Original Research Paper



OLFACTORY GROOVE MENINGIOMA (A COHERENT STUDY)

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	proove meningiomas (OGMs) take their origin from the cribriform plate and front ethmoidal suture in the

ABSTRACT Objectory groove meningiomas (OGMs) take their origin from the criphrorm plate and front ethnoldal suture in the floor of anterior cranial base. These meningiomas are thought to arise from arachnoid cap cells of arachnoid granulations in this region and comprise 10% of all meningiomas in the brain. OGMs represent 9.8% of all intracranial meningiomas, with a maximum occurrence between the 3rd and 5th decade with an average age of 47 years with a clear female predominance (F:M ratio 3:1).this is a single center coherent study done in the neurosurgical department in the ghazi al-Haririhospital of specialized surgeries / the medical city/ Baghdad/Iraq, between the years 1990 to 2001 that reviews 29 cases of OGMs presented to this center, their clinical, radiological, pathological, surgical and operative outcome with comparison to other studies done involving the same subject.

KEYWORDS:

Introduction:

The incidence of meningiomas among all intracranial neoplasms is 15-18%, although it may occur at any age, meningiomas most commonly present in middle age, with a peak incidence around 45.they are found predominantly in women which account for approximately 60% of the total.OGMs account for 9.8% of the total distribution. These tumors arise from the floor of the anterior cranial fossa over the cribriform plate of the ethmoid bone. The site of origin frequently extends anteriorly or posteriorly and across the midline from this primary siteOGMs are often large before they are detected because they tend to grow slowly, and because compression of the frontal lobes is gradual, it becomes apparent only when severe.A large tumor size, a firm and vascular nature, extension on both sides of the midline and a wide basal attachment are the general characteristics. Neurological symptoms, when present, may include mental states changes, decreased visual acuity, or seizures. Anosmia is often present on examination but is not usually a presenting complaint. An MRI can delineate the relationship of the tumor to the optic nerves, the anterior cerebral arteries, and the ethmoidal sinus (1, 2, 17, 18, 19, and 20).

Method and aims:

This is a single center coherent study with the objective to describe our experience with OGMs, analyzing their clinical and radiological form of presentation and their surgical treatment.

A. Aims of the study:

- 1. To determine the clinical, radiological and pathological patterns of OGMs.
- 2. To establish a correlation between the CT and the histological findings of the tumor.
- 3. To discuss the results of surgery.
- 4. To identify the risk of recurrence.

B. Site of the study: Ghazi Al-Hariri hospital for Specialized Surgeries/neurosurgical department/Baghdad/Iraq.

C. Time interval of the study: from the years 1990-2001.

The follow up of these patients was done by reevaluating the previous admissions and management plans.

Results:

A. Male/female ratio (chart 1)

female	69% (20 patients)
male	31% (9 patients)

B. Age incidence (chart 2)

Age in years	percentage
31-40	37.48%
41-50	27.52%
51-60	20.64%
61-70	10%
71-80	4.63%

C. Residency ratio of Iraq (chart 3)

area	Percentage
Middle	45%
North	31%
south	24%

D. The incidence of married and multigravida females (chart 4)

married		Not married (no children)
90%		10%
multigravida	Less than 5 children	
72.2%	27.7%	

E. The incidence of smokers and nonsmokers

Smokers 55.16%						Nonsmokers
males females					44.82%	
high	Mod.	mild	high	Mod.	mild	
17.24%	13.79%	3.44%	10.34%	6.89%	3.44%	

F. Incidence of endocrine disturbances (only in females): Two female have had history of prolonged irregular menstruation and have underwent hysterectomy for that reason, also there was another female who has history of goiter and underwent thyroidectomy.

