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Characteristics of midline suprasellar meningiomas based on their origin and growth pattern

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ABSTRACT

Background: The aim of the present study was to elucidate clinical and prognostic characteristics of the midline suprasellar meningiomas based on their origin and growth pattern.
Methods: A retrospective review of the medical records was conducted for patients undergoing surgical resection of the midline suprasellar meningioma. The meningiomas were divided into group A – planum sphenoidale meningioma (PSM), group B – tuberculum sellae meningioma (TSM) and group C – diaphragma sellae meningioma (DSM), based on their growth pattern in relation to the optic pathway and pituitary stalk, group C was then divided into groups C1 and C2.
Results: The mean age of 32 men and 74 women was 48.5 ± 13.1 years (range, 20–78 years). The rate of visual impairment was highest in patients in group C2 and lowest in group A patients ($P < 0.001$). The h–p axis impairment and MRI evidence of the pituitary stalk involvement was more frequent in patients with group C1 meningioma ($P < 0.001$). The gross total resection (GTR) was achieved in 84/106 (79%) patients. The mean follow-up period was 70.4 months (median 86 months, range 64.5–76.3 months). The fronto-temporal approach was the only significant predictor of the postoperative visual acuity impairment ($P = 0.001$, OR: 8.2, CI: 2.45–27.42) and visual field impairment ($P = 0.016$, OR: 0.071, CI: 0.008–0.607). The meningiomas in groups B ($P = 0.024$, OR: 0.198, CI: 0.049–0.812) and C1 ($P = 0.012$, OR: 0.082, CI: 0.012–0.580) were significant predictors of the postoperative visual field deficits. The group C1 ($P = 0.036$, OR: 0.244, CI: 0.065–0.912) and surgical approach employed ($P = 0.032$, OR: 0.013, CI: 0.000–0.684) was significant predictors of the postoperative h–p function impairment. The mean recurrence free survival (RFS) time and rate were 102.9 ± 3.2 months and 86%. The group C1 meningiomas had the lowest RFS rate and time (33.3% and 55.6 ± 8.3 months). The subtotal resection and the group C1 meningioma ($P = 0.001$, OR: 15.6, CI: 2.9–82.8) were the significant predictors of recurrence ($P = 0.008$, OR: 0.08, CI: 0.014–0.529).
Conclusion: The group A meningioma had the high rate of complete resection and favorable RFS. Groups B and C2 involve optic pathway and optic canal predominately. The group C1 DSM was an independent predictor of subtotal resection, postoperative visual field and h–p axis impairment. The subtotal resection was an independent predictor of the recurrence.

1. Introduction

The suprasellar meningioma constitutes 5–10% of all the intracranial meningiomas; they are common yet challenging tumors of the skull base [1–7]. A variety of nomenclature for the suprasellar meningiomas exists in the literature [1,8–15]. In 1916, Cushing and Eisenhardt described the meningiomas arising from the tuberculum sellae and sulcus chiasmatis as the suprasellar meningiomas. In 1927, Holmes and Sargent introduced the term chiasmal syndrome, for the suprasellar meningioma presenting with primary optic atrophy with bitemporal field defects with an essentially normal sella turcica. The tumors originating from the dura of the planum sphenoidale (PS), tuberculum sellae (TS), diaphragma sellae (DS) and anterior clinoid process are classified as suprasellar meningioma [16–20]. Anterior clinoid meningiomas are the lateral suprasellar meningiomas which represents a distinct anatomical and clinical entity due to high mortality and morbidity rate, frequent invasion of anterior cavernous sinus, encasement of carotid artery, failure of total removal and higher recurrence rates

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compared to other suprasellar meningiomas [8]. The meningioma originating from planum sphenoidale (PSM), tuberculum sellae (TSM) and diaphragma sellae (DSM) can be classified as midline suprasellar meningiomas [1–3,9,16,18,21–24].

The TS is a slight bony elevation that separates the anterior roof of the pituitary fossa from the prechiasmal sulcus [27]. Because of the relatively small dimensions of the sella, the dural attachment of these tumors can extend anteriorly to the sphenoid limbus and planum sphenoidale or posteriorly to involve the diaphragma sellae [5,28]. The TSM and DSM often encase or displace the optic nerves and chiasm, anterior cerebral artery (ACA) complex and internal carotid arteries (ICA) and their perforators, pituitary stalk and infundibulum. The meningioma originating from the midline suprasellar region and growing in various patterns might have a distinct clinical, neuroimaging and postoperative outcome [1,19,23,34,35]. The present study was conducted to elucidate the clinical, neuroimaging characteristics, surgical outcomes and recurrence in the midline suprasellar meningioma.

