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Evaluation of endoscopic endonasal approach for management of suprasellar meningiomas

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Abstract

To evaluate the surgical outcome, the perioeperative complications and technical challenges of the endoscopic endonasal approach for excision of the tuberculum sellae and planum sphenoidale meningiomas. A prospective randomized clinical study which is conducted on 20 patients with suprasellar meningiomas starting from June 2021till Marsh 2023. All patients are evaluated clinically and radiographically preoperatively. Intraoperaive technical challenges are documented. Postoperaive evaluation included radiological assessment to evaluate the extend of resection, postoperative hospitalization, operation time, blood loss, and intraoperative complications. This study included 6 males and 14 females. The mean ago was 47.9 years old. Visual affection was the most common preoperative manifestation (100%% of patients for visual acuity and 80% for visual field). Maximal tumor diameter for was 5.2 cm. Gross total resection was achievable in 90% of cases. Post-operative assessment of the visual field and acuity revealed 70% with pre-operative visual affection showed post-operative improvement. Complications included hyposmia, prolonged crusting, CSF leak, and 1 mortality case. The post-operative CSF leak rate was15% which was the most serious complication. The tuberculum sellae and planum sphenoidale meningiomas are resectable via the endoscopic endonasal approach with several advantages such as early devascularization, radical tumor excision by removing the involved bone and excision of the adjacent dura, central debulking which facilitates dissection of the vital neurovascular structures. CSF leakage is a fatal complication and all measures should be taken to avoid it.

Keywords: Endoscopic endonasal, Transcranial, Minimal invasive surgery, Meningioma, Sellar region.

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1. Introduction

Suprasellar meningiomas, including tuberculum sellae and planum sphenoidale, are slow growing, benign tumors which account for 5–10% of intracranial meningiomas. They often present with visual impairment as a result of optic nerve and chiasm compression. The surgical management of these tumors can offer optic nerve decompression, preventing further visual impairment. Gross total resection of the tumor, the involved dura and bone is recommended in order to minimize tumor recurrence and prevent invasion into surrounding structures [1-2]. Several surgical approaches have been utilized to excise suprasellar meningiomas,. Recently, the endoscopic endonasal route has become an option for carefully selected suprasellar meningiomas. Technological advances of endoscopes and instrumentations, intraoperative neuronavigation, neurophysiological monitoring and multilayer skull base reconstruction techniques have pushed the boundaries of indications of endoscopic endonasal surgery achieving higher success rates [3]. Over the past two decades, the endoscopic endonasal route has been increasingly recognized and accepted for surgical resection of the suprasellar lesions. These tumors have been an attractive target for the approach, as it is a subchiasmatic approach which targets a subchiasmatic lesion. Theoretically, the endoscopic endonasal route avoids manipulation over the adjacent critical structures by approaching the tumor through its dural base decreasing the risk for postoperative visual deterioration. Also, the minimal invasiveness improves patient comfort and shortens hospitalizations. It has been criticized due to the higher rate of CSF leakage [5].

1.1 Aim of the work

To analyse the surgical experience with tuberculum sellae operated via the endoscopic endonasal approach, with evaluation of the clinical outcome and discuss the advantages and disadvantages of each approach.

2. Patients and methods

This is a prospective randomized clinical trial study that will be conducted on 20 patients with suprasellar meningiomas who will be admitted to Cairo University Hospitals starting from June 2021to February 2023. The aim of this work is to analyze of the surgical experience of the endoscopic endonasal approach for resection of the suprasellar meningiomas, with evaluation of the clinical outcome and discuss the advantages and disadvantages of each approach.

2.1 Inclusion criteria

Age: Older than 18 years, radiographic finding suggesting meningiomas involving the tuberculum sellae or the planum sphenoidale and meningiomas with no or with inferior or with medial invasion of the optic canal.

2.2 Exclusion criteria

Age: Younger than 18 years old, meningiomas with lateral extension to the optic nerve or the supraclinoid segment of the internal carotid artery, encasement of major arteries or severely narrowed intercarotid distance, meningiomas with inaccessible optic canal extension (superior or lateral extension), meningiomans with radiological anterior extension beyond the planum sphenoidale and recurrent cases.

