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Research Article

Evaluation of Tumor Resection and Optic Apparatus Decompression in Cases of Supra-sellar and Parasellar Meningioma Using Two Different Surgical Modalities: A Comparative Study

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Abstract

Objects: A retrospective comparative study for evaluation of tumor resection and optic system decompression in patients have suprasellar meningioma using subfrontal and pterional craniotomy approaches.

Methods: Patients having suprasellar meningioma presenting to Arab contractor medical center, EL Demerdash Hospital and Dr. Soliman Fakeeh hospital over 4 years' period between February 2015 and December 2018.

Results: We performed 30 craniotomies for suprasellar meningioma patients. 16 patients showed visual improvement, 11 patients showed stationary visual status and unfortunately, 3 patients showed deteriorated vision.

Conclusion: Pterional approach is an effective alternative to subfrontal approach particularly if the tumor extending to one side. And it is comparable in primary outcome, gross total resection, morbidity and mortality with lower surgical aggressiveness.

Keywords: *Meningioma; Suprasellar; Subfrontal; Pterional*

Introduction

The majority of meningiomas are supratentorial, with a large number located along the convexities. Approximately 17 to 25% occur in a frontobasal location; however, only about 10% occur in the posterior fossa. Within the frontobasal region, the olfactory grooves, tuberculum sellae and parasellar region, and the petrous bone are preferred sites. Approximately 5% occur along the cerebellar convexity, 2 to 4% at the tentorium cerebelli and 2 to 4% within the cerebellopontine angle. Uncommonly, meningiomas are found within the ventricular system or arise within the optic nerve sheath [9].

Meningiomas of the suprasellar region involving the tuberculum sellae, anterior clinoid processes, diaphragm selae, and planum sphenoidale are rare tumors that have proved difficult to treat, partly because of their intimate association with the optic nerves and chiasm, hypothalamus, and internal carotid arteries [3].

The goal of treatment cannot be more eloquently stated than the words of Cushing: "There is today nothing in the whole realm of surgery more gratifying than the successful removal of a meningioma with subsequent perfect functional recovery [6].

One must admit that not every meningioma can be removed totally, and the surgeon is forced in some cases to accept residual tumor, but it should be the surgeon's goal to attempt a total removal while preserving or improving the patient's neurological function [6].

The ideal surgical approach should provide enough exposure of the tumor and the surrounding structures, including its dural attachment, to interrupt its blood supply early in the procedure [4].

Many different surgical approaches have been described for the resection of supra-sellar and para-sellar lesions. The common approaches include sub-frontal, pterional, fronto-lateral approaches and its modifications [4].

Authors report their experience Evaluation of Tumor Resection and Optic Apparatus Decompression in Cases of Supra-sellar and Parasellar Meningioma using two Surgical Modalities.

Patients and Methods

Patients having suprasellar meningioma presenting to Arab contractor medical center, EL Demerdash Hospital and Dr. Soliman Fakeeh over 4 years' period between February 2015 and December 2018.

All patients with intracranial supra-sellar meningioma are included in this study with of the following criteria:

- Ages Eligible for Study: Child, Adult, Older Adult
- Sexes Eligible for Study: All
- Accepts Healthy Volunteers: No

Study population

patients with suprasellar and parasellar meningioma

Criteria

Inclusion Criteria:

- Patient with a single lesion.
- Patient with a de novo lesion.

Exclusion Criteria:

- Patient with recurrent lesions.
- Patient with lesions after adjuvant therapy

Treatment strategy

The ideal surgical approach should provide enough exposure of the tumor and the surrounding structures, including its dural attachment, to interrupt its blood supply early in the procedure. In addition, brain retraction and manipulation of critical neurovascular structures should be minimized as much as possible to avoid procedure-related morbidity. The selection of the most appropriate approach depends on multiple factors, including surgeon's preference and experience, tumor size and location, extent of dural attachment, and relation with the surrounding neurovascular structures.

Many different surgical approaches have been described for the resection of supra-sellar and para-sellar lesions. The common approaches include subfrontal (Figure 1), pterional (Figure 2), fronto-lateral and their modifications. Those approaches constitutes a short route to the supra and parasellar region and allows early visualization of important structures such as the optic apparatus and the ICA and its branches.

