Falx meningioma

J.Sales-Llopis, R.López García

Neurosurgery Department, University General Hospital of Alicante, Foundation for the Promotion of Health and Biomedical Research in the Valencian Region (FISABIO), Alicante, Spain

Falx or falcine meningioma, as defined by Harvey Williams Cushing, is a intracranial meningioma arising from the falx cerebri and completely concealed by the overlying cortex.\(^1\)

Not involving the superior sagittal sinus.

Epidemiology

Falcine meningiomas account for 9% of all intracranial meningiomas.

Falcine meningioma tends to grow predominately into one cerebral hemisphere but is often bilateral, and in some patients the tumor grows into the inferior edge of the sagittal sinus.

The patients with falcine meningiomas with reference to gender had the following ratio of male:female of 1:2.1 and an average age of 55 years.

In the series of Pires de Aguiar et al 1:6 (men:women) relationship, and the mean age was 55.4 years old.\(^2\)

Classification

They can be divided into anterior, middle, and posterior types, depending on their origin in the falx.\(^3\)

The anterior type extends from the floor of the anterior cranial fossa to the coronal suture, the middle type from the coronal suture to the lambdoid suture, and the posterior type extends from the lambdoid suture to the torcular Herophili.

Falcine meningioma of the anterior third

Falcine meningioma of the middle third

Falcine meningioma of the posterior third.

Yasargil classified falcine meningiomas into outer and inner types. The former arise from the main body of the falx in the frontal (anterior or posterior), central parietal, or occipital regions, whereas inner falcine meningiomas arise in conjunction with the inferior sagittal sinus.\(^4\)

Zuo et al classified FM 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.\(^5\)
Das et al. proposed a new classification schema:

Thirty-five patients with FM (mean age, 50.03 years; male/female ratio, 16:19) were classified into unilateral conventional (type I; n = 17), unilateral high (type II; n = 9) and bilateral FM (type III; n = 9) based on the coronal magnetic resonance imaging findings. We excluded the primary parasagittal meningiomas from our analysis.

Type II and III tumors were more common in males (unlike the overall cohort), presented more often with seizures, and were associated with less favorable postoperative outcomes. Preoperative motor weakness was almost exclusively seen with the unilateral tumors (type I/II). Preexisting weakness (P = 0.02) was a strong predictor of the likelihood of postoperative motor power worsening, the major surgical complication in our series (n = 9; 25.7%). New-onset postoperative weakness (n = 2) recovered completely, whereas worsening of the preexisting weakness showed only a partial improvement (n = 6).

The proposed classification scheme characterizes FMs comprehensively. Bilaterality and parasagittal extensions in FMs affect their clinical presentation, increase surgical difficulty, and influence the surgical outcome adversely. Preexisting motor weakness portends a poor postoperative motor outcome.

see also cystic falx meningioma.

Clinical features

Symptoms can vary depending upon the location of these tumors along the falx.

Those located in the frontal section may impair higher levels of brain functioning such as reasoning and memory, while those located in the middle section would be more likely to cause leg weakness.

In the series of Chung et al. at presentation, symptom durations were found to vary widely. Twenty-one patients (30%) presented with headache, and eleven (16%) with unilateral motor weakness. Five (7%) patients had a chief complaint of a seizure history. Five (7%) patients presented with personality change and four (6%) were asymptomatic and their brain tumors were detected incidentally.

Diagnosis

MRI with and without gadolinium helps better to delineate the tumor in relation to the dural sinus, the tumor interface with the cerebral cortex, presence of significant blood supply, and presence of cysts or other intra-tumoral structures that will add to the complexity and malignant potential of the tumor. Good pre-operative evaluation of falcine meningiomas is also important when integrated with neuronavigation protocols to be utilized in the operating room. Furthermore, the junction between tumor and adjacent brain suggests the presence or absence of an accessible arachnoid plane and enables the surgeon to predict the potential degree of neurologic deficit that may follow surgical removal. Gadolinium-enhanced MRI allows demonstration of tumoral or adjacent dural enhancement. The radiological appearance affords a valid predictor of the degree of dural involvement in the region of the sinus and adjacent falx. This may suggest the presence of syncytium of meningeal cells.
spreading along the falx from the site of major dural attachment.

Multiplanar MRI is the current standard study for the preoperative evaluation of patients with falcine meningiomas. Coronal, sagittal, and axial T1-weighted gadolinium-enhanced sequences help define the anatomical locations, sizes, and medial hemisphere involvements of these tumors.

MR venography in vertex view can be useful for demonstrating nearby parasagittal draining veins, which must be protected \(^8\), but MRA alone seems to be inadequate in the lack of venous phase of cerebral vasculature around tumors.

**Cerebral angiography**

Cerebral angiography is necessary in patients with these meningiomas, and the pericallosal artery is often displaced and may actually be engulfed by the tumor. Arterial phase cerebral or MR angiograms should be studied to determine the relationship between tumor and ACA. Anterior falcine meningiomas are usually supplied by the ACA or by a tentorial branch of the ophthalmic artery. Venous phase cerebral angiography is important because it provides significant information about whether a tumor mass has invaded the sagittal sinus. Moreover, it provides information about the courses of many large drainers around a mass, which must be determined to identify trajectory to a falcine mass and to prevent postoperative venous infarction. It is also useful for determining sinus patency and for delineating the anatomical location of the major cortical draining vein. Signs of venous occlusion include the disappearance of a segment of the superior sagittal sinus (SSS), a delay in venous drainage in the area of obstruction, and failure of the cortical vein to reach the sinus.