2.3 Statistical analysis

Data will be analyzed using the statistical program for social science (SPSS) version 24.0 using the appropriate statistical test. Categorical variables will be compared using two tailed Fisher's Exact test as appropriate. Normally distributed continuous variables will be compared using Student's t-test, while abnormally distributed variables will be compared using Mann Whitney u test. A p value < 0.05 will be statistically significant.

2.4 Preoperative Patient Evaluation

2.4.1 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 patient's symptoms. The present history: evaluated the location, character, onset, course, duration, severity, frequency, diurnal/nocturnal variability, precipitating or relieving factors and associated symptoms of the condition. Neurological symptoms: included visual affection, as diminution of vision, blurring of vision, field defects, and diplopia; symptoms of increased intracranial tension as headache, vomiting and altered level of consciousness, cranial nerve affection, motor or sensory manifestations, fits and behavioral changes are also evaluated. Symptoms of hypothalamic and endocrinal affection, as growth retardation, anorexia, fatigue, diabetes insipidus, amenorrhea, galactorrhea and decreased libido were also noted. Past history: of surgery, medications, irradiation or other medical disorders were included.

2.4.2 Examination

General examination: patients' vital signs, height, weight, secondary sex characters, head, neck, chest and abdomen were examined. Signs and symptoms of endocrinal affection were also looked for as hirsutism, weight gain or loss, fatigability, increased sensitivity to cold or heat, frequent urination, irregular period, fat distribution, pigmentation, and facial features. ***Neurological examination:*** included examination of conscious level, cognitive function, speech, cranial nerves, motor power and sensory function. ***Visual examination:*** Visual acuity is examined via Snellen chart. Visual field is examined by confrontation test or perimetry test.

2.5 Preoperative Planning

The preoperative planning is the cornerstone of achieving an uneventful successful surgery.

2.5.1 Investigations

Routine laboratory investigation: as CBC, liver and kidney function, PT, PTT, INR, 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: MRI with contrast is the gold standard radiological investigation for brain tumors. CT brain is performed to assess the boney involvement. Ct paranasal sinuses is performed to assess the anatomical variations of the nasal cavity and the sphenoid sinus. Pathologies were evaluated for site, size, shape, consistency, enhancement, calcification, and extension, the presence of associated edema, hemorrhage, hydrocephalus, and their relation to the adjacent vital structures. Multi axial, coronal, sagittal cuts were essential for planning, and inclusion.

2.6 Surgical Management

2.6.1 Preoperative Preparation

All patients were given pre- operative steroids; dexamethazone or hydrocortisone. 1 gram of a third generation cephalosporin was given intravenously after induction of anesthesia.

2.6.2 Operative Management

surgical findings included tumor composition, consistency, extension and attachment to the adjacent structures. Any complication or operative nuances that occurred during surgery was recorded and evaluated. Other surgical procedures as CSF diversion were also recorded. All specimens that were obtained were examined by a neuropathologist. The extent of resection was evaluated and subdivided into three groups; "Gross Total resection": which is defined as 100% resection of the tumor. "Near Total resection": which is defined as the resection is more than 90% resection of the tumor with residual less than 1cm3. "Sub-Total resection": which is defined as the resection is less than 90% resection of the tumor. Recent studies questioned the eligibility of Simpson's grading system to predict the recurrence rate based on the extent of resection as it was stablished fare prior to the worldwide usage of the

MRI scans and microscopes. Also, the modern evolution of stereotactic radiosurgery affected the recurrence rate dramatically. Therefore, aggressive resections of the overlying bone and dura may not be needed to achieve similar recurrence rates as the original Simpson grades. But still a sub-total resection is associated with high recurrence rate specially with high grade meningiomas with boney infiltration [6,7].

2.6.3 Positioning

In supine position, the patient is positioned. The head is fixed in the Mayfield clamp with tilting to the left and rotation to the right. The body is elevated 15-30° and the surgeons are standing opposite to each other. Sterilization of the nasal cavity and the periumbilical region is performed routinely.

