HEMOSTASIS IN ENDOSCOPIC SINUS SURGERY

DEPARTMENT OF OTOLARYNGOLOGY, HEAD AND NECK SURGERY, UNIVERSITY OF ADELAIDE SCHOOL OF MEDICINE, FROME ROAD, ADELAIDE, SA 5005, AUSTRALIA

Arwa Alkhunaizi
otolaryngology H&N surgery resident ,level 5, KFSHRC
Rhinology chair activity, KAUH
20/2/17
Function endoscopic sinus surgery considered to be a moderate bleeding risk surgery.

Bleeding is anticipated during sinonasal surgery when treating inflammatory and vascular disorders, and is due in part to the inherently rich blood supply derived from the external and internal carotid arteries in this region.

Expected surgical bleeding is encountered from mucosa, bone and vascular tumors.
Correct assessment of the source of the bleeding, and a detailed knowledge of surgical vascular anatomy and of hemostatic techniques, is
WHY IS HEMOSTASIS IMPORTANT IN SINONASAL SURGERY?

To improve intraoperative surgical field and visualization

1) Avoid injury (vascular, cerebrospinal fluid leak, orbital)
2) Allow completion of the surgical procedure

Minimize bleeding associated comorbidities
Nausea, emesis and aspiration
Significant blood loss, hypoxia and blood transfusion

Prevent the need for nasal packing and related complications

Prevent postoperative complications and improve healing
Hematoma and bleeding
Adhesions and scarring
Broad classification of hemostasis during endoscopic sinus surgery

1) Disorders
   - Chronic rhinosinusitis with nasal polyps, eosinophilic mucus chronic rhinosinusitis (EMCRS), allergic fungal rhinosinusitis (AFRS)
   - Rhinitis medicamentosa
   - Infection, subperiosteal abscess
   - Thyroid eye disease
   - Immunopathology: for example, Sarcoidosis, Wegener granulomatosis, Churg-Strauss disease
   - Vascular tumors (juvenile angiofibroma, metastatic renal cell carcinoma)
   - Prior surgery, radiotherapy
   - Patient
     - Morbid obesity, hypertension
     - Chronic alcohol, liver, kidney disease, Smoking,
     - Coagulopathies (congenital or acquired)
   - Risk of

Management of expected bleeding

- Microvascular circulation: mucosa, bone, vascular tumors

Management of inadvertent vascular injury

- Macrovascular circulation: named vessels

1) Incorrect diagnosis
   - Internal carotid artery aneurysm, vascular tumor
2) Unfavorable vascular and sinonasal anatomy
   - Ethmoidal arteries (anterior, posterior, and sometimes middle)
   - Internal carotid artery
   - Onodi cell
   - Sphenoid sinus septations
3) Previous sinonasal surgery
   - Bone dehiscence, scarring, altered or absent anatomic landmarks
4) Surgical mistakes
APPROACH TO HEMOSTASIS IN SINUS SURGERY

- Prevention of excessive bleeding
- Management of intraoperative bleeding
- Management of postoperative bleeding
1) preoperative
1) PREOPERATIVE HEMOSTASIS STRATEGIES

- Assessment and treatment of comorbid patient factor
- Timely cessation of medications that increase the risk of bleeding
- Minimize sinonasal inflammatory and vascular burden
- Thoroughly examine clinically relevant vascular anatomy on patient's sinus computed tomography (CT) scans
What are the risk factors for perioperative bleeding?

1) Hereditary or acquired bleeding tendency
2) Personal or family history of predisposition to bleeding
3) Abnormal coagulation testing results
4) Coexisting medical conditions
5) Medication use (including herbal).
6) Need for antithrombotic therapy in the perioperative period.
Why obtain laboratory tests at all?

1) Unreliable historian: patient does not recognize bleeding disorder

2) Patient not exposed to significant bleeding risk, such as trauma, surgery, or dental extractions (ie, factor XI deficiency)

3) Acquired hemostatic defects (ie, thrombocytopenia)
<table>
<thead>
<tr>
<th>Significant Bleeding History</th>
<th>Prior Exposure to Hemostatic Risk</th>
<th>Major Surgery/Surgical Bleeding Risk</th>
<th>Concern Level</th>
<th>Suggested Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Yes</td>
<td>No</td>
<td>Minimal</td>
<td>None</td>
</tr>
<tr>
<td>None</td>
<td>None</td>
<td>No</td>
<td>Mild</td>
<td>None</td>
</tr>
<tr>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Mild-moderate</td>
<td>Coagulation test (PTT/PT/INR)</td>
</tr>
<tr>
<td>Suspected but unclear</td>
<td>Yes or No</td>
<td>Yes or No</td>
<td>Moderate</td>
<td>Initial testing (platelet count, bleeding time, coagulation tests) vs hematology consultation</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes or No</td>
<td>No</td>
<td>Moderate-severe</td>
<td>Initial testing (platelet count, bleeding time, coagulation) and hematology consultation counseling</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes or No</td>
<td>Yes</td>
<td>Severe</td>
<td>As above with intensive counseling</td>
</tr>
</tbody>
</table>
RHINITIS MEDICAMENTOSA

- **Why?**
  - Chronic topical exposure $\rightarrow$ causes dysregulation of vascular tone $\rightarrow$ intraoperative topical vasoconstrictors are **ineffective** in controlling the microvascular circulation $\rightarrow$ rebound congestion

- **Should be recognize preoperative** $\rightarrow$
  - Offending topical decongestant discontinued as soon as possible.
  - started on **topical saline** and **corticosteroids**.