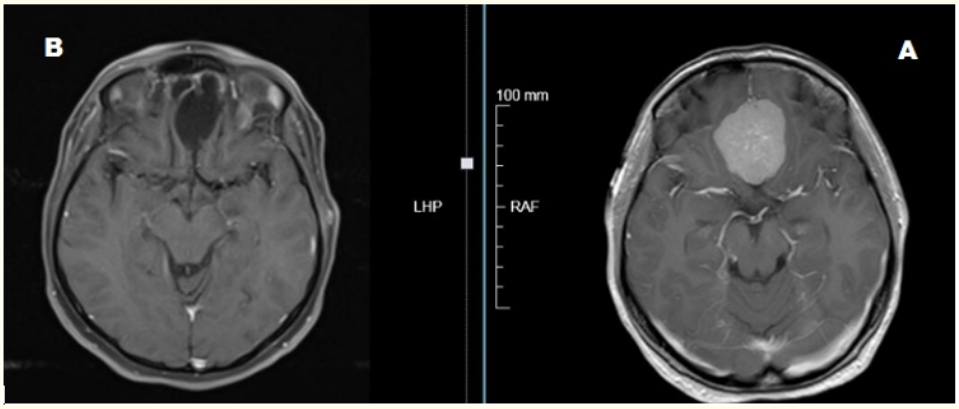

Figure 1: *Axial MRI cuts show a midline supra-sellar meningioma (A) with post-operative image shows gross total resection(B) via a sub-frontal approach.*

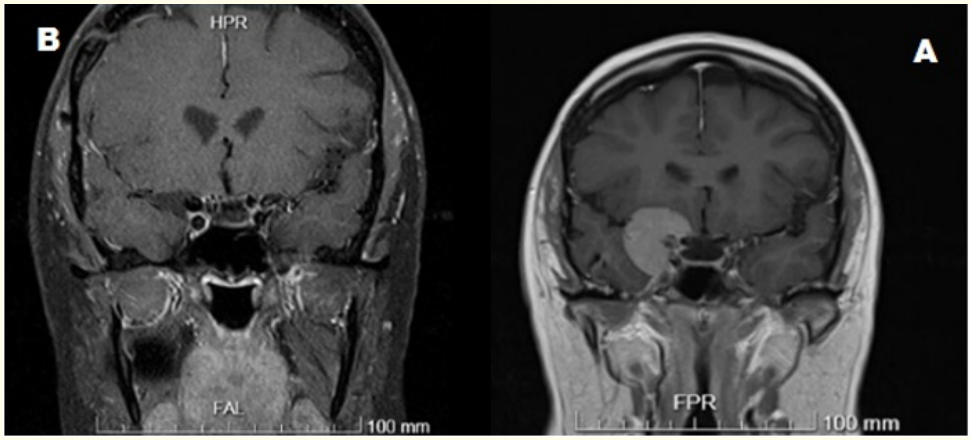

Figure 2: *Coronal MRI cuts show a righ side para-sellar meningioma (A) with post-operative image shows gross total resection(B) via a pterional approach.*

The patient's non dominant side is usually approached, unless the tumor extends predominantly to the left side with significant encasement of the left ICA.

The basal cisterns are opened early to allow CSF release and brain relaxation and thus an adequate exposure is possible before the tumor is dissected. The main disadvantage of those approaches is the difficulty in removing tumor located underneath the ipsilateral optic nerve without considerable manipulation.

Results and Discussion

Age and sex distribution: this study include 30 patients, 19 male (63 %) and 11 male (36 %). The mean age ± SD for the patients operated via the bilateral pterional approach was 56.894 ± 8.517 and was 56.894 ± 8.517 for patients underwent bicoronal subfrontal approach (Table 1 and Table 2).

Groups	Age	
	Range	Mean ± SD
Group I	37.000 - 70.000	56.894 ± 8.517
Group II	30.000 - 61.000	52.000 ± 9.518

Table 1: *Age Distribution.*

Sex	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
Male	4	21.05	7	63.6	11	36.6
Female	15	78.94	4	36.36	19	63.33
Total	19	100.00	11	100.00	30	100

Table 2: *Sex Distribution.*

Decreased visual acuity was the presenting symptom in 24 out of 30 patients (80%). The duration of visual loss ranged from 1 month to 10 years (mean 17.6 months) (Table 3).

Pre-Op Visual Symptoms	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
No	3	15.78	3	27.27	6	20
Yes	16	84.21	8	72.72	24	80
Total	19	100.00	11	100.00	30	100

Table 3: *Pre-Op Visual Symptoms.*

Of the 24 patients with preoperative decreased visual acuity, 16 of them (66%) had varying degrees of improvement, three patients (12.5%) experienced worsening and eleven patients showed no changes.

Of the 24 patients presented with decreased visual acuity, 16 of them underwent pterional approach and 8 patients underwent subfrontal approach. Of the 16 patients underwent pterional approach, 10 of them showed improvement of visual acuity and of the 8 patients underwent subfrontal approach, 6 of them showed improvement (Table 8-10).

Headache was present in 16 out of 30 patients (53.3%) (Table 5). 10 patients (33%) presented with seizures, all of them controlled with anti-epileptic drugs at time of diagnosis (Table 4). Two out of thirty presented with partial ophthalmoplegia and one with complete ophthalmoplegia.

