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Treatment of Pineal Region Lesions: Our Experience in 39 Patients

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A B S T R A C T

The pineal region is the origin of lesions with a highly diverse histopathology. The aim of this study was to present our experience in treating patients with the pineal region lesions. In period between 1990 and 2007, 39 patients with pineal region lesions were operated on at the Department of Neurosurgery, University Hospital »Sestre milosrdnice«, Zagreb, Croatia. The study group consisted of 21 female and 18 male patients with the median age of 24.4 years (4–66 years). Surgery was performed using the infratentorial supracerebellar approach in all patients. The pineal region lesions were removed totally in 23 (58.97%), subtotal in 14 (35.9%) and partially in 2 (5.13%) patients. Pathohistological examination revealed 13 pineocytomas (33.33%), 10 germinomas (25.64%), 7 glial cysts (17.94%), 3 pineoblastomas (7.69%), two pilocytic astrocytomas (7.69%) and one case (2.56%) of papilloma plexus chorioideus, epidermal cyst, yolk sack tumor and ganglioglioma. There was no surgical mortality. Thirteen patients (33.3%) experienced complications in the postoperative period. During the follow-up period that ranged from 3 to 48 months six patients died (15.4%). The infratentorial supracerebellar approach is a safe and effective surgical approach. Benign pineal lesions could be cured with surgery alone. In the case of malignant pineal lesions radical surgical resection allowed determining the exact pathohistological diagnosis and facilitated adjuvant therapy (irradiation and chemotherapy).

Key words: *pineal region tumors, surgery, infratentorial-supracerebellar approach, outcome*

Introduction

Pineal region lesions are rare, comprising 0.4% to 1% of adult brain tumors and 3–8% of all brain tumors in the pediatric age group[1,2]. The three major categories include germ cell tumors, pineal parenchymal cell tumors and the supporting tissue neoplasms[3].

The histological heterogeneity of pineal region lesions and their favorable response to other treatment modalities, such as irradiation, chemotherapy and radiosurgery significantly influence the role of surgery in their management.

The repertoire of surgical approaches to pineal region tumors has evolved considerably over the past 100 years with an associated decline in operative mortality from almost 100% to less than 4%[4,5]. Outcome analysis of surgical strategies for pineal lesions are hindered by the small patient numbers reported in surgical series and the retrospective design of nearly all studies[4,6–9]. Improved therapeutic options, often involving multimodality therapy, are providing increasingly favorable long-term outcomes for even highly malignant pineal lesions.

We report our experience in surgically treating 39 patients with pineal region lesions. Only infratentorial supracerebellar (ITSC) approach has been used. We have decided upon an open surgical approach in order to achieve the exact pathohistological diagnosis and possible total lesion removal.

Patients and Methods

Patient population

A retrospective clinical evaluation of patients with pineal region lesions was performed. During the period from 1990 to 2007, 39 patients were operated on at De-

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partment of Neurosurgery University Hospital »Sestre milosrdnice«, Zagreb, Croatia. There were 18 male and 21 female patients (Table 1). The patients' median age was 24.4 years (4–66 years). Mean follow up was 37 months (3–48 months).

Preoperative clinical signs

The dominant clinical symptoms were related to the effects of increased intracranial pressure. Headache was present in almost all patients (n=35). Blurred vision was present in 17 patients (43.58%). Parinaud's syndrome was observed in 8 patients (20.51%). Interestingly, a relatively high number of patients (n=12) experienced a seizure. Obstructive hydrocephalus was detected in 10 patients (25.64%). One patient had a Glasgow coma score (GCS) 8 at admission due to acute hydrocephalus, one had a significant diabetes insipidus (DI) and one patient with pineoblastoma presented with drop metastases (Table 2).

Preoperative diagnostic studies

Preoperative diagnostic evaluation consisted of a medical history, physical examination, detailed neurological examination, and neuroradiological studies.

Computed tomography (CT) and magnetic resonance imaging (MRI) of the brain revealed information about tumor localization and extension. CT scans were obtained for 16 of the 39 patients, mainly in the earliest patients in this series. MRI scans were performed for the rest of patients (Figure 1 and 2).