- **What to do intraoperative if local vasoconstriction ineffective?**
  - tranexamic acid (TXA) (1 mg during induction)
Adequate perioperative management of hypertension is imperative to achieve optimum intraoperative conditions.
# Anticoagulant Medication

<table>
<thead>
<tr>
<th>Anticoagulant Type</th>
<th>Name</th>
<th>Discontinuation Timeline</th>
<th>How to Bridge</th>
<th>Antidote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin K antagonist</td>
<td>Warfarin</td>
<td>5 d</td>
<td>Subcutaneous LMWH or intravenous UFH</td>
<td>Vitamin K reversal, may need FFP, PCC, or recombinant factor VIIa</td>
</tr>
<tr>
<td>Anticardiothrombin III</td>
<td>UFH (bridging)</td>
<td>4–6 h</td>
<td>N/A</td>
<td>Protamine sulfate</td>
</tr>
<tr>
<td>Anti-factor Xa</td>
<td>LMWH (enoxaparin, dalteparin)</td>
<td>24 h</td>
<td>UFH</td>
<td>Protamine sulfate</td>
</tr>
<tr>
<td></td>
<td>Apixaban, rivaroxaban</td>
<td>1 d (2 d if high bleeding risk)</td>
<td>UFH</td>
<td>None</td>
</tr>
<tr>
<td>Direct thrombin inhibitor</td>
<td>Argatroban, dabigatran</td>
<td>1–2 d (2–4 d if high bleeding risk)</td>
<td>UFH</td>
<td>None</td>
</tr>
<tr>
<td>Antiplatelet</td>
<td>ASA</td>
<td>7–10 d (if low cardiac risk)</td>
<td>Glycoprotein IIb/IIla inhibitor</td>
<td>dDAVP and platelet transfusion</td>
</tr>
<tr>
<td></td>
<td>Cilostazol</td>
<td>1–2 d</td>
<td>Glycoprotein IIb/IIla inhibitor</td>
<td>dDAVP and platelet transfusion</td>
</tr>
<tr>
<td></td>
<td>Clopidogrel (Plavix)</td>
<td>7–10 d (if low cardiac risk)</td>
<td>Glycoprotein IIb/IIla inhibitor</td>
<td>dDAVP and platelet transfusion</td>
</tr>
<tr>
<td></td>
<td>Dipyridamole (Persantine)</td>
<td>1–2 d</td>
<td>Glycoprotein IIb/IIla inhibitor</td>
<td>dDAVP and platelet transfusion</td>
</tr>
<tr>
<td></td>
<td>Prasugrel (Effient)</td>
<td>5–7 d</td>
<td>Glycoprotein IIb/IIla inhibitor</td>
<td>dDAVP and platelet transfusion</td>
</tr>
<tr>
<td>NSAIDs</td>
<td>Celecoxib, diclofenac, ibuprofen, indomethacin, ketorolac, meloxicam, naproxen, sulindac</td>
<td>7 d</td>
<td>N/A</td>
<td>Unlikely, but if needed could use dDAVP and/or platelet transfusion</td>
</tr>
</tbody>
</table>

**Abbreviations:** ASA, aspirin; dDAVP, desmopressin; FFP, fresh frozen plasma; N/A, not applicable; NSAID, nonsteroidal anti-inflammatory drugs; PCC, prothrombin complex concentrate.
4 Gs (ginseng, garlic, ginger, and ginkgo biloba) → affect platelet function and should be stopped **10 days**

- Saw palmetto, and high doses of vitamin E and omega-3 can increase bleeding risk as well.
The risk of surgical bleeding is estimated to **increase 1.5-fold** with aspirin but for most procedures the severity of bleeding is not increased.

The mean estimated blood loss during ESS in patients on aspirin was **slightly higher than in controls**, especially when more sinuses were opened.

It is generally possible to safely perform ESS in patients on aspirin by using **other strategies to manage the surgical field**.

It is advisable to cease aspirin **10 days earlier**. Before stopping aspirin, the risk of doing so needs to be discussed with the patient’s cardiologist or primary care physician because 10% of acute cardiovascular events are preceded by aspirin withdrawal.
Low-dose aspirin for secondary cardiovascular prevention – cardiovascular risks after its perioperative withdrawal versus bleeding risks with its continuation – review and meta-analysis

W. BURGER, J.-M. CHEMNIITIUS, G. D. KNEISSL, G. RÜCKER

OBJECTIVES: Low-dose aspirin given for secondary prevention of cardiovascular disease is frequently withdrawn prior to surgical or diagnostic procedures to reduce bleeding complications. This may expose patients to increased cardiovascular morbidity and mortality. Aim of the study was to review and quantify cardiovascular risks because of periprocedural aspirin withdrawal and bleeding risks with the continuation of aspirin.