2. Methods

2.1. Patient population

A retrospective review of medical records of the patients with midline suprasellar meningioma was conducted. The local ethics committee approved the study. Between January 2000 and December 2008, 106 patients with midline suprasellar meningioma underwent surgical resection at our institution. None of the patients had any prior treatment for meningioma. All the patients underwent a standard preoperative evaluation including history, neurological and ophthalmologic examination. The ophthalmologic examination consisted of testing visual acuity and visual field using the standard techniques. The hypothalamo-pituitary axis impairment was evaluated using the baseline endocrine panel of pituitary and target organ hormones. The operative reports, surgical videotapes and inpatient charts were reviewed for the details of the surgical techniques, intraoperative findings and postoperative course. The factors that might influence the outcome and recurrence were analyzed: patient's age and sex, duration of preoperative symptoms, tumor size, involvement of optic pathway, PS and ACA complex by the tumor, surgical approach used, postoperative complications and WHO grading of meningioma.

2.2. Neuroimaging

Pre- and post-gadolinium MRI and post-contrast computerized tomography (CT) were reviewed. Based on the origin and location of the tumor, we classified the cases into groups A, B and C. Group A: tumor originating from the planum sphenoidale, rarely involves the optic pathway or pituitary stalk; group B is the tumor located at the tuberculum sellae, mainly involves the optic pathway but rarely involves pituitary stalk; group C located at the diaphragma sellae, which involves both the optic pathway and the pituitary stalk. Group C was then divided into C1 and C2, C1: tumor pushes the chiasm anteriorly in to "pre-fixed chiasm" position, resulting in minimal pre-chiasmal working area, C2: tumor pushes the optic chiasm posteriorly, putting it in to "post-fixed chiasm" position, resulting in expansion of the pre-chiasmatic working area (Fig. 1). The tumor type and invasion of surrounding structures including optic pathway, pituitary stalk and ACA complex was defined on the

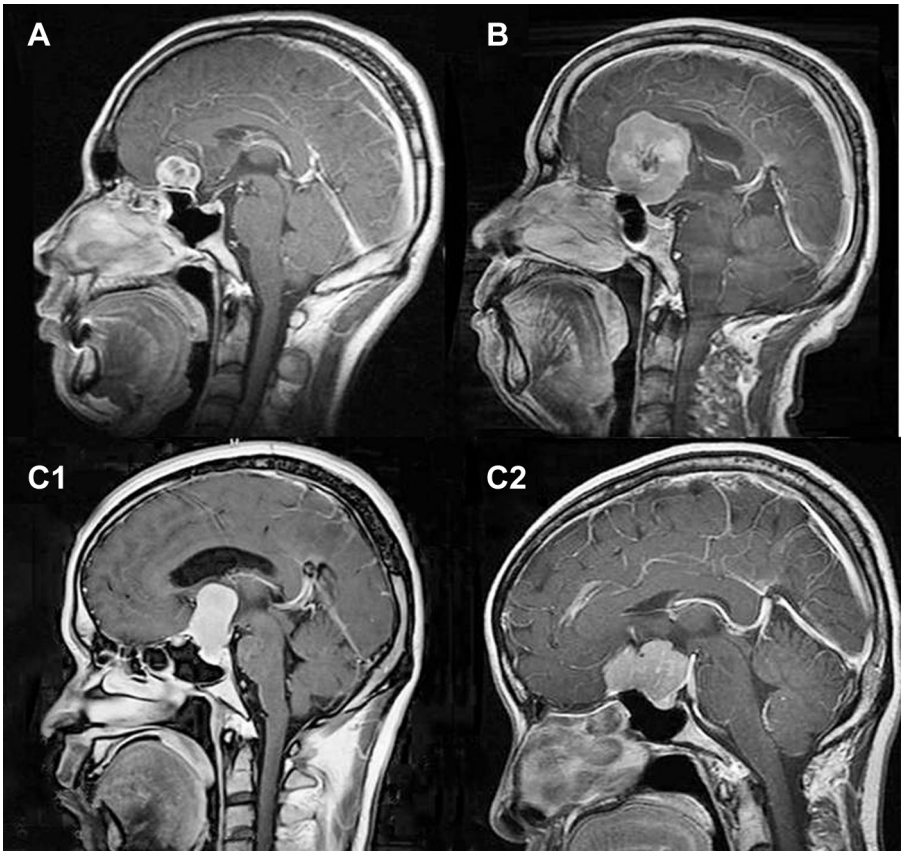

Fig. 1. (a–c2) T1-weighted gadolinium enhanced MRI demonstrating (a) Group A meningioma located at the planum sphenoidale, rarely involves the optic pathway or pituitary stalk; (b) Group B located at the tuberculum sellae, mainly involves the optic pathway but rarely involves pituitary stalk; (c1 and c2) Group C located at the diaphragma sellae (DS), involving both the optic pathway and the pituitary stalk, (c1) group C1 DSM, tumor pushes the chiasm in pre-fixed position, (c2) group C2 DSM, tumor pushes the optic chiasm in post-fixed position with expansion of pre-chiasmatic space.