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Abstract

In the past two decades, endoscopic sinus surgeries (ESS) have been widely advocated as a safe and effective treatment for disorders of paranasal sinuses that are refractory to medical therapy. ESS caters surgeons with two-dimensional visualization of the anatomical structures; however in scenarios where there is a close anatomical relation between the disease and delicate intracranial or intraorbital structures drastic complications can occur. Hence, endoscopic procedures had to be converted into open surgical procedures if the extent of the disease could not be visualized or cleared thoroughly.

Recently however; neuronavigation systems have been combined with ESS to yield better results and facilitate this procedure. The implementation of these systems with ESS has aided surgeons in difficult approaches.We recently decided to use the neuronavigation system of our Neurosurgical department to help aid eradicate various nasal and sinus pathologies in a series of patients.

Keywords: Endoscopic sinus surgeries, Neuronavigation systems, Neurosurgical department.

Introduction

In the past two decades, endoscopic sinus surgery (ESS) has been widely used as a safe and effective treatment for disorders of paranasal sinuses,[1] by allowing real time visualization of the pathologies. However this visualization may be compromised becase of angulation of the telescopes, anatomic variability, intraoperative bleeding and modifications in the sinus architecture.

Poor surgical field visualization may lead to a loss of orientation which can have drastic complications where there is a close relation between the disease and delicate intracranial or intraorbital structures.Complications in such scenarios include cerebrospinal fluid leaks, fistula formation, pneumocephalus, intracranial infections, neurovascular haemorrhage, permanent neurological deficits,and orbital or optic nerve injury leading to ocular deficits.[2,3] Due to these limitations, endoscopic procedures had to be converted into open surgical procedures if the extent of the disease could not be visualized or cleared thoroughly.[4]

Recently however neuronavigation systems have been combined with ESS to facilitate this procedure and yield more favourable outcomes. We recently decided to use the neuronavigation system of our Neurosurgical department to help in the correction of various nasal and sinus pathologies in a series of patients. The series illustrate our experience at the Aga Khan University Hospital. This procedure was offered to patients with disease closely surrounding sensitive structures, such as the orbit, dura etc. which would normally not be accessible by ESS as an alternate to open procedures.

Case 1:

A 22 year old female, presented to our clinic with a left sided headache for the past 2 months. She also complained of bilateral nasal obstruction and flu like symptoms for the last year which were associated with peri-orbital swelling on the left side. There was no history of fever or epistaxis. She suffered from episodic sneezing with a clear water discharge and post nasal dripping. Her symptoms resolved on taking over the counter nasal decongestants and pain killers.

On examination, the right inferior turbinate was also hypertrophied. No tenderness, bleeding or ulceration was noted on nasal examination.

She brought an old computed tomography (CT) scan of her paranasal sinuses with her, showing bilateral nasal polyps, with intracranial extension through the left ethimoid sinus. However no surgical intervention was taken.

Repeat CT showed high density material with calcifications in all paranasal sinuses, completely obliterating the nasal cavity and paranasal sinuses along with multiple bony erosions. Erosions of both medial orbital walls were noted along with evidence of extradural extension into the anterior cranial fossa via the posterior wall of left frontal sinus. There was also evidence of erosion along the floor of the anterior cranial fossa, including the pituitary fossa along with extradural extension.

On consultation, our neurosurgical team did not recommend any neurosurgical intervention at that point. It was decided to proceed with ESS aided by neuronavigation.

There were no postoperative complications or deficits and she was discharged under regular follow up.

Histapathological examination of the excised tissue showed benign polypoid tissue, with numerous septate fungal hyphae, suggestive of allergic nasal polyposis. Tissue culture revealed moderate growth of Aspergillus flavus.

Case 2:

A 20 year old female, known case of allergic rhinitis presented to our clinic with complaints of bilateral nasal obstruction with watery discharge and anosmia for the past 4 years. She had been previously operated for nasal polyps.

On examination nasal polyps and purulent discharge was noted bilaterally. Swelling and hyperaemia of the right medial canthal fold was noted. Eye movements were normal and visual acuity was lower in the right eye. However, visual acuity was deceased since birth. There were no neurological deficits noted.

MRI showed abnormal signal intensity material and mucosal thickening with expansion in maxillary, ethmoid, sphenoid and frontal sinuses bilaterally. The imaging was suggestive of fungal infection. There was evidence of extra dural intracranial extension in the region of right frontal sinus along with involvement of the lamina papyracea and medial wall of the orbit on the right side. The orbital fat and muscles were intact bilaterally (Figure).

