Endoscopic Endonasal Transsphenoidal Hypophysectomy: Two Hand Versus Four Hand Technique: Our Experience

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Abstract An endoscope was used in transsphenoidal surgery and eventually replaced the operating microscope as a tool for visualization. Initially patients underwent operation via a sublabial transseptal approach using a rigid endoscope in conjunction with an operating microscope. The subsequent operations were performed through a nostril using only rigid endoscopes, initially through single nostril by one surgeon (two hands) and later through both nostrils by two surgeons (four surgeons). This is a retrospective study of 96 patients who had pituitary adenomas in last ten years. Postoperatively all patients who had undergone endonasal endoscopic surgery had unobstructed nasal airways with minimal discomfort. More than half of the patients required only an overnight hospitalization.

Keywords Hypophysectomy · Transsphenoidal · Endoscopic

Introduction

Skull base surgery is a dynamic subspecialty and the last decade has witnessed the application of endoscopic techniques to the ventral skull base using an endonasal corridor which has seen a significant decline in patient morbidity and inpatient care. Traditionally there are four methods of endoscopic approach to the pituitary namely, the sublabial

trans-septal, endonasal trans-septal, trans-columellar and direct trans-sphenoidal approach [1].

Multidisciplinary collaborations in managing complex pathologies of the skull base have evolved into a field of neurorhinology and this interaction with multiple specialties, notably otolaryngologists and neurosurgeons, has allowed procedures to be developed that offer significant advantages over treatment modalities from 25 years ago. Using the two-hole and four-hand technique when performing the operation, simultaneously is of added advantage in the diverse and expanding field of cranial base surgery. As technological advancements and novel surgical instruments were developed for use in inflammatory disorders, otolaryngologists, with neurosurgeons, have begun to perform complex procedures endoscopically via the nostrils. The progression to the endoscopic approach in the management of the pituitary lesions has been brought about by our greater understanding of the complex anatomy from an endoscopic perspective and advances in equipment. Much of this advancement was in endoscopes and the advent of high definition camera and recording systems. Critical to this has been the development of new instruments to allow the surgeon to complete removing large tumours via a nasal-only route.

Pituitary adenoma, accounting for 10 % of intracranial tumours [2], often remains undiagnosed due to their small size. They become clinically significant only when they produce symptoms related to vision due to compression of the optic nerve, or due to various hormonal disorders. They can either be micro-adenomas, without sellar enlargement having greater cure rate than the macro-adenomas, enlarging the sella and causing mass effects like permanent visual loss, and cranial nerve palsies. The endoscopic endonasal trans-sphenoidal hypophysectomy with four hand technique gives an excellent panoramic view for a better clearance of the disease than a two hand technique.

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Materials and Methods

Patients

96 patients with pituitary adenomas underwent operation via endoscopic techniques, between August 2003 and May 2013. Our patient population included 42 men and 54 women, ranging in age from 16 to 78 years (median 42 years).

Management

The personal data, presenting complaints, history of presenting complaints, personal and family history were recorded. Endocrinal status was assessed and medical fitness for surgery as ascertained. Preoperative magnetic resonance (MR) imaging, and CT scans were obtained in all the patients. The exquisite definition of the bony boundaries of the sinus, provided by thin-sliced axial and coronal computerized tomography (CT) scans, was essential to assess the symmetry and aeration of the sphenoid sinus and to decipher the relationship of the sphenoid sinus septum to the sella turcica floor and carotid canals.

Surgery

The first four patients in this series were treated via a sublabial transseptal transsphenoidal approach using the operating microscope as the primary instrument for tumor visualization. The endoscope was then used in addition to the operating microscope. Encouraged by these experiences, the next 24 operations were performed through the nasal cavity using only endoscopes. Only one nostril was used in these patients with two hand technique.

Then we introduced the use of four hand technique in which after doing a posterior septectomy and a wide sphenoidotomy, we operated through both the nostrils. One surgeon operated on the pituitary while the other helped in visualisation, holding the scope and the suction. This method was used in 68 patients.