METHODS: We screened MEDLINE (January 1970-October 2004) with additional manual cross-referencing for clinical studies, surveys on the opinions of doctors and guidelines.

RESULTS: Studies reporting the relative risk of acute cardiovascular events after aspirin withdrawal when compared with its continuation were not found. However, retrospective investigations revealed that aspirin withdrawal precedes up to 10.2% of acute cardiovascular syndromes. The time interval between discontinuation and acute cerebral events was 14.3 +/- 11.3 days, 8.5 +/- 3.6 days for acute coronary syndromes, and 25.8 +/- 18.1 days for acute peripheral arterial syndromes (P < 0.02 versus acute coronary syndromes). On aspirin-related bleeding risks, we obtained 41 (12 observational retrospective, 19 observational prospective, 10 randomized) studies, reporting on 49590 patients (14981 on aspirin). Baseline frequency of bleeding complications varied between 0 (skin lesion excision, cataract surgery) and 75% (transrectal prostate biopsy). Whilst aspirin increased the rate of bleeding complications by factor 1.5 (median, interquartile range: 1.0-2.5), it did not lead to a higher level of the severity of bleeding complications (exception: intracranial surgery, and possibly transurethral prostatectomy). Surveys amongst doctors on the management of this problem demonstrate wide variations. Available guidelines are scarce and in part contradictory.

CONCLUSIONS: Only if low-dose aspirin may cause bleeding risks with increased mortality or sequels comparable with the observed cardiovascular risks after aspirin withdrawal, it should be discontinued prior to an intended operation or procedure. Controlled clinical studies are urgently needed.
Do preoperative GCs improve the surgical field in ESS?

- **The Hypothesis is** that GCs minimize sinonasal inflammatory and vascular burden → improving the surgical field
- **Options** →
  - 1) Topical intranasal GC
  - 2) From 5 to 10 days of prednisolone or other oral GC
  - 3) Single preoperative dose of oral GC
- In nasal polyps, there is a trend toward reduced blood loss
- Some evidence that a **single preoperative** dose may be sufficient to improve surgical field
Preoperative treatment with topical corticoids and bleeding during primary endoscopic sinus surgery

Silviu Albu, MD, Anamaria Gocea, MD, Ileana Mitre, MD

First Published October 1, 2010 | research-article

OBJECTIVE: To find out whether the constant preoperative use of a topical corticoid (mometasone furoate [MF]) could really improve the operative field quality and decrease bleeding during endoscopic sinus surgery (ESS).

STUDY DESIGN: Double-blind, randomized controlled trial. SETTING: Tertiary referral center.

SUBJECTS AND METHODS: Seventy patients with chronic rhinosinusitis (CRS) with and without polyps underwent ESS under standardized general anesthesia with equal randomization into two groups. During four weeks within the preoperative period, 35 cases were treated with MF, while the other half received placebo matching sprays. Total blood loss, operation time, and surgical field quality were recorded.

RESULTS: Intraoperative blood loss in the MF-treated group was 142.8 mL, less than in the control group (170.6 mL). The difference between the groups is 27.7 mL (95% confidence interval [CI] 3.5–51.92), statistically significant: $P = 0.025$. Time of surgery was 59 minutes in the MF group and 70 minutes in the control group. The difference was 11.2 minutes (95% CI 2.82–19.51), which is statistically significant: $P = 0.009$. The quality of the endoscopic surgical field was significantly better for patients treated with MF. Treatment with topical corticoid enables significantly reduced bleeding, decreased operation time, and improved endoscopic vision during ESS for CRS.

CONCLUSION: The use of topical corticoid (MF) in the preoperative period can improve endoscopic vision, reduce bleeding, and decrease operation time in CRS patients with and without polyps undergoing ESS, but our sample size cannot exclude small, and possibly trivial, group differences.
Oral steroids and intraoperative bleeding during endoscopic sinus surgery.

Günel C, Başak HS, Bleier BS.

Abstract

OBJECTIVES: Our main objective was to investigate the effect of preoperative oral steroids on intraoperative bleeding and quality of the surgical field during endoscopic sinus surgery (ESS). Our second objective was to determine whether the osteitis score could be used to predict the volume of intraoperative bleeding.

METHODOLOGY: This double-blinded, randomized trial included 65 patients with chronic rhinosinusitis with nasal polyps. The corticosteroid group received oral prednisolone (1 mg/kg), administered to patients once daily for 2 days and then tapered down, with treatment completed on the day 10. The control group received placebo before the operation. Endoscopic exams were recorded, and preoperative sinus computed tomography scans were scored. Intraoperative blood loss was recorded. Quality of the surgical field was assessed by the surgeon, using a linear scale from 1 to 10.

