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Frontal Skull-Base Meningioma: Its Management and Outcome

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ABSTRACT

***Objective**: To analyze the clinical manifestations, diagnostic evaluation and the functional outcome of surgery of anterior skull base meningioma. **Material and method**: It is a prospective hospital based study on 22 patients who were admitted and diagnosed to be a case of anterior skull base meningioma and have completed at least three months of follow-up after surgery. **Result**: Anterior skull base meningioma is commonly seen in the female population with a female to male ratio of 1.75:1. Maximum incidence was found in the age group of 40 to 50 years of age. Visual impairment was the most common (59.1%) mode of presentation. Due to the involvement of the other cranial nerves of anterior cranial fossa, diplopia (22.7%), ocular paresis (22.7%), papilledema (50%), optic atrophy (31.8%), Foster Kennedy Syndrome (13.6%), anosmia (22.7%) are common findings. Due to the mass effect, headache (54.5%), mental changes (27.3%), seizure (22.7%) are also commonly found. Computerized tomography scanning was useful for defining the osseous anatomy while MR imaging and MR angiography defined the relationship of the tumor to the optic nerves and chiasm as well as the other intracranial neurovascular structures. **Conclusion**: Thus early diagnosis is desirable for successful treatment with a better chance of good postoperative outcome.*

***Keywords**: Frontal Skull, Meningioma, Outcome*

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INTRODUCTION

Meningioma is among the most common intracranial neoplasms of adulthood and is the most common primary intracranial tumour. They are usually slow growing, circumscribed benign neoplasms. They account for 18-20% of all primary intracranial neoplasm and among them around 25% arise from the anterior skull base. Any person treated with radiotherapy of the scalp or cranium are more prone to develop meningiomas and also appear at an earlier age.[1] There are number of reports of meningioma developing at the site of previous trauma and also of genetic influence in its development. Although, meningiomas are usually well circumscribed, an uncommon en-plaque variety is also seen and they commonly arise along the skull base.[2]

Meningiomas are commonly seen between 20 to 60 years of age, the peak being around the age of 40 and are common in women than in men (2:1). While many tumours are asymptomatic and remain so throughout life, meningiomas of the anterior skull base will frequently cause visual or oculomotor disturbances that lead to their early diagnosis. Patients with anterior skull base meningioma may present with variety of symptoms – raised intra-cranial pressure, lobar symptoms, multiple cranial nerves involvement, ocular manifestations, bony hyperostosis and involvement of other intra-cranial structures. Radiologically, they are best evaluated by CECT head and CEMRI brain to look for bony involvement as well as extent of the tumour, dural and other neurovascular involvement.[3]

The treatment of meningioma is surgical resection. Complete tumour resection along with removal of other

involved intracranial structure is important to prevent recurrence. As many cranial nerves and other important intracranial structures are located along the anterior skull base, clear anatomical knowledge of the region and surgical skill are of paramount importance for complete tumour resection and better surgical outcome. Radiotherapy is included for incompletely resected tumours or recurrent disease for better results.[4]

Due to the complexity of the anatomy of the anterior cranial fossa, the outcome of surgery along the anterior skull base depends upon the tumour location and its involvement of other intracranial structures, surgical approach, surgical expertise and prevention of intra and post-operative complications. With better understanding of the anatomy, preoperative clinical and diagnostic evaluations and proper microsurgical techniques, we can achieve good clinical and functional outcomes following surgery [5] and the same is approached in this study.

Material and method:

It is a prospective hospital based study on 22 patients who were admitted and diagnosed to be a case of anterior skull base meningioma in the department of Neurosurgery, Gauhati Medical College and Hospital, Guwahati during the period of January 2012 to December 2013 and have completed at least three months of follow-up after surgery.

RESULTS

In this study, emphasis was put on the clinical presentations, clinical and radiological findings, surgical approaches undertaken according to tumor locations and outcome of surgery in patients with anterior skull base meningioma.

Anterior skull base meningioma is commonly seen in the female population with a female to male ratio of 1.75:1. Maximum incidence was found in the age group of 40 to 50 years of age.

Visual impairment was the most common (59.1%) mode of presentation. Due to the involvement of the other cranial nerves of anterior cranial fossa, Diplopia (22.7%), ocular paresis (22.7%), Papilledema (50%), optic atrophy (31.8%), Foster Kennedy Syndrome (13.6%), Anosmia (22.7%) are common findings. Due to the mass effect, headache (54.5%), mental changes (27.3%), seizure (22.7%) are also commonly found.

