotid line (5).

Kitano et al. considered the centrifugal or medio-lateral expansion of pituitary adenomas and proposed a 5-grade system (6).

Kassam proposed medial and lateral CS modules (7). Frank G. et al. developed endoscopic ethmoidopterygo-sphenoidal (EPSea) route to the CS, with drilling off the medial pterygoid process to expose the inferolateral portion of the CS (8).

There are relatively few clinical series employing a microscopic or endoscopic trans-sphenoidal approach to invasive adenomas using two basic routes – medially and laterally to the intracavernous ICA (6,8). We present our experience with 13 patients with pituitary adenomas extending into the parasellar space. Invasion of the CS was confirmed intraoperatively.

Patients and methods

Surgical technique

The endoscopic endonasal approach to the CS was always ipsilateral. Bimanual technique through one nostril or two nostrils was employed, the endoscope being held by the assistant.

A 0-degree endoscope, 4 mm in diameter and 18 cm in length (Karl Storz, Tuttlingen, Germany), was generally used; it was occasionally switched to 45 ° for final inspection. A Haddad's mucosal flap was always prepared from the left septal mucosa.

Middle turbinectomy and posterior ethmoidectomy allowed for maximal anterior sphenoidotomy and lateral exposure of the sphenoid sinus, and permitted drilling of the lateral wall of the sphenoid toward the orbital apex and unroofing of the superior orbital fissure and foramen rotundum.

Drilling off the bony massive below and between the V2 and the Vidian nerve afforded the most inferior exposure of the CS; this was rarely necessary, except lateral to the proximal paraclival ICA to expose the quadrilateral space.

Once the whole lateral wall of the sphenoid sinus had been removed, incision in the sellar dura was made with a semicircular microknife, and continued from the sellar to the parasellar space. The adenoma was removed from the CS compartments by suction, and the compartments were expanded by a bayonet microretractor enabling the suction tip to reach every deep point in the compartment. Curved aspirators and angled vision were used to remove the adenoma located behind the anterior loop. In the lateral and anterior compartments, the proximal dural ring was dissected in order to allow for medial transposition of the anterior loop of the ICA and full exposure of the lateral compartment. The bleeding from the emptied CS was stopped by applying FloSeal.

During the operation neuronavigation was used several times to check midline and surface markers on the posterior and lateral sphenoid sinus walls. The posterior (the deepest) extension of the adenoma was also checked by neuronavigation by inserting the probe lateral and medial to the paraclival carotid.

Figure 1 shows transsphenoidal exposure of the right CS structures in a cadaver specimen.

Figure 2 shows intraoperative step-by-step exposure of the CS.

Patients

Only patients with intraoperatively confirmed CS invasion were enrolled in the study.

The enhancement of free or partially obliterated CS compartments was evaluated additionally to adenoma invasion from postcontrast T1-weighted MRI images. Adenoma invasion into several CS compartments was analysed preoperatively from 3D image reconstruction, derived from merged CT and MR images (Stealth Station, Medtronic, USA). The compartments were defined as medio-ventral, medio-dorsal, and lateral as related to the horizontal segment of the intracavernous ICA,

