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Differences in clinical presentation, intraoperative findings and outcome between petroclival and lateral posterior pyramid meningioma

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ABSTRACT

Objective: The goal of this study was to determine the impact of the location of the most frequent skull base meningioma of the posterior fossa, i.e. petroclival (PCM) and lateral posterior pyramid meningioma (LPPM) on clinical presentation, surgical treatment and treatment results.
Patients and methods: We retrospectively reviewed a consecutive series of patients operated on for PCM ($n = 46$) and LPPM ($n = 32$). Uni- and multivariate analyses were performed to identify differences in clinical presentation, surgical treatment and pre-, intra- and postoperative factors of influence upon the outcome parameters: Complications rate, mortality, tumour recurrence/progress, hospital stay, Karnofsky Performance Score (KPS).
Results: At Presentation, the rate of dizziness was higher in LPPM (56% vs. 7%, $p < 0{,}001$) and trigeminal nerve impairment was more frequent in PCM (50% vs. 3%, $p < 0{,}001$). Complete tumour resections were more often achieved (91% vs. 39%, $p < 0{,}001$), and surgery lasted shorter (median: 247 min vs. 500 min, $p < 0{,}001$) with less blood loss (median: 525 ml vs. 1000 ml, $p < 0{,}001$) in LPPM compared to PCM. The overall complication rates (73% vs. 31%, $p < 0{,}001$) as well the rate of irreversible complications (57% vs. 9%, $p < 0{,}004$) were higher in PCM than in LPPM. The most frequent complications of PCM surgery were eye movement (46% vs. 6%, $p < 0{,}001$), facial nerve (28% vs. 3%, $p < 0.02$) and swallowing impairments (21% vs. 3%, $p < 0.02$). The perioperative mortality was 11% in PCM and 0% in LPPM patients. In the multivariate analyses, KPS at discharge correlate positively with age ($p = 0.034$) and preoperative KPS ($p = 0.0048$) in LPPM and positively with staged resection ($p = 0.056$) and negatively with the occurrence of surgical complications ($p = 0{,}0427$) in PCM. Hospitalization time correlated with the blood loss ($p < 0{,}001$) for PCM, negatively with the preoperative KPS ($p = 0.0002$) for PCM and LPPM and positively with tumour diameter ($p = 0.0001$) and non-surgical complications rate ($p = 0.0001$) for LPPM.
Conclusion: As compared to LPPM, surgical treatment of PCM is associated with higher morbidity and mortality. The outcome of LPPM was primarily influenced by preoperative factors: Patients age, tumour size, preoperative KPS. The outcome of PCM was primarily influenced by intraoperative factors like: blood loss, surgery duration, staged tumour resection and the surgical complications rate.
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1. Introduction

Skull base meningioma of the posterior fossa are difficult to treat extra axial benign tumours. Because of their often long-term fatal natural history [28,27], treatment modalities may comprise surgical resection and/or radiosurgery. Despite technical and technological advances, the perioperative morbidity and mortality is high, because of their intimate anatomical relationship to brain, cranial nerves and essential blood vessels [3,32]. The most frequent skull base meningioma of the posterior fossa are those situated on the posterior surface of the pyramid and clivus, i.e. the lateral posterior pyramid (LPPM) and the petroclival (PCM) meningiomas [14]. The anatomical location of these tumours may be an important factor of influence upon their clinical presentation and outcome following surgical treatment. We therefore focus in this publication on the differences of preoperative presentation, intraoperative findings and postoperative outcome of PCM and LPPM.

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Table 1
Preoperative findings, * median (range).

	All (LPPM and PCM)	LPPM	PCM	p (LPPM/PCM)
Patients (*n*)	78	32	46	
Gender female (%)	78	81	76	$p < .306$
Age (years)*	57 (31–82)	58 (36–82)	55 (31–75)	$p < .322$
ASA *	2 (1–3)	2 (1–3)	2 (1–3)	$p < .054$
KPI preOP *	80 (40–100)	80 (40–100)	90 (60–100)	$p < .336$
Tumor-diameter (cm)*	4 (1–7)	4 (1–6)	4 (2–7)	$p < .737$
Clinical findings				
Hemiparesis (%)	6	13	2	$p < .109$
Eye motility impairment (%)	21	6	30	$p < .007$
Trigeminal affection (%)	31	3	50	$p < .000$
Hypacusis/Anacusis (%)	29	31	28	$p < .130$
Dizziness (%)	27	56	7	$p < .000$
Facialis palsy (%)	10	6	13	$p < .336$
Swallowing impairments (%)	14	6	20	$p < .097$
Headache (%)	32	47	22	$p < .006$
Mental disturbance (%)	9	3	13	$p < .173$
Others (%)	15	13	17	$p < .339$
Asymptomatic (%)	9	6	11	$p < .466$

