Endoscopic Skull Base Surgery : Our Initial Experience

Rajarshi Chakraborty,[1] Mukesh Kumar Singh,[1] Swapan Kumar Ghosh,[1] Indranath Kundu[1]

ABSTRACT

Introduction

Patients with lesions of the skull base form a minor but very important subgroup of patients presenting to the ENT surgeon or are referred from other departments with complaints such as headache, nasal discharge and nasal obstruction. This study was done to study the clinical presentation of the patients with lesions of the skull base, assess intra operative findings and complications, and to document post operative clinical course and histopathological reports.

Materials and Methods

A prospective study was conducted on 10 patients with skull base lesions, who were operated on at our institution between August 2014 and August 2015. Patients with clinically and radiologically documented skull base lesions operated by endoscopic methods were included, while those operated on with open methods or those having involvement of the cavernous sinuses and the internal carotid arteries were excluded.

Results

All patients in the group were successfully operated on with no major intra operative or post operative complications encountered. Adequate tissue was obtained for biopsy with adequate sellar decompression and plugging of CSF leaks was done as required.

Conclusion

Endoscopic interventions for the skull base lesions can be safely performed in tertiary care set ups with minimal intra operative and post operative morbidity and have a better prognosis than other open procedures.

Keywords

Skull Base; Pituitary Neoplasms; Cerebrospinal Fluid Rhinorrhea; Endoscopic Surgical Procedure

Patients with lesions of the skull base form a minor but very important subgroup of patients presenting to the ENT surgeon with complaints such as headache, nasal discharge and nasal obstruction, as well as referred cases from other departments. In 1910, Oskar Hirsch, an otolaryngologist, introduced a trans-septal, trans-sphenoidal approach to the pituitary gland,[1] an operation which is still in use today. Cushing rapidly adopted Hirsh's approach adding a sublabial incision and a headlamp to improve visualization of the sella. Using this approach he performed 231 operations with a 5.6% mortality rate.[2]

However, because of difficulties with cerebrospinal fluid (CSF) leak, hemorrhage control, post operative cerebral edema, and concerns regarding vision outcomes and recurrence, he eventually abandoned the trans-sphenoidal approach and went to a transcranial approach. This was a huge setback for the trans-sphenoidal approach as it led to the vast majority of pituitary operations being performed transcranially for the next 35 years.

The modern rigid endoscope was developed by Harold Hopkins in 1960 and was then improved upon by Karl Storz in 1965 using the principles of fiber optics. Jankowski, et al in 1992 described the successful use of nasal endoscope in the operation of pituitary tumors.[3]

Since 2005 the expanded endonasal approach has been established as a feasible approach to the middle third of the clivus, petrous ICA, cavernous sinus, and medial infratemporal fossa in cases in which the lesion is located centrally, with neurovascular structures displaced laterally.[4]

1 - Department of ENT, R G Kar Medical College, Kolkata

Corresponding author:
Dr Rajarshi Chakraborty
email: rctua29@gmail.com

Surgical anatomy

The skull base has been traditionally divided into three regions, based on their intracranial relations to the overlying cranial fossae, namely the anterior, middle and posterior skull bases. The anterior and middle skull bases can be considered together from the surgical point of view, as both share anatomic relationship with the orbits, the nasal cavities and the paranasal sinuses. Hence, they are also affected by many related pathologic processes.

The anterior skull base: Intracranially, the anterior skull base is composed of the frontal bone, orbital plates of the frontal, ethmoid and the sphenoid bones. Important landmarks include from anterior to posterior, the frontal sinuses, the foramen caecum, the crista galli, the cribriform plate with olfactory fossa forming on either side of crista galli, the plenum sphenoidale overlying the sphenoid sinuses. The anterior skull base is posteriorly delineated by the lesser wings of sphenoid and the anterior clinoid processes, which are closely related to the optic canal and internal carotid arteries.

Extracranially, the anterior skull base is related to the orbits, ethmoid sinuses, sphenoid sinuses, and the nasal cavities. The orbit contains the superior orbital fissure communicating with the middle cranial fossa, the inferior orbital fissure communicating with the pterygopalatine fossa, and the optic canal.

The middle skull base: Intracranially, the middle skull base consists of posterior border of the lesser wing of sphenoid, the greater wings of sphenoid, the squamous part of temporal bone and the petrous part of temporal bone. Extracranially, the middle skull base is related to the posterior wall of maxillary sinus, the infratemporal fossa , and the pterygopalatine fossa.