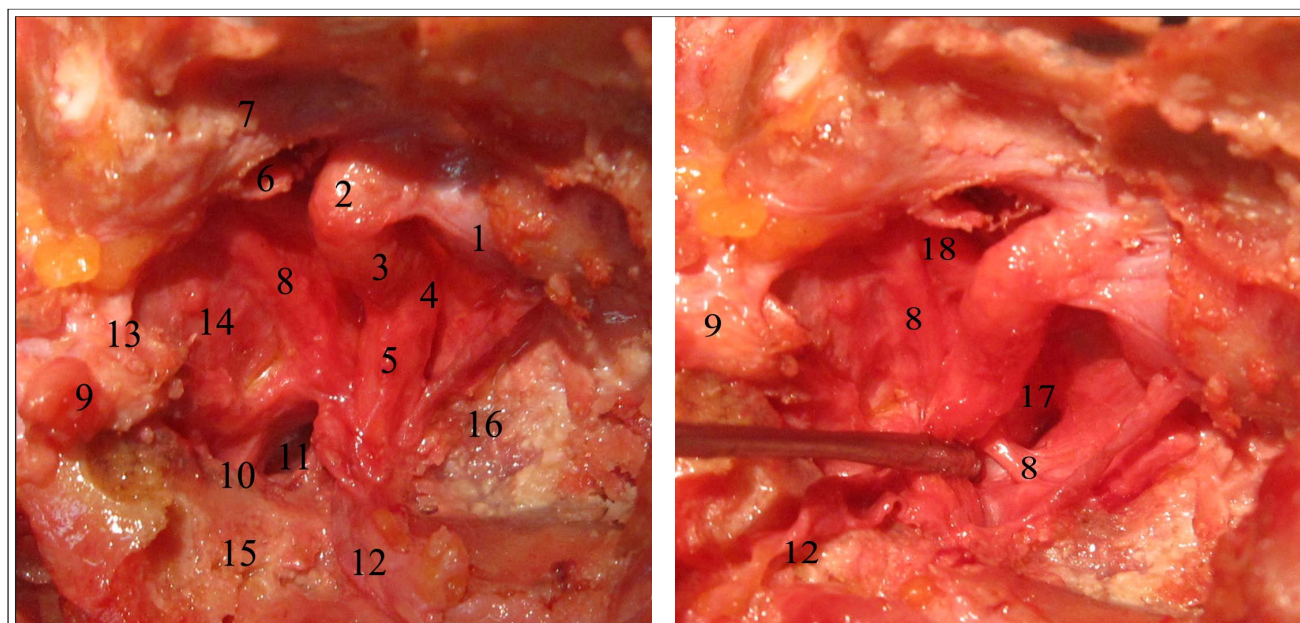
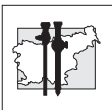


Figure 1

Exposure of the right CS in a cadaver specimen – a transsphenoidal view.

1-pituitary gland, 2-ICA anterior loop, 3-ICA horizontal segment, 4-ICA posterior loop, 5-ICA paraclival, 6-OCR maior, 7-optic nerve, 8-abducens nerve, 9-maxillary nerve, 10-mandibular nerve, 11-quadrangular space, 12-Vidian nerve, 13-bone spur, separating SOF and FR, 14-lateral wall, parietal layer, 15-medial pterygoid, 16-clivus, 17-confluens of superior petrosal sinus, 18-oculomotor nerve.

and posterior and anterior, as related to anterior and posterior loops of the ICA.

The minimum follow-up period after endonasal surgery was three months; the patients were followed up by MRI and endocrinological tests.

The patients' clinical and radiological findings and outcomes are shown in Table 1.

Preoperatively, all lesions were diagnosed by MRI and staged according to the Knosp classification. All tumors extended to one CS or both CSs. Parasellar residual adenomas were also operated on if secretory or increased growth was present. The patients were Knosp grade 3 (extension lateral to the lateral intercarotid line) or grade 4 (encasement of the intracavernous carotid), except for a few Knosp grade 2 cases (extension lateral to the mid-intercarotid line), but with significant expansion into the posterior CS. Knosp classification was not suitable for

grading single compartmental residual tumors or some posterior CS residual tumors.

Preoperative and postoperative endocrinological, ophthalmological and radiological findings were compared.

Postoperatively, the excision was classified as complete or total, subtotal (>80%) or partial (<80%). Residual adenomas were frequently very small, questionable or not seen, in cases of secretory adenomas.

The outcome was classified as cured (no residual tumor, normal hormonal secretion), controlled (pharmacologically, gamma knife), not cured and partially controlled.

Postoperative pituitary function was classified as unchanged, worse (partial hypopituitarism) or absent (panhypopituitarism). Complications (CSF leak, meningitis, diabetes insipidus, other) were evaluated separately.