RESULTS: The mean bleeding volume was 239 ml in the corticosteroid group and 203 ml in control group. There was no significant difference between the groups (p = 0.495). Surgical field quality scores were higher in the corticosteroid group than in the control group, but the difference was not significant (p = 0.36). There was no statistically significant relationship between the bleeding volume and Kennedy Osteitis Scores in corticosteroid group (r = 0.225, p = 0.186) and control group (r = 0.084, p = 0.663).

CONCLUSION: Our findings suggest that using oral corticosteroids, which have rare but serious side effects, is not necessary in the preoperative period. Furthermore, we found that the radiological osteitis score was not a suitable marker for predicting intraoperative bleeding volumes.
Effect of steroids for nasal polyposis surgery: A placebo-controlled, randomized, double-blind study

Mustafa Cenk Ecevit MD, FEBORL-HNS, Taner Kemal Erdag MD, Ersoy Dogan MD, Semih Sutay MD

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Cited by: 4 articles Citation tools

Abstract

Objectives/Hypothesis

Although medical intervention is the first option for treatment of nasal polyps, surgery is still a therapeutic option for symptomatic cases that do not respond or partially respond to medical intervention. However, there is a need for high-level evidence for the perioperative use of steroids in nasal polyposis surgery. We aimed to assess the perioperative effect of preoperative use of oral prednisolone for advanced-stage diffuse nasal polyposis.

Study Design

Prospective, double-blind, randomized, placebo-controlled study.

Methods

A visual analog scale (VAS) was evaluated for smell, nasal discharge, nasal obstruction, facial pressure, headache, butanol smell threshold, and peak nasal inspiratory flow (PNIF) before and after the use of study drug. Perioperative bleeding volume, visibility of operative field, operative time, hospital stay, and complication rate were also evaluated.

Results

The improvement in the corticosteroid group (CG) in the VAS scores, butanol thresholds, and PNIF values showed statistically significant differences compared to the placebo group (PG) \((P < .05)\). The perioperative bleeding volume, visibility score, operative time, and hospital stay for CG/PG were 141 mL/384 mL, 2.4/3.4, 61 min/71.6 min, and 1.1 day/1.8 day, respectively \((P < .05)\). The difference between the complication rates for the two groups did not show any statistically significant difference \((P = .214)\).

Conclusions

Preoperative administration of systemic corticosteroids improves the perioperative visibility by reducing blood loss and shortens the operation time. We recommend the use of preoperative corticosteroid for the safety of the patients. The optimum dose and duration have not been established and require further studies.
- **Preoperative devascularization**
  - Not used for routine sinus surgery or inflammatory disorders.
  - Reserved for *vascular tumors* such as angiofibroma.
WHAT STEPS CAN BE TAKEN FOR A THOROUGH PREOPERATIVE ASSESSMENT OF A PATIENT’S SINONASAL CT

- Ensure the images belong to the correct patient
- Examine the most recent, high-resolution, fine-cut sinus CT scans
- Examine different planes: coronal, axial, and sagittal
- Systematic assessment
- **Cribriform plate**: depth, symmetry, slope, dehiscence
- **Lamina papyracea**: dehiscence
- **Onodi cell**: if present, relationship to optic nerve, internal carotid artery, dehiscence
- **Sphenoid sinus**: pneumatization, septations, dehiscence
- **Skull base**: dehiscence, slope (examine sagittal plane)
- **Ethmoidal arteries**: position (skull base or pedicle), symmetry
- Diagnosis: confirm clinical with radiological.
2) intraoperative
WHAT ARE SOME PREVENTIVE INTRAOPERATIVE HEMOSTASIS STRATEGIES?

- Patient position
- Local vasoconstriction
- General anesthetic technique
- Surgical technique
- TXA
Studies addressing this issue consistently show a reduced blood loss and better surgical field with an elevated head position.

How high to raise the head of the bed relative to chest (heart) position?

- Reverse Trendelenburg position → reduce venous pressure and mucosal blood flow.
- Minimum of 10 head elevation to show a benefit in the surgical field
- Achieve a balance between improved surgical field and cerebral perfusion Pressure Aim for 10 to 20 head elevation
What are some technical aspects of local vasoconstrictor application during ESS?

- Atraumatic manner
- Allow time to exert its effects
- Injection/infiltration site
- Topical application sites
WHICH TOPICAL VASOCONSTRICTORS ACHIEVE THE BEST SURGICAL FIELD IN ESS?

<table>
<thead>
<tr>
<th>Vasoconstrictor options for topical (not injectable) application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenaline: nonselective α1, α2, and β receptor agonist</td>
</tr>
<tr>
<td>Oxymetazoline: predominantly α1 receptor agonist</td>
</tr>
<tr>
<td>Phenylephrine: predominantly α1 receptor agonist</td>
</tr>
<tr>
<td>Cocaine: potentiates α1, α2, and β activity of endogenous catecholamines</td>
</tr>
<tr>
<td>Variations of Moffett’s solution (mix of cocaine, adrenaline and sodium bicarbonate solution)</td>
</tr>
</tbody>
</table>

- Recommend rational use based on knowledge of pharmacologic vascular anatomy and side-effect profile (discussed later)
  - Single agent
  - Judicious use

- Amount delivered to mucosa may vary on the surgical pledget (cottonoid, neuropatties or gauze) used. The more absorbent the material, the less available to mucosa
Does the addition of local vasoconstrictor injection provide a better surgical field in ESS?

