How to avoid complications in ESS?

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Robot chirurgo: vi opera a casa, senza medici, senza costi.
How to avoid Complications

■ Preoperative measures
  ■ Know your-self:
    ■ Surgical skills
    ■ Appropriate instruments, including optical aids
    ■ Explicit knowledge of the surgical anatomy
  ■ Know your patient
    ■ Appropriate history (“bleeding” risk factors, antiplatelet medication)
    ■ Preop. treatment
    ■ Adequate preoperative imaging

■ Intraoperative measures
  ■ Anesthesia
  ■ Adjusting the operative strategy to the specific goal
  ■ Hemostatic measures
  ■ Intraoperative image guidance systems
  ■ Closure of the surgical defect

■ Postoperative measures
  ■ Antiinfectious treatment
  ■ Lumbar drain (when needed)
  ■ Nasal lavage, ointments, crusts removal
## Complications of endoscopic sinus surgery

<table>
<thead>
<tr>
<th>Site</th>
<th>Complication</th>
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<tbody>
<tr>
<td><strong>Orbit</strong></td>
<td>Nasolacrimal duct damage</td>
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<td></td>
<td>Extraocular muscle injury</td>
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<tr>
<td></td>
<td>Intraorbital haemorrhage/emphysema</td>
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<td>Optic nerve damage</td>
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<tr>
<td><strong>Intracranial</strong></td>
<td>Haemorrhage</td>
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<td></td>
<td>Cerebrospinal fluid leak +/- meningitis</td>
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<tr>
<td><strong>Nasal Haemorrhage</strong></td>
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<tr>
<td><strong>Minor complications</strong></td>
<td>– synechia, crusting, adhesions, epistaxis</td>
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# Complications of endoscopic sinus surgery

<table>
<thead>
<tr>
<th>Group</th>
<th>Patients (n)</th>
<th>CSF leak</th>
<th>I/C</th>
<th>Orbit</th>
<th>Haem</th>
<th>Death</th>
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<tbody>
<tr>
<td>Schaefer &amp; al.</td>
<td>100</td>
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<td>Levine°</td>
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<td>Wigand &amp; Hosemann</td>
<td>1000+</td>
<td>10</td>
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<td>Stammberger'</td>
<td>6000+</td>
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<tr>
<td>Kennedy</td>
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<td>Vleming et al.</td>
<td>593</td>
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<td>Mackay</td>
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<td>Dessi et al.</td>
<td>386</td>
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<td>730</td>
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<td>4</td>
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</table>
Optimize Medical Treatment

Medical treatment

1. Will complement surgery in making the mucosa as healthy as possible
2. Can be a useful predictor of what can be achieved by surgery
Preoperative considerations

- Appropriate history ("bleeding" risk factors, antiplatelet medication)

- Preop. treatment with antibiotics and steroids (even if not effective, this will optimize the condition of the nasal mucosa before surgery)

- Review of pertinent imaging studies (defects in lamina papyracea, low-lying cribriform plate, dehiscence of carotid or optic nerve canal)
Steps….approaching the patient

- Anatomic variants (silent sinus, Onodi cell undeveloped frontal sinus)
- Image-guidance technology reduce the complications risk
- Check the visual status of the patient before surgery
- Discussion regarding possible results and outcomes (should be formally noted)
Imaging of the sphenoid area

Distance between the floor of the sphenoid sinus and sphenopalatine foramen

Sphenopalatine foramen close to the anterior and inferior edges of the sphenoid sinus
Imaging of the sphenoid area

Relationship between the posterior ethmoidal cells and sphenoid sinuses

The posterior wall of the ethmoid is not always flat or entirely in contact with the sphenoid.

The extension of the ethmoid above, beside or below the sphenoid – Onodi’s cell.

Most common extension is above.