2.6.4 The Nasal Phase

This phase is performed by an ENT colleague. A 0-degree rigid rod-lens endoscope is used for carful inspection of both nasal cavities identifying the inferior, middle, and superior turbinates and the choana. Lateral displacement of the middle and inferior is performed. Middle turbinatectomy is performed whenever needed. The ostium of the sphenoid sinus is identified. Hadad-Bassagasteguy vascularized nasoseptal flap is prepared on one side and a rescue flap on the opposite side. Posterior septectomy is performed, the rostrum is drilled and the floor of the sphenoid is flattened. The sphenoidectomy is widened using a high-speed drill and Kerrison rongeurs. The posterior sphenoid sinus mucosa is coagulated and removed. Bony landmarks (the medial opticocarotid recess, the suprasellar notch and the clival recess) are identified. A high-speed drill is used to remove the bone over the anterosuperior sella just below the superior intercavernous sinus, extending up to the tuberculum, lateral to the medial opticocarotid recesses and forward along the planum to the anterior extent of the tumor and its dural tail. The medial optic canal is drilled if there is an optic canal extension of the tumor.

2.6.5 The Intradural Phase

It is when the neurosurgeon takes over. First, the dural base of the tumor is devascularized with bipolar electrocautery. The dura is open above and below the intercavernous connection, and so it could be trapped between bipolar tips and coagulated. Then the rest of dura is opened exposing the tumor. After devascularization, a sufficient internal debulking is performed enough to create a safe dissection plane between the tumor and the adjacent neurovascular structures. According to the consistency of the tumor, internal decompression can be performed with bimanual suction, pituitary rongeurs, or an ultrasonic aspirator. The dissection starts with the anterosuperior portion of the tumor as it is the safest. Then followed by lateral dissection of the tumor reaching the posterior portion of the tumor. The A 2 branches are identified and dissected sharply from the tumor capsule. Then, the optic chiasm starts to come into view. The tumor is rolled off the chiasm with extensive care is paid for the perforators for the chiasm without direct manipulation over the chiasm itself. The key to safe chiasmal decompression is avoiding any manipulation of the chiasm itself. A 30° scope could be used to facilitate this step.

The inferior portion of the tumor is then dissected the inferior chiasm, the pituitary stalk and gland with combination of blunt and sharp dissection. At this step the interpeduncular fossa subarachnoid space is exposed and care must be taken to not damage the superior hypophyseal arteries. After the tumor is totally free, it is rolled into the center of the resection cavity while the nerves or any perforating vessels are protected. If the tumor is not extending into the canal, the dura of the optic canal is then opened sharply along its superior portion and tumor is resected with no manipulation of the optic nerve and with care paid for the ophthalmic artery. By the end of dissection frequent irrigation is done and meticulous hemostasis is achieved. Skull base reconstruction starts with a fat graft to fill the large dead space followed by inlay layer of collagen graft between the dura and the brain. Followed by fascia lata onlay. And then the vascularized nasoseptal flap is placed and its lateral edges extend beyond the lateral edges of the fascia lata layer. The flap is then covered with tissue sealant to keep it in place. Nasal gauze or tampons can be placed for 3-5 days.

2.6.6 Postoperative care

Postoperative, all patients spent the first 24 hours in intensive care unit. Patients continued receiving the same third generation cephalosporin intravenously for three days and then shifted to oral amoxicillin clavulanate for 1 week. Patients receiving preoperative hormonal supplementation were kept on them postoperatively. Serum electrolytes, hemoglobin, and renal functions were obtained in the early postoperative period. Urine output was also recorded. A complete neurological evaluation was performed for evaluation of consciousness, visual functions, cranial nerve affection, hypothalamic manifestations, frontal manifestations or other neurological deficits. Variable forms of morbidity such as CSF rhinorrhea, wound infection, neurological deficits, and endocrine dysfunction were documented. Mortality causes and timing were also documented. For patients of endonasal approach, the nasal packs are removed within 3-5 days. Patients continued hospitalization till they were found stable enough for discharge. A postoperative CT scan or MRI was performed before discharge. Patients with endocrine dysfunction were referred to an endocrinologist.

2.6.7 Follow up and outcome

All patients had a variable period of follow up on an outpatient basis. Follow up included newly developed neurological manifestations or delayed postoperative complications. Also, the progression or regression of any immediate postoperative morbidities is evaluated. Follow up radiological evaluation was performed when necessary.