- **Middle turbinate anterior buttress injection**[^13]
  - Bupivacaine 0.25%, 1:200,000 adrenaline
  - *No significant benefit in surgical field or blood loss*

- **Middle turbinate, lateral nasal wall, agger nasi region, sphenopalatine foramen**[^14]
  - Adrenaline 1:100,000
  - *No significant benefit in surgical field or blood loss*

- **Greater palatine canal injection (via oral cavity)**
  - Bupivacaine solution (2 mL of 0.5%) injection for compressive effects[^10]
    - **Reduction of 4.7% in inferior turbinate blood flow**
    - Xylocaine 1%, 1:100,000 adrenaline[^15]
      - *No significant benefit in surgical field or blood loss*
  - Not recommended for routine ESS for this purpose
  - May have a role in the surgical management of unilateral epistaxis from the sphenopalatine region (posterior epistaxis)
Most surgeons use a combination of local injection and topical application of vasoconstrictors on pledgets within the nose.

Based on available data, if already using topical vasoconstrictors, additional injection of a vasoconstrictor may not provide further hemostatic benefit during routine ESS.

Injection of a long-acting local anesthetic may be considered for postoperative local pain control if not already diluting topical vasoconstrictors in a local anesthetic solution, such as ropivacaine.
When used as a **single agent**, **adrenaline** or **cocaine** theoretically also reduce mucosal blood flow and congestion, and have recently been suggested to achieve similar surgical field scores and blood loss to each other during ESS.
What are some relevant vasoactive pharmacokinetic and safety parameters of adrenaline?

- These data are based on the pharmacokinetics of adrenaline administered via the subcutaneous (injected) route in mediating local vasoconstriction
  - Dosage for effective vasoconstriction: 1:50,000 to 1:200,000
  - Onset of action: 5 to 15 minutes
  - Peak effect: 30 minutes
  - Duration: 1 to 4 hours
  - Metabolized in liver, intravenous half-life 2 to 5 minutes, but prolonged when administered subcutaneously

- Adrenaline is deactivated by oxidizing agents, alkalis (including sodium bicarbonate), and halogens

- Beta2 (vasodilatory) effects may predominate on blood vessels after 6 hours of adrenaline stimulation

- For skull base surgery anticipated to extend beyond this time, an alpha1 agonist such as oxymetazoline may be preferred
The available evidence lends support to the following suggestions with regard to either oxymetazoline or phenylephrine use:

- Only topical application (not for local injection/infiltration)
- Not to combine its use with other vasoconstrictors, hence single-agent use
- Phenylephrine dosage (assumes 100% bioavailability): Groudine et al.
  - In adults, initial dose should not exceed 0.5 mg
  - In children < 25 kg, should not exceed 20 μg/kg
- Oxymetazoline dosage:
  - No specific guidelines exist, use manufacturer’s instructions
- Exercise caution by using:
  - A measured amount
  - The least amount required to achieve hemostasis
- **hemodynamic parameters** during general anesthesia have a significant effect on the surgical field during ESS.
- **good communication** with the anesthetist throughout surgery is invaluable for achieving hemodynamic conditions that are ideal for ESS.
Does Hypotensive Anesthesia Achieve the Best Surgical Field in Endoscopic Sinus Surgery? (CONTROLLED HYPOTENSION)

- systolic blood pressure to 80 to 90 mm Hg,
- (MAP) 50 to 65 mm Hg OR 30% reduction of baseline MAP.
- DON’T FORGET THE HR!

MAP = Heart rate \times Stroke volume \times Systemic vascular resistance
Is Total Intravenous Anesthesia Necessary to Achieve the Best Surgical Field?

IDEA → to achieve the desired conditions of hypotension without reflex tachycardia BY by causing less variability in MAP and HR → decrease need for b bloker

- propofol alone or in combination with an opioid such as remifentanil.
- Challenging why ??.
- What about if use inhalation anesthesia with remifentanil?
Comparison of surgical condition in endoscopic sinus surgery using remifentanil combined with propofol, sevoflurane, or desflurane

Hyung-Seok Yoo,1 Jin Hee Han,2 Sung Wook Park,2 and Keon Sik Kim2

1Department of Anesthesiology and Pain Medicine, Seoul National University Bundang Hospital, Seongnam, Korea.
2Department of Anesthesiology and Pain Medicine, Kyung Hee University Medical Center, Seoul, Korea.

Background
Various maneuvers are commonly used to achieve the ideal operative field necessary for successful endoscopic sinus surgery (ESS). There are a few contradictory reports on this subject and the consensus is that propofol anesthesia results in a better or similar surgical field and less or similar amount of bleeding than volatile anesthesia. The aim of this study was to compare the surgical field in patients in whom intravenous anesthesia is used as opposed to balanced general anesthesia.