2. Patients and methods

We retrospectively reviewed the clinical data of 78 consecutive patients with LPPM ($n = 32$) and PCM ($n = 46$) managed surgically during a 16 years period. The data were collected from the patients' records. For follow-up the patients were contacted by mail or by phone. If we were not able to contact the patients the follow up was extracted solely from the patients' charts.

All patients were initially studied with computerized tomography (CT) and magnetic resonance imaging (MRI). The follow-up was done by MRI. The largest tumour diameter was determined on MRI or CT. The differentiation between PCM and LPPM was made by the anatomical origin of the meningioma. LPPM were meningioma with the main attachment lateral and PCM medial to the line defined by the entrance of the Meckel's cave, the Meatus acusticus internus and the jugular foramen [30,23].

For the tumour part situated in the posterior fossa a retrosigmoidal approach was routinely done. Alternatively an anterosigmoidal/transpetrosal approach was done in 8 (10%) patients, all PCM. If a second approach was needed to resect supratentorial tumour parts, tailored approaches were used: subtemporal (14%), pterional (8%), orbitozygomatic (3%) or frontotemporal (4%). If two approaches were needed they were usually done in two sessions 14 (±8) days apart. Preoperative tumour vessel embolization was not used. Intraoperative electrophysiological monitoring was routinely used. The goal of surgery was always a gross tumour resection (Simpson grade I or II). However, tumour resection from within the cavernous sinus and the resection of tumour-infiltrated pia of the brainstem were never attempted.

Postoperatively worsened or new neurological deficits were classified as reversible if they resolved by the last follow up. Hydrocephalus was considered as complication, if it was shunt dependent. The duration of postoperative hospitalisation, the KPS at discharge, KPS at the last follow up, surgical and non-surgical complications and tumour recurrence/progress were selected as clinical outcome parameters.

Tumour recurrence and residual tumour progress were summed up as tumour recurrence/progress, and was commonly conformed by neuroradiologists and neurosurgeons based on the first postoperative MRIs obtain 3 months postoperativly. Tumour recurrence/progress was considered asymptomatic, if it was without clinical correlate, and symptomatic, if neurological function or the general health status of the patient was affected by the tumour growth.

Univariate comparison of the two groups was made using Pearson's chi-squared test of independence (categorical outcomes), Student's *t*-test (numeric outcomes) or Wilcoxon rank-sum test. In a second step we performed multivariate analyses, subgroup-wise and overall, to identify pre-, intra- and postoperative factors of influence upon the outcome of the patients. The following variables were included in the multivariate analyses: age, preoperative KPS, tumour diameter, incidental finding, ASA score (American Society of Anesthesiologists physical status classification system), surgery duration, two-staged resection, blood loss, Simpson resection grade, non-surgical complications, surgical complications, radiotherapy, follow-up duration. The following endpoints were considered: surgical complications rate, non-surgical complications rate, perioperative mortality, tumour recurrence/progression (all dichotomous), KPS at discharge, hospitalization time and KPS at the last follow up (all numeric). Logistic regression was chosen for dichotomous response variables and general linear regression for numeric outcomes, employing a logarithmic link for hospitalization time. Statistical analyses were carried out using SPSS 22 (IBM Corp., Armonk, NY) and SAS 9.2 (SAS Institute, Cary, NC).

3. Results

3.1. Preoperative data

Between the two meningioma types there were no significant differences regarding: KPS, tumour size, gender and age. While LPPM patients complained significantly more often of dizziness (56%) and headache (49%), PCM patients had a significant higher rate of trigeminal nerve impairments (50%). The results are summarized in Table 1.

3.2. Intraoperative data

The resection of PCM was significantly more often done two-staged (24%) compared to LPPM (3%) and lasted significantly longer (500 min vs. 247 min). PCM resection led to a significantly higher blood loss (1000 ml vs. 525 ml). A gross total resection (Simpson grade I or II) was significantly more often achieved in LPPM than PCM (91% vs. 39%). The results are summarized in Table 2.

3.3. Postoperative data

The overall complications rate (72% vs. 31%), as well as the irreversible complications rate (57% vs. 9%) were significantly higher

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