MR imaging markedly improved the quality of information concerning the localization of tumors and differentiation among blood, CSF, fat and calcium within tumors. Also, MR angiography provided important information about the very complex deep venous system in pineal region[10].

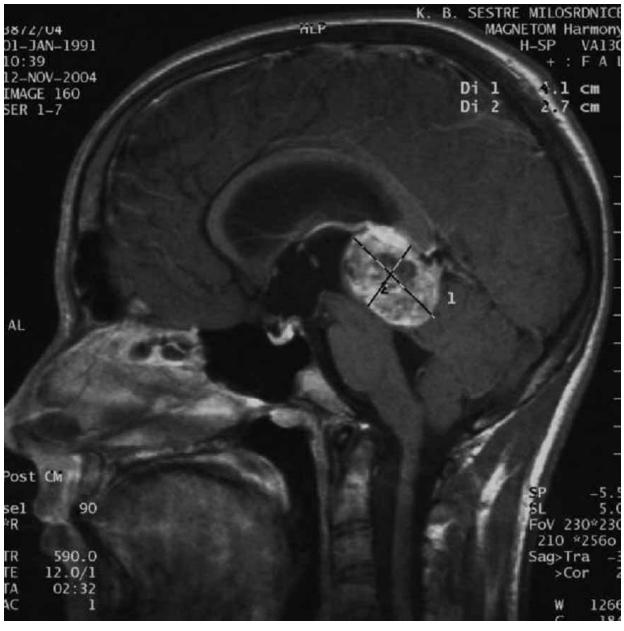

Fig. 1. Sagittal preoperative contrast MR scan showing a inhomogeneous tumorous lesion measuring 4.1 × 2.7cm in the pineal region.

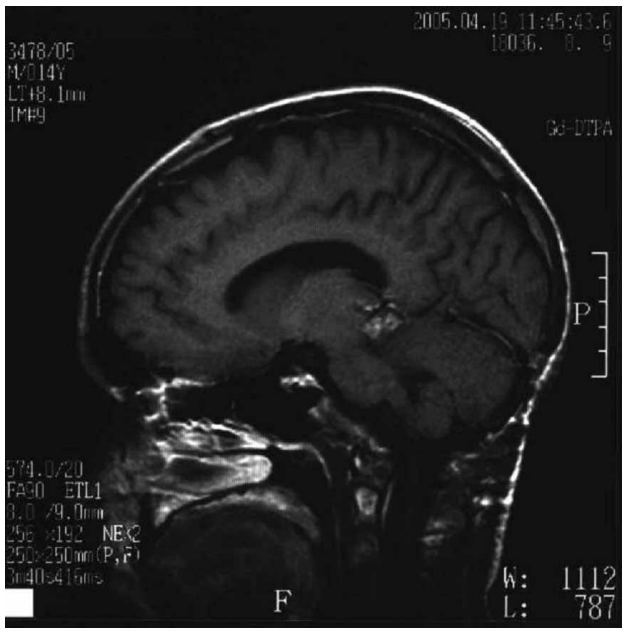

Fig. 2. Sagittal postoperative contrast MR scan showing a small residual/recurrent part of the tumor after the surgical procedure. The pathohistological examination revealed a yolk-sac tumor.

Surgical treatment

The infratentorial supracerebellar (ITSC) approach was used in all patients. The surgical procedure was done as described elsewhere[9]. Although it has been reported that the sitting position is no longer in use due to the high incidence of venous air embolism we have maximally reduced the possibility of venous air embolism following the standardized protocol as described by Jadik S et al.[11]. In ten patients (25.64%) a significant obstructive hydrocephalus was diagnosed preoperatively and a ventriculoperitoneal (VP) shunt was placed. Stereotactic biopsy and endoscopic third ventriculostomy were not performed.

Results

Pathohistology

Pathohistological examination revealed 13 pineocytomas (33.33%), 10 germinomas (25.54%), 7 pineal cysts (17.94%), 3 pineoblastomas (7.69%), two pilocytic astrocytomas and one case (2.56%) of *papilloma plexus chorioideus*, epidermoid cyst, yolk sack tumor and ganglioglioma. The histological diagnoses of patients are summarized in Table 1.

