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Clinical Study

A proposed scheme for the classification and surgical planning of falcine meningioma treatment

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ABSTRACT

Falcine meningiomas (FM) represent a surgical challenge even in the microsurgical era. An individualised surgical approach to different FM is indispensable, but there have been few reports in this regard. Thus, based on our series of 20 patients with FM who underwent surgery between October 2001 and June 2010, we propose a classification scheme for FM removal and demonstrate its effectiveness. FM in our series were classified into four types, according to tumour growth patterns on coronal MRI: Type I, hemispheroid-shaped tumours invaginating deeply into one hemisphere without shifting the falx (10 patients); Type II, olive-shaped tumours shifting the falx substantially to the contralateral side (six patients); Type IIIA, globular- or dumbbell-shaped tumours extending into both hemispheres, but to different extents (one patient); and Type IIIB, globular- or dumbbell-shaped tumours extending into both hemispheres to approximately equal extent (three patients). An ipsilateral interhemispheric approach was performed for Type I tumours, and a contralateral transfalcine approach for Type II. Type IIIA tumour was approached from the side where the smaller tumour was located. Type IIIB tumours were approached from the non-dominant hemisphere. Simpson grade I resection was achieved in all 20 patients. The follow-up ranged from 12 months to 114 months. There was no postoperative mortality, serious neurological deficits, or tumour recurrence. The preliminary results suggest that the proposed scheme can facilitate surgical planning and accomplish complete tumour resection with minimal invasion.

1. Introduction

Falcine meningiomas (FM) are meningiomas arising from the falx cerebri and are completely concealed by the overlying brain parenchyma, and typically do not involve the superior sagittal sinus (SSS). These usually large benign tumours sometimes have a dumbbell shape and invaginate the medial aspects of both the left and right hemispheres.[1,2]

FM remain a surgical challenge even in the microsurgical era.[2,3] Subtotal removal is associated with a high rate of recurrence,[4–7] but achieving radical resection without neurological deficit is not always possible. First, exposure of the deep-seated tumour poses great risks to the adjacent cortex and pyramidal fibres.[8,9] Brain contusion caused by excessive retraction may lead to severe postoperative complications such as hemiparesis and seizures.[10] Second, meningiomas are hypervascularised from the attached dura.[10–12] Therefore, early devascularisation is crucial to avoid severe bleeding, which may reduce visibility and even threaten the life of the patient. Finally, there are different growth patterns of FM, as depicted by MRI in the coronal plane[2] (Fig. 1A–D). An individualised surgical approach to tumour removal is indispensable in achieving minimal brain retraction, early devascularisation, and an excellent visual angle.

However, there have been few detailed reports concerning a classification scale to facilitate the surgical planning of FM. In our study, we proposed a scheme for the classification and surgical planning of FM, and 20 patients with FM were operated on according to the scheme. Patients where the FM involved the SSS were excluded. The clinical results were assessed.

2. Materials and methods

2.1. Scheme for classifying and surgical planning

The study was approved by the ethical committee of the Cancer Hospital, Peking Union Medical College, Chinese Academy of Medical Sciences.

FM in this series were classified into one of four types according to the main growth pattern seen on coronal MRI (Fig. 1A–D). The growth type served as a guide to the surgical approach (Table 1, Fig. 2).

2.2. Patient population

Between October 2001 and June 2010, 20 patients with FM were operated on in our department. All tumours were verified

