Chapter

# 11
# Complications of Endoscopic Surgery of Nose and Paranasal Sinuses

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Since its introduction endoscopic sinus surgery has revolutionized the treatment of sinus disease. But with advent of its popularity the number of documented complications has also risen due to the intimate relation of sinuses to the orbit and anterior cranial fossa (Neuman 1994). Knowledge of the surgical anatomy by the endoscopic surgeon is absolutely essential to prevent complications. Even the most experienced surgeon may encounter problems. Stankiewicz (1989) in his first series of FESS patients, he reported a complication rate of 29% and in his second series he reported a complication rate of 2.2%. The incidence of major perioperative complications was 0.85%, with cerebrospinal fluid (CSF) leak being the most common, the complication rate drops as on gain experience and training, handling endoscopes and instruments, thorough understanding of sinus anatomy including variations and pathological changes (Knanna & Sama 2019). With expansion in the scope in endoscopic surgery, including approach to anterior skull base and transsphenoidal approaches, catastrophic complications like injury to internal carotid artery can happen although rare.

The most common minor complications of ESS were those related to orbital penetration and middle turbinate adhesions; minor complications occurred in 6.9% (Levine, et al. 1994). Despite advances in endoscopic sinus surgery technique and instrumentation, serious ophthalmic complications may still occur. Inadvertent entry into the medial orbital wall can result in ocular motility complications (Bhatti, et al. 2001). The risk of complications is most common in patients with revision surgery, extensive sinus disease like allergic fungal sinusitis, invasive fungal sinusitis, etc. associated with gross pathological changes dehiscences, anatomical variations in the skull base and lateral wall and use of powered instruments (Stankiewicz, et al 2011). Availability of navigation during surgery can minimize these complications. The compli-cations are characterized as:

### Major

- Haemorrhage
- Blindness
- Injury to internal carotid artery
- Cavernous sinus—ICA fistula
- Intracranial haemorrhage
- Pneumocephalus
- Brain abscess
- Death

### Minor

- Orbital haematoma
- Orbital surgical emphysema
- Nasolacrimal duct injury
- Antrostomy closure
- Synechiae

## HOW TO AVOID COMPLICATIONS

### Preoperatively

- Careful history of bleeding disorders

- Adequate medical treatment for chronic inflammatory conditions of paranasal sinuses before planning for surgery. This includes both antibiotics and steroids (local/systemic).
- Ophthalmological examination including visual status of the patient.
- Proper outpatient endoscopic assessment prior to surgery.
- Preoperative CT scan is extremely important to assess the anatomical and pathological abnormalities which should ideally contain both axial and coronal cuts. The coronal cuts give better information about anterior ethmoid, cribriform plate and frontal sinus in relation to the anterior cranial fossa, whereas axial cuts give more information about the posterior ethmoid, sphenoid and the orbit.

### Perioperatively

- Use of adequate decongestant before starting surgery is extremely important.
- As a beginner, local anaesthesia should be preferred over general anaesthesia.
- 0° endoscope is the best to start with for a beginner.
- Angle endoscope should be avoided, if the surgeon is not able to appreciate the landmarks properly. Absence of surgical landmarks like dehiscent lamina papyracea, radically resected middle turbinate, not able to identify maxillary ostium due to extensive disease or previous surgery are the potential risk factors for complications. In such situation, a beginner should better avoid attempting such cases. Such cases should be handled by surgeon having enough expertise. Preoperative CT scan is very useful in such cases. Recently CT guided surgery has been introduced to tackle such cases.
- The concept of surgery suggests beginner should strictly follow the learning curve and start with endoscopic middle meatal antrostomy initially. Once the surgeon gain confidence and are well acquainted with endoscopic anatomy, he can venture into posterior ethmoid and sphenoid sinuses. Finally the frontal recess should be tackled to prevent major complications.

## COMMON PERIOPERATIVE AND POSTOPERATIVE COMPLICATIONS

### Haemorrhage

Major complications following endoscopic sinus surgery account between 0.36 and 3.1% of patients, and including severe haemorrhage, injury to orbit and lacrimal system, CSF leak, and intracranial injury (Halderman 2015).