Surgical management, complications and outcome

The ITSC approach was performed in all cases. The extent of lesion removal was graded as total, subtotal and

TABLE 1
PINEAL REGION TUMORS (1990–2007)

Tumor type	No. of pts		Therapy				Outcome					
			Surgery		RT	CHT	Morbidity					Mortality
	Male	Female	ITSC	VPS			S	H	M	CSFF	DI	
Germinoma	9	1	10	4	8		2	1			1	4
Pineocytoma	4	9	13	1			1		2	1		
Pineoblastoma	2	1	3	2	2			1				2
Pineal cysts		7	7						1	2		
Epidermoid cyst	1		1						1			
Papiloma Plexus Chorioideus	1		1	1								
Ganglioglioma		1	1	1								
Pilocytic astrocytoma		2	2									
Yolk-sac tumor	1		1	1	1	1						
Total (%)	18 (46.15%)	21 (53.85%)	39 (100%)	10 (25.64%)	11 (28.2%)	1 (2.6%)	13 (33.33%)					6 (15.4%)

ITSC – infratentorial-supracerebellar, VPS – ventriculoperitoneal shunt, RT – radiotherapy, CHT – chemotherapy, S – seizure, H – hemiparesis, M – meningitis, CSFF – cerebrospinal fluid fistula, DI – diabetes insipidus

partial. Total tumor removal was achieved in 23 patients (58.97%), subtotal in 14 (35.9%) and partial in 2 patients (5.13%). 10 patients (25.64%) underwent shunt placement for hydrocephalus. Patients with malignant pineal lesions (10 patients with germinomas, 3 patients with pineoblastomas and a patient with a yolk sac tumor-endodermal sinus tumor) underwent irradiation and/or chemotherapy according to standardized protocol[12,13]. All benign lesions were completely removed.

There was no perioperative mortality. Three patients had postoperative seizures that were couped with antiepileptic drugs. Four patients experienced meningitis and were treated with systemic antibiotic administration. There were three patients with a cerebrospinal fluid fistula who needed wound revision and plastic of the dura. Other complications included mild hemiparesis (n=2) and diabetes insipidus (n=1) (Table 1).

Overall mortality was 15.4%. Six patients died and these included four patients with germinomas and two patients with pineoblastomas.

Discussion

Pineal region tumors are challenging to treat because they show a great histological heterogeneity and are intimately related to critical neurovascular structures. The preservation of the deep cerebral venous system and the surrounding neural structures in the pineal region pose a great challenge to a neurosurgeon.

We report our experience in treating 39 patients. The preoperative clinical findings in our patients were similar to those described in other series[14–20]. All the patients in our series underwent open surgical procedure. Stereotactic biopsy followed by radiosurgery alone or in combination with chemotherapy has been advocated as an alternative to microsurgical removal of pineal tumors[21]. We have decided upon direct surgical resection because it can provide accurate tissue diagnosis with a greater diagnostic yield than stereotactic biopsy which is in concordance with other literature reports[22]. Also, benign lesions such as pineocytoma or pineal cyst can be totally removed with an open surgical procedure and in malignant lesions surgery has the cytoreductive effect that improve the efficacy of chemotherapy and radiation therapy[23].

The surgical removal of the tumor and opening the posterior third ventricle can relieve the obstructive hydrocephalus. In our series ten patients were treated with a VP shunt preoperatively, although shunting may cause the appearance of peritoneal metastases, especially in

TABLE 2
PRESENTING SYMPTOMS IN 39 PATIENTS WITH PINEAL REGION TUMORS

Symptoms	No. of patients
Headache	35
Nausea	24
Vomiting	22
Blurred vision	17
Diplopia	15
Seizure	12
Parinaud's syndrome	8
Coma	1
Diabetes insipidus	1

cases of pineoblastomas and germ cell tumors and a ventricular collapse, with a subsequent tumor enlargement that makes total tumor removal less likely[9,24]. Today performing the endoscopic third ventriculostomy seems to be the best option in patients presenting with obstructive hydrocephalus[25].