Skull base lesions

Benign lesions: These may be classified into extracranial (such as inverted papillomas, nasopharyngeal angiofibromas, paragangliomas, salivary gland tumours), intracranial (such as pituitary adenomas, craniopharyngiomas, meningiomas, aneurysms), and primary basicranial (fibrous dysplasias , osteomas , encaphaloceles, dermoids, CSF fistulas).

Malignant lesions: These may be classified as extracranial (such as carcinomas, sarcomas, hemangiopericytomas), intracranial (such as malignant schwannomas and esthesioneuroblastomas), primary basicranial such as chondrosarcomas, and metastatic tumours.

Materials and Methods

A prospective study was conducted with the aim to evaluate the clinical and radiological findings in different cases undergoing endoscopic skull base operations and to assess intra-operative access to various sites and document operative findings and complications as well as documentation of the histopathological findings or culture reports of intra operative tissue specimens obtained with follow up off all the cases for monitoring the postoperative clinical course.

Ten patients were selected by simple random sampling. The study period was between August 2014 and 2015. The inclusion criteria included patients attending OPD of Department of Otorhinolaryngology with complaints like blockage of nose, nasal discharge, headache, diplopia, diminished vision and radiologically proven to have skull base involvement by CT or MRI scans. The exclusion criteria included patients under 5 years of age, patients with involvement of areas such as cavernous sinus, internal carotid artery, dural venous sinuses and cerebral and brainstem areas.

On obtaining the informed consent, the patients were subjected to detailed history taking and thorough clinical examination to come to a diagnosis. The study tools also included rigid 4mm Nasal endoscopes (0° and 30°), standard FESS and skull base instrument sets with video recording system, CT scan-2mm cuts without contrast in coronal and axial planes with parasagittal reconstruction of bone windows and histopathological reports of the samples.

Preoperative Considerations

Diagnostic nasal endoscopy: to assess the size, adequacy, and presence or absence of normal anatomy of the nasal cavities.

CT scan: for assessment of critical anatomic information

important during surgery including the presence and extent of erosions of the skull base; integrity of the medial orbital wall; position of the anterior skull base vessels.

MRI scan: to differentiate between neoplastic or inflammatory tissue and retained secretions, and to assist in clarifying the diagnosis of skull base malformations when meningoencephalocele, meningocele, or nasal glioma is suspected.

CT angiography: is a robust technology that allows simultaneous visualization of bony and vascular structures.

Special tests: including CT cisternography and biochemical assays for suspected CSF rhinorrhea and hormonal assays (including serum cortisol, ACTH, prolactin, IGF-1) for pituitary adenomas.

Operative technique

We have used a purely endoscopic technique for all the skull base surgeries that have been included in this study. For CSF fistula repair we have mostly used the 2F repair consisting of plugging by a fat graft and a fascia lata graft. For endoscopic pituitary operations, we start with decongestion of the nasal cavity with adrenaline soaked neuropatties and identification of the sphenoid sinuses bilaterally. This is followed by widening of the sphenoid sinus by sphenoidotomy and dislocation of the posterior septum followed by breaking off the rostrum of sphenoid.

The intersinus septum is then drilled down to the level of the sellar floor and the sellar floor is identified between the planum sphenoidale anteriorly and the clivus posteriorly and the cavernous carotids bilaterally. Drilling of the sellar floor is done and a plane created between the bony sellar floor and the dura. The gap in the sellar floor is widened and a cruciate shaped incision made on the dura. Pituitary tissue is then curetted out. The skull base defect is then repaired with the 3F technique comprised of fat, fascia lata and the posterior nasoseptal mucosal flap (Hadad flap).

Post-operative care of the patients included Nasal cavity packing and broad spectrum antibiotic. Antihistaminic was prescribed to prevent nasal airway irritability and fibre-rich soft diet to prevent constipation. The CCU setup was used for proper monitoring of various physiological parameters, if required.

Results

Out of the 10 patients in our series 3 patients presented with headache, 2 had visual problems, 4 patients presented with watery nasal discharge, 2 had symptoms of nasal obstruction while 1 patient presented with epistaxis (Fig. 1). Further two patients also had Acromegalic features (Fig. 2). The patients presenting with visual problems underwent visual acuity and field testing, none of which revealed significant findings.