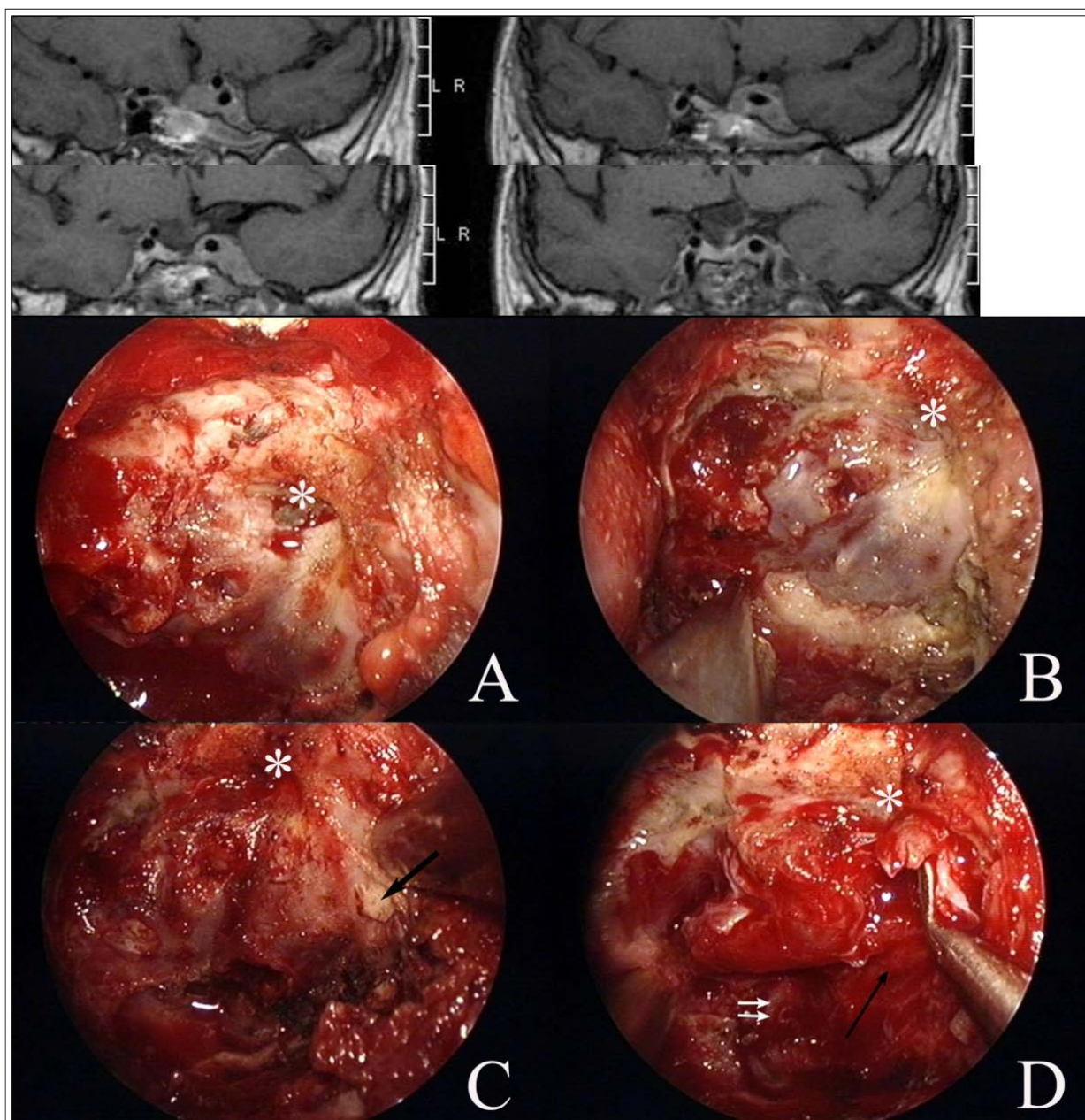
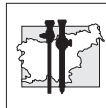


Figure 2

Intraoperative step-by-step exposure of the CS (left side; case 6 from Table 1). A fully exposed residual parasellar adenoma produced two bulgings: medial into the sella and lateral toward the superior orbital fissure (SOF) and foramen rotundum (FR). A bony spur separates SOF and FR after unroofing (black arrow, C). The adenoma is removed from the ventral (between horizontal and vertical – two white arrows, D – segments of intracavernous ICA) and from the anterior compartment (between anterior loop of the ICA and bony spur of the FR). The abducent nerve is seen running into the SOF (black arrow, D). For medialisation of the anterior loop to enter the lateral compartment, the proximal dural ring must be completely resected (not shown).

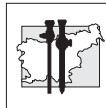
* - mOCR, major opticocarotid recess

**Table 1**

Preoperative clinical features of patients with invasive pituitary macroadenomas and surgical outcome after endonasal surgery