**Differential diagnosis**

Falx meningioma differential diagnosis.

**Treatment**

see Falx meningioma treatment.

**Complications**

The falcine meningiomas may be present with bleeding as intraparenchymal hematomas, subdural hematomas and subarachnoid hemorrhage, causing a clinical finding of apoplexy in the patients.

Hemorrhages occurring in asymptomatic falcine meningiomas are known beforehand to have been described after the internal use of low-dose aspirin for prolonged period.

During falcine meningioma surgery, we must pay attention to cardiac monitoring due to the risk that the handling of falx and tentorium could provoke cardiac asystole. The mechanical stimulation of the falcine area may result in the hyperactivity of the trigeminal ganglion, thereby triggering TCR.

The dorsal region of the spinal trigeminal tract includes neurons from hypoglossal and vagus nerves, and projections have been seen between the vagus and trigeminal nuclei.

**Recurrence**

It has been reported that parasagittal meningioma and falc meningiomas recur more frequently than other intracranial meningiomas \(^9\).
The rate of recurrence of falx meningiomas significantly increases in cases of non-radical resection of tumor. Aggressive surgical treatment obviously may present several hazards and may carry an increased risk of unsatisfactory outcome; however, the risk of recurrence is significantly decreased\(^\text{10}\).

Abou Al-Shaar et al. have utilized brachytherapy as a salvage treatment in two patients with a unique implantation technique. Both patients had recurrence of WHO Grade II falcine meningiomas despite multiple prior surgical and RT treatments. Radioactive I-125 seeds were made into strands and sutured into a mesh implant, with 1 cm spacing, in a size appropriate to cover the cavity and region of susceptible falcine dura. Following resection the vicryl mesh was implanted and fixed to the margins of the falx. Implantation in this interhemispheric space provides good dose conformality with targeting of at-risk tissue and minimal radiation exposure to normal neural tissues. The patients are recurrence free 31 and 10 months after brachytherapy treatment. Brachytherapy was an effective salvage treatment for the recurrent aggressive falcine meningiomas in two patients\(^\text{11}\).

**Videos**

**Books**

Parasagittal and falx meningiomas 1970 by P. C Gautier-Smith (Author)


**Case series**

**2017**

Murrone et al. analyzed 95 patients with falcine meningiomas who underwent surgical removal of their lesion at our institution between 2001 and 2014. Surgical management of these patients, focusing on anatomical and clinical features is described. Thus, based on our series, a surgical algorithm, classifying the falcine meningioma into four types, according to location at the falx, and using an ipsilateral interhemispheric approach in supine or prone position, is described. The median length of follow-up was 7.1 years (range 1.6-12.3 years). Approximately one-third of all patients was asymptomatic, headaches occurred in 27 patients, seizures in 14 cases, and lower-extremity weakness in 9 cases. In this series, the middle third of the falx was the most frequently involved site (55.78%), while the anterior third (26.31%) and the posterior type (17.89%) were less common. The transitional and meningothelial types occurred in 69 of patients and a high grade in only two patients. Compared with previous series in literature, there was no mortality and Gross Total Resection was obtained in 83 (87.5%) cases. Three of 95 patients experienced new or worsened neurological deficits after surgery while other complications were relatively in only 6 cases. This study presents our good results about removal of the tumor while preserving major cortical veins and the sinus using advanced microsurgical tools\(^\text{12}\).

**2007**

68 patients with meningiomas arising from the falx underwent craniotomies. There were 22 male and 46 female patients (1:2.1). Mean age was 55 years and ranged from 14 to 77 years. Locations of falcine meningioma were; the anterior third in 33 cases, middle in 20, and falcine meningioma of the posterior third in 15.

Mean tumor volume was 42 cc and ranged from 4 to 140 cc. In 58 of the 68 patients tumors were
totally removed. Additional surgery for recurrence was performed in 6 patients over 15 years. Of these 6 patients, only two patients underwent gross total tumor resection at first operation; the other four underwent subtotal tumor resection. Based on pathologic reports, the largest tumor subtype was transitional. There were four patients with a high grade tumor-three atypical and one anaplastic meningioma. Of the 68 patients, 59 achieved a good outcome (no neurological deficit or recurrence), six had temporary complications, two suffered new permanent postoperative deficits, and the remaining one died due to severe brain swelling despite postoperative intensive care. Extent of surgical resection was found to be significantly related to tumor recurrence.

Falcine meningioma accounted for 8.5% of intracranial meningiomas and the transitional meningioma was the most common subtype of falcine meningioma. Gross total resection of tumor was the single most important predictor of an improved surgical outcome.\(^\text{13}\)

**Case reports**

see Falx meningioma case reports


\(^8\) Alvernia J, Sindou M. Preoperative neuroimaging findings as a predictor of surgical plane of cleavage: Prospective study of 100 consecutive cases of intracranial meningioma. J Neurosurg. 2004;100:422-430.