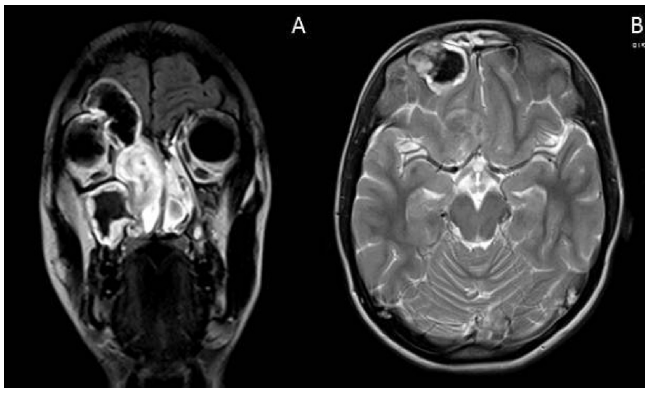

Figure: Coronal (A) and axial (B) MRI scan of a patient showing disease in the nose, ethemoid sinuses, eroding the orbital wall and extending intracranially.

It was decided to proceed with ESS aided by neuronavigation. There were no postoperative complications or deficits and she was discharged under regular follow up.

Histapathological examination of the excised tissue showed benign polypoid tissue, with numerous septate fungal hyphae, suggestive of allergic nasal polyposis. Tissue culture revealed moderate growth of Aspergillus flavus.

Case 3:

A 35 year old male, known case of cavernous haemangioma, epilepsy controlled on valproic acid, presented to ENT clinic with complaints of right sided nasal obstruction, epistaxis and headaches. He had undergone a polypectomy 3 years ago. Examination of the nose and paranasal sinuses additionally revealed mucosal fullness.

CT scan revealed extensive sinus disease with attenuated material and erosion, involving the ethmoid, sphenoid and maxillary sinuses bilaterally along with the right frontal sinus. Erosions were noted in the right inferior orbital wall and the disease was noted to involve the inferior oblique and medial rectus muscles, pushing right optic nerve superiorly. The disease was also involving the infratemporal fossa superior alveolus on the right side. On the left side it was noted to breach the orbital plate of left frontal bone, abutting the medial rectus muscle posteriorly.

After an ophthalmic examination he underwent ESS aided by neuronavigation. There were no postoperative complications or deficits and he was discharged under regular follow up. Analysis of the excised tissue revealed Asperigillous infection and he was further managed on anti fungals by our infectious diseases department.

Discussion

Although becoming increasingly popular in the developed world this case series represents the first few neuronavigation assisted ESSs in Pakistan. The significance of combining the neuronavigation system with ESS lies in its ability to allow the surgeon to accurately determine the boundaries of the surgical field and the location of surrounding vital structures in order to facilitate safer and thorough eradication of disease, particularly in cases of extensive polyposis, revision surgery and neoplastic sinonasal disease.[5]

The disease pattern illustrated in our cases could not have been eradicated using an endoscopic approach and would have been deferred or converted to an open approach at one point as the disease was extending into orbit and cranium. The assistance of the neuronavigation system made this relatively conservative approach possible. In fact Olson et. al, showed that the navigation system helped in decreasing the postoperative deficits in patients undergoing surgical debridement in the area.[6] The increased field of vision helps decrease healthy tissue loss and complications such as orbital or cranial haemorrhage and injury to structures in the vicinity; this is reflected in the fact that none of our cases had any postoperative deficits and were uneventfully discharged on regular follow-ups. Strauss et al. also reported better postoperative results and lowered surgical workload with the assistance of navigation systems and our experience has also led us to the same conclusion.[7]

Initially, we faced some difficulties when operating the navigation system. However, the device has

a steep learning curve and user friendly interface; as after the first couple of procedures we were comfortable with the system.

However, as with every technology pointer-based neuronavigation systems also has its limitations and when used for ESS they include: the necessity of changing instruments for navigation, changes in the surgeon's line-of-sight and axis resulting from the change in instrumentation, and the limited length of use of the navigation information. These limitations result in negative consequences regarding the surgeon's attentiveness in any given situation, as well as increase his cognitive work-load.[8]

Another limitation of our current system is the fact that it relies on preoperative imaging to map the surgical terrain; however once the architecture has been disturbed by surgical manipulation, especially in cases where cystic structures maybe ruptured, the navigation system is no longer reliable. Recently the systems have been extended to involve real-time computer-assisted surgical navigation using an operating room-based CT or MRI.[9] This ensures the monitoring of any intraoperative changes and modification in the surgical site due to tissue manipulation, formation and organ shift. However due to a limitation of financial resources such systems including intra-operative CT and MRIs are unavailable in our setting at the moment.

Conclusion

In conclusion, this technique has been used in a very small set of patients in our setting and although further research is necessary to statistically validate its efficacy and long term outcome, we feel that this case series presents a paradigm for the increased application of neuronavigation system in assisting ESS and thereby decreasing postoperative complications in Pakistan.

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