Pt. N°	Age, sex (yr, M/F)	Previous surgery	Year of surgery	Adenoma type	Hypopituitarism & visual disturbance	Size (cm) WxHxD	Suprasellar extension	Parasellar extension	Knosp grade	Residual adenoma	Visual outcome	Hormonal outcome	Treatment	CSF leak	DI	Follow-up (mo)
1	50, M	TC, 2003	2010	NF, residual	Tyr, Gon, normal vision	2,5x1,8x2,3	1	dorsal, posterior	3	no	normal	same	no	intra	transit	10
2	56, F	no	2010	ACTH	no	2,1x1,2x2,2	no	dorsal, posterior	3	not seen	normal	near-suppression	no hydrocortison	no	no	5
3	27, M	no	2010	NF	Tyr, Gon, normal vision	3,5x4,2x3,2	4	bilateral, ventral, dorsal, posterior	3R / 4L	suspect	normal	pan	substitution (Tyr, Adr, Gon)	no	transit	6
4	56, F	TS, 2005	2010	NF, residual	no (primary hypopit), normal vision	1,1x1,5	no	ventral	3	no	normal	same	no	no	no	7
5	48, F	TC, 1999, 2004	2010	NF, residual	Tyr, Gon	1,5x1	no	ventral	3	no	normal	same	same	no	no	5
6	48, F	TC, 1994, TS, 2007	2011	STH, residual	pan	2,5 x 1,2	no	ventral	4	no	normal	IGF-1 norm	substitution (Tyr, Adr, Gon)	no	no	3
7	49, F	No	2009	NF	low normal IGF	2,4x1,5x2,4	2	ventral, dorsal, posterior	3	no	normal	Tyr, Adr	substitution (Tyr, Adr, Gon)	intra	no	18
8	48, F	no	2007	NF, bleeding	pan, DI, ptosis, concentric, ophthalmoplegia	3x3x3	3	dorsal, posterior	3	no	normalised	same	substitution (Tyr, Adr, Gon)	no	same	40
9	76, M	no	2007	NF	pan, decreased vision, bitemp. hemianopsia	4 x 4,2x3,5	4	dorsal, lateral, ventral	4R	yes	vision improved	same	substitution (Tyr, Adr, Gon)	no	transit	31
10	36, M	no	2007	PRL	Tyr, Adr, Gon, (bitemp. hemianopsy improved before TS)	3,5 x 3	2	dorsal, ventral, lateral	4	yes	normalised	same, normal vision	Bromergon, Dostinex	no	no	30
11	65, M	TC, 2000, TC, 2007	2010	NF, residual	Tyr, Gon, permanent ptosis	2,5x1,5x1,5	no	posterior	2	no	normal	same	substitution (Tyr, Gon)	no	no	14
12	42, M	no	2010	STH	Adr, Gon	3,4x3,4x2	2	bilateral dorsal, ventral, lateral	4R / 3L	yes, intrasellar (8 mm)	normal	same; not cured (IGF1/2, STH 1/5)	SandostatimLAR, Somavert	intra	no	13
13	35, M	no	2010	NF, bleeding	pan, abductors & bitemp. hemianopsia	3x3,5x1,9	2	ventral, dorsal	3	no	normalized	same	substitution (Tyr, Adr, Gon)	no	no	8

TC - transcranial, TS - transsphenoidal; NF - nonfunctional adenoma; Tyr - thyroid, Adr - adrenal, Gon - gonadal insufficiency or hormone substitution; suprasellar extension: 1 - below chiasm, 2 - touching chiasm, 3 - pushing chiasm upward, 4 - dislocation floor of 3rd ventricle or intraventricular; R - right, L - left;



Results

A series of 13 patients with invasive adenomas extending into the CS, or with residual intracavernous adenomas (Figure 3) were analysed by adenoma location, surgical approach, completeness of removal and surgical morbidity (Table 1).

The follow-up period was 14.6 months (range 3–40 months).

Vision improved in 4/13 patients or remained unchanged from before surgery.

Small residual tumors were found or suspected in 5/13 patients (subtotal removal > 90%).

The preoperative level of pituitary function was preserved in 11/13 cases. All cases of secretory adenomas were either cured or controlled.

Discussion

Endoscopic view and dedicated instruments enable surgeons to remove adenomas from different CS compartments in a centrifugal way out from the sella in the direction of growth. En-

doscopic visualization of the lateral sphenoidal wall, which covers the CS, is achieved by a diagonal trajectory of the endoscope in the nasal cavity from the contralateral nostril and by angled optic view.

Although transcranial CS microsurgery is the first choice approach for the removal of spatio-compressive nonadenomatous tumors (9), invasive pituitary adenomas were found to bear an unacceptably high lifelong morbidity from cranial nerves damage resulting in diplopia and ptosis. Stereotactic radiosurgery was therefore considered for the treatment of residual and recurrent parasellar adenomas. The recent introduction of extended endonasal approaches to the CS had additional impact on the treatment decision.

