Surgical Management of Sellar Lesions with Parasellar Extension

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Abstract: Objective: The aim of this work is to Assess and evaluate different surgical treatment modalities of sellar brain lesions with parasellar extension regarding extent of radicality, difficulty in lesion excision and postoperative outcome. **Methods:** Pathological lesions involving the sellar region with parasellar extension are included. Lesions include different tumors, developmental pathology, congenital lesions, and inflammatory lesions. The patients will be evaluated and investigated preoperatively. The operative procedure will be evaluated and analyzed. The patients will be followed for evaluation of extent of resection, postoperative complication and outcome. **Results:** In this study 30 cases were operated upon, 5 by the pterional, 5 by the subfrontal And 20 by endoscopic transsphenoidal approach. There were a total of 12 males and 18 females, the ages of whom ranged from 18 years to 55 years. The parasellar extension ranged from 1cm to 4 cm. The extent of removal was found to be total removal in 23 (76.6%) cases. Subtotal removal was 7 (23.3%) cases. Regarding the outcome of the patients: 24 (80%) cases had an excellent outcome, 3(10%) cases had a good outcome, 2(6.6%) had a poor outcome, and one (3.3%) died. **Conclusion:** After viewing the literature and comparing the results with our results we can conclude that patients with parasellar extension medial to the carotid artery 1 cm or less specially in pituitary adenomas can be approached safely without technical difficulty via all approaches for the suprasellar area, moderate parasellar extension 1 to 2 cm lateral to the carotid artery poses surgical challenge for the extended endoscopic endonasal approaches specially in meningiom as due to consistency of the tumor so it's better to approach this lesion via transcranial rout whether subfrontal or pterional approach which have comparable results. In parasellar extension more than 2 cm involving the carotid system and the cavernous sinus it's advisable to approach the tumor via pterional approach and its extension to assure proper radicality, early identification of the carotid system with good surgical visibility and ability to do bony work at the skull bas if needed.

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Abbreviations: C.T: Computerized Tomographic Scanning.

1. Introduction:

The sella is located in the center of the cranial base. Access to the sella is limited from above by the optic nerve (ON), optic chiasm (Och) and circle of Willis, laterally by the cavernous sinuses (CS) and internal carotid arteries (ICA), and from behind by the brain stem and basilar artery. **(Rhoton, 2000)**

Suprasellar region lies above the sellar region. Several critical structures traverse this area, including the circle of Willis, optic nerves and optic chiasm, hypothalamus, pituitary infundibulum, and the infundibular and suprachiasmatic recesses of the third ventricle. **(Simonetta, 1999)**

Three different compartments could be identified lateral to the sella turcica. Orbital and pterygopalatine compartments in the anterior part of the parasellar space which are usually small and connected with extracranial tissue spaces, they were filled with characteristic adipose bodies and separated by connective tissue from the remaining parasellar Pituitary (Pit) gland is a pea sized endocrine gland lies in the pituitary fossa which is imprtant part of the sellar region at the base of the brain. It is composed of the adenophysis and neurohypophysis. The pars distalis, pars intermedia and pars tuberalis form the adenohypophysis. The neurohypophysis is made up of the pars nervosa, infundibular stalk and the infundibula proper. It helps control the release of hormones from other endocrine glands, such as the thyroid and adrenal glands. The pituitary also releases hormones that directly affect body tissues, such as bones. **(Kronenberg et al., 2009)**

Pituitary adenomas are benign epithelial tumors that arise from adenohypophysial cells and constitute the most common lesions in the hypothalamic/pituitary region, representing 10–20% of all intracranial tumors. (**Marco Losa et al., 2008**)

The hypothalamus and pituitary gland are connected by important neurovascular connections. Axons of supraoptic and paraventricular nuclei of the hypothalamus traverse the infundibular stalk and extend into the neurohypophysis. (**Heather, 2010**)

Craniopharyngiomas are benign tumours accounting for between approximately 9% of all

intracranial tumours in childhood, and are the most common peripituitary tumour in this age group. In adults, craniopharyngiomas account for 1% of brain tumours. They are usually situated close to the Pituitary gland and Hypothalamus. (**Rhoton, 2000**)

Suprasellar meningiomas include those that arise from the tuberculum sellae, the planum sphenoidale, and the diaphragm sellae. Meningiomas originating from the tuberculum sellae commonly extend into the optic canal, and visual loss in an affected eye is the initial and most common symptom. They comprise approximately 3 to 10% of all intracranial meningiomas. (**Masahiko et al., 2007**) space, which was termed the lateral sellar compartment **(Wolfgang et al., 2000)**

2. Patients and Methods:

This is a study of 30 patients operated upon between the period of 12/2015 till 5/2017 with different pathological lesions in the sellar area with parasellar extension. These patients were operated by different approacahes (subfrontal approach, the pterional approach and endoscopic endonasal approache), and their modifications. Patients were operated upon in AL Azhar University, which involves AL Hussein Hospital, El Sayed Galal Hospital.