Several operative approaches to the pineal region are available. Two approaches are rarely used and those are the Dandy's transcallosal approach and van Wagenen's transcortical transventricular approach[26,27]. Nowadays, two approaches to the pineal region are widely used and those include Poppen-Yasargil occipital interhemispheric approach and Krause-Stein infratentorial supracerebellar approach[28]. The optimal approach for a specific patient depends on the anatomical features of the tumor. Also, the surgeon's level of experience and comfort with each approach should be considered[29].

We decided upon the infratentorial supracerebellar approach because it provides a direct midline view to the pineal region between the dorsal cerebellum and tentorium. Its main disadvantage is the difficult access to larger tumors and tumors with lateral extension, but it facilitates the dissection of the tumor from its attachment along the velum interpositum and deep venous system which often represents the most difficult aspect of surgical tumor removal[1]. In 16 patients (41%) subtotal or partial tumor removal was achieved, mainly due to tumor lateral extension and infiltration or adhesion to the vital neurovascular structures.

In our series the larger tumors, mainly germinomas, were sub totally resected followed by adjuvant therapy. The recent literature recommends stereotactic biopsy and radiation therapy in cases of »pure« germinomas (based on blood tumor marker levels such as beta-human chorionic gonadotropin (β-HCG) and alpha-fetoprotein (α-FP)[17,30]. Considering the fact that in these tumors may be elements of mixed cellularity, we opted for the open surgical procedure in order to obtain the exact pathohistological diagnosis and to maximally possible reduce the lesion[9].

Totally removed tumors in our series were pineocytomas and symptomatic pineal cyst. The number of benign pineal cysts is increasing due to improved neuroradiological diagnostic methods[31,32]. In our series patients with pineal cysts operated on had a median cyst size of 20x15 mm and persistent symptoms.

In our series there was no perioperative mortality. Morbidity was 33.3% and overall mortality was 15.4%. We believe these results confirm other literature reports that surgery in the pineal region, especially using infratentorial supracecebellar approach, can be accomplished with relatively low morbidity and mortality.

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LIJEČENJE TUMORA PINEALNE REGIJE: NAŠE ISKUSTVO S 39 PACIJENATA

S A Ž E T A K

U pinealnoj regiji pojavljuju se različiti histološki tipovi tumora. Cilj ovog rada je prikaz našeg iskustva u liječenju bolesnika sa tumorima pinealne regije. U razdoblju od 1990. do 2007. godine u Klinici za neurokirurgiju, Kliničke bolnice »Sestre milosrdnice«, kirurški su liječena 39 bolesnika sa tumorima pinealne regije. Proučavana skupina sastojala se od 21 žene i 18 muškaraca dobi od 4– 66 godina (medijan 24,4 godine). U svih bolesnika provedeno je operacijsko liječenje koristeći infratentorijski supracerebelarni pristup. Potpuno odstranjenje tumora postignuto je u 23 (58,97%), subtotalno u 14 (35,9%), a djelomično u 2 (5,13%) bolesnika. Patohistološka analiza otkrila je 13 (33,33%) pineocitoma, 10 (25,64%) germinoma, 7 (17,94%) glijalnih cisti, 3 (7,69%) pineoblastoma, dva pilocitna astrocitoma, te po jedan (2,56%) slučaj papiloma pleksus korioideusa, epidermalne ciste, endodermalnog sinus tumora (tumor žumanjčane vreće) i gangliogliома. Nije bilo operativnog mortaliteta. Trinaest bolesnika (33,3%) je razvilo poslijeoperacijske komplikacije. U tijeku razdoblja praćenja bolesnika koji se kretao od 3 do 48 mjeseci (medijan 37 mjeseci) šest bolesnika je umrlo (15,4%). Infratentorijski supracerebelarni pristup na tumore pinealne regije predstavlja siguran i učinkovit kirurški postupak. Dobroćudni pinealni tumori mogu se u potpunosti izliječiti operacijom. U slučaju malignih tumora kirurška resekcija omogućuje postavljanje točne patohistološke dijagnoze te olakšava učinak adjuvantne terapije (zračenje i kemoterapija).