G. The incidence of blood group association with olfactory groove meningioma (chart 5)

Bl.group	A+	A-	B+	B-	AB+	AB-	0+	0-
No. of patients	12	0	5	0	4	0	7	1
percentage	41.37%	0	17.24%	0	13.79%	0	24.13%	3.44%

H. Presenting symptoms (chart 6)

symptom	No. of patients
Headache	21
Anosmia	24
Visual symp.	16
Behavior	11
Urinary	4
Seizures	6

I. Presenting complaint (chart 7)

Complaint	Percentage	
Headache	41.37%	
Visual deterioration	17.24% history less	27.58% history more
	than 1 month	than 1 month
Fits	6.89%	
Memory dist.	3.44%	
Facial deformity	3.44%	

N. findings in imaging studies: 1. C.T findings in relation to histopathological subtype:

C.T. findings		Meningoepith.	Transitional	Fibroblastic	Psamom	Angioplastic	Malignant
-		4patients	7 patients	7 patients	4 pat.	1 patient	1 patient
Edema	mild						
	Mod.	2 pat.	2 pat.	3 pat.	1 pat.		
	severe	2 pat.	5 pat.	4 pat.	3 pat.	1 pat.	1 pat.
regularity		regular	Regular	Regular	Regular	Regular	regular
calcification	mild						
	Mod.	2 pat.	1 pat.	4 pat.		1 pat.	1 pat.
	severe	2 pat.	7 pat.	3 pat.	4 pat.		
Enhanceme.		Homog.	Homog.	Homog.	Homog.	Homog.	Homog.
Cystic changes		-	1 pat.	-	-	-	-
density		hyper	hyper	hyper	hyper	hyper	hyper
hemmorrage		-	-	-	-	-	-
Bony change		-	1 pat.	1 pat.	-	-	-

2. MRI findings (9 pat.):

T1-8 patient's isointense (about 90%), 1patient hypointense (about 10%).

T2- 6 patients isointense (about 60%), three patients hyper intense(about 40%).

There was evidence of moderate to severe edema and homogenous contrast enhancement; two MRA studies were done showing only vascular displacement of the involved vessels.

3. Angiography(five patients):

Showed mainly capillary blush, increased vascularity and vascular displacement of the anterior cerebral artery with the anterior communicating artery wit participation of the ophthalmic arteries of the same side of the lesion in tumor blood supply.

Note that all of the imaging studies showed indentation of the anterior aspect of the ventricular system (frontal horns mainly) and obliteration of the suprasellar cisterns but no evidence of hydrocephaly was found.

O. type of operation:

1.Crani	otomy
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Bifrontal	Unifrontal	Postponed
65.51% (19 pat.)	13.76% (4 pat.)	24.08 (6 pat.)

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J. Visual symptoms

Visual acuity	percentage
Decreased bilateral	68.96%
Decreased unilateral	6.89%
Blind	10.34%
Not affected	0

K. visual field

Visual field	Percentage
Constricted bilateral	75.83%
Constricted unilateral	11.68%
Blind	10.34%
Not affected	6.89%

L. Optic disc

Optic atrophy		Papilledema	1	Foster-kennedy
Unilateral	0	Unilateral	17.24%	3.44%
Bilateral	24.13%	Bilateral	37.29%	

M. Skull x-ray abnormality percentage (chart 8)

Abn. Calcification	24.13% (7 pat.)
Osteotic changes	10.34% (3 pat.)
Marked vascularity	17.24% (5 pat.)
Raised ICP	13.79% (4 pat.)
Non	51.27% (15 pat.)

2. Type of removal for those operated upon:

Total	subtotal	Partial	Biopsy
43.47 %(10 pat.)	39.13% (9 pat.)	8.69% (2 pat.)	8. 69% (2 pat.)

Type of tumor removal piecemeal as internal decompression is achieved the tumor capsule will easily retracted the tumor can be easily dissected from the adjacent brain. Blood vessels encountered between the capsule and adjacent brain are coagulated with bipolar diathermy, the capsule is dissected and excised until the tumor is completely removed. special attention should be taken for dissection of the posterior aspect of the capsule in order to avoid injury to branches of the anterior cerebral artery which comes in contact with the capsule and it is also important to identify the anterior clinoid processes and optic nerves which may be covered by thickened arachnoid under the posterior part of the tumor.