Adenomas are now diagnosed earlier when they are still small in size. Because they grow first into the medial compartments, safe removal from the CS presents a challenge to endonasal endoscope-assisted neurosurgery, which may postpone or annul radiosurgery and second surgery, or improve pharmacological control of the disease.

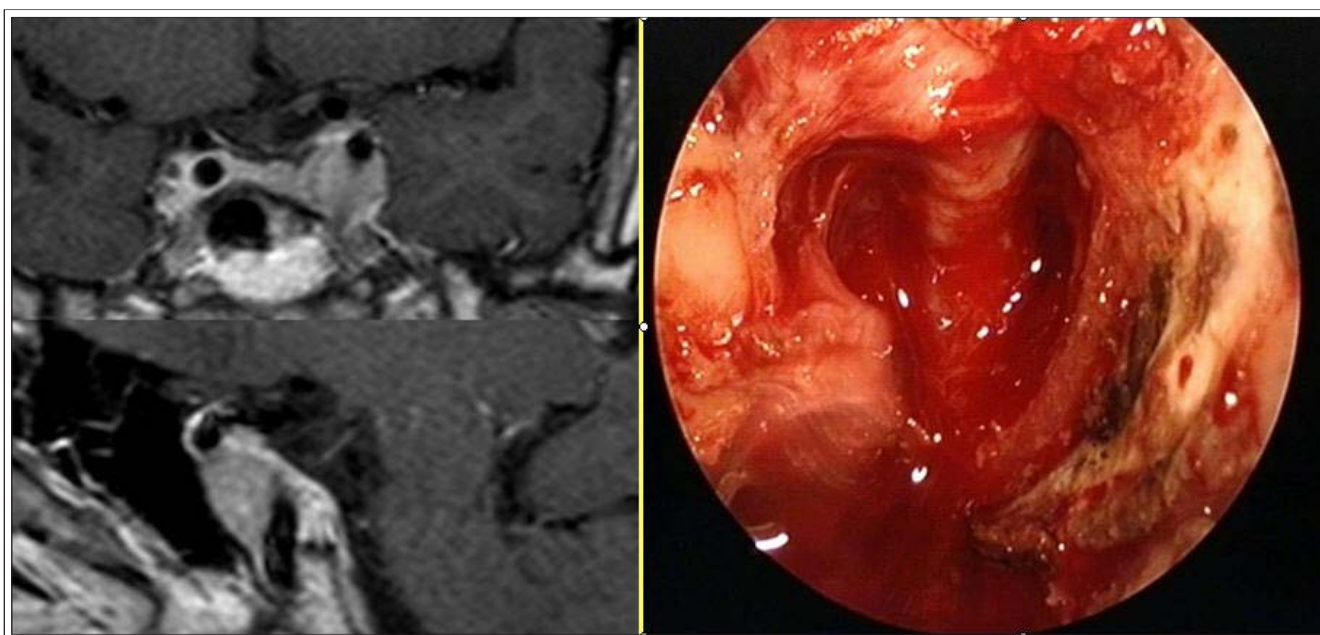


Figure 3

Selective removal of residual parasellar adenoma from the ventral compartment (case 5).