The operation is performed after general anesthesia has been induced in the patient via orotracheal intubation. The patient is maintained supine, with the head tilted to the left and the torso elevated gently. The periumbilical abdomen is also prepared for the harvest of a free fat graft. The patient, C-arm fluoroscopic device, and the endoscopic/video camera equipment are then draped following aseptic techniques. We used 4-mm rigid endoscopes with 0° and 30° angled lenses for these operations. Our endoscopes do not have a built-in work channel. Surgical instruments are inserted adjacent to the endoscope through the same nostril. The endoscope was held in the surgeon's nondominant hand until an anterior sphenoidotomy was performed. Once the anterior sphenoidotomy was completed, posterior septectomy was

performed and the endoscope was held by the assistant passing through the opposite nostril along with the suction cannula. This provided the surgeon with a steady video image and freed both hands to manoeuvre the surgical instruments. The anterior wall of the sella was identified and opened using curettes. The dura mater was opened in cruciate fashion using curved single-blade microscissors. Under direct endoscopic visualization, the tumor was removed using micropituitary rongeurs, microsuction cannulas, and pituitary curettes while preserving the normal pituitary gland tissue. The removal of a macroadenoma requires the insertion of a 30° endoscope into the sella that will directly visualize suprasellar anatomy. The free fat graft was laid in the tumour resection cavity only when the resection cavity was large or if a CSF leak was encountered intraoperatively. The sphenoid sinus was then packed with an absorbable gelatin sponge to provide additional support to the fat graft.

The incidence of CSF leaks inspite of the above procedure was controlled by vascularized mucosal flaps which hastens the healing process. Hadad nasoseptal flap, supplied by the posterior nasoseptal arteries which are branches of the posterior nasal artery were used in 12 cases.

Intranasal packing was occasionally used and removed on the second post-operative day.

Results

Twenty eight patients had microadenomas, 35 had intrasellar macroadenomas, 20 had macroadenomas with suprasellar extension, and 13 had invasive macroadenomas involving the cavernous sinus. Among nineteen patients with Cushing's disease, seventeen were cured. Of 37 patients with prolactinomas, 21 were cured clinically and chemically. Among 41 patients with nonsecreting adenomas, 35 underwent total resection and six underwent subtotal resection, with residual tumor in the cavernous sinus. In our series only 6 patients developed CSF leaks.

The four cases done initially using the combination of microscope and the endoscope, post operatively showed relief in the symptoms due to decompression of the mass effect but there was a major radiological residual tumour (average 75 %). In the 24 cases done by two hand technique there was remarkable improvement in the result with the residual tumour dropping to 30 %. The residual tumour when four hands technique was used was just 11 %. This incidence was more with macro-adenomas than micro-adenomas (ratio being 3:1).

Discussion

Microsurgical transsphenoidal surgery for pituitary adenoma has been the standard treatment for decades in the

neurosurgical community [3, 4]. Among the different techniques for transsphenoidal pituitary surgery, the sublabial transseptal approach and transnasal transseptal approach were used most commonly. Griffith and Veerapen reported an endonasal approach to the sella in 1987 [5], and in 1994 Cooke and Jones reported their experiences in implementing an endonasal microscopic approach to the sella [6].

Papay et al. [7] reported a case of transseptal endoscopic repair of CSF leakage that occurred after transcranial pituitary surgery. Jankowski et al. [8] first reported the successful endonasal endoscopic resection of pituitary adenomas in three patients. They removed the middle turbinate to gain access to the sphenoid sinus. They performed the operation via one nostril in two patients and via both nostrils in another. Sethi and Pillay [9] reported approximately 40 patients in whom they had performed endoscopic pituitary surgery via either the transnasal transseptal or ethmoidectomy approach with a sphenoid retractor. The use of thin-sliced axial and coronal CT scans is essential to avoid unexpected findings from anatomical variations in the sphenoid sinus. Magnetic resonance imaging alone will not provide the necessary detail of bone anatomy of the sphenoid sinus.

