Haemostasis in Endoscopic Sinus Surgery

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Why is haemostasis important?

- Surgical field and visualisation
  - avoid injury
  - complete the surgical procedure

- Bleeding co-morbidities
  - Hypoxia, hypovolaemia, blood transfusion

- Post-op bleeding, improve healing
  - Haematoma
  - Avoid packing, adhesions, scarring
Learning objectives

At the end of this chapter the reader will be able to:

• Apply key peri-operative preventative strategies to minimise bleeding

• Critically assess named vessels that may be at risk of injury

• Understand the rational application of local vasoconstrictors

• Understand the effects of relevant haemodynamic parameters during general anaesthesia on the surgical field

• Apply a logical approach to manage intra-operative bleeding

• Apply a rational approach in the management of suspected orbital compartment syndrome due to anterior ethmoid artery bleed
Broad Classification of Haemostasis

• Management of **expected bleeding**
  Microvascular circulation: mucosa, bone, vascular tumors

• Management of **inadvertent vascular injury**
  Macrovascular circulation: named vessels
Surgical bleeding

- Expected bleeding - MUCOSA
Surgical bleeding

• Expected bleeding - BONE
Surgical bleeding

• Expected bleeding - TUMOUR
Surgical bleeding

- Renal cell carcinoma metastasis to sinonasal cavity
- do everything you need to minimise bleeding
- highly vascular tumour
Surgical bleeding

- Inadvertent VASCULAR INJURY
Risk of mucosal bleeding

- Pathology
  - Nasal polyps
  - Rhinitis medicamentosa
  - Infection, subperiosteal abscess
  - Vascular tumors, thyroid eye disease
  - Immunopathology eg. vasculitides
- Prior surgery, radiotherapy
- Morbid obesity, venous hypertension
- Chronic alcohol, liver, kidney disease
- Smoking
Risk of mucosal bleeding

- Coagulopathies & platelet disorders

- Natural remedies (4 G’s)
  - Ginseng - platelet aggregation, 7 days
  - Garlic - platelet aggregation, 7 days
  - Ginger - platelet aggregation, 7 days
  - Gingko biloba - platelet activating factor, 24 hr

- Saw Palmetto, excessive intraoperative bleeding

- Vitamin E, Fish oil (Omega 3, >3 g / day)
Risk of Vascular Injury

- Correct diagnosis

ICA aneurysm
Risk of Vascular Injury

- Unfavourable vascular anatomy
- Anterior ethmoid artery, Onodi cell, sphenoid septations, internal carotid artery
Challenging situations

- Paediatric patients - low blood volume
- Co-morbidities that limit manipulation of BP and HR - cardiac, renal
- Hereditary Haemorrhagic Telangiectasia
- Aversion to receiving blood products - religious, personal
Approach to haemostasis

- Prevention
  - Pre-operative strategies
  - Intraoperative strategies
- Management of intra-operative bleeding
- Management of post-operative bleeding
Pre-operative preparation

• Optimise coagulation and platelet function
• Assess and manage co-morbid conditions
• Minimise inflammatory and vascular burden
• Pre-operative tumour devascularisation
• Examine clinically relevant vascular anatomy on pre-operative sinus computed tomography (CT) scans
Minimise inflammatory burden

- Treat infection, culture-directed antibiotics
  - **purulent** CRS
  - dental aetiology
  - subperiosteal abscess

- Rhinitis medicamentosa
  - Topical corticosteroids
Do pre-operative steroids improve surgical field?

• Hypothesis: GC minimises sinonasal inflammatory and vascular burden, thereby improving the surgical field

• Options
  
  • Topical intranasal GC
  
  • 5-10 days of prednisolone or other oral GC
  
  • Single pre-operative dose of oral GC

• In nasal polyps, there is a trend towards reduced blood loss

• A single pre-operative dose may be sufficient to improve surgical field
Pre-operative devascularisation

- Not used routinely for sinus surgery
- Vascular tumors, angiofibroma, haemangiopericytoma
- IMAX - transpterygoid, infratemporal fossa approach
- ICA contribution - if present, generally persists
Preoperative sinus CT evaluation

- Correct patient, most recent scans, high resolution, different planes
- Systematic approach
  - Cribiform 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)
- Diagnosis – confirm clinical with radiological characteristics
Intra-operative strategies

- Key strategies that are closely linked

- Local vasoconstriction
- Patient Position
- Surgical technique
- Anaesthetic technique

- And Tranexemic acid ...
How high to raise the head of the bed?

