Intracranial Injury Following Nasogastric Tube Placement After Skull Base Surgery: A Systematic Review

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Abstract

Introduction: Inadvertent intracranial nasogastric tube (NGT) placement is a known risk after facial trauma resulting in skull base fracture; however, history of skull base surgery presents another significant risk factor for this potentially fatal complication.

Methods: We present the case of a 75-year-old patient admitted with *C difficile* colitis six months after endoscopic endonasal resection of a pituitary macroadenoma. NGT placement was attempted, however the patient became obtunded and was placed on positive pressure ventilation resulting in tension pneumocephalus and pontine hemorrhage. Further studies were consistent with traumatic injury of the prior repair site. The patient underwent successful repair with a nasoseptal flap, however, ultimately showed no signs of neurologic recovery and was terminally extubated. We also present a systematic review of the literature of traumatic tube placement following skull base surgery.

Results: Systematic review of the literature revealed eight cases of intracranial tube placement including one intracranial nasotracheal tube placement after skull base surgery as well as two cases after other sinonasal procedures (septoplasty, unilateral choanal atresia repair). Cadaver studies show durable middle turbinate medialization and use of small-bore flexible feeding tubes, when possible, may improve skull base protection.

Conclusions: Patients, families, and providers should be educated of the potential consequences of blind nasal procedures in patients with a history of skull base surgery.

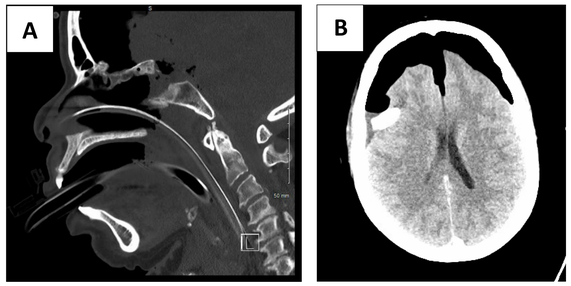
Introduction

Nasoenteric tubes are commonly placed in the hospital setting for gastric decompression and administration of enteral feeds. Trauma resulting in skull base fracture is a well-documented contraindication due to risk of intracranial placement; however, the risk presented by previous anterior skull base surgery is less well-known. Defects resulting from anterior skull base surgery can become an intracranial pathway if traumatized by blind instrumentation. We present a case of suspected intracranial insertion of a nasogastric tube (NGT) as well as a systematic review of the literature.

Case Presentation

A 75-year-old female underwent urgent endoscopic endonasal transsphenoidal resection of a pituitary macroadenoma complicated by apoplexy. After resection of the tumor, no cerebrospinal fluid (CSF) leak was appreciated. The sellar defect was repaired with intrasellar absorbable packing followed by dural substitute placement in the epidural space. The middle turbinates were medialized after closure. The patient was discharged on post op day 5.

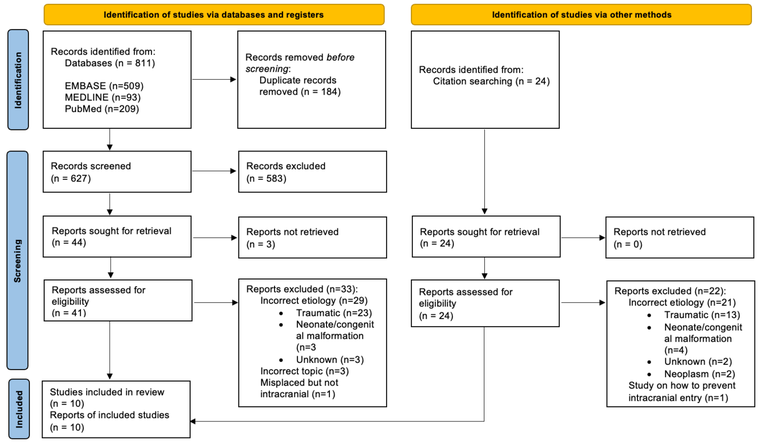
The patient presented to an outside hospital six months later with *C difficile* colitis. During hospitalization, she became non-responsive with computed tomography (CT) of the head showing pneumocephalus. She was transferred to a tertiary care academic center for further management of suspected CSF leak. Upon arrival, emergent burr hole and drain placement was performed for evacuation of tension pneumocephalus. Additional history was elicited that a NGT was placed after several unsuccessful attempts. Shortly after placement, the patient became altered, and she was placed on positive pressure ventilation (PPV). Endoscopic evaluation at our facility showed a defect at the superior aspect of prior sellar repair with air and CSF expression with application of pressure on the abdomen, most consistent with traumatic injury. Notably, NGT was in the proper position at time of arrival to our institution. The defect was repaired with placement of a dural substitute in the epidural space and a pedicled nasoseptal flap. Unfortunately, the patient's neurological status remained poor; imaging demonstrated evolving pontine hemorrhage. The patient was terminally extubated 18 days after injury.