3. Results and discussion

3.1 Demographics

20 patients with suprasellar meningiomas fulfilled the inclusion and exclusion criteria of this study from June 2021to February 2023. 10 patients were operated via endoscopic endonasal approach. This study included more females (n = 14) than males (n = 6). The mean age was 43.2 for all patients. The operative time was recorded starting from induction of anesthesia until the patient is out of the operating room, mean = 6 hours and 53 minutes. The

availability of ultrasonic aspirator has much influence on the operative time especially in large size tumors. The mean blood loss was calculated which mean was = 233.4 ml. The hospital stay mean was mean = 3.9, 2 patients who developed post-operative meningitis, which have a prolonged hospitalization, were excluded (Table: 1). Through the past three decades, suprasellaer meningiomas have been an interesting challenge for many surgeons worldwide. Several approaches have been described to deal with these lesions. The indications for the endoscopic endonasal approach is being significantly expanding through the last few decades. In this study we are trying to document our institutional experience with the approach and how to improve it. We also have tried to pushed the boundaries of the recommended tumor diameter for endoscopic endonasal approach which was less than 4 cm.

3.2 Evaluating the extent of resection in this study

Gross total resection was achievable in 90% of cases. There was a single case with subtotal resection. This case was one of the early cases in our study. The tumor was firm with extensive calcification and no clear arachnoid margin between it and the surrounding structure. Central debulking of the tumor was done with bilateral optic nerve decompression was achieved, leaving a significant tumor residual behind. The patient was referred for radiotherapy. On 6 months follow up the residual showed stationary coarse and the patient had no symptoms progression. Another case with near total resection The maximal tumor diameter was 5.2cm, gross total resection was achievable, and that is beyond the recommended diameter in the literature which is 4 cm.

3.3 Visual outcome

Our study showed 70% improvement of vision and 30% of stable vision with no postoperative deterioration. The endonasal route provides direct exposure of the tumor with no manipulation over the optic never, as the tumor is peeled of the optic nerve. It also provides an excellent visualization of the vasculature of the optic nerve and the superior hypophyseal artery which supplies the optic chaiasm. It also gives adequate exposure for the optic canal bilaterally, but it is limited for the medial and inferior wall of the canal.

3.4 Post-operative complications

For the endoscopic endonasal approach, the CSF leak has been always the most serious complication. 15% of the patients has post-operative CSF leak they had secondary repair. Two patients showed immediate post-operative CSF leak and he had a secondary repair on the 1st post-operative day and a lumbar drain was placed for 4 days. They were discharged on the 5 post-operative day and he had no further CSF leak. The last patient was the one with the largest tumor diameter. The patient had CSF leak on the 1st post-operative day. The otorhinolaryngologist decision was to “wait and see” as it may resolve spontaneously. On the 3rd post-operative day, the patient developed fever and headache, the CT scan showed extensive pneumochephaly, and the CSF leak is persistent. The patient had secondary repair. The nasoseptal flap dropped down and was infected. CSF Sample showed elevated TLC levels and the culture revealed infection. The patient developed significant ventriculomegaly and an external ventricular drain was placed. The patient was kept on intravenous and intraventricular antibiotics according to the culture and sensitivity test. CSF TLC was followed up every 3 days. The patient had prolonged hospitalization. On the 4th post-operative week, the TLC significantly dropped, but still not enough to replace the external ventricular drain with a V-P shunt. On the 33 post-operative day the patient died as a result of sudden pulmonary embolism. It is important to be mentioned that in both cases the primary skull base repair was not done by an experienced otorhinolaryngologist. Also, there was two patients had prolonged crusting and one patient had hyposmia. These complications are specific to the endonasal route and they could be avoided and managed via a well experienced otorhinolaryngologist.

