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Results of surgical treatment of anterior clinoidal meningiomas – our experiences

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ABSTRACT

Objective: Presentation of our experience in the treatment of anterior clinoidal meningiomas, including evaluation of factors that may affect early and long-term treatment outcomes.

Methods: Thirty patients were operated with strategy of complete tumor resection using fronto-orbito-zygomatic approach. Outcomes were assessed by Glasgow Outcome Scale at discharge and by Karnofsky Performance Scale at follow-up.

Results: There were 6 tumors in group I, 20 in group II, and 4 in group III according to Al-Mefty classification. Complete tumor resection (Simpson I or II) was achieved in 19 patients, incomplete resection (Simpson IV) in 11: due to strict tumor adhesion to cerebral arteries in 5 and tumor extension to cavernous sinus in 6 cases. Operative mortality was 6.7%. Visual acuity improved in six among nine patients with impaired vision but in no one among nine patients with blindness. Normal life activity (80–100 KPS) could be carried out by 88% patients at follow-up. Recurrence was observed in two (11.8%) patients after radical removal and progression of residual tumor in two (25%) after subtotal resection.

Conclusions: Complete tumor removal is possible with an acceptable risk of death and severe neurological deficits, except for cases with tumor extension to the cavernous sinus or strict tumor adhesion to cerebral arteries. Visual acuity improvement may be expected in two thirds of patients with impaired vision, but not in cases of blindness. In cases of incomplete tumor removal, use of stereotactic radiosurgery immediately after surgery seems justified.

1. Introduction

Sphenoid wing meningiomas are traditionally divided into tumors of the outer part (pterional meningiomas), the middle part, and the inner (medial) part of the wing [1]. Among the latter group, meningiomas with dural attachment at the anterior clinoid process (clinoidal meningiomas) are distinguished [2–4]. Based on anatomical intraoperative observations and observed surgical difficulties, anterior

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clinoidal meningiomas were divided by Al-Mefty in 1990 [5] into three groups depending on the location of dural attachment on the anterior clinoid process, which determines the relationship of the tumor to the arteries and the anterior visual pathways. Group I meningiomas originate on lower surface of the process and when grow, they surround the internal carotid artery on its short length after leaving the cavernous sinus, but prior to entering the arachnoid cistern, with the result that they are directly adhering to the arterial adventitia, without interfacing arachnoidal membrane. With further tumor growth, this direct adhesion to the wall of the internal carotid artery can continue to its bifurcation and can encase middle cerebral artery, pushing the arachnoid away. In this anatomical situation, dissection of the tumor from the vessels is usually impossible. Group II includes meningiomas with dural attachment to the superior or lateral surface of the anterior clinoid process, where the internal carotid artery is already surrounded by the carotid cistern, and thus these tumors have a preserved arachnoid layer separating them from the vessels. Both group I and group II tumors are separated from the optic nerve by an arachnoid layer. Group III meningiomas according to the Al-Mefty classification, with dural attachment at the optic foramen, extend into the optic canal and surround the tip of the anterior clinoid process. An arachnoid layer is preserved between the vessels and the tumor but it may be destroyed by tumor invasion within the optic nerve meninges. These tumors are usually small. Al-Mefty classification of anterior clinoidal meningiomas proved to be extremely useful in relation to the expected intraoperative difficulties, possibility of total removal, and outcome. In group I meningiomas which closely encircle the naked artery, complete tumor removal is often not possible [5–7]. In the past, neurosurgeons were satisfied with subtotal removal of these meningiomas with concerns about the risk of damage to the cerebral arteries. Incomplete removal caused these tumors the most frequently regrowing skull base meningiomas [8]. With advances in surgical techniques treatment outcomes improved and safe and complete tumor removal became possible. Currently, not only preservation, but even improvement of vision may be expected after the surgery [4,6,7,9,10].

The aim of this study was to present our own experience in the treatment of anterior clinoidal meningiomas, including evaluation of factors that may affect early and long-term treatment outcomes.

2. Materials and methods

We performed a retrospective analysis of data obtained in 30 consecutive patients (23 women and 7 men) operated on for the anterior clinoidal meningiomas in our Department of Neurosurgery between 1992 and 2011. The mean patient age was 54 years (range 31–72 years, median 55 years). The mean duration of symptoms was 123 weeks (median 52 weeks) but it ranged widely from 5 days to 20 years. The tumor was right-sided in 16 patients and left-sided in 14 patients. Preoperative contrast-enhanced MRI scans were performed in 24 patients, and the remaining patients, who were treated in the first years of the study period, were operated based on computed tomography. CT bone window imaging was performed in 22 patients, digital subtraction angiography in 27 patients, and CT angiography in 3 patients. No preoperative embolization of the tumor was done [11]. Dimension of tumors, defined by the largest diameter of the tumor, ranged from 13 to 64 mm (mean 37.3 mm, median 40 mm). Meningiomas were categorized according to the Al-Mefty classification [5]. Our goal was complete tumor resection with excision or coagulation of its dural attachment. Fronto-orbito-zygomatic approach with superior orbital fissure opening, optic canal unroofing, and extradural anterior clinoidectomy was used. In some patients, anterior clinoid process was removed partially in extradural step of operation, and its remaining fragment intradurally. Histopathologically, all resected tumors were WHO grade I, including transitional subtype in 12, endothelial in 7, meningothelial in 5, fibroblastic in 3 and psammomatous in 3 cases. The extent of resection was evaluated using Simpson scale [8] based on the intraoperative assessment by the surgeon, the result of early postoperative CT and the result of control MRI performed up to 6 months after the surgery. In case of cranial base meningiomas Simpson I removal is not always possible and reasonable to obtain, and thus removal with coagulation of the dural attachment (Simpson II) may also be assessed as a complete removal. For this reason, Simpson I and Simpson II were both categorized as a complete removal when evaluating the results. If even the smallest portion of the tumor was left on the arteries or in the cavernous sinus, tumor removal was assessed as incomplete– Simpson IV. Outcomes were evaluated at the time of discharge and during long-term follow-up based on the assessment of the neurological status and late follow-up MRI findings. Enlargement of the tumor remnant in a late control MRI in relation to the baseline postoperative MRI was considered as tumor progression. Tumor recurrence was recognized in case when the operating surgeon assessed tumor removal as complete (Simpson I or II) as well as no tumor remnant was seen in the baseline postoperative MRI and then reappearance of a tumor was observed in a late control MRI.

The follow-up data were obtained in 25 of 28 patients (89.3%) discharged from our unit. Duration of follow-up ranged from 13 to 193 months (mean 83 months, median 72 months).

Data were analyzed using the Statistica software, version 10.0 (StatSoft). Analyses included basic descriptive statistics, the Student *t*-test, and contingency tables with the Pearson chi-square test and the exact Fisher test. $P \leq 0.05$ was considered statistically significant.

3. Results

3.1. *Symptoms of the disease*

The most common first symptom of the disease was ipsilateral visual impairment (in 17 patients), including impaired visual acuity in 13 patients and visual field defects in 4 patients (Table 1). Duration of symptoms in the 17 patients, whose disease started with visual impairment was longer compared to the remaining patients (mean 178 weeks vs. 50 weeks, p = ns). Among them, 11 patients had history of visual disturbances longer than one year, including 3 patients with symptoms present for many years (10, 10, and 20 years, respectively).