Sometimes direct relationship between Onodi’s cell and the optic nerve or ICA.
Haller’s infraorbital cells

Excessive pneumatisation - drainage impairment

Sometimes difficult to identify – risk of orbital penetration

Agger nasi cell

Excessive pneumatisation

Frontal recess blocking
Maxillary sinus hypoplasia

Orbital penetration risk

*Often associated with uncinate process hypoplasia*
Ethmoidal transverse diameter narrowing

- High risk of orbital penetration
- ”Medialisation” of the orbital wall
Ethmoidal roof

- Lateral – fovea ethmoidalis of the frontal bone
- Medial – olfactory fossa
Keros clasification* - Olfactive fosse

Type 1
< 4 mm

Type 2
4 - 7 mm

Type 3
8-16 mm

* Keros, 1965 / Stammberger et al. 1995
Vulnerability of the carotid canal

Dehiscent carotid canal
Vulnerability of the carotid canal

Internal carotid artery bulges into sphenoid sinus
Vulnerability of the optic nerve (I)

1. **Onodi cell** (bulging of the optic canal into the posterior ethmoid)

2. **Pneumatization of the lesser wing of the sphenoid bone**

3. **Pneumatization of the anterior clinoid process of the sphenoid bone**
1. Bulging of the optic nerve into the sphenoid sinus
2. Dehiscent optic canal
Local versus general anaesthesia

- General anaesthesia continues to prevail because surgeons have not been persuaded of the 'safety' of local anaesthesia.
- Stankiewicz - no difference between the two in incidence of complications

“Minimize bleeding” measures

- decongestants (cottons) 30 minutes before the operation
- patient in a reverse Trendelenburg position
- decongestants during the operation
- inducing mild hypotension if appropriate.
- instruments that incorporate suction devices can be helpful

but !!!!! are only.....

complementary to a knowledge of the anatomy

and

.......... **scrupulous surgical technique**
Risk areas in ESS

- **Vascular structures**
  - Ant.Eth. Artery
  - Post.Eth. Artery
  - Sphenopalatine Artery
  - ICA

- **Nerves**
  - Optic nerve

- **Skull base**

- **Orbit**

- **Naso-lachrymal duct**

#### Normal Anatomy/Anatomic Variants
Ethmoidal arteries
Anterior Ethmoidal Artery

In cases of accidents:

- *Intranasal hemorrhage*
- *Retrobulbar hematoma*
  - proptosis,
  - mydriasis,
  - edema of the lid,
  - chemosis,
  - massive increase of bulb pressure,
  - loss of vision
Intraorbital Hematoma

N.B. The retina can tolerate 30-90 min of ischemia

Medical management (slowly expanding hematomas):
pack removal,
Systemic steroids (0.2 mg/kg),
manitol (1-2 mg/kg) and
acetazolamide (10-15 mg/kg)

Rapid expanding hematomas
Lateral cantotomy and cantholysis
Orbital decompression
Sphenopalatine artery and branches
26 yrs old patient

- Operated on several times for nasopharyngeal angiofibroma (according to the medical documents)

- In fact – septoplasty, biopsy of the tumor, and failed tentative of tumor removal (just major bleeding followed by nasal packing 7 days!!!!)

- Patient informed about external carotid artery ligation

- No carotid ligation (angiography showed this and allowed selective embolisation of the internal maxillary artery)

- No tumor removal
Orbital fat exposure

- Lamina papyracea disruption – aggressive ethmoidectomy, silent sinus syndrome
- Exposure of the periorbit – no treatment, no consequences
- Injury of the periorbit – let the fat into the ethmoid; no manipulation of the fat
- Avoid nasal packing
- Packing – one way valve, air or blood trap within the orbital tissues – periorbital edema, ecchymosis, subcutaneous emphysema or proptosis
Orbital injury

- Injury of the medial rectus the most frequent – diplopia
- Sometimes – inferior rectus or superior oblique
- Increased risk with shavers

Management: ophthalmology evaluation, exploration and repair
Strabism surgery – not always successful
Optic nerve injury

- Papyracea injury not recognized (especially in the posterior ethmoid)
- Unrecognized Onodi cell
- Partial loss of vision or blindness
- Sphenoidotomy and optic nerve decompression

Suspected ON injury:
- Systemic steroids
- Ophthalmology assessment
- CT scan evaluation
CSF - leak

**Conditions:** excessive intraop. bleeding, revision cases, massive polyposis

**Management:**

- Single layer repair – free intranasal mucosal graft harvested from the septum or turbinate
- Sometimes – 2 layers procedure using septal bone or cartilage + absorbable packing material + nonabsorbable packing (7 days)