3.5 Results other series

Evan D. Bander et al. compared the transcranial approach versus the endoscopic endonasal approach in as similar cohort. His study included 32 patients. They were divided into 2 groups, endonasal group included 17 patients and the transcranial group included 15 patients. All patients had a comparable tumor size. The extent of resection was not significantly different between the 2 groups (98.80% ± 3.32% vs 95.13% ± 11.69%, p = 0.206). Postoperatively, the transcranial group demonstrated a significant increase in the brain edema signal compared with endonasal patients (4.15 ± 7.10 vs -0.69 ± 2.73 cm 3, p = 0.014). Also, the postoperative diffusion-weighted imaging signal of cytotoxic ischemic damage was significantly higher in the transcranial group (1.88 ± 1.96 vs 0.40 ± 0.55 cm 3, p = 0.008). Overall, significantly more endoscopic endonasal patients experienced improved or stable visual outcomes compared with TCA patients (93% vs 56%, p = 0.049). Visual deterioration was greater after TCA than EEA (44% vs 0%, p = 0.012). While more patients experienced postoperative seizures after the transcranial approach (27% vs 0%, p = 0.038). The CSF leakage and anosmia after the endonasal approach were higher (11.8% vs 0%, p = 0.486 and 11.8% vs 0%, p = 0.118, respectively) [2]. *Sang Woo Song et al.* analyzed and compared the surgical outcomes of each approach to determine factors affecting tumor relapse and post-operative visual outcome. He operated 44 patients via the endonasal approach and 40 patients via a transcranial approach. Gross total resection rates favored the endonasal approach (84.1% vs 68.4), but it has no statistical significance. However, the locations of residual or recurred tumor definitely differed. For the transcranial group, the residual was in the sella turcica, whereas residual tumors in endonasal group was mainly located at lateral or superior to the clinoid process. The complete or partial improvement rate of visual function in the endonasal group was 97.7%, but 9 patients (23.7%) in the transcranial group experienced visual deterioration. It was also noticed that younger age (<55 years) were associated with favorable visual outcome. Cerebrospinal fluid leakage occurred in only one case in the endonasal group [8].

Table 1: Demographic distribution

Variable	
Sex	
Male	6
Female	14
Age	
Mean	42.3
Max	58
Min	27
Mean Operative Time	6:53
Mean Blood Loss	233.4 ml
Mean Hospital Stay	3.9 days
Recurrence	1

Table 2: Distribution of Symptoms

Symptoms & Signs	
Visual Acuity	20
Monocular	15
Binocular	5
Visual Field Defect	16
Monocular	12
Binocular	4
Headache	8
Seizures	2
Behavioral Changes	-
Hormonal Disturbance	-
Memory Deficit	1

Table 3: Radiological Extension

Radiological Analysis	
Extension	
Tuberculum	12
Planum	4
Planum / tuberculum	4
3rd Ventricular	5
Tumor Volume	
Mean	7.51 cm3
Max Diameter	5.2 cm
Optic Canal Invasion	
Unilateral	3
Bilateral	1

Table 4: Pathologies of the lesions

Pathology	Patients	Percentage
Meningothelial (Grade I)	13	65%
Fibroblastic (Grade I)	4	20%
Transitional (Grade I)	2	10%
Atypical (Grade II)	1	5%

Table 5: Extent of resection

Extent of Resection	
Gross Total Resection	18
Near Total Resection	1
Sub-total Resection	1

Table 6: Visual affection postoperatively

Visual Assessment	
Pre-operative affection	20
Improved	14
Stable	6
Deteriorated	-

Table 7: Postoperative Complications

Complications	
Seizure	-
CSF leakage	3
Permanent Diabetes Insipidus	-
Weakness	-
Hydrocephalus	1
Deterioration of Consciousness	-
Hemorrhage	-
Radiological Brain edema	-
Cranial Nerves Affection	-
Frontalis Nerve Palsy	-
Superficial Wound Infection	-
Subgaleal Collection	-
Complication with NSF	1
Scarring & Prolonged Crusting	2
Hyposmia and anosmia	1
Meningitis	2
Pulmonary embolism	1
Recurrence	1
Mortality	1
Total Number of Events	9

Doo-Sik Kong et al. operated 84 patients via endoscopic endonasal approach and 94 patients via a transcranial approach. Gross-total resection was achieved in 145 patients (81.5%); it did not differ significantly between the two groups (83.3% vs 79.8%). Of 157 patients with preoperative visual disturbance, 140 had improved or stable vision postoperatively. The endonasal approach showed superiority in the improvement of vision (85% vs 55.8%, p-value = 0.001). Also, 17 patients (9.6%) experienced some visual deterioration after surgery more in the transcranial group (5% vs 16.9%, p-value = 0.015). The transcranial group also had a worse visual outcome in patients with preoperative optic canal involvement (77.6% vs 93.2%, p-value = 0.019). The endonasal group had 4 (4.7%) patients with post-operative CSF leak and 6 (7.1%) patients with meningitis. There were 2 cases of death of uknown cause, 1 in each group [9]. In Rudolf Magnus brain center, Utrecht University, Ivo S. Muskens et al. underwent a systematic review of the literature from 2004 till 2017. Sixty-four case series were included in this meta-analysis. The gross total resection not significantly higher at the transcranial group (83.0% vs 85.8%, p-value = 0.34). Visual improvement was higher for the endoscopic endonasal approach than the transcranial approach (p-value < 0.01. CSF leak was significantly higher among the endonasal approach cases (19.3%, vs. 5.81%, p-value < 0.01). Intraoperative arterial injury was higher among the endoscopic endonasal group (4.89 vs.1.86, p-value = 0.03). Mortality was not significantly different (p-value = 0.88) [1].