P. complications:

Intraoperative		Postoperative	
Massive brain edema with	17.39%	Postoperative fits	4.34%
frontal lobectomy	(4 pat.)		(1 pat.)
Excessive bony removal	13%	Postoperative death	17.39 %
due to tumor involvement	(3 pat.)		(4 pat.)
Excessive bleeding requiring	65.5%	Wound infection	13.04%
multiple blood transfusion	(15 pat.)		(3 pat.)
Frontal sinus penetration	17.39%	CSF leak	8.69%
	(4 pat.)		(2 pat

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	Pulmonaryembolism	
		(1 pat,)
	Facial abnormality	4.34%
		(1 pat.)

Q. tumor residual (proved by C.T. or M.R.I.) was five of all patients (17.24%).

R. histopathology:

Туре	Percentage
Meningothelial	17.39 %(4 pat.)
Psammomatus	17.39 %(4 pat.)
Transitional	30.43 %(7 pat.)
Fibroblastic	26.08 %(6 pat.)
Mixed	0
Angioblastic	4.34 %(1pat.)
Malignant	4.34 %(1pat.)

Discussion:

Meningiomas represent 16.75% of all primary brain tumors in Iraq while OGMs represent 9.8% of all intracranial meningiomas.

The age incidence of the patients was between the 3^{rd} to 8^{th} decades with a maximum incidence in between the third to the 5^{th} decade with a mean age of 47 years while in other studies it was 45 years.

There was a clear female predominance (female: male ratio was 3:1) and the highest incidence was to fertile female (with children: no children ratio 9:1) and the highest incidence in fertile females was to multigravida (more than 5 children) females (more than 5: less than five children ratio 4:1).

The area distribution of the affected patients showed a clear predominance to residents of the middle of Iraq (45%) as compared to those from the north (31%) and south (24%), which could be attributed to the high population in this area and the better access to the health facilities.

More than half of the patients (55.16%) were smokers and about 25% of the patients were heavy smokers.

There were 2 cases that had an irregular menstruation and 1 of these females had hysterectomy, there was another case who had thyroidectomy due to goiter so some of these disturbances could be attributed to the effect of the tumor on the pituitary area but the available data was not enough to make such a connection because there were no hormonal studies done to the patients.

A very significant finding was that 41.37% of patients were of the blood group A+ and this could give a significant clue to the genetic predisposition of meningiomas specially that there is a very well known relation of this blood group with gastric carcinoma (15).

Clinical features: the visual deterioration was the most common chief complaint (45%) with 17.24% of patients presenting with history of less than one month and 27.58% with history of less than one month and 27.58% with history longer than one month ,the majority of cases (68.96%) showed a bilateral decrease in visual acuity, while the unilateral decrease was 6.89% and 10% of patients came totally blind and none of the patients had a normal vision, as in regards to the visual field 75.83% showed a bilateral constricted field while 10.34% were blind and 6.89% were unaffected. The extent of visual deficit was an important factor that determined the course and outcome of surgery. The more extensive the involvement of the optic nerve, as depicted by the extent of visual deficit, the more intense was the relationship of the tumor with the optic nerve and the internal carotid artery and its branches to the tumor, and consequently, the more difficult was the dissection(1,2,3,4,22).

Regarding optic disc bilateral optic atrophy was found in 24.13% of patients, unilateral papilledema was found in 17.24%, bilateral in 37.29% and foster Kennedy syndrome in 3.44%.

The previous visual results shows the huge effect of this kind of tumor on the optic apparatus to it is close relation to the tumor and the tumor and that may explain why the visual symptoms are more common than headache in contrast to other meningiomas.

The second most common presenting chief complaint was headache (41.37%) yet there were no specific features for this headache, no associated vomiting or time preference and only two patients showed a frontal headache localized to the side of the tumor and a single female showed history of temporal headache.

The third presenting chief complaint is fits 6.89% all were generalized tonic-clonic fits.