Both CT and MRI scans were done in patients presenting with nasal mass or headache. Sellar mass was found in 3 patients (Fig. 3) while sinunasal mass was found in 2 patients. CT scans as well as CT cisternography was done for patients with nasal discharge. CSF leak was detected by CT cisternography in 4 patients while plain CT scan detected CSF leak in 1 patient. (Fig. 4)

Diagnostic nasal endoscopy was done in all patients, which revealed septal deviation in 4 patients, CSF leak in 4 patients, sinunasal mass in 2 patients, and normal anatomy in 2 patients. (Fig. 5)

During the course of operations we did not encounter any major intra-operative complications like major bleeding or brain injury. There was minor bleeding in 3 patients, which was controlled with Surgicel®, and CSF leak in 2 patients which was repaired using fat graft.

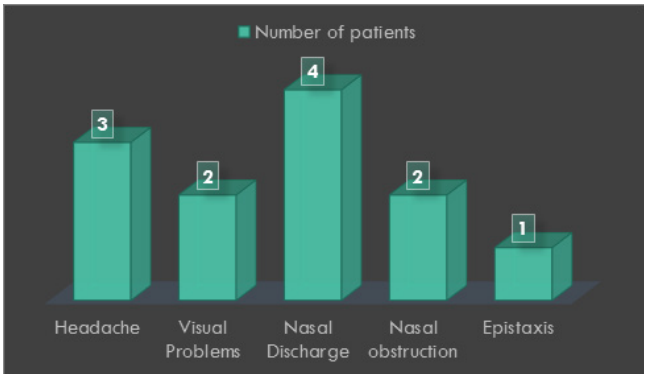

Fig.1 Presenting symptoms of the patients

Fig.2 Patient with Acromegalic features

(Fig. 6)

In all patients of sellar and sinunasal mass tissue specimens were sent for histopathological examination, and fungal culture where fungal infection was suspected. Tissue diagnosis obtained was pituitary adenoma in 3 patients, squamous cell carcinoma in 1 patient, sinunasal undifferentiated carcinoma in 1 patient. Fungal culture was positive in 1 patient. (Table I)

Discussion

The field of skull base surgery has undergone a rapid expansion in the last two decades. Initially starting

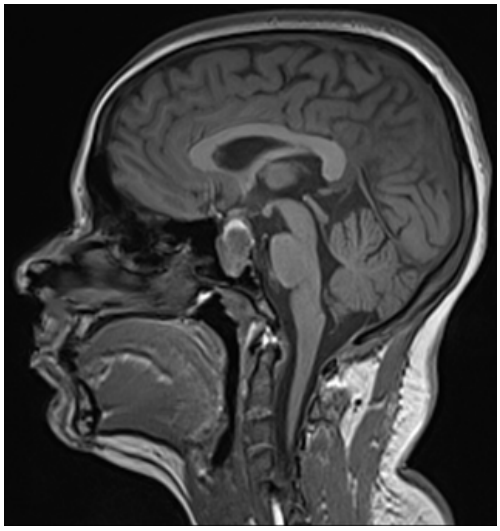

Fig.3 MRI scan showing sellar lesion eroding into sphenoid sinus

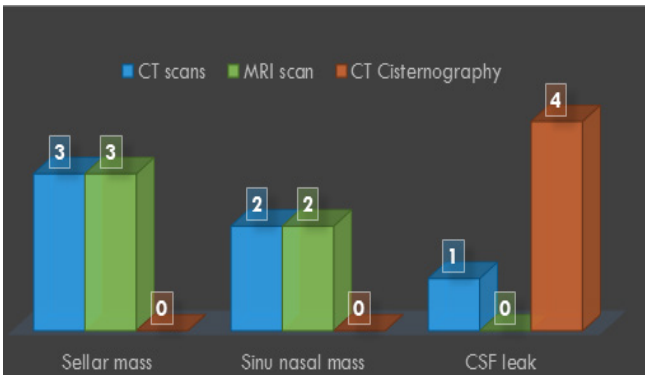

Fig.4 Radiological findings

with CSF rhinorrhea repair and pituitary surgery, the discipline has now expanded to include suprasellar, parasellar, clival, petrous apex and cervical spine lesions.