It is very important to assess the patient preoperatively for hypertension, bleeding disorder, current medications including aspirin and other nonsteroidal anti-inflammatory drugs, etc. If patient is on any such medications, it should be stopped at least for a week before doing surgery. Intraoperative bleeding can compromise visibility and may seriously hamper to identify landmarks. A reverse Trendelenburg position can significantly reduce perioperative bleeding. Controlled hypotension of 70 mm Hg can also reduce bleeding. Total intravenous anaesthesia is being used recently to control perioperative bleeding (Halderman, et al 2015).

Injury to internal carotid artery (ICA) varies from 0.1–0.3%. This catastrophic injury can be prevented by studying the axial and coronal CT thoroughly preoperatively with a clear plan for dehiscence or another abnormality. Any bleeding during surgery in the sphenoid sinus should be treated as injury to ICA and the sinus should be packed immediately. An autologous muscle patch is to be kept ready. After carefully removing the sinus pack, if the bleeding still persists, the muscle patch should be kept over the leak site and the sinus cavity is repacked. The anesthesiologist should be informed to facilitate adequate cerebral blood prefusion (Halderman, et al 2015). Adequate blood transfusion should be arranged. Role of an interventional radiologist is crucial at this stage to identify the leak site by doing angiogram, and balloon occlusion in case of adequate cross-circulation and stenting, if

cross-circulation is not adequate (Solarace et al. 2010). Inspite of best possible management, mortality still remains a concern. Anterior ethmoidal artery injury commonly occurs during anterior ethmoidectomy and frontal sinustomy can be controlled with bipolar cautery. If the artery is injured closed to lamina papyracea, it gets retracted into the orbit causing retrobulbar haematoma as described later.

Major bleeding points are anterior ethmoidal, posterior septal artery and the traumatized turbinate.

Packing usually controls bleeding. Cautery may be used judiciously.

Always terminate the surgery, if the bleeding impairs visualization. Never operate in a bloody field. Pack, wait and then proceed. Postoperative blood-stained discharge is a normal phenomenon. Retained blood clot and secretions can cause postoperative nasal block. Use of alkaline saline irrigation can minimize that. Absorbable packing materials also are helpful to minimize postoperative ooze and enhance patient comfort besides reducing the incidence of adhesion (synechia) formation. Postoperative haemorrhage can have serious implications and should be suspected for arterial bleed. It should be managed in the operative set up. Posterior bleeding can be controlled by passing a Foley's catheter into nasopharynx and inflating it and anterior nasal packing.

### Synechiae (Figs 11.1 and 11.2)

Synechia is usually caused because of opposed raw surfaces of the middle turbinate and ethmoid cavity. Figure 11.1 is showing the synechia between inferior turbinate and septum and Fig. 11.2 showing early synechia between middle turbinate and lateral wall that may obstruct middle meatal drainage. Only 20% are symptomatic and requiring revision surgery. Symptoms include nasal obstruction, headaches and smell dysfunction. Nayak, et al. in 1998 classified this adhesive condition, based on their site and clinical presentation, into four different groups and advocated use of splint made up of wax plate to prevent this complication.