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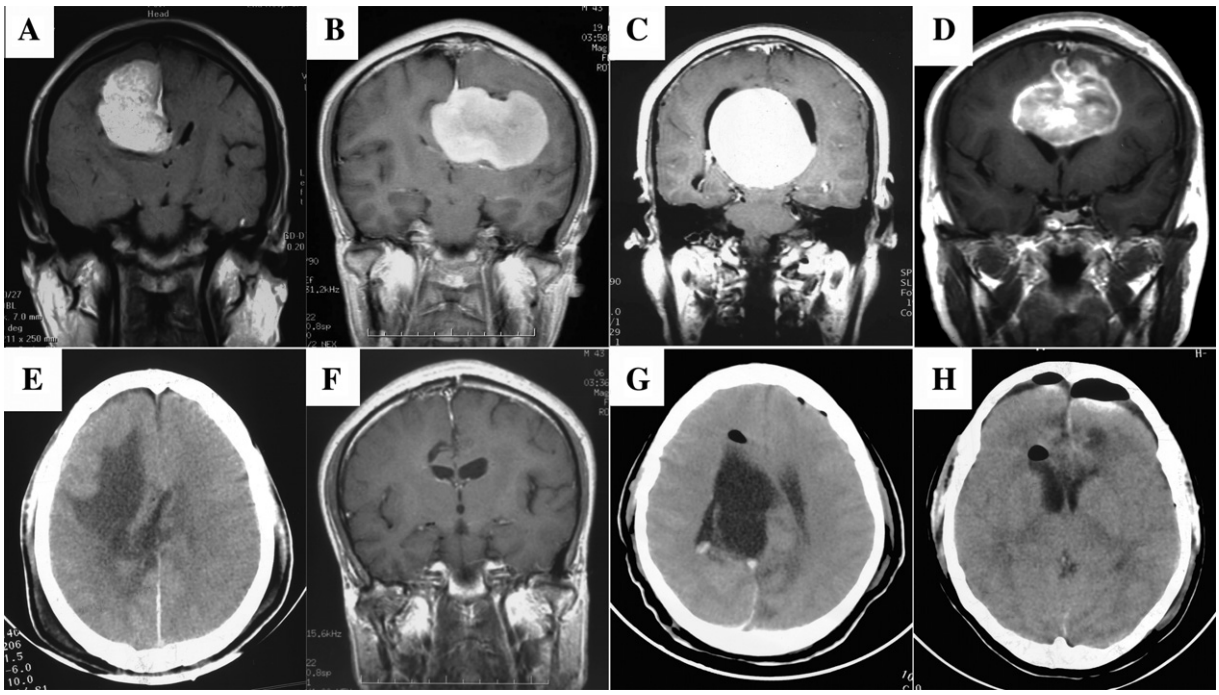

Fig. 1. (A–D) Preoperative coronal, contrast-enhanced T1-weighted MRI revealing four types of falcine meningioma (FM): (A) Type I, (B) Type II, (C) Type IIIA, and (D) Type IIIB. (E–H) Postoperative axial CT scans (E, G, and H) and coronal contrast enhanced T1-weighted MRI (F) showing complete tumour resection (E, Type I; F, Type II; G, Type IIIA; H, Type IIIB).

Table 1
Scheme for classification of falcine meningioma and surgical planning

Tumour type (no. patients)	Growth pattern	Surgical planning	
		Head rotation[a]	Approach
I (10)	Hemispheroid-shaped tumour invaginating deeply into one hemisphere without shifting the falx	Rotation of 10° ipsilateral to the tumour	Ipsilateral interhemispheric
II (6)	Olive-shaped tumour substantially shifting the falx to the contralateral side	Neutral position initially, and subsequently 10° to 15° rotation ipsilateral to the tumour	Contralateral transfalcine
IIIA (1)	Globular- or dumbbell-shaped tumour extending into both hemispheres, but to different extents	Neutral position initially, and then 15° to 20° rotation to the side of main bulk	From the side of the smaller tumour volume
IIIB (3)	Globular- or dumbbell-shaped tumour extending into both hemispheres, to approximately equal extents	15° to 20° rotation to the NDH initially, and subsequently tilted to the dominant hemisphere to form an angle of 15° to 20° with the vertical plane	From the side of the NDH

NDH = non-dominant hemisphere.
[a] The surgical approach is illustrated in Fig. 2.

by histological examination. There was a slight prevalence of female patients (12:8, 60%). The patients had a mean age of 47.7 years (range, 30–70 years). The initial symptom for which they sought medical help was pyramidal motor deficits or sensory disturbances (12 patients, 60%), vertigo (eight patients, 40%), epilepsy (generalised tonic–clonic seizures in two patients, and simple partial seizures in six patients, 40%), or headache (six patients, 30%). In addition, six patients (30%) had visual defects followed by personality changes (two patients, 10%), speech disturbances (two patients, 10%) or memory deficits (two patients, 10%). The mean preoperative duration of the presenting symptoms was 1.2 years (range, 1 week–5 years).

2.3. Preoperative neuroimaging

All patients were examined preoperatively by pre-contrast and enhanced CT scans and MRI including T1-contrast-enhanced sequences in the axial, sagittal and coronal planes. Nine patients (45%) harboured tumours on the left side, and seven patients (35%) harboured tumours on the right. Bilateral extension was present in four patients (20%). The maximum diameter of FM ranged from 3.1 cm to 9 cm (mean, 4.3 cm). The tumour growth patterns depicted by preoperative coronal MRI helped in selecting the optimal surgical approach (Fig. 1A–D).

2.4. Surgical procedures

2.4.1. Patient positioning and craniotomy

After general anaesthesia, the patients were positioned as proposed by Al-Mefty.[11] FM in the anterior third were approached with patients in the supine position and the head straight in the sagittal plane. For tumours in the middle third, the patients were supine with the head brought into moderate anterior flexion (30°). FM in the posterior third were approached with patients in a prone position. The head rotation is described in Table 1. After the scalp flap was reflected, paramedian burr holes were drilled