In general, pituitary adenomas are diagnosed more frequently in women than in men probably because of the association of these tumours with menstrual irregularities [10] which correlates with our study. The incidence of pituitary adenoma increases with age, peaking between the third and sixth decades [10]. In our series, the peak age is at sixth decades accounting for 34 patients.

Pituitary adenoma can be divided into functioning and non functioning tumours, or according to size namely microadenomas or macroadenomas. Functioning pituitary adenomas can be clinically classified by means of the hormone they secrete. These tumours become symptomatic because they secrete hormones such as growth hormone, adrenocorticotrophic hormone (ACTH) and prolactin.

The incidence of residual tumour is higher in pituitary macroadenoma. This is probably due to size and extension of tumour to surrounding structures namely suprasellar extension to optic chiasm and lateral extension to engulf the internal carotid artery. Twenty eight percent of pituitary macroadenomas can extend into the cavernous sinus as reported in the literature [11]. Complete removal in macroadenoma may be difficult without adequate decompression. Out of 23 cases of residual tumours, majority of them (18) had extension either to suprasellar, cavernous sinus or engulfing the carotids.

Complications of endoscopic surgery of the paranasal sinuses can be classified according to the severity as minor or major and according to the time of appearance as immediate or delayed. Minor complications occur in

between 2 and 21 % [4] of cases which include synechiae, crusts, minor bleeding, nasal septum perforation, headache, facial pain, alteration of dental sensitivity, edema, local infection, periorbital ecchymosis, palpebral edema, subcutaneous emphysema, stenosis of sinus ostia, hyposmia, epiphora, exacerbation of bronchial asthma, and postoperative sinusitis. The principal major complications anticipated are vascular injury and orbital and intracranial complications which vary from 1 to 3 %. [2]. The most frequent immediate complications are CSF leak [3], intraoperative bleeding, orbital hematoma and injury to brain. Delayed complications include progressive loss of vision or smell, meningitis, bleeding, synechiae, and infection.

Use of the endoscope for pituitary tumour resection represents significant advancement in pituitary surgery. The visualization advantage of an endoscope, especially the 30° endoscope, over an operating microscope was obvious in the suprasellar region; it eliminated the need to blindly curette for a suprasellar tumor. Wide-angled panoramic view is useful for pituitary tumour surgery because it allows excellent anatomic visualization at the posterior wall of the sphenoid sinus [12]. While, angled-lens views such as 30, 45 and 70° endoscopes allow direct visualization at the suprasellar region or various anatomic corners.

Four handed technique have greater advantages for removal of pituitary macroadenoma extending to the suprasellar region or invading into the cavernous sinus or engulfing the carotids, thus reducing the incidence of residual tumour, with minimum complications and maximum tumour removal.

Conclusion

The minimally invasive endoscopic surgery of the cranial base and the pituitary fossa is an interactive real-time live surgical team effort. The collaborative effort between the otolaryngologists and the neurosurgeon is critical and valuable in effectively managing pituitary fossa with minimal morbidity. A sound approach is required to balance carefully, the need for removal with the impact of surgery on the patient's life. Endoscopic endonasal surgery is indicated when control of symptoms is directly related to pathologic findings, or when there are pending complications. The morbidity of surgery around the dental roots, dura, periorbital, or exposed critical structures (e.g., ICA) should influence the aggressiveness of surgical resection. Endoscopic surgical resection has replaced transfacial approaches at many institutions. Pain, recovery, hospital stay, and disfigurement can all be reduced with aggressive endoscopic approach.

In conclusion, this study showed that patient with pituitary macroadenomas had higher rates of residual tumour

compared to pituitary microadenomas. This is most likely due to difficulties encountered in complete tumour removal more so with suprasellar extension involving optic chiasm and lateral extension engulfing the carotid artery and carotid sinus. Pure endonasal endoscopic assisted transsphenoidal hypophysectomy provides an excellent and rapid access to the sphenoid sinus and sella turcica. More-over there is clear advantage of four hand technique over two hand one with better clearance of the disease and minimal morbidity and so we advocate this to be the procedure of choice.

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