We grouped the patients into two groups, group one for those operated via pterional approach and group two for patients underwent subfrontal approach. Group one included 19 patients and group two included 11 patients.

Pre-Op. Seizures	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
No	12	63.51	8	72.72	20	66.66
Yes	7	36.84	3	27.27	10	33.33
Total	19	100.00	11	100.00	30	100

Table 4: *Pre-Op. Seizures.*

Pre-Op Headache	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
No	8	42.1	6	54.54	14	46.66
Yes	11	57.89	5	45.45	16	53.00
Total	19	100.00	11	100.00	30	100

Table 5: *Pre-Op. Headache.*

In group one, 10 patients showed vision improvement, 8 patients showed no changes in visual acuity and two patient showed visual deterioration (Table 8-10). Grade I-II-III simpson tumor resection was achieved in 15/19 patients (78%) (Table 6), while grade IV-V simpson achieved in 4/19 patients (21%) (Table 7).

Post-Op Tumor Resection G I-II-III Sipmson	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
No	4	21.05	4	36.36	8	26.66
Yes	15	78.94	7	63.6	22	73.33
Total	19	100.00	11	100.00	30	100

Table 6: *Post-Op. Tumor Resection G I-II-III Sipmson.*

Post-Op Tumor Resection G IV-V Sipmson	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
No	15	78.94	7	63.6	22	73.33
Yes	4	21.05	4	36.36	8	26.66
Total	19	100.00	11	100.00	30	100

Table 7: *Post-Op. Tumor Resection G IV-V Sipmson.*

Post-Op Visual Improvement	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
No	10	52.63	4	36.36	14	46.66
Yes	9	47.36	7	63.6	16	53.33
Total	19	100.00	11	100.00	30	100

Table 8: *Post-Op. Visual Improvement.*

Post-Op. Stationary Vision	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
No	11	57.89	8	72.72	19	63.33
Yes	8	42.10	3	27.27	11	36.66
Total	19	100.00	11	100.00	30	100

Table 9: *Post-Op. Stationary Vision.*

Post-Op Visual Deterioration	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
No	17	89.47	10	90.9	27	90
Yes	2	10.52	1	9.1	3	10
Total	19	100.00	11	100.00	30	100

Table 10: *Post-Op.Visual Deterioration.*

Group one showed non visual complications as follow; two patients showed post-operative CSF leak (Table 11) from the wound. One of them underwent temporary CSF diversional procedure with lumber drain (Duet™ External Drainage and Monitoring System) after failure of control with daily dressing and head bandage.

Post-Op CSF Leak	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
NO	17	89.47	10	90.9	27	90
YES	2	10.5	1	9.1	3	10
Total	19	100.00	11	100.00	30	100

Table 11: *Post-Op CSF Leak.*

One patient showed post-operative partial ptosis which improved spontaneously and one patient presented 8 months later with disturbed conscious level and his investigations showed acquired arachnoid cyst. He underwent CSF diversional procedure (cysto-peritoneal shunt) and recovered well.

In group two, 11 patients underwent subfrontal approach. 8 of them presented with decreased visual acuity, 6 out of 8 (75%) showed some degrees of improvement. one patient in this group showed post-operative visual deterioration with late spontaneous improvement after 6 months. Grade I-II-III simpson tumor resection was achieved in 7/11 patients (63%), while grade IV-V simpson achieved in 4/11 patients (36%).

Post-operative mood disorder was evident in this group, as three patients complicated with frontal manifestations and treated with anti-psychotic medications for 1 to 2 months (Table 12).

Post-Op Mood Disorders	Groups					
	Group I		Group II		Total	
	N	%	N	%	N	%
No	19	100	8	72.72	27	90
Yes	0	0	3	27.27	3	10
Total	19	100.00	11	100.00	30	100

Table 12: *Post-Op. Mood Disorders.*

One patient developed CSF leak from the wound and showed spontaneous improvement with daily dressing and head bandage. As a trial to limit the incidence of postoperative rhinorrhea in the subfrontal approach, proper packing of the frontal air sinus with Betadine impregnated muscle graft in addition to the attached pericranial graft over the base of the anterior cranial fossa then final sealing with DuraSeal® Cranial Sealant System.

One patient complicated with bilateral anosmia and another one complicated with diabetes insipidus which improved with medical treatment.

In comparison to previous studies

Chuan., *et al.* (2011) [10] operated patients with suprasellar meningioma as follow, 8 patients underwent bilateral subfrontal and 16 patients underwent pterional approach. Total tumor (simpson I-II-III) resection was achieved in 88.9% and subtotal (simpson IV - V) in 11.1%. With respect to visual outcome, 60% improved, 26.7% remained unchanged, and 13.3% had worsened.