Different sites of origin of anterior skull base meningioma are shown in **Table 1.**

Table 1 Tumor Location

Origin of tumor	No. of cases (%)		
Sphenoid wing	Lateral 1/3rd	3(13.6%)	7 (31.8%)
	Middle 1/3rd	2 (9%)	
	Medial 1/3rd	2 (9%)	
Olfactory groove		5 (22.7%)	
Optic nerve sheath & orbital		4 (18.2%)	
Tuberculum sellae		5 (22.7%)	
Planum sphenoidale		1 (4.5%)	

Tumour was approached through the Unilateral sub frontal approach in 31.8% cases, Fronto- Temporo- Orbito-Zygomatic approach in 27.3% cases, Bilateral subfrontal approach in 22.7% cases and Pterional approach in 18.2% cases. Most of the tumours were approached through the unilateral subfrontal approach (31.8%). The next common route was through the fronto-temporo-orbito-zygomatic approach (27.3%). In 77.3% patients, total tumour resection (Simpson Grade I & II) could be achieved. In rest of the 22.7% of cases, gross total resection of tumour was done.

Post-operatively, the most common complication was the frontal lobe contusion/edema and subdural hygroma (18.2% of patients each). Frontal lobe contusion/edema was most commonly seen in unilateral subfrontal approach (42.9% patients of this group).

Histopathologically, 90.9% of the tumour was of WHO Grade I. Before discharge and during each follow-up, the patients were re-evaluated in detail by history and neurological examinations to know the improvement or detoriation of the clinical and functional status. Post-operative CECT head or CEMRI brain were done before discharge from the hospital, at 3 months and yearly thereafter.

Among the 13 patients presenting with visual symptoms, the vision improved post-operatively in 61.5% cases (**Table 2)**.

Table 2 Pre and postoperative visual field status in tumour subsets

Tumor Origin	Presentation With Visual Field Deficits			
	No. of Patients	Postoperative Visual Status		
		Improved	Same	Deterio-rated
Sphenoid Wing	2 of 7 (28.6%)	2 of 2 (100%)	-	-
Olfactory Groove	1 of 5 (20%)	1 of 1 (100%)	-	-
Optic Nerve Sheath & Orbital	4 of 4 (100%)	1 of 4 (25%)	2 of 4 (50%)	1 of 4 (25%)
Tuberculum Sellae	5 of 5 (100%)	4 of 5 (80%)	1 of 5 (20%)	-
Planum Sphenoidale	1 of 1 (100%)	-	1 of 1 (100%)	-
TOTAL	**13 of 22 (59%)**	**8 of 13 (61.5%)**	**4 of 13 (30.8%)**	**1 of 13 (7.7%)**

Post-operatively seizure in the five cases was controlled. But in one patient of olfactory groove meningioma, there was new onset seizure during the post-operative period.

Table 3 Pre And Postoperative Karnofsky Performance Status & Glasgow Outcome Scale Of Patients

Preof KPS	KPS 3 month	KPS 6 month	KPS 3 month	KPS 6 month
80	80	90	5	5
90	90	90	5	5
70	80	90	5	5
70	80	90	5	5
80	90	100	5	5
60	80	90	5	5
70	70	70	4	4
70	80	100	5	5
80	80	90	5	5
80	80	90	5	5
70	80	90	5	5
70	90	80	5	5
80	70	70	4	4
70	80	90	5	5
70	80	90	5	5
90	100	100	5	5
60	0	0	1	1
80	90	90	5	5
70	80	Yet to do	5	Yet to do
80	90	Yet to do	5	Yet to do
60	70	Yet to do	4	Yet to do
90	90	Yet to do	5	Yet to do

DISCUSSION

Anterior skull base meningioma are mostly seen among the female population in the age group from 40 to 50 years in this study. Previous studies also found similar results with a maximal incidence in the 4th and 5th decades of life.[6]

Anterior skull base meningiomas give rise to an early visual pathology with relatively slow progression, but due to the fact that other symptoms are missing or are subtle, they have a larger tendency to remain undiagnosed for longer periods of time.[7, 8] Optic nerve compressions is variable depending on the size and the location of the tumor; bilateral optic nerve involvement and optic chiasm compression further add to the complexity of the surgical decision-making process.[9-12] Optic canal involvement by these tumors is not rare, and reports have described unilateral or bilateral optic canal extension. The most common presentation was visual disturbance (59.1%) in our series. Due to involvement of ocular motor nerves (CN III,IV & VI), 22.7% patients had ocular paresis and diplopia. Although headache and other features of raised ICP are usually less common mode of presentation in meningiom as of anterior skull base,[7, 8] we have found headache in 54% of our cases.

CT scanning is particularly useful for defining the osseous anatomy, including areas of hyperostosis or erosion that may assist in the diagnosis or planning of a surgical approach to these lesions. Both MR imaging and MR angiography defines the relationship of the tumor to the optic nerves and chiasm as well as the ACAs and communicating complex.