The endoscopic technique of CSF fistula repair has been reported to be a successful intervention by Lopatin et al in 2003,[5] which is also confirmed by our experience. Jho and Carrau in 1997 published the seminal paper describing endoscopic transsphenoidal pituitary operation in 50 patients, and demonstrated that what was earlier considered to be a major operation could now be achieved with minimal morbidity through minimally invasive endoscopic techniques.[6] Cappabianca et al in 1998 also confirmed similar results.[7]

In our experience, based on the limited number of patients we have handled, we have been able to confirm the findings of the authors mentioned above, regarding

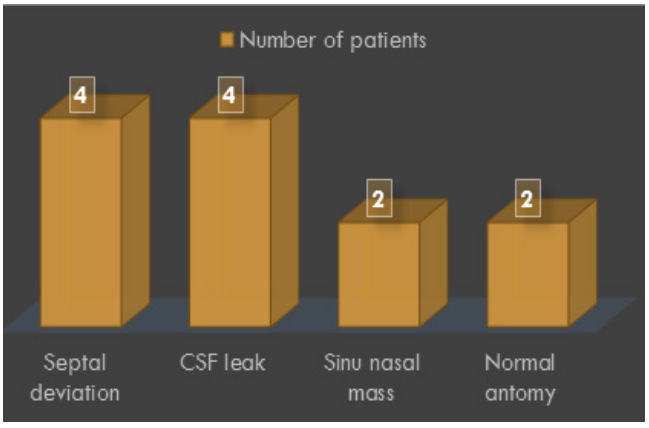

Fig.5 Findings on Diagnostic Nasal Endoscopy

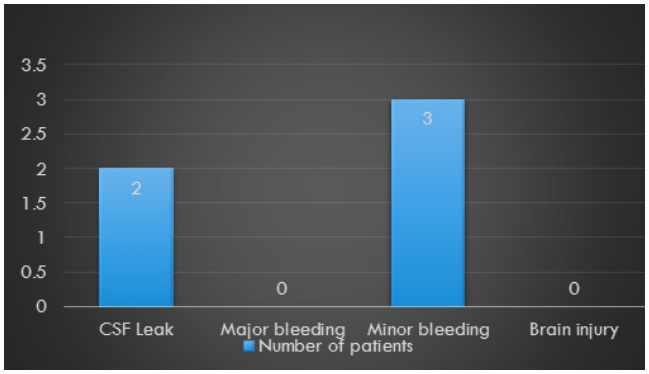

Fig.6 Intraoperative complications

the operative success and postoperative clinical course. In all the patients we have operated on, the postoperative urine output, serum electrolytes, day 3 fasting cortisol levels were normal. Operative success was demonstrable in the postoperative CT scans which showed adequate sellar clearance.

One key area of skull base surgery is skull base reconstruction. For small sized encephaloceles or CSF leak defects, we used fat graft and fascia lata graft with a strut of cartilage if required. For larger sized defects a vascularized flap is required due to high rate of postoperative CSF leak. The flap that we have used is the vascularized septonasal flap based on the posterior septal branch of sphenopalatine artery, also called the Hadad flap.[8]

Table I : Final diagnoses

FINAL DIAGNOSIS	NO. OF PATIENTS (N=10)
CSF rhinorrhoea	4
Pituitary macroadenoma	3
Sinunasal undifferentiated carcinoma	1
Squamous cell carcinoma	1
Fungal sinusitis with intracranial extension	1

In all the pituitary operations done at our institution, we did not encounter any major complications. Minor bleeding was stemmed using Surgicel®, while CSF leak was repaired with fat graft.

Conclusion

In this study we have intended to show that it is feasible to carry out skull base interventions in our existing tertiary care setups with minimal complication rates and postoperative morbidity. While this study is limited in scope, based on the fact that our initial experience largely corroborated the findings of many other workers from the same field, 5,6 we have made an endeavour to demonstrate that the ENT surgeon with standard endoscopic skills can easily handle these type of cases with assistance from the Neurosurgeon in the existing tertiary care set-ups.

This has become even more relevant today as minimally invasive endoscopic techniques are being favoured over the more invasive transcranial and other techniques by most Neurosurgeons nowadays, resulting in more number of cases being referred to the ENT surgeon. Therefore, we also believe that more studies are required in this direction as more and more experience is gained by the ENT fraternity in endoscopic skull base surgery.

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