Post-operativly, mood disorder was 12.2%, mild ptosis was 4.4%, intracranial infection was 8.9%, CSF rhinorrhea was 4.4%, anosmia 4.4%, diabetes insipidus 4.4% and one patient died after surgery.

Martin M., *et al.* (2016) [7] operated 25 patients with pterional approach, the most common presenting symptom was visual disturbance (77%). Vision improved in 90% of those who presented with visual decline, and there was no permanent visual deterioration. Simpson grade I-II-III resection was accomplished in 92.5% of patients, and the remaining 7.5% of patients had Simpson IV-V.

Cerebrospinal fluid leak occurred in one (4%) and resolved with treatment. There was no surgical mortality. Postoperative cranial nerve (CN) complications were found in 30% of patients, these include partial oculomotor (third) nerve paresis 14.8% of patients, partial abducens (sixth) nerve paresis 4% of patient and partial frontalis nerve paresis 8% of patients.

Karsy M., *et al.* (2017) [1] operated 49 patients and compared pterional approach and bi-coronal sub-frontal approach in resection of suprasellar meningioma. Simpson grade I-II-III resection was achieved in 85.7% cases and Simpson grade VI-V resection was in 14.3% cases. On follow-up, most patients reported stable vision 44.9%, followed by improved 34.7%, intact 12.2% and worsened 2.0% vision. A total of 16 patients had 16 complications, including cerebrospinal fluid (CSF) leak, vessel injury, infection, diabetes insipidus, seizure, and hypocortisolemia in 2 patients each (4.1%).

On 2014, Y Liu., *et al.* [2] published a series of 106 patients operated for suprasellar meningioma through pterional and sub-frontal approaches. The most common presenting symptom was visual impairment in 82/106 (77%) patients. Headache was present in 68/106 (64%) patients. Simpson grade I-II-III resection was achieved in 84/106 (79%) patients while simpson grade VI-V resection was achieved in the 22/106 (21%) patients. The postoperative visual acuity improvement was seen in 60/100 (60%) patients, 6/100 (6%) patients were stable and 34/100 (34%) had worsening of vision.

Postoperative complications included cerebrospinal fluid (CSF) leak (18/106, 17%), intracranial infection (16/106, 15%) and hematoma (5/106, 5%). The CSF leaks were successfully treated with placement of a temporary lumbar CSF drain. All the patients with intracranial infections were treated with antibiotics and a temporary lumbar CSF drain. A second craniotomy was required for three patients with hematoma and other two responded to conservative treatment. Total six patients (6%) died during the peri-operative period; three had hematoma at the surgical site, one patient had meningitis, and other two had ventriculitis.

	No.	↓vision	Post op visual improvement	Post op visual deterioration	G I/II/III Simpson
Chuan., *et al*. 2011 [10]	24	93.3%	60%	13.3%	88.9%
Martin., *et al*. 2016 [5]	25	77%	90%	0%	92.5%
Karsy., *et al*. 2017 [1]	49	91%	34.7%	2%	85%
Liu., *et al*. 2014 [2]	106	77%	60%	34%	79%
Current study	30	80%	53%	10%	73%

Table

Although the tumor size is not an inclusion criteria in this study, but it was noticed that in large lesions (more than 4 - 6 cm). It was difficult to achieve total resection. Also extension to cavernous sinus and/ or encasement of the carotid artery limit the resection of the tumor and threaten the patient's life.

From the above data it was obvious that the pterional approach was comparable to the subfrontal approach in management of suprasellar meningioma in the presence of experienced hands especially in the points of degree of resection, clinical outcome, and postoperative complications.

However, many authors found significantly better rates of visual improvement in patients who had the visual symptoms for less than 6 months, Chul-Kee., *et al.* 2006 [8] documented that the surgical insult is presumed to be the single most important factor for visual outcome, and thus favorable visual outcome is secured by cautious surgical manipulation around the optic nerve. However, routine optic canal decompression is not always necessary for this purpose.

Conclusion

The choice of surgical strategies depended on several factors, including the tumor size, location, direction of tumor growth, relationships among tumor and the adjoining structures, dural attachment of the tumor.

The optimal approach for a particular patient should be tailored according to the tumor anatomy, surgeon's experience and theater setup.

Pterional approach is an effective alternative to subfrontal approach particularly if the tumor extending to one side. And it is comparable in primary outcome, gross total resection, morbidity and mortality with lower surgical aggressiveness. However, statistical data, particularly on visual outcome, are still limited to settle definitive conclusion. It should be stressed early identification of the optic apparatus guarantee low risk of visual system injury and early CSF drainage for brain relaxation minimize the risk of cortical irritation through prolonged brain retraction.

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