Spine Surgery Perspective

- **Pre-operative planning**
  - There are many cases in which large volume blood loss is anticipated
    - Tumors: Renal, Thyroid
    - Deformity
    - Osteoporosis

- **Intra-operative management**
  - Pre-operative preparation
  - Team approach
  - Anticipate blood loss

- **Case examples**

Pre-operative planning

- **Optimize their Physiology**
  - Weight loss
    - Lap band
  - Nutritional support
  - Smoking cessation

- **Nutritional Considerations**
  - 25% of patient undergoing elective spine surgery are malnourished (Klein 1996)
  - 42%, over 60% are malnourished
  - Osteomyelitis and SCI have 75% malnourishment

- **Autologous blood**
  - Pre-op autologous blood donation (PABD)
    - In elective spine surgery (Brookfield et al 2008)
      - Does not reduce homologous transfusion rate
      - 40% of cases still required homologous blood
      - 45-55% of pre-donated units wasted
      - Those who pre-donated had higher requirements for homologous transfusion
  - Intra/post-op blood salvage

- **Optimizing of pre-op hematocrit**
  - Erythropoietin
  - Fe rich diet

Pre-operative planning

- **Stopping of all nutritional supplements**
  - Ginseng
  - Ginger
  - Garlic
  - Spirulina

- **Appropriate consults**

Case 1

- 75 M with history of L3 compression fracture and previous laminectomies

- **Medical history:** ASA 3
  - Stage IV Liver disease (NASH)
  - BMI = 31
  - CHF, T2DM

- **Surgical history:**
  - Decompression halted due to excessive bleeding
  - Compressive epidural hematoma requiring second, more extensive decompressive laminectomy

- **Surgical Plan:**
  - Lateral L3 corpectomy followed by posterior fixation with cement augmentation
Case 1

- Labs:
  - HH – 12.9/33.5
  - Platelet count 77
  - INR 1.3, PT 15.9, PTT 36.3
  - ALT 15, AST 23, Alk Phos 108

- Considerations:
  - Liver disease – platelet number/function, factors and ability to clot
  - Previous surgery halted, compressive epidural
  - Surgery – corpectomy, use of cement

Case 1

- PRBC – 2 units
- Platelets – 2 units
- FFP – 4 units
- Cell Saver – 1370 mL
- Crystalloid – 2000 mL
- Albumin – 1000 mL

- EBL – 3600
- UOP - 1300

Intra-operative care

- Patient Factors
  - BMI
  - Medical co-morbidities

- Surgical Factors
  - Elective versus Trauma
  - Complexity
  - Approaches

- Unexpected Factors
  - Vascular injuries
  - Neurologic issues
Surgical Factors - Neck

- **Anterior:**
  - Recurrent laryngeal nerve injury
  - Exposure related bleeding
  - Esophageal injuries
  - Direct compression
  - Late rupture due to burn wounds and necrosis
  - Spinal cord injury
  - Vertebral artery injury

- **Posterior:**
  - Vertebral artery injuries
  - Exposure related bleeding
  - Nerve root injury
  - Spinal cord injury

Surgical Factors - Thoracic

- **Anterior:**
  - Lung injury
  - Vascular injury
  - Segmental bleeding

- **Posterior:**
  - Cord injury
  - Direct injury
  - Positioning
  - Pedicle screws
  - Most narrow part of the spinal canal
  - Sensitive to manipulation
  - Blood supply

Surgical Factors - Lumbar

- **Anterior:**
  - Vessel injury
  - Ureter injury
  - Bowel injury

- **Posterior:**
  - Epidural bleeding
  - Cauda equina injury
  - Nerve root injury
  - Dural tears
  - Fracture of the pedicles
  - Related to implants

Surgical Factors - Interbody Fusion Approaches

- **ALIF:** requires exposure surgeon, approach risks, avoids dural sac, no decompression option
- **PLIF:** decompression, exposes dural elements, retraction risks
- **TLIF:** avoids dural sac, decompression possible
- **XLIF:** L5-S1 not accessible,
- **AxiaLIF:** percutaneous access to L5-S1. An anterior interbody fusion technique with a novel approach