Inclusion criteria:

Patients of all ages and both sex were included in the study.

Pathological lesions involving the sellar region with parasellar extension were included.

Lesions were considered indicated for surgery if the lesion produced mass effect, hormonal disturbance indicating surgery, or had a natural history of being a progressive disorder needing early intervention and not only follow up.

Exclusion criteria:

Unfit for surgery cases were excluded from the study.

Small sellar lesions with no parasellar extension were not included in the study.

Methodology:

Preoperative Patient Evaluation:

History

Personal history included: name, age, sex, occupation, residence, marital status, and special habits of medical importance.

The presenting complaint was the most single distressing complaint to the patient, other complaints were included in the patients symptoms.

The present history evaluated the onset, course and duration of the condition.

Neurological symptoms included visual affection, as diminution of vision, blurring of vision, field defects, diplopia and proptosis; symptoms of increased intracranial tension as headache, vomiting and disturbed conscious level were also evaluated. Cranial nerve affection, motor or sensory manifestations, fits and behavioral changes were accounted for.

Symptoms of hypothalamic and endocrinal affection, as growth retardation, anorexia, fatigue, diabetes incipidus (DI), amenorrhea, galactorrhea and libido were also noted.

Past history of surgery, medications, irradiation or other medical disorders were included.

Examination:

A complete general examination of the patients' vital signs, height, weight, secondary sex characters, head, neck, chest and abdomen was performed. Signs of endocrinal affection were also looked for as hirsutism, fat distribution, pigmentation, and facial features.

Neurological examination included examination of conscious level, cognitive function, speech, cranial nerves, motor and sensory function.

Investigations

Routine laboratory investigation as CBC, liver and kidney function, blood sugar serum sodium and potassium were performed. Hormonal assays were performed in lesions affecting the hypothalamus or the pituitary gland, or in cases with clinical endocrinal abnormalities.

Radiological examinations included preoperative CT scan and/or MRI. Lesions were evaluated for site, size, shape, consistency, enhancement, calcification, and extension, the presence of associated edema, midline shift or hydrocephalus. Multi axial cuts were essential for planning, and inclusion.

Surgical Management

Preoperative Preparation.

All patients were given pre-operative steroids, dexamethazone or hydrocortisone in patients with pituitary lesions or craniopharyngiomas. 1 gram of a third generation cephalosporin was given intravenously after induction of anesthesia. Patients were preoperatively loaded with phenytoin, 15-20 mg/kg.

Operative Management:

Three main approaches, with their modifications and extension, were used in this study. The subfrontal approach was used in 10 cases. The pterional approach was performed on 15 patients and 5 patients by endoscopic endonasal approache.

The pterional approach:

The pterional approach used was as that described by Yasergil 1984. The patients were placed supine and head tilted to the contralateral side. A curvilinear skin incision was used extending from the zygoma till the midline and placed behind the anterior hair line.

The temporalis was then incised behind the frontozygomatic process to expose the pterion and also incised at the posterior wend of the incision. Burr holes were drilled by a Hudson brace; one at the key hole, one at the midpupillary line, one posteriorly below the superior temporal line, and a final one at the base of the temporal bone.

Subfrontal approach:

In positioning the head, the orbital roof extended 30 degrees from vertical toward the surgeon. The head positioned without lateral rotation.

In most cases the approach will be from the right side, the more convenient for a right-handed surgeon. Opening the dural mater and retracting the frontal lobe are facilitated by draining spinal fluid. Additional room can be provided by using osmotic diuretics and hyperventilation.

The olfactory tract leads to the optic nerves as the brain is gradually retracted. Once the ipsilateral optic nerve is located, the arachnoid that binds the frontal lobes to the nerves is divided with microscissors or a sharp dissecting instrument, thereby exposing both optic nerves and the chiasm. And so removal of the lesion.