In Johns Hopkins University, Adrian E. Jimenez et al. conducted a PRISMA-compliant systematic review of literature detailing the outcomes of both approaches. Forty-four retrospective studies were included in this meta-analysis most of them from single centers, from 2004 till 2020. The endonasal approach showed significantly higher rates of visual improvement (p-value = 0.0053) and significantly higher rates of CSF leakage (p-value = 0.0098) in comparison with the transcranial approach. However, there were no significant differences between the post-operative visual deterioration (p-value = 0.17), complications (p-value = 0.51), and gross total resection rates (p = 0.30) for the two approaches. In the early studies, the endoscopic approach showed high rates of CSF leaks which ranged from 25 to 40%. Recently, the evolution of skull base repair techniques and the frequent application of the vascularized naso-septal flap have lowered the rates reaching 5% [10].

3.6 Limitations of this study

This study has some limitations in several aspects. First, the follow up period, 3-6 months, was limited in comparison to other studies. Second, the endonasal approach was performed by several otorhinolaryngologists with different levels of experience, which may have affected the quality of skull base repair which eventually affects the post-operative CSF leak. Third, the post-operative CSF leak has many predisposing factors, which we did not control such as: the size of dural defect, the size of the tumor itself, 3rd ventricular extension of the tumor, if the patient had post-operative hydrocephalic changes, application of lumbar drain and the availability of collagen-based dural graft. Forth, there are several factors which can affect the post-operative visual improvement such as: the duration and severity of the preoperative visual affection, the age of the patient, the optic canal involvement, the intraoperative patency of arachnoid plane, the preoperative peritumoral edema and the tumor texture.

3.7 Our experience with the endoscopic endonasal approach

One of the main goals of this study is to emphasize the advantages and limitations of the endoscopic endonasal approach and how to achieve the best results using it for resection suprasellar meningiomas, mainly the tuberculum sellae and planum sphenoidale meningiomas. The endonasal approach has provided an excellent exposure for the optic canals. 270 ° decompression of the optic nerve is feasible via the endonasal approach starting by removing the floor, medial wall and the roof of the optic canal followed by sectioning of the intracanalicular dura and falciform ligament from medial to lateral which facilitates excision of the canalicular extension with no manipulation over the optic never. As the post-operative visual deterioration is much related to ischemia of the optic apparatus, the endoscopic endonasal approach provided a close visualization of the fine blood supply to the optic chiasm and nerve, the anterior communicating artery complex which supplies the superior and dorsal aspects and the superior hypophyseal artery which supplies the dorsal aspect. Therefore, it provides a direct visualization of the suprasellar and the infra-chiasmatic region superior to any transcranial route, facilitating safe gross total resection of suprasellar lesions with the minimal manipulation over the neurovascular structures as the optic nerve, the pituitary stalk, and the anterior circulation. Early devascularization of the tumor as it is approached through it dural base is also one of the advantages of the endoscopic endonasal approach. Drilling the involved bone and excision of the dural tail of the tumor is more feasible via the endonasal route than other transcranial approaches which significantly affect the recurrence rate of the tumor. Approaching the tumor is the same direction of its long axis facilitates resection of tumors with superior extension, reaching the 3rd ventricle, without traction over the brain tissue which markedly affects early post-operative recovery and shortens the duration of hospitalization. As the endoscopic endonasal approach is performed by a dual team which consists of a neurosurgeon and an otorhinolaryngologist, both surgeons should be in harmony to achieve best results. Thus, it is important establish fixed tag team of a neurosurgeon and an otorhinolaryngologist, so they got used to each other achieving better and better outcomes overtime. The post-operative CSF leak has been the most serious complication of the endoscopic endonasal approach which is affected by several factors. In this study, the leakage of experience of the otorhinolaryngologist was a common factor in both cases with post-operative CSF leak. We also believe that the size of the dural defect increases the liability for CSF leak. Achieving the triple layer skull base repair was not feasible in all cases as the collagen-based dural graft was not available in some cases due to its high cost. In cases with post-operative CSF leak, early intervention for secondary repair is critically important to avoid meningitis which is significantly associated with mortality. Lumbar drain is also found to be helpful to avoid CSF leak. The texture of the lesion and pial invasion markedly affect the feasibility of its