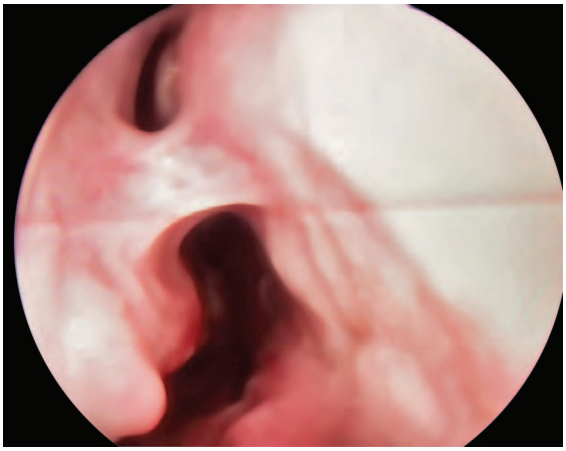


**Fig. 11.1:** Video endoscopic photograph showing advanced synechia between septum and inferior turbinate

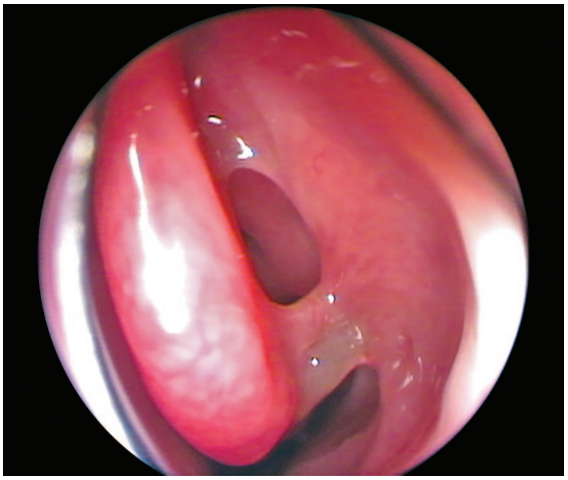


**Fig. 11.2:** Video endoscopic photograph showing early synechia between middle turbinate and lateral nasal wall

Partial amputation of the middle turbinate anteroinferiorly may prevent synechiae. Gelfoam, MeroGel, etc. have been proposed as spacers. Use of dental wax plate as a spacer in the ethmoid cavity between middle turbinate and lateral wall following endoscopic sinus surgery can prevent synechia formation (Nayak, et al 1998). Most adhesions can be lysed in the early postoperative period during suction and cleaning.

### Middle Meatal Antrostomy (MMA) Closure

This occurs in about 2% of cases. A circumferential removal of tissue during antrostomy

will contribute to scarring and subsequent closure. However, a 3 mm diameter opening is thought to be adequate for physiological drainage (Hollmstead 1982).

Preservation of natural mucosal drainage pathway at the maxillary ostium is the key to prevent stenosis of middle meatal antrostomy Nayak (2015). Extensive mucosal trimming arround maxillary ostium can lead to shrinkage and fibrosis during healing, resulting in stenosis of MMA, that can be prevented by mucosal conservation, meticulous cleaning of crust and granulations (Kim, et al 2020).

Recent use of steroid-eluting stent is effective in improving wound healing by preserving sinus patency, reducing inflammation, and minimizing adhesions via controlled local steroid delivery without measurable systemic exposure (Murr, et al. 2011).

### Nasolacrimal Duct Injury

This occurs due to excessive enlargement of the antrostomy anteriorly. Normally, there is injury to the lacrimal bone found superiorly in the middle meatus (Bolger 1992).

Preventive recommendations include enlarging the maxillary ostium posteriorly and inferiorly. Anterior dissection should be limited to the level of the anterior end of the middle turbinate.

### Periorbital Emphysema

Lid oedema, ecchymosis and emphysema all indicate disruption of the lamina papyracea (Fig 11.3). Even in experienced hands, the incidence of orbital complications is at 0.5–1.5%.

These findings usually will resolve spontaneously in 1–2 weeks. Close observation of visual acuity and pressure is necessary.

The presence of yellow orbital fat prolapsing into the operative field along with transmitted movements on movement of the eyeball is almost pathognomonic. All tissues removed during the surgery should be placed in water. Floating tissues normally indicate presence of fat.

### Retrobulbar Haematoma

This is characterized by ecchymosis, proptosis, orbital pain, conjunctival haemorrhage. This is caused often due to injury to the anterior ethmoidal artery which retracts into the orbit and continues bleeding. An immediate lateral canthotomy is helpful (Dallan et al, 2009). A lateral canthotomy is done to immediately release intraorbital pressure on operation table and if detected later can aso be performed at the bedside. This should be followed by cantholysis (release inferior orbital septum) to achieve further increase in orbital volume. These procedures are emergency procedures to save vision. Then endoscopic orbital decompression can be done if identified while performing endoscopic sinus surgery or as an emergency adjunctive procedure (Tyler, et al. 2017). Endoscopic orbital decompression is described in Chapter 22 (endoscopic endonasal approach to orbit).