Methods
Sixty patients undergoing ESS were randomly assigned into three groups, each of which used a different type of anesthesia: propofol/remifentanil (PRO/REM) group, sevoflurane/remifentanil (SEV/REM) group, and desflurane/remifentanil (DES/REM) group. We aimed to maintain the intraoperative mean blood pressure (MBP) at 65 mmHg and the heart rate (HR) at about 75 beats per minute. The quality of visibility of the surgical field was graded, using a validated scoring system, 60 minutes after the start of the operation.

Results
All groups had a similar MBP and mean HR at 60 minutes after the operation started. There was no significant differences among the three groups for surgical grade score (P = 0.83).

Conclusions
In this comparative study of three anesthetic combinations (PRO/REM, SEV/REM, and DES/REM) in patients undergoing ESS with controlled BP and HR, we did not observe any significant differences in the surgical grade scores.
TRANEXAMIC ACID

- What is the current evidence for the hemostatic effect of TXA in ESS?
  - prevents clot breakdown (antifibrinolytic)
  - Systemic use preoperatively Significantly improved visualization, reduced bleeding
    (Some concern regarding systemic TXA use and risk of deep vein thrombosis)
    single pre op dose
  - Topical TXA (5%) in sinus surgery compared with no TXA Significantly improved surgical field (in the first 30 minutes).
  - Consider it in high risk bleeding group.
SURGICAL TECHNIQUE

- Prevent unwanted mucosal injury
- Methodical surgical approach
- Avoid potential vascular injury
- Confirm with intraoperative navigation
- Avoid unnecessary mucosal stripping
- Establish intraoperative surgical landmarks
3) Intraoperative bleeding
IDENTIFY THE SOURCE OF BLEEDING

mucosa

bone

Name vessel
WHAT ARE SOME STRATEGIES TO CONTROL MUCOSAL BLEEDING IN ESS?

- Communication with anesthesia
- Topical vasoconstrictor
- Cautery
WHAT ARE SOME OPTIONS FOR CONTINUED MUCOSAL BLEEDING?

- Hot saline irrigation
- TXA (if not already given)
- Topical hemostatic agents
- DDAVP
- Vasoconstrictor injection or cauterization of major feeding vessels
  - Posterior septal artery
  - Sphenopalatine artery
DOES HOT SALINE IRRIGATION IMPROVE THE SURGICAL FIELD IN ESS?

- Hot water irrigation has been used to successfully treat posterior epistaxis and reduce intraoperative bleeding with adenoidectomy.
- **Mechanism** → vasodilation → interstitial mucosal edema and compression of the blood vessel lumen → reduce mucosal blood flow into the surgical field.
- **What temperature to use?** In ESS, hot saline irrigation at 49C39.
- Improvement in surgical field and blood loss for surgeries of greater than 2 hours’ duration.
- Hot saline irrigation is as effective as topical TXA in ESS.
Hemostatic effect of hot saline irrigation during functional endoscopic sinus surgery: a randomized controlled trial

Eng Cern Gan MBBS, MRCS (Edin), MMed (ORL), FAMS, Saad Alsaleh MBBS, FRCSC, Jamil Manji MSc, Al-Rahim R. Habib MSc, Ameen Amanian BASc, Amin R. Javer MD, FRCSC, FARS

Abstract

Background
The endoscopically magnified operative field in functional endoscopic sinus surgery (FESS) makes even a small amount of bleeding a potentially significant hindrance. It is thought that irrigation with hot saline during surgery may improve surgical field of view by producing a hemostatic effect. Our objective was to assess the effectiveness of hot saline irrigation (HSI) compared to room temperature saline irrigation (RTSI) in the control of intraoperative bleeding during FESS.

Methods
Sixty-two chronic rhinosinusitis (CRS) patients undergoing FESS were randomized to 2 treatment arms in an equal ratio. Subjects received either HSI (49°C) or RTSI (18°C), 20 mL every 10 minutes, for the duration of FESS. The Boezaart endoscopic field of view grading system was the primary outcome measure. Boezaart score, heart rate, and mean arterial pressure.

Results
Mean endoscopic surgical field of view (Boezaart score) did not significantly differ between the HSI and RTSI groups (1.5 ± 0.6 vs 1.3 ± 0.5; p = 0.23). However, when FESS was longer than 2 hours in duration, the Boezaart scores were significantly better in the HSI group (1.6 ± 0.6 vs 1.2 ± 0.4; p = 0.04). We found that blood loss per minute was significantly reduced (p = 0.02) in all cases in which HSI was used (2.3 ± 1.0) compared to RTSI (1.7 ± 1.1). Despite this, heart rate (p = 0.32) and MABP (p = 0.14) did not significantly differ between treatment groups.

Conclusion
HSI may be beneficial in improving surgical field of view in FESS after 2 hours of operating time. A significant reduction in rate of blood loss may be attained with HSI.
Bleeding from bone is typically encountered when mucosa is stripped or while drilling.

If bone bleeding continues despite topical application of vasoconstrictors, this is expected given the microvascular bone anatomy.