The advantage of the bifrontal craniotomy with subfrontal approach is described in many papers.[13-17] This approach provides excellent opportunity for radical tumour resection, drilling of hyperostosis in the anterior skull base and unroofing of optic nerves when necessary. Chances of opening up of frontal sinus are high through this approach with subsequent CSF leak and meningitis. Bilateral subfrontal approach was used in 5 patients of our series who had large tumor size and not suitable for resection by unilateral approach. Total excision of tumour (Simpson Gr I & Gr II) was achieved in 3 cases. Gross total resection was done in two cases as the tumor was encasing the optic chiasma and ACA.

Unilateral sub-frontal approach was used in 31.8% cases. Simpson Gr. I resection was achieved in 2 cases and Gr. II excision in rest of the 5 cases. The disadvantage was

that it required lot of brain retraction and the incidence of post-operative brain edema and contusion was high (42.9%) in unilateral subfrontal group like that of in previous studies.[18-20]

The pterional approach was first popularised by Yasargil[21] and has been used to treat various pathological conditions in skull base. Our rationale to use this approach is a consideration of taking advantages of natural planes and spaces in which nature has provided to expose the base of the brain without significant brain retraction. The advantages of pterional approach are early visualization of optic apparatus and internal carotid artery (ICA), attacking side is on the more severe optic nerve palsy, shorter distance to sellar region, and less retraction of frontal lobe.[20] The disadvantages of pterional approach are narrow space and angle, and risk of profuse bleeding when removing the tumor.[18-21]

The fronto-temporo-orbito-zygomatic (FTOZ) approach provides a direct angle of attack and improved tumour exposure, as proven by Schwartz *et al*.[22] It is best suitable for tumour originating or extending into the orbit. Proper excision of both intracranial and orbital part of the tumour can be achieved through this basal approach. In our series, we performed 6 operations through this approach. Total excision was done in 3 cases. In rest of the 3 cases total excision could not be done because of the encasement of the optic nerve by the tumour.

In our study, total resection of tumour was achieved in 77.3% cases. In this group of patients, tumour was either approached through unilateral subfrontal or pterional approach. The main reason of gross total resection (simpson Gr III, Gr. IV & Gr. V) in remaining 22.7% cases was due to the tumor encasement of the optic nerve, chiasma or tract and involvement of major vessels (ACA,ICA or AcomA). Tumor removal achieved (77.3%) is well between the described 56 to 100% margins found in the literature.[12, 23] It should be mentioned that even though complete tumor removal was the proposed surgical target for all the surgical interventions in our study we feel that this should not be imperative and be performed at the expense of higher morbidity. In our study, three patients (13.6%) patients got post-operative radiotherapy. With current microsurgical techniques, the complication rates associated with skull base meningioma resection is very low. Mortality rates in the literature vary from 0% [15, 24-27] to 17%[28] and even 22.7%.[29]

The objective of anterior skull base meningioma surgery is to remove the tumour pathology and preserve or improve the functional status of the patient. Improvement of visual function, according to several reports, varies from 32% to 91%.[7,19,30,31] In our study group, 13 patients (59%) presented with decreased vision. Post-operatively, 8 (61.5%) of them had improved vision, in 4 patients (30.8%), vision remained same and in one case (7.7%), the vision deteriorated. This finding is similar to microsurgical series presented in the literature.[23] Important finding was that, all the patients presenting within 6 months of onset of visual symptoms had improved vision. Patients presenting 6 months or later, the visual outcome was not favourable. In most of them the vision remained same as in pre-operative status.

The functional outcome was assessed on the basis of Karnofsky Performance Scale (KPS) and Glasgow Outcome Scale (GOS). Although GOS is meant for assessment of outcome in head injury patient, we have compared the outcome scores of KPS to GOS and assessed the functional outcome following surgery accordingly. The functional outcome was assessed during the follow-ups of patients and based on the clinical evaluation, cognitive, physical, emotional, and social functioning after surgery. We have found that during the first 6 months after surgery there was a gradual improvement in quality of life measures, while later on no significant change in was reported by the patients or their family members. This dynamic change in quality of life measures after anterior skull base meningioma surgery was similar to that found by De Jesus *et al*.[32] for meningiomas involving the cavernous sinus.

CONCLUSION

Thus, favourable functional outcome can be anticipated in anterior skull base meningioma by early diagnosis, good neurological evaluation and proper microsurgical techniques. The most successful predictor for outcome is the extent of neurological compromise at the time of presentation and diagnosis. Thus, early diagnosis is desirable for successful treatment with a better chance of good postoperative outcome. Major advances in diagnostic evaluations and microsurgical techniques over the last few decades have raised the survival rates and functional outcome of surgery in patients with anterior skull base meningioma.

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