Behavioral changes and memory disturbances represented a minority of cases not as seen in other literatures. Some studies have claimed that the symptoms could be unrelated to the site involved, and the relationship with some psychiatry symptoms has been much disputed. However, Lampl et al.and Bommakanti et al. affirmed a significant correlation between psychiatric symptoms and the site of the lesions. Depression mainly present in frontal convexity meningioma. Basifrontal and sphenoid wing meningiomas present predominantly with mania or depression; and suprasellar lesions and temporal convexity meningiomas mostly present with delusional disorders (21).

A single patient presented with facial deformity, this patient had been operated on before for the same tumor and this deformity started 6 years after the first operation, yet he did not seek advice only after 7 years of the beginning of the deformity so between the two operations were 14 years.

In regards to the presenting symptoms, the most common one was anosmia, which in most cases was noted and neglected for several years, in one case the anosmia started 14 years, treated as a case of sinusitis whole this period.

The headache, visual symptoms comes next respectively while the behavioral symptoms comes next with the fact of neglection of the relatives to seek medical advice for it.

Last presenting complaint was seizure.

Radiological findings:

Skull x-rays:

Plain skull x-rays films showed interesting radiological findings in 49% of the cases in our study suggestive of an intracranial pathology. The commonest was abnormal calcification, which was found in 24.13% of patients, the second most common was marked vascularity in 17.24% of patients, signs of raised ICP was found in 13.79% and lastly bony changes in 10.34% of patients. In comparison to the data regarding meningioma in other series, the incidence of x-ray findings is 63%.

Skull x-rays may be considered to a certain degree a sensitive but not specific investigation because of the high incidence of normal films and does not give any specific information about the histological type or site of the lesion. Calcification most commonly found associated with transitional meningioma. Marked vascularity usually reflect the vascular nature of the tumor. The high ICP represent a non-specific finding to the intracranial pathology.The osteotic changes may give an indication of the aggresivity of the lesion due to bone invasion.

CT scan: the tumor is with characteristic CT appearance and represented no difficulty in the diagnosis of olfactory groove meningioma so the diagnosis of this tumor can be made with certainty with CT scan.

MRI:

T1 isointense in 90%, hypointense in 10%. T2 isointense in 60%, hyper intense in 40%.

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These figures are identical to those mentioned for all meningiomas; there was evidence of moderate to severe edema and homogenous contrast enhancement. MRA studies were done showing only vascular displacement of the involved vessels (5).

Angiography:

Showed mainly capillary blush, increasing vascularity and vascular displacement of the anterior cerebral artery with the anterior communicating artery with participation of the ophthalmic arteries of the same side of the lesion in tumor blood supply. Note that all of the imaging studies showed indentation of the anterior aspect of the ventricular system (frontal horns mainly) and obliteration of the suprasellar cisterns but no evidence of hydrocephaly was found.

Pathology:

Grossly meningiomas are globular and firmly attached to the dura with a clear margin of demarcation from the surrounding brain. The surface of the tumor may be smooth or nodular in texture with greatly variable vascularity, in our study these gross features were similar to other studies. Microscopically meningothelial and transitional meningiomas appear to have the highest incidence while in our study the highest incidence goes to transitional and fibroblastic meningiomas. Regarding tumor location, most of the tumors were bilateral and only four cases showed more extension for one side than the other did (six, 7, 8).

4.43% of the cases proved by histopathological examination were found to be malignant and this is of relation to the overall malignancy to meningiomas same as in other series.

No extracranial metastases were found but local ethmoidal extension was found in a single case but no histopathological confirmation was done because the case was not operated because of severe chest infection and this low level (single case) correlates with the international data, which considers the paranasal extension of this tumor as an unusual incident.

Five patients gave history of head trauma, which required hospitalization, which gives a total percentage of 17.24%, and this may be related to the trauma theory of etiology meningiomas.

Regarding multiple lesions: a single case was found with an associated an occipital meningioma but there were no clinical evidence for NF-2 and there were no genetic studies to prove that.