The intraosseous vessels do not respond well to vasoconstriction and generally rely on clot formation or physical occlusion for hemostasis. The clotting process can be facilitated by topical application of a hemostatic material or TXA, and through physical occlusion by diamond burr or Surgifoam application followed by gentle pressure with a pledget.
What are some strategies to control named vessel bleeding?

<table>
<thead>
<tr>
<th>Vessels at Risk</th>
<th>Site of Encounter During ESS</th>
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<tbody>
<tr>
<td>Sphenopalatine artery <em>(see Lin G, Bleier B: Surgical management of severe epistaxis, in this issue)</em>&lt;br&gt;Main trunk&lt;br&gt;Branches to middle and inferior turbinates&lt;br&gt;Posterior septal artery</td>
<td>Extended antrostomy,&lt;br&gt;medial maxillectomy,&lt;br&gt;vidian neurectomy&lt;br&gt;Middle and inferior&lt;br&gt;turbinate surgery&lt;br&gt;Sphenoidotomy</td>
</tr>
<tr>
<td>Vidian and posterior pharyngeal artery <em>(see Lin G, Bleier B: Surgical management of severe epistaxis, in this issue; and Snyderman C, Pant H: Endoscopic management of vascular sinonasal tumors including angiofibroma, in this issue)</em></td>
<td>Vidian neurectomy</td>
</tr>
<tr>
<td>Greater palatine artery</td>
<td>Extended antrostomy&lt;br&gt;Medial maxillectomy</td>
</tr>
<tr>
<td>Branch to the Little area at incisive foramen <em>(Stensen canal)</em>&lt;sup&gt;47&lt;/sup&gt;</td>
<td>Septoplasty, septal flap surgery</td>
</tr>
<tr>
<td>Anterior and posterior ethmoid artery <em>(see Lin G, Bleier B: Surgical management of severe epistaxis, in this issue; and Shaftel SS, Chang S-H, Moe KS: Hemostasis in orbital surgery, in this issue)</em></td>
<td>Ethmoid sinus surgery</td>
</tr>
</tbody>
</table>
3) Postoperative bleeding
WHAT STEPS CAN BE TAKEN AT THE END OF SURGERY TO MINIMIZE THE RISK OF POSTOPERATIVE BLEEDING COMPLICATIONS?

- 15% to 25% of postoperative hemorrhage occurs within 24 hours of ESS.
- Significant bleed can occur up to 6 weeks after ESS and the most common time frame is between 1 and 2 weeks after ESS.
- Expose persistent bleeding areas:
  - Use saline irrigation to wash away blood clots
  - Request a Valsalva maneuver by the anesthetist
- If operating in the vicinity, ensure that posterior septal artery (sphenoid rostrum), sphenopalatine artery, and vessels at the root of the middle and inferior turbinates are adequately controlled
- If performing a septoplasty, a drainage-hole on 1 mucosal surface suturing the mucosal flaps or temporary septal splints may help reduce the risk of septal hematoma46
- Routine generalized nonabsorbable nasal packing is not necessary
- Focal or targeted application of a topical hemostatic agent may be considered select situations, generalized application of a topical antihemostatic agent may be required
The endoscopic approach to sinonasal surgery relies on hemostasis for visualization so that surgical goals can be accomplished without increasing the risk of serious complications or compromising patient outcomes.

Despite best efforts, if bleeding compromises endoscopic visualization, it is advisable to stop pursuing surgical goals, focus on bleeding control and return at a later date.

Proper surgical planning and prevention of bleeding here possible afford the best results. Although major vascular injury such as AEA or ICA bleed is uncommon during ESS, the surgical team and institution should have protocols in place and be prepared to execute proficient management to achieve best patient outcomes.
<table>
<thead>
<tr>
<th>Prevention</th>
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<tbody>
<tr>
<td>Make the correct diagnosis</td>
</tr>
<tr>
<td>Assess preoperative sinus imaging</td>
</tr>
<tr>
<td>Assess and manage:</td>
</tr>
<tr>
<td>Patient comorbid factors</td>
</tr>
<tr>
<td>Medications (off antiplatelet medication where possible)</td>
</tr>
<tr>
<td>No smoking 4 weeks before and after surgery</td>
</tr>
<tr>
<td>Preoperative embolization for vascular tumors</td>
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<table>
<thead>
<tr>
<th>Preoperative</th>
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</thead>
<tbody>
<tr>
<td>Patient position: reverse Trendelenburg 10° to 20°</td>
</tr>
<tr>
<td>Maintain body temperature</td>
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<tr>
<td>Local topical vasoconstriction: single-agent use</td>
</tr>
<tr>
<td>Suggestion: 1:10,000 adrenaline in 0.75% ropivacaine (1 mL of 1:1000 adrenaline mixed with 9 mL of 0.75% ropivacaine, total 10 mL) or oxymetazoline; refer to dosage on the preparation</td>
</tr>
<tr>
<td>Maintain favorable intraoperative hemodynamics (HR and blood pressure)</td>
</tr>
<tr>
<td>Talk to anesthetist</td>
</tr>
<tr>
<td>TXA: in patients at high risk of mucosal bleeding</td>
</tr>
<tr>
<td>Nasal polyps, EMCRS, AFRS</td>
</tr>
<tr>
<td>Meticulous surgical technique</td>
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<table>
<thead>
<tr>
<th>Intraoperative</th>
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<tbody>
<tr>
<td>Management of intraoperative bleeding</td>
</tr>
<tr>
<td>Assess site of bleeding: mucosa, bone, named vessel</td>
</tr>
<tr>
<td>Mucosal bleeding</td>
</tr>
<tr>
<td>Communicate with the anesthetist, check hemodynamics (HR, blood pressure)</td>
</tr>
<tr>
<td>Hot saline irrigation (40°–49°C) to clear clots and identify bleeding site, also independent hemostatic effect</td>
</tr>
<tr>
<td>Reapply topical vasoconstrictor, inform anesthetist</td>
</tr>
<tr>
<td>Cautery to specific bleeding sites</td>
</tr>
<tr>
<td>Topical hemostatic agents</td>
</tr>
<tr>
<td>TXA (if not given already)</td>
</tr>
<tr>
<td>DDAVP</td>
</tr>
<tr>
<td>Cautery of posterior septal artery or sphenopalatine artery</td>
</tr>
</tbody>
</table>