Endoscopic endonasal approach:

The endoscope is introduced through any of the nasal floor, allowing the identification of the inferior and middle turbinates and the nasal septum. First, an anterior ethmoidectomy is accomplished, with removal of the uncinate process and ethmoid bulla. Then a posterior ethmoidectomy is performed exposing the anterior wall of the sphenoid sinus and skull base.

3. Results:

Correlation between Approach Used and Parasellar Extension:

The largest parasellar extension was 4 cm (1 patient) in this study operated using subfrontal approach while the smallest was 1cm (8 patients), 4 patients operated by endoscopic transphenoid approach.

Table (1): Correlation between approach used and parasellar extension:

Parasellar extension	Subfrontal	Pterional	Trans
1cm	0	0	8
2cm	0	1	10
3cm	4	4	2
4cm	1	0	0

Correlation between Radicality and Parasellar Extension:

Total removal had performed in 8 patients with 1cm parasellar extension, 9 patients with 2cm, 6 patients with 3cm parasellar extension. 7 patients with subtotal removal.

Table (2): Correlation between radicality and parasellar extension:

Parasellar extension	Total	Subtotal
1cm	8	0
2cm	9	2
3cm	6	4
4cm	0	1

Correlation Between Parasellar Extension And Pathology:

The largest parasellar extension (4cm) was a meningioma.

Table (3): Correlation between parasellar extension and pathology:

Parasellar extension	Adenoma	Meningioma	craniopharyngioma
1cm	8	0	0
2cm	5	2	4
3cm	5	2	3
4cm	0	1	1

Radicality:

The extent of removal was to found to be total removal in 23 (77%) cases. Subtotal removal was 7 (23%) cases. No cases were operated upon for biopsy.

Table (4): Radicality in different pathologies distribution.

Pathology	Total removal	Subtotal removal
Adenoma	14	4
Meningioma	4	1
craniopharyngioma	5	2

4. Discussion:

In our study we operated on 30 patients, 67% females and 33% males which were similar to Bondy and Ligon who found that females were two times more affected than males in their study. **Ashish Kumar et al. (2010)** also found the same percentage in their sellar meningioma study. **Kitthisak Kitthaweesin et al. (2008)** accounts 61% females and 39% were males which were near our results

On the other hand, **Jamal and Ajabnoor (2012).** operated on 36 patients of sellar and parasellar lesions 22 male and 14 female.

Visual symptoms were found to be the most common affecting symptoms in all of these study patients followed by headache. Which were nearly similar in **Junko Matsuyama et al. (2010)** study 71.7% of the patient presented with visual symptoms and 12.8% of the patients had headache. The same finding in **Enrico et al. (2007)** they operated on six patients with tuberculm sella meningiomas five of them had visual deficits mainly decrease visual acuity and field affection. Also **Bing Zhao et al (2010)** operated on 126 patients of pituitary adenoma 104 patients with a visual dysfunction

Stephen et al. (2000) operated on 35 patients of meningioma the most common presentation was visual deficit in 19 patients and in **Pamir et al. (2005)** study they operated on 42 patients with meningioma 81 % of them had visual manifestation. But only Forty percent of **Yukiho Nakahara et al. (2004)** patients had a visual symptom while 80% of their patients had a headache.

We operated on 5 patients by pterional approch in this study, subfrontal approach in other 5 patients and endoscopic transsphenoidal approach in 20 patients. **Arifin et al. (2012)** operated on 20 patients with a meningioma in their study by pterional and subfrontal approach ten patients each.

Pterional approach was used by Stephen et al. () on 35 patients with sellar meningiomas with parasellar extension **(Stephen et al. 2008).**

Endoscopic transphenoidal approach was used in six patients with tuberculum sellae meningiomas in **Enrico et al. (2007)** series and in 12 patients with sellar pararasellar lesions in **Dehdashti et al. (2008a)** study**.** Also endoscopic transsphenoidal approachwasused in 126 patients with pituitary adenomas by **Bing Zhao et al. (2010).**

Landeiro et al. (2000) operated on 19 patients with sellar mass with parasellar extension via subfrontal approachs.

Pituitary adenoma was the most common pathology in this study (60%), meningioma (16.6%) and (23.3%) with a craniopharynigioma.

Pituitary adenoma was also the most common pathology in **Landeiro et al. (2000)** study, eleven patients (57.8%) were pituitary adenomas, three (15.7%) were craniopharyngeomas and two (10.5%) were meningiomas. **Ligia Tataranu1 et al. (2010)** also reports 200 patients treated by the endoscopic transsphenoidal approach. Among them 160 (80%) had pituitary adenomas, ten (5%) had skull base meningiomas, eight (4%) had clival chordomas, and additional 22 (11%) had other skull base pathologies.