Surgery and complications:

Meningiomas are benign tumors where total removal (which can usually be achieved) provide complete cure, so it is treatment is very rewarding to the surgeon and to the patient, the completeness of surgical removal of the tumor is the single most important prognostic factor. In our study, total removal was achieved in 43.47% of the patients. Subtotal and partial removal was achieved in 48% of the patients and in these cases, total removal could not be done because of the following technical difficulties:

- 1. Tumorhyper vascularity, which caused massive bleeding that, rendered the resection impossible.
- 2. The close proximity of the tumor to certain structures including anterior cerebral artery and optic nerve.
- 3. Bony invasion that makes total resection impossible.
- 4. The encasement of major vessels.

The outcome of surgery was very rewarding where visual symptoms improved in 43.47% of patients immediately postoperatively, also the behavioral changes all improved these were probably due to relieve pf pressure from the frontal lobe and the optic nerve. There was a very poor prognosis regarding theanosmia, which may be due to sustained pressure on olfactory nerve, direct invasion of the nerve or offence during surgery (9, 10, and 11).

65.51% of patients were operated on by bifrontal approach while 13.76% operated through unifrontal approach. Bifrontal craniotomy has proved to be most efficient approach in early ligation of the superior sagittal sinus, good tumor exposure with better tumor removal, minimal brain retraction wit better cosmetic figures and less complications, where 2 of the patients operated on by unifrontal craniotomy suffered from massive brain edema with extensive bleeding leading to resection of part of the frontal lobe and early closure ending with only tumor biopsy.

Regarding intraoperative complications as mentioned above four patients ended with frontal polar lobectomy due to massive brain edema, herniation and excessive bleeding which might have occurred mainly due to excessive brain retraction brain injury due to poor exposure and in one case, there was early injury to the superior sagittal sinus with difficulty in stopping the bleeding. In fourpatients, there was excessive bony bleeding due to extensive bony involvement and removal.

Extensive bleeding which required multiple blood transfusion occurred in 65.5% of patients, which could be attributed to the high vascularity of the tumor, none of these patients, suffered fromblood reaction.

In fourpatients, there was frontal sinus penetration, which was dealt with by sinus obliteration, this complication sometimes can be overcomed by proper skull x-ray yet sometimes proper tumor tumor removed may require opening of the sinus cavity. Two of the patients have ended up with CSF leak, which required reopening, in one case after failure of conservative measures and the possible explanation for such a complication in the absence of dilated ventricles, or raised ICP is poor surgical technique and poor dural tight closure.

Most of the patients with behavioral changes have dramatic improvement probably because of decrease in edema and pressure over the frontal lobe.

Those patients with visual symptoms mostly have shown improvement with theexception of those with optic atrophy have shown no improvement because of irreversible damage; and those with severe papilledema and visual field defects have regained good function after removal probably due to pressure relieve over the optic nerve; most of the patients who benefited were the patients with unilateral papilledema.

As compared to other series, the olfactory function had a very poor prognostic factor so it is neither has importance in the diagnosis of the tumor nor restored after surgery.

Recurrence: regarding the rate of recurrence, 4 of these patients have been operated on for recurrence 2(transitional) 1 year later, 1 (meningothelial) 14 years later and a forth (transitional) operated on for the third time with an interval of 6 years between the operations, so if we add these to the patients with incomplete removal who are 11 patients this suggest a very high recurrence rate and this is mostly dependent on incomplete surgical removal rather than histopathology and this figure is considered very high as compared to other series(12,13,14).

Five high-risk factors involving obvious edema (≥ 20 mm), soft tumor texture, hyperostosis and dural tail sign, indicated a high frequency of recurrence. Some OGM cases with complete resection and greater edema extension were also associated with a worse prognosis.Significant peritumoral edema was associated with a longer hospital stay, difficulty of surgical resection, and a risk of intracranial hypertension compared with meningiomas with less edema (16).