A. Maxillofacial CT demonstrating large pneumocephalus and correctly positioned nasogastric tube.

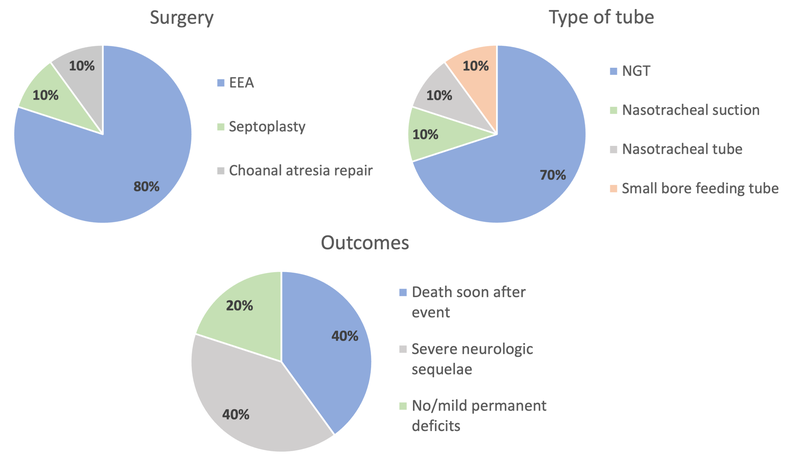
B. CT head with "Mt. Fuji" sign indicative of tension pneumocephalus

Methods



Results

The length of time between surgery and intracranial insertion ranged from day of surgery to six months after surgery.



Discussion

Intracranial penetration by nasally introduced tubes is a rare occurrence, but the risk is increased when a skull base defect exists, most commonly due to traumatic fracture. In this systematic review, 62 cases were encountered, of which 36 (58%) were traumatic. Conversely, only 11 cases (18%) of post-surgical intracranial insertion were found, including the case described herein. The risk persists over time, with two of the published cases occurring three months post-surgery, and the case detailed here taking place six months after initial skull base surgery.

Although most cases in this review occurred after transsphenoidal or transclival surgery, two cases were seen after other otolaryngologic surgeries. During septoplasty, twisting of the posterior bony septum to remove a portion of the perpendicular plate of the ethmoid bone can lead to fracture and/or defect along the cribriform plate. The skull base is also at risk during choanal atresia repair due to the proximity of the clivus and basisphenoid to the choana.

Studies on reducing risk of intracranial penetration after skull base surgery:

- Bhattacharyya et al – cadaver study
  - NGT entered the sphenoid sinus easily in 91.7% of specimens and could be preferentially funneled into the sinus by inferior septal spurs
  - Unable to penetrate the sphenoid roof in any cases, therefore concluded that the risk of intracranial penetration by NGT after standard ESS was low
- Gill et al
  - operative techniques to limit exposure of the sphenoid sinus: wide unilateral sphenoidotomy with conservative contralateral sphenoidotomy, middle turbinate preservation and medialization, limited posterior septectomy, transseptal approach to the sphenoid ostium
- Shah et al – cadaver study
  - permanent medialization of the middle turbinate via septal pexy was superior to either neutral positioning or resection of the middle turbinate
  - higher rates of entry with NGT as compared to DHT

Intra-operative tactics to protect the skull base (limited posterior septectomy, permanent medialization of the middle turbinate) can be considered; however, they must be weighed against the necessary operative exposure for safe and complete surgery, and feasibility of post-operative visualization and care of the surgical site. There is insufficient data to conclude if a different repair strategy may provide extra protection in the case of sphenoid entry. Post-operatively, we recommend the use of small-bore flexible feeding tubes over stiff NGT if possible. Authors have described the use of medical bracelets alerting providers that the patient has had a skull base procedure and to avoid blind instrumentation of the nose; however, data are needed to determine if this strategy is effective in terms of outcomes and cost. We do recommend educating patients and involved family of potential risks of subsequent nasal procedures pre- and post-operatively so that they may inform future providers.

Conclusion

Although intracranial tube placement remains rare following skull base surgery, these events result in death or neurologic devastation in the majority of cases. Patients, families, and providers should be educated of the potential consequences of blind nasal procedures in patients with a history of skull base surgery.

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