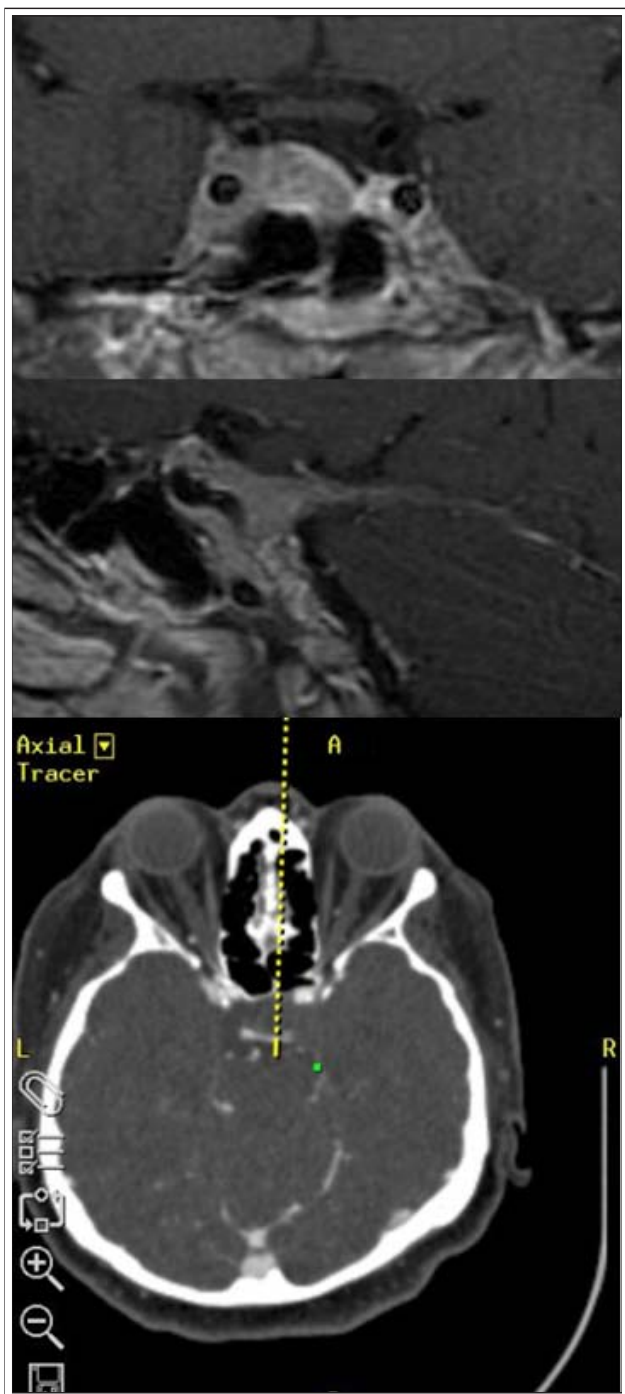
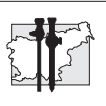


Figure 4

Pituitary adenoma (Knosp-Steiner grade 3) showing significant invasion into the posterior compartment. A neuronavigational pointing instrument (green dot) shows that the most distant point, about 1.5 cm behind the posterior clinoid, can be reached and tumor completely removed from the posterior compartment (lower picture; case 2)

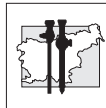
Preoperative MRI evaluation of the invasiveness is important for the planning of the extended endonasal approach. Haris and Rhoton divided a normal CS into four compartments based on their relation to the intracavernous ICA: anteroinferior, posterosuperior, medial and lateral (4). Knosp grade evaluates parasellar extension only in the coronal plane of the anterior part of the sella just behind the anterior ICA loop, and is not concerned with adenoma within the paraclival ICA region (5). Kitano et al. named the region below the horizontal segment in front of the paraclival ICA, ventral extension (6). Cottier et al. referred to it as inferolateral extension (10). Adenomas enlarge both the sella and the CS (Figure 2). The sellar floor and the lateral wall of the sphenoid are remodeled by adenoma growth and invasion.

Little attention was paid to the posterior extension of the adenoma toward the venous confluents of the superior petrosal sinus behind the posterior loop and the paraclival ICA (Figure 4). This is an oculomotor triangle which expands by pushing the posterior ICA loop antero-inferiorly and grows backward toward superior and inferior petrous sinus inflow into the CS. This is a significant space behind the posterior clinoid. The neuronavigational probe can reach 1.5-2 cm behind the posterior loop of the ICA (Figure 4).

Similarly, the adenoma can extend anterior to the anterior ICA loop toward SOF and FR. This approach necessitates the most anterior drilling of the anterior wall. To enter the lateral compartment the proximal ring must be cut, which allows medial transposition of the ICA to reach its lateral aspect and space of the lateral compartment between the lateral ICA and the lateral wall of the CS (9,11-13).

In patients with invasive tumors endocrinological remission is rarely obtained after surgery alone.

There is a lot of discussion on preoperative imaging criteria for the CS invasion. The percentage of encasement of the intracavernous ICA higher than 45%, occlusion of three or more CS venous compartments and occlusion of the CS lateral venous compartment have the highest prediction value. The CS is very likely to be invaded if the inferior venous compartment is not detected, if



the lateral intercarotid line is crossed or if a bulging of the lateral dural wall of the CS is seen (10,14). These criteria may aid surgical planning and improve the results of endocrinological remission after surgery, or increase control rates for secretory adenomas.

Conclusions

Detailed preoperative evaluation, adequate exposure of the inferior wall of the CS, avoidance of blind curettage and control of venous bleeding make the extended endonasal approach to the CS a safe and effective procedure associated with minimal or no morbidity. Removal of the adenoma from the CS may cure the disease, delay or postpone radiosurgery or second surgery, and improve pharmacological control of the disease.

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