- Reverse Trendelenberg position

- Minimum of 10 degrees head elevation to show a benefit in surgical field

- Achieve a balance between improved surgical field and cerebral perfusion pressure

- Aim for 10 – 20 degree head elevation
Local vascular control - a rational approach

stimulation of both provides best vasoconstriction and decongestion

- adrenaline - non-selective alpha agonist (alpha 1 + alpha 2)
- oxymetazoline, phenylephrine - alpha 1 > alpha 2 agonist
- cocaine - potentiates action of Adrenaline + Noradrenaline
  - local anaesthetic
Topical mucosal application

- **Recommended options:**
  - adrenaline 1:1000; 1:2000 diluted in LA
  - oxymetazoline

- **Pledged position**
  - 0.5 x 2 inches; 4 in each nostril
  - root of middle turbinate, middle meatus
  - sphenoid rostrum
  - working space (anterior septum, floor, IT)
  - atraumatic technique
  - no pledgets should be seen from outside
Local vasoconstriction

- Single agent use
- Allow time to exert its effects
  - Usually 15 min, peak effect 30 min
- Atraumatic application
- Sites of topical application
  - Root of middle turbinate/middle meatus (sphenopalatine artery)
  - Sphenoid rostrum (posterior septal artery)
  - Anterior nasal cavity (working area, mucosal decongestion)
  - Anterior floor of nose (greater palatine artery at incisive foramen)
- Adding vasoconstrictor injection has no further hemostatic benefit (including greater palatine canal injection)
General anaesthetic technique

**Does hypotensive anaesthesia give best surgical field?**

\[ \text{HR} \times \text{SV} = \text{CO} \quad \text{HR} \times \text{SV} \times (\text{CO} \times \text{SVR}) = \text{MAP} \]

In most studies, consistent relationship between low HR and MAP and surgical field.

**Is total intravenous anaesthesia (TIVA) needed for best surgical field?**

- TIVA causes less variability in MAP and HR, therefore stable conditions.
- These stable conditions can also be achieved without TIVA.
  - Inhalational anaesthesia and remifentanyl infusion.

**Key Issues**

- Good communication with anaesthetist.
- Up to anaesthetist to utilise effective technique that achieves a balance between ideal physiological parameters that is safely tolerated by patient.
Tranexamic acid (TA)

- TXA prevents clot breakdown (antifibrinolytic)
- Systemic use pre-operatively\textsuperscript{30,31}
  - Significantly improved visualisation, reduced bleeding
- Some concern regarding systemic TXA use and risk of deep vein thrombosis
- Topical TXA (5\%) in sinus surgery compared with no TXA\textsuperscript{32}
  - Significantly improved surgical field (in the first 30 min)
  - Overall less bleeding in the TXA group
Surgical Techniques to minimise bleeding

- Prevent unwanted mucosal injury
- Precise and strategic placement of endoscope and instruments
- Use suction with atraumatic tip
- Minimise direct suction of normal tissues
- Avoid unnecessary mucosal stripping
- Use sharp, through-biting or cutting powered instruments
- Methodical surgical approach
  - Working quickly to debulk inflammatory tissue eg. nasal polyps
  - Where possible, work from inferiorly to superiorly to avoid blood tracking down the endoscope
Surgical Techniques to minimise bleeding

- Avoid potential vascular injury
- Establish intra-operative surgical landmarks
  - Level of orbital floor
  - Lateral limit, lamina papyracea
  - Choana, sphenoid ostium, skull base
- Confirm with intraoperative navigation
- Revision sinus surgery
- Extensive nasal polyps
- Frontal sinus Draf 3 surgery
- Skull base surgery
Nasal polyps

- Start inferiorly when removing polyps
- Use microdebrider or if using cutting instruments, grasp “neck” of polyp and clean cuts
- Work quickly and carefully
- As diseased tissue is removed, surgical field improves
Debulking tumor

- Work around the periphery

- Address site of attachment = site of vascular supply towards the end

- Bimanual dissection (2 surgeons)
When intraoperative bleeding occurs....