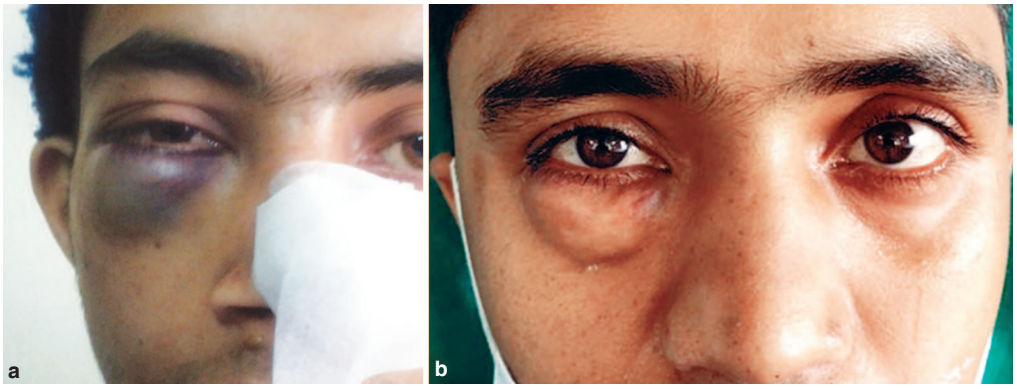



**Fig. 11.3: a.** Mild proptosis, periorbital ecchymosis, and **b.** Infraorbital emphysema due to breach in lamina papyracea following FESS

## Optic Nerve Injury

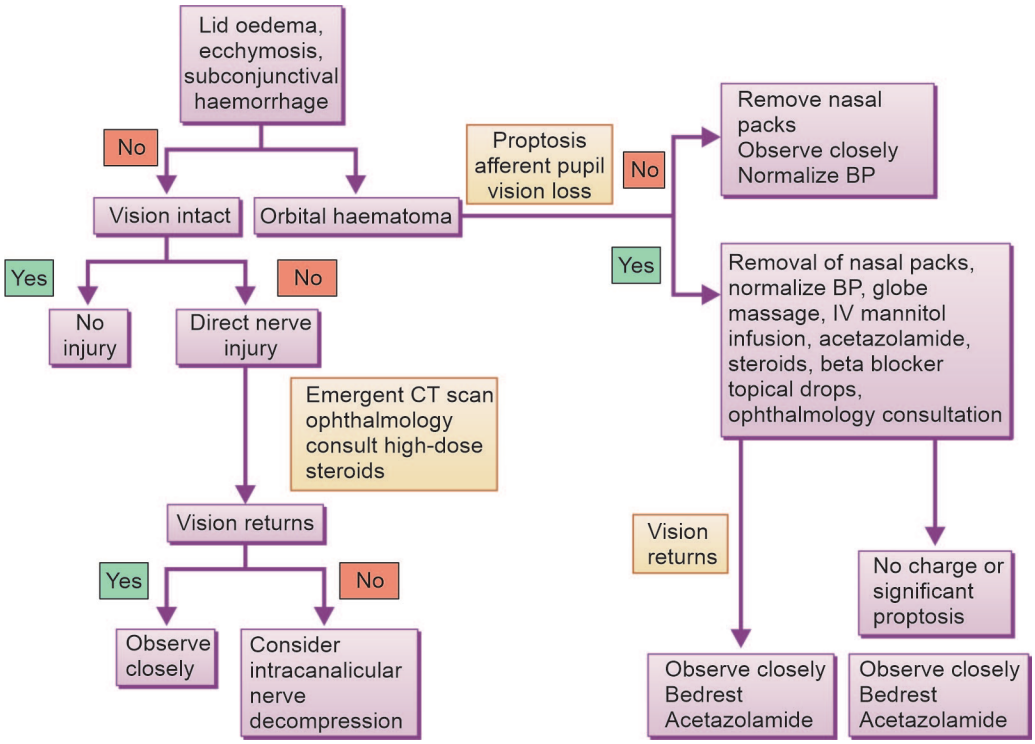
Direct injury to the optic nerve, in some cases bilaterally, has been reported in literature.