Roberto Attanasio et al. (2009) mentioned in their study that Pituitary adenomas accounted for about 90% of lesions of the sellar and parasellar region according to different large surgical series: (**Freda & Post, 1999**) collected 1120 cases in 18 years in a single center, the German Registry of pituitary tumors (**Saeger et al., 2007**) collected 4122 cases in 10 years, **Valassi et al. (2010)** collected 1469 cases in 10 years in a single center. Thus in 8-15% of cases, an etiology other than a pituitary adenoma are encountered: other tumors in 4.2-5.6%, malformative lesions in 2.9-5.2%, and inflammatory lesions in 0.7-1.2% of cases.

On the other hand **Kaptain et al. (2001)** operated on 14 patients via endoscopic endonasal approach, Seven (50%) of 14 tumors were craniopharyngiomas, three (21.4%) were pituitary adenomas, and two (14.2%) were meningiomas. There was one case of lymphocytic hypophysitis and one yolk sac tumor. **Couldwell et al. (2004)** operated on 105 patients with sellar lesions with parasellar extension, 30 (28.5%) cases of pituitary adenomas, 27 (25.7%) craniopharyngiomas, 11 (10.4%) tuberculum/diaphragma sellae meningiomas, ten (9.5%) sphenoid sinus mucoceles, 18 (17.1%) clivus chordomas, four cases (3.8%) of carcinoma of the sphenoid sinus, two (1.9%) cases of breast carcinoma metastatic to the sella, and three cases (2.8%) of monostotic fibrous dysplasia involving the clivus.

In this series 24 patients (80%) had an excellent outcome, three patients (10%) had a good outcome, two patients (6%) had a poor outcome, and one patient (3%) died.

Nearly the same in **Landeiro et al. (2000)** series. 19 patients had a sellar lesion with parasellar

extension which operated by subfrontal and extended subfrontal approach 14 (73.6%) patients had an excellent outcome, four (21%) patients had a good outcome, one (5.2%) patient had a poor outcome, and no mortality.

In **Dehdashti et al. (2008b)** series 12 patients had a sellar lesions with parasellar extension which operated by endoscopic endonasal approach seven (58.3%) patients had an excellent outcome, four (33.3%) patients had a good outcome, one (8.3%) patient had a poor outcome, and no mortality. In **González-Darder et al. (2012)** series 31patients were operated via pterional approach, 21 (67.7%) patients had an excellent outcome, ten (32.2%) patients with good and poor outcome (author didn't specify) and no mortality in this study.

Nine (30%) patients developed postoperative CSF leak in our series, in all patients the leak stopped spontaneously without any surgical repair.

The most common complication in **Gardner et al. (2008)** study is CSF leak in 11 patients (57.8%) of 19 patients who had a craniopharyngioma with parasellar extension operated via endoscopic transsphenoidal approach.

Postoperative CSF leak was found to be less in other series. In Jho series 2002 he operated on 200 patients with various sellar pathologies with parasellar extension via endoscopic transsphenoidal approach, 12 (6%) patients developed postoperative CSF and he didn't mention whether stopped spontaneously or after intervention **(Ligia Tataranu et al 2010). Cappabianca et al. (2004)** series of 100 patients with pituitary adenomas, craniopharyngiomas and clival chordomas with parasellar extension via endoscopic transsphenoidal approach, three (3%) patients developed postoperative CSF and stopped spontaneously. **Couldwell et al. (2004)** had six (5.7%) patients with postoperative CSF leak among 105 patients with parasellar extension lesions operated via standard endoscopic transsphenoid approach.

In our series the post operative CSF leak might be due to aggressive attempts of radical removal of the lesion in all patients.

The extent of removal was found to be total in 23 (76.6%) cases. Subtotal removal was seven (23.3%) cases. 14 cases of pituitary adenomas were radically removed while four were subtotally removed; four cases of meningioma were radically removed while one was subtotally removed, five cases of craniopharyngioma were totally removed and two caaes were subtotally removed.

Nearly the same in **Kaptain et al. (2001)** series who operated on 14 patients with a sellar and pararasellar lesions via endoscopic endonasal approach, 11 (78.5%) patients had a total removal of their lesion while three (21.5%) had a subtotal removal.