- Identify source of bleeding
- mucosa
- bone
- specific, named vessel
Mucosal bleeding

- Specific site?
  - topical vasoconstrictor, electrocautery

- General ooze
  - go through checklist, communicate with anaesthetist
  - hot saline irrigation for a few minutes
  - can identify specific problem areas to be targeted with topical vasoconstrictor or cautery
Does hot saline irrigation improve the surgical field in ESS?

- What temperature to use? Animal study of sinus mucosal histology after hot water exposure

  - >52 °C cell necrosis
  - 48-50 °C moderate mucosal change, no necrosis
  - 46 °C slight mucosal change, no necrosis
  - 40-44 °C no significant mucosal change

- In ESS, hot saline irrigation at 49°C

  - Improvement in surgical field and blood loss for surgeries >2 hours duration
Mucosal bleeding continues?

- Tranexamic acid (if not already given)
- Topical haemostatic agents
- DDAVP
- Vasoconstrictor injection or cauterization of major feeding vessels to reduce blood flow
  - Posterior septal artery
  - Sphenopalatine artery
Specific vessel control

- SPA, Posterior septal artery, greater palatine artery, root of inferior turbinate
  - monopolar cautery can be used effectively

- Anterior ethmoid bleed
  - bipolar, topical adrenaline soaked gauze, ligation

- May need more expose to adequately control the vessel
Posterior nasal artery
Anterior ethmoid ligation
Avoid Surgical mistakes

- Limit monopolar cautery for SPA, PSA, IT, PNS, sphenoid rostrum and septum
- Everything else, use bipolar cautery, target strategically to bleeding site
- ICA injury
  - straying from midline
  - “blind” puncture of thick anterior sphenoid wall
  - use of monopolar currenttes
  - blind dissection
Avoid Surgical mistakes

- Anterior and Posterior ethmoid artery
  - recognise pre-op the location of the ethmoid arteries

- CSF leak
  - overzealous opening of superior sphenoidotomy. Between sphenoid bone and ethmoid
  - lateral lamella

- Meticulous surgical technique
  - wide exposure, landmarks, navigation
  - proper use of ronguers
Other considerations

- Prolonged surgery
  - Blood loss, haemodilution, hypothermia
  - Fresh frozen plasma

- Unrecognised von Willebrand disease
  - Autosomal dominant or recessive; Acquired
  - Normal platelet count, INR
  - AbN bleeding time, APTT
  - Desmopressin (DDAVP) – releases endothelial vWF
Minimise risk of post-operative bleeding

• At the end of ESS, “expose” persistent bleeding areas
  • Use saline irrigation to wash away blood clots
  • Request a valsalva manouvre by the anaesthetist

• Adequate control of posterior septal artery (sphenoid rostrum), sphenopalatine artery, vessels at root of middle and inferior turbinates

• Routine generalised non-absorbable nasal packing is not necessary

• “Focal” or “targeted” application of a topical haemostatic agent may be considered

• In select situations, generalised application of a topical anti-haemostatic agent may be required
Summary & Suggestions

• **Pre-operative**
  
  • off antiplatelet meds where possible
  
  • no smoking 4 weeks pre-operatively
  
  • careful assessment of CT scans
  
  • pre-operative corticosteroids
  
  • Nasal polyps, single dose may be helpful
Summary & Suggestions

• **Intra-operative**
  - Single dose of dexamethasone
  - Patient position - 15 degrees head up
  - Topical vasoconstrictor
    - Single agent, either oxymetazoline or adrenaline
    - Adrenaline – 1: 10 000 solution in 0.75% naropin
    - 0.5 x 2 inch cottonoids
    - Leave for 15 minutes
  - Nasal polyps - 1 g IVI Tranexamic acid
  - General anaesthesia – aim for low MAP and HR
Summary & Suggestions

- **Intra-operative bleeding**
  - Target specific sites
  - General mucosal bleeding
    - run through checklist, talk to anaesthetist - tranexamic acid, DDAVP, plasma
    - hot saline irrigation, electrocautery, Surgicel mesh, Surgiflo
    - SPA ligation, posterior nasal artery cautery
  - Specific site bleeding
    - Identify arterial or venous bleeding & manage accordingly