Direct optic nerve injury should be suspected, if the pupil dilates rapidly during surgery (Rene, et al 2001). Probable factors involved are inadequate visualization, poor understanding of anatomy and disorientation secondary to bleeding. 14% of patients have posterior ethmoid cells which extend over the sphenoid (Onodi cells). 88% of sphenoid sinuses juxtaposed the optic nerve and 23% of these had a significant bulge to the sphenoid. Knowledge, therefore, of the sphenoid and the posterior ethmoids is mandatory.

***Prevention of orbital complications is possible, if the following guidelines are followed*** **(Flowchart 11.1):**

- Preoperative evaluation with regard to history of bleeding diathesis, aspirin use, hypertension, prolonged steroid use, glaucoma, visual acquity, previous nasal surgery are extremely important.
- Preoperative CT is important especially in patients with nasal polyposis and previous nasal surgery. Check for anatomical landmarks prior to surgery.
- Keep the eyes uncovered after draping. Ask the patient to alert you in case of eye pain during the procedure, if under local anaesthesia.
- All tissues removed during surgery should be examined for orbital fat. Orbital ballotment may be necessary during the procedure to check for injury to the orbital periosteum.
- Recognition of orbital haematoma is critical. Intranasal packs should be removed. Eye massage should be started immediately to redistribute the retro-orbital blood into the surrounding fat, thereby decreasing the orbital pressure.
- Diuretics are given to decrease intraocular volume. Mannitol IV 20% over 20 minutes to reduce intraocular pressure, acetazolamide 500 mg IV reduces production of aqueous humor, dexamethasone 10 mg IV bolus.

**Flowchart 11.1:** Orbital bleed/visual change algorithm



- If conservative management fails, then a lateral canthotomy with superior and inferior cantholysis will allow the orbit to expand.
- A Lynch-Howarth approach with external ethmoidectomy and ligation of anterior and posterior ethmoid arteries will allow the periorbita to expand and help in the control of ocular pressure.
- The intraocular pressure must be normalized within 98 minutes to prevent irreversible damage to the eye.

### Cerebrospinal Fluid Leak

The incidence of CSF leak during FESS is reported at 0.05–0.9%. Leaks occur most often from the lateral lamella of cribriform plate, from the roof of the sphenoid or fovea ethmoidalis. Improper visualization, poor orientation, poor knowledge of anatomy, extensive polyposis and anatomical aberrations may cause these accidents. Keros' classification of olfactory fossa is a helpful guideline for the surgeon while dealing with the ethmoidal roof. Keros' type-3 has the highest risk for intracranial entry (Fig. 11.4).

Prevention of this complication is the best arrangement. Intraoperatively, the leak can be plugged with temporalis fascia, fat or muscle. Postoperative leaks usually close spontaneously—advise the patient to avoid nose blowing, keep the head elevated, no lifting, bending or straining and absolute bedrest for 48 hours. A lumbar CSF drain may be required in some persistent leaks. If the leak persists in spite of a drain, then an endoscopic repair is advisable as described in Chapter 17. Larger defect requires anterior craniotomy for repair with 3-layer closure including sealing the bony defect.

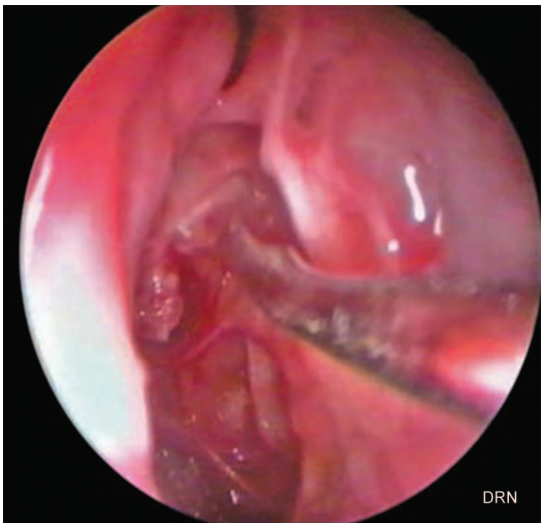



**Fig. 11.4:** Post sinus surgery dural herniation with CSF leak as pointed with sickle knife

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