excision. The availability of the ultrasonic aspirator has significant affection on the operative time specially in large tumors as the central debulking is an essential step for achieving safe gross total resection. Moreover, the operative time affects the liability of post-operative infection. As a result of infection the viability of the naso-septal flap may be affected, which has a direct influence over the skull base repair and the post-operative CSF leak. It was found that the adequate central debulking is the most important step with facilitates safe dissection of large tumors from the lateral critical neurovascular structures. Although, the recommended tumor diameter for the endoscopic endonasal approach is less than 4 cm in most of literature, with adequate central debulking we were able to achieve gross total resection of a suprasellar meningioma with 5.2 cm diameter. As tumor selection plays an important role in achieving gross total resection, the carotid bifurcation should always be considered as the lateral limitation of endoscopic endonasal approach. All patients were followed up for 3-6 months post-operatively. 1 patient showed recurrence in radiological follow up 6 months post-operatively with no development of new symptoms. And he was referred for radiotherapy.

3.8 Preoperative Symptoms and Signs

The most common presentation was diminution of visual affection, 100% for the acuity and 80% for the field. Followed by headache in 35% of cases *(Table 2).*

3.9 Radiological analysis

All tumors appeared as extra-axial, well circumscribed, isointense relative to gray matter with homogeneous post contrast enhancement with dural tail in MRI. 5 (25%) showed skull base hyperostosis. 6 (30%) showed peritumoral edema. The mean tumor volume was 6.92 cm3 and the largest tumor was 24.2 cm3. Most of the tumors were limited to the tuberculum sellae, 11(55%) cases. 6 (30%) cases had optic canal invasion. *(Table 3.)*

3.10 Pathology

Meningothelial (WHO Grade I) was the most common pathological subtype with (13) 65% cases, follow by transitional 20% and transitional 10%, 1 case was atypical meningioma (WHO Grade II) *(Table 4).*

3.11 Extent of resection

Gross total resection was achievable in 90% of cases, with removing of the attached dura and drilling of the involved skull base bone. Near total resection was achived in 1 case with residual attached to the right carotid and the cases with subtotal resection was one of the earlies cases in our study, only central debulking was achieved *(Table 5).*

3.12 Visual & Clinical Outcome

All patients were followed up in the outpatient clinic postoperatively. The shortest period of follow up was 3 months, the longest was 6 months. As visual affection was the most common preoperative manifestation. Post-operative assessment of the visual field and acuity revealed 70% with pre-operative visual affection showed post-operative improvement *(Table 6, Chart:1).*

3.13 Post-operative complications

Post-operative complication has been reported for each group. Most of them are specifically related to the approach. 3 (15%) patients developed CSF leakage which required secondary skull base repair. two of them developed meningitis, hydrocephalus, operated upon external ventricular drain, the patient had prolonged hospitalization till the infection resolved. Unfortunately, one of the patients suddenly died due to massive pulmonary embolism. Also, one of them had ischemic naso-septal flap which was the cause of the leakage. 2 patients had prolonged crusting which is eventually cured. 1 patients had Hyposmia. 1 patients developed hydrocephalus which presented with severe headache 6 days postoperatively and was operated upon VP-shunt placement. 1 case had recurrence on 6 months follow up and was refereed for radiotherapy. *(Table 7).*

4. Conclusion

The endoscopic endonasal approach provides early devascularization of the suprasellar meningiomas, drilling the involved bone, resection of the attached dura, central debulking of the tumor, and fine dissection of the vital neurovascular through the adjacent arachnoid planes. It offers a better visual outcome as the tumor is peeled off the optic nerve with better visualization of the blood supply of the optic apparatus. CSF leak was found to be the most serious post-operative complication.

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