Arbolay et al series who operated on 12 patients with sellar lesions via extended endoscopic endonasal approach; total removal achievd in eight (66.6%) patients, four (33.3%) patients had subtotal excision. (O. L. Arbolay 2008). Total removal was achieved in 17 cases (89.4%) in **Landeiro et al. (2000)** study while two cases (10.5%) had a subtotal removal of sellar and suprasellar lesion via subfrontal approach. Our results were near the degree of gross total removal of adenomas via endoscopic endonasal approach in **Dehdashti et al. (2008a)** series was 78% for patients with parasellar extension without cavernous sinus involvement.

In other series the degree of gross total excision of the adenoma was less than our results. Bing Zhao et al operated on 126 sellar pituitary adenoma with parasellar extension via endoscopic endonasal approach, total removal achieved in 78 (61.9%) patients and 48 (38.1%) patients had subtotal removal of their adenomas. **(Bing Zhao et al 2010)**. **Xiao Ying et al (2010)** operated on 24 patients of sellar adenoma with parasellar extension via subfrontal approach, 17 (70.8%) patients had total removal of the adenoma and seven (29.2%) patients had subtotal removal. Other 38 patients operated via endoscopic endonasal approach, 28 (73.6%) patients had total removal and ten (26.4%) patients had subtotal removal. Cargill H Alleyne Jr et al operated on ten patients with a giant pituitary tumor via compined endoscopic transsphenoid and pterional approach, gross total excision was in sex (60%) patients and subtotal in four (40%) patients. **(Cargill H Alleyne Jr et al 2002)**.

Cappabianca et al. (2008) operated on sex patients with sellar adenoma with parasellar extension via extended endoscopic endonasal approach, in two (33.3%) patints total removal achieved and in four (66.7%) patients had subtotal excision.

We operated on five cases of sellar meningioma with parasellar extension, total removal done for four (80%) patients, four patients using subfrontal approach and one patient using endoscopic transsphnoidal appproach. Subtotal removal for one (20%) patient. This was due to adherence of the tumor to the carotid system.

The results in our results werw better than in other series. **Pamir et al. (2005)** operated on 24 patients with suprasellar meningioma via pterional approach; total removal in 17 (70.8%) patients and seven (29.2%) patients had a subtotal removal.

We did total removal for 23 cases of sellar lesions with parasellar extension which was one cm in eight (34.7%) patients who had totally removed lesions, two cm in nine (39.1%) patients totally

removed, and three cm parasellar extension in six (26%) patients due to fear of vascular injury.

Bing Zhao et al. (2010) operated on 126 patient with sellar lesions ranged in diameter between 1.54 cm and 6.5 cm via extended endoscopic endonasal approach, Gross-total resection was achieved in 78 (61.9%) patients, subtotal resection in 48 (38.1%) patients.

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Summary

Several critical structures traverse suprasellar and parasellar regions including the circle of Willis, optic nerves and optic chiasm, hypothalamus, pituitary infundibulum, and the infundibular and suprachiasmatic recesses of the third ventricle. There are several pathological lesions in this area, Pituitary adenomas, craniopharyngioma and suprasellar meningiomas constitute the most common lesions.

Patients clinical and radiological data were collected and compared with other litretures preoperatively, visual manifestations was the most common presenting symptoms in all patients.

Thirty Patients operated via subfrontal, pterional and endoscopic transsphenoidal approaches with their extensions. There were a total of 12 males and 18 females, the ages of whom ranged from 18 years to 55 years. The parasellar extension ranged from 1cm to 4 cm. The extent of removal was found to be total removal in 23 (76.6%) patients. Subtotal removal was 7 (23.3%) patients. Regarding the outcome of the patients: 24 (80%) patients had an excellent outcome, 3(10%) patients had a good outcome, 2 (6.6%) had a poor outcome, and one (3.3%) died.

This study conclude that patients with parasellar extension medial to the carotid artery 1 cm or less specially in pituitary adenomas can be approached safely without technical difficulty via all approaches for the suprasellar area, moderate parasellar extension 1 to 2 cm lateral to the carotid artery poses surgical challenge for the extended endoscopic endonasal approache specially in meningiomas due to consistency of the tumor so it's better to approach this lesion via transcranial rout whether subfrontal or pterional approach which have comparable results. In parasellar extension more than 2 cm involving the carotid system and the cavernous sinus it's advisable to approach the tumor via pterional approach and its extension to assure proper radicality, early identification of the carotid system with good surgical visibility and ability to do bony work at the skull base if needed.

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