To prevent postoperative bleeding |
| At the end of surgery, Valsalva maneuver to expose and control bleeding sites |
| Other measures may be used, such as absorbable nasal packing, Silastic splints; elevation of head of bed, and topical oxymetazoline spray |
Table 3: Common errors and pitfalls during ESS with some suggestions

<table>
<thead>
<tr>
<th>Problem</th>
<th>Likely Explanations and Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhinitis medicamentosa</td>
<td>Topical vasoconstrictors may not work effectively</td>
</tr>
<tr>
<td></td>
<td>TXA can be of benefit intraoperatively</td>
</tr>
<tr>
<td>Use of natural or herbal therapies</td>
<td>Many have antiplatelet activity and should be stopped 10 d before surgery</td>
</tr>
<tr>
<td></td>
<td>Consider DDAVP intraoperatively</td>
</tr>
<tr>
<td>Ineffective reverse Trendelenburg position</td>
<td>It might not be a 10°–20° tilt. Confirm with a clinometer</td>
</tr>
<tr>
<td>Ineffective topical vasoconstrictor effect</td>
<td>1. Strategic and atraumatic placement of vasoconstrictors at sites of vascular supply</td>
</tr>
<tr>
<td></td>
<td>2. Allow time to work: peak vasoconstrictor effect noted ~30 min from application</td>
</tr>
<tr>
<td></td>
<td>3. If using adrenaline, do not dilute in alkaline solutions; it reduces its efficacy</td>
</tr>
<tr>
<td>Using primary vasodilators to reduce MAP</td>
<td>This reduces SVR and causes reflex tachycardia, which increases rate of blood flow to sinuses and no significant change to surgical field</td>
</tr>
<tr>
<td>Blood frequently tracking along the endoscope</td>
<td>Check the mucosa in the area where the endoscope is placed in the nose; this may be traumatized and requiring bleeding control</td>
</tr>
<tr>
<td>Bone bleeding not settling with topical vasoconstrictors</td>
<td>Bone vessel hemostasis usually relies on clotting mechanisms. Suggest topical Gelfoam, Surgifoam, or TXA application to facilitate control</td>
</tr>
<tr>
<td>Use of room-temperature or lukewarm saline irrigation</td>
<td>Hot irrigation rather than cold is shown to have hemostatic properties</td>
</tr>
</tbody>
</table>

Completely covering eyes with tape or drapes during ESS:
- This precludes or hinders intraoperative:
  - Palpation of the ipsilateral globe intermittently to check for lateral lamina bulge or dehiscence
  - Early detection of potential intraorbital hemorrhage by restricting proptosis, and causing early increase in IOP
- Suggest keeping eyes within the surgical field protected with copious amounts of lubrication ± consider taping the lateral canthus

Unrecognized Onodi cell:
- Surgeons may not appreciate that they are working in an area more superior and even lateral to the sphenoid sinus boundaries, hence placing the optic nerve and ICA at risk. This needs to be identified on CT scans pre-operatively

Anterior ethmoid artery on a pedicle below skull base:
- If not recognised pre-operatively, puts this vessel at risk during ethmoidectomy and frontal recess surgery. If injured, it also risks an intraorbital bleed

Overzealous superior and inferior extension of sphenoidotomy:
- Superior:
  - This risks injury to posterior ethmoid artery, and may cause a cerebrospinal fluid leak. Note that the dura dips to a varying extent at the junction of the roof of sphenoid (planum) and ethmoid bones, and a through-biter or rongeur can bite through this fold of dura against the skull base
  - Suggestion: use a straight curette to gauge the level of skull base immediately behind the sphenoid opening
- Inferior:
  - Injury to the posterior septal artery at the inferior limit of sphenoidotomy; this can also bleed postoperatively