Immediately after the procedure - CT scan to assess pneumocephalus or brain injury
- 62 yrs old women
- Left nasal fossa watery discharge (last 2 yrs)
- 2 episodes of bacterial meningitis (Pneumococcal)
- No trauma, no prior surgery
- Several negative ENT examinations (including endoscopy)
- CT – scan interpreted as normal (but a mild asymmetric olfactory cleft can be observed)
- What would you like to do next?
Carotid Artery Injury

**Conditions**
- Sphenoid sinus entered too far laterally
- Dissection performed along the lateral sphenoid wall
- Intersphenoid bony septum manipulated aggressively

**Management**
- Packing the sphenoid
- Aggressive fluid resuscitation – hemodynamic control
- Interventional radiology – coils or balloons to occlude the hole
- Stent of the ICA
- Cross-cranial vascular by-pass
ICA

- As with conventional cranial base surgery, the risk of vascular injury, and the ability to treat it effectively, are related to the experience of the operating team.

- A neurosurgeon (who has cerebrovascular expertise) is a valuable addition to the skull base surgery team and may be a critical component for the management of cases with complexity Levels IV and V.

- The surgical team should acquire experience incrementally with surgeries of lower levels of complexity prior to undertaking procedures with complexity Levels IV and V.

- Increased incidence of vascular events is directly proportional to the increase in the level of surgical complexity.
Intra op or postop. minor complications

Epistaxis
During the operation – coagulation or packing

Immediate after surgery or at 5-7 days when intranasal crusts dislodge

Management
Vasoconstrictors and aspiration of the clots and secretions
Packing materials – the best way
Silver –nitrate cauterization
Electro cauterization
Extremely rare – selective embolisation
Synechiae

Dense synechiae – source of anosmia, recurrent sinusitis and mucocele formation
Place spacer or a packing material during surgery when the middle turbinate mucosa is injured
Office procedures during the first weeks to divide the adhesions
LASER procedures under GA once healing completed
Orbital complications

**Corneal abrasion**
due to inadequate protection during surgery
ophthalmology assessment, eye drops or ointments or eye patching

**Epiphora**
Injury of the naso-lacrimal duct during antrostomy
Back biting forceps for too far in an anterior direction
Probing, irrigation and intubation of the duct. If persists: Endoscopic DCR

**Orbital infection**
**Conditions:** direct spread through bony dehiscence, retrograde thrombophlebitis
Periorbital cellulitis, erythema, oedema, eye pain, etc
I.V. Antibiotics, packing removal and close monitoring
Worsening of symptoms – CT scan
Know your-self - Train your-self

1. Intensive theoretical studies
2. Cadaver dissections
3. Visiting surgical courses
4. Assist more experienced surgeons
5. Multimedia teaching (network of surgical sites, CT interpretation repair complications)
6. The novice surgeon: first 50 operations with the help of an experienced surgeon and the next 50 with help readily available (according to Draf)
Know your-self - Equip your-self

1. Appropriate *instrumentation*

2. High quality endoscopic equipment
   1. Visualization (*High Definition*)
   2. Optics (0, 30, 45, 70 degree *telescopes*)

3. Image-guidance technology reduce the complications risk
Learning curve

1. Anatomy
2. Imaging
3. Diagnostic endoscopy
4. Surgery
5. Tips and tricks

Keep in mind!

Surgical goal may not be achieved

Complications may be frequent during the first operations
Recommendations

- Extended surgery (Skull base) undertaken only after performing > 1000 level I procedures (ESS)
- Cadaver dissection
- Supervised surgery
- Staged surgery
- Dedicated follow-up clinics

The concept of **staged surgery**
Take home messages

- Do as little as possible and as much as necessary (Wigand 1990)

- What we need: minimally invasive surgery or radical surgery – judge the disease and it’s treatment options…

- Staging is mandatory – symptoms score, CT score, endoscopic score, histopathologic score

- Operate patients to relief symptoms, do not operate CT scans!

- If complications occur you have to be able to manage them (alone or team)

- The most serious complications belong to the most experienced surgeons (Draf)!