Conclusion:

- 1. Olfactory groove meningioma represent 9.8% of all intracranial meningiomas and they most commonly detected in the middle age with a clear predominance for fertile women with strong association to A+ blood group.
- 2. The symptoms and signs produced by olfactory groove

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meningioma fall into headache, visual symptoms, olfactory symptoms, behavioral changes and seizures.

- The commonest presenting complaints were visual disturbances and headache while the major presenting symptom was anosmia.
- 4. CT scan is an important radiographic test in the imaging of olfactory groove meningiomas, in addition to identifying the tumor, it demonstrates brain anatomy, edema, calcification, bony changes, and is useful for following up the patient and detect recurrence, progression of the tumor, yet it provide little clues about the histological subtype or the aggrevisity of the tumor.
- Angiography provides valuable information regarding the tumor feeders, vascularity; identify the relation and the possibility of major arterial encasement, venous drainage and the state of venous sinuses. If possible, it should be obtained in every case for proper preoperative evaluation and planning for surgery.
- 6. MRI, MRA now provide a perfect combination of a less invasive more describitive method of imaging modality that it gives more reliable information regarding soft tissue and vascular structures, yet it has the defect of poorly detecting bony involvement and time consumption.
- 7. Meningiomas are benign tumors (mostof our cases fall into WHO classification grade 1 with similar behavioral) where total removal with preservation and improvement of function is very rewarding and completeness of surgical removal of the tumor is the single most important prognostic factor, yet total removal of the olfactory groove meningiomas may prove to be a difficult task owing to the time of tumor diagnosis where it attains a large size and engulfs major vascular structures which render their complete removal difficult and dangerous.
- The late diagnosis, incomplete total removal due to the poor surgical preparation and technique has led to the high incidence of recurrence rather than the pathology.
- The overall mortality was 13.6%, this figure is approaching the figure in the literature not using microsurgery, but it is high in comparison to the figure in the literatures using microsurgery and other adjuvants.
- 10. The most common cause of death was brain herniation, which can be minimized by good surgical technique and good hemostasis.

Recommendations and some further prospects:

- The operative plan should considers a bifrontal craniotomy with early ligation of the anterior third of the superior sagittal sinus to avoid the risk of minimal exposure, excessive brain retraction, damage to the sinus and further more increasing of bleeding and brain edema.
- The high operative mortality, operative incidents, and postoperative complications can generally be reduced with the introduction of proper aesthetic monitoring and the application of the new technology in the surgical procedure (microsurgery, CUSA, LASER).
- The surgical team should be prepared to spend enough time on difficult cases and not work in a hurry in order not to cause unnecessary injury or damage.
- The cases in this study should be followed further for longer period to determine the recurrence rate and the possible factors behind it.
- Enhance for the use of a more describitive and delicate documentation for operative notes especially regarding the use of Simpsons classification to describe type of tumor removal rather than using vague descriptions.
- Proper monitoring of the patients postoperatively and proper management may reduce the risk of postoperative complications.
- 7. Other management plans could include:
- a. Psychiatric evaluation for each patient because of the frontal offensive nature of the lesion which would lead to some degree of behavioral abnormality and which might later on affect the legal consequences for the patient management outcome and

further rehabilitation.

- b. Most of the patients presented with large tumors and long history so this would suggest the follow up method especially if the patient is asymptomatic or symptomatic with no or mild brain edema or mass effect and is not willing to go through surgery.
- c. The preoperative embolization to decrease the vascular component of the tumor is also a choice but not a substitute to surgery because of the tumor size and nature with attention regarding damage to the anterior cerebral artery circulation.
- d. Stereotactic surgery would make this tumor more vulnerable to surgery especially if it engulfs major blood vessels.
- e. Radiosurgery may not be of favor here because of the nature of the tumor (big size and benign) and so may be confined only to the malignant tumors proved by histopathology or residual tumors in no operable cases.
- f. The histopathologic tumor studies should include search for tumor markers and receptors especially hormonal receptors that might affect the further management plan.

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