Cases 2 and 3

- **TLIF** – 69 M T1DM
  - EBL – 200 mL
  - UOP – 400 mL
  - Crystalloids – 2000 mL
  - No complications

- **ALIF** – 28 M o/w healthy
  - EBL – 200 mL
  - UOP – 400 mL
  - Crystalloids – 1800 mL
  - No complications
Intra-operative management

- Anticipated Blood loss in excess of 1500 – 5000 ml
  - Central line
  - 2 peripheral lines
  - Arterial line
  - Urinary catheter

- EBL
  - Keep HB AROUND 10
  - Balance crystalloid and colloid replacement
    - >4 hours
    - 40% blood loss
    - Colloid
    - With increased blood loss
  - FFP and platelets
    - Scoliosis has abnormal bleeding times related to calmodulin and platelets
    - Tumors

Acute Blood Loss

- Intra-op
  - Cell saver
  - No platelets or coagulation factors
  - Cochrane review in 2010 – 40% reduction in transfusion
  - TXA
    - Meta-analysis 2015 – Reduces bleeding, no increased adverse outcomes
  - Body temperature at 37
  - Flo seal
  - Thrombin
  - Tissue
  - Replace blood with blood or at least a colloid
  - Start transfusion of colloid after first 250 ml of loss
  - Platelets/FFP

Blood pressure

- Keep MAP between 70 -75 mmHg
  - Correlate for each patient if hypertensive, keep higher

- Keep the capillary osmotic pressure high
  - Perfusion of the spinal cord
  - Optic nerve infarction and blindness
  - Stroke
  - ATN
    - Oliguric and acidosis will further increase the bleeding
Case 4

- 66 F w/ L5-S1 pseudarthrosis and sagittal plane imbalance
- ASA 2
- PMHx:
  - GERD
  - HTN
  - BMI 31

Case 4

- Revision of L5-S1 anterior
- Avulsion of common iliac vein feeder
  - ~ 1800 mL blood loss with anterior approach

Case 4

- Posterior Osteotomy
- EBL (Total) – 3800 mL
- PRBC – 4 units
- FFP – 2 units
- Cell Saver – 1400 mL
- UOP – 1150 mL
- Crystalloid – 3300 mL
- Albumin – 1900 mL

Case 4

- Considerations:
  - Anterior approach vascular injury
  - Previous surgery (although posterior)
  - Osteotomy – high blood loss

Neurological compromise

- Base line SSEP, MEP and H-reflexes

- Compare the values for upper and lower extremities as well as L and R

- Nerve root compromise
  - Local
  - Unrelated to the surgical procedure
Signal loss

• ALWAYS RESPOND
• Raise the blood pressure (MAPS to 80-90)
• Remove all the distraction devices
• Do not manipulate the cord
• Reposition the neck of the patient
• Steroids may play a role

Case 5

35 F w/ T7 and T8 fractures and eventual infection treated non-operatively

PMHx:
• Hypertension
• Stroke
• Asthma
• Migraine
• Ulcer
• Arthritis
• Trigeminal neuralgia
• Trigeminal neuralgia
• Kidney stones
• Dislocation of mandible
• Amenorrhea
• PTSD (post-traumatic stress disorder)

Surgical plan:
• T7 vertebral body resection
• Posterior instrumented fusion T2 – L2
• Maintain MAP > 90

EBL – 1500 mL
• PRBC – 3 units
• FFP – 1 unit
• Cell Saver – 540 mL
• UOP – 1425 mL
• Crystalloid – 3500 mL
• Colloid – 1500 mL

Complications related to surgery

• Inherent to the pathology
  • Vascular tumors
• Inherent to the level of technical difficulty
  • Anatomy
  • Implant related
  • Broken equipment
• Surgeon related
• Risks of anesthesia
• Positioning in the OR!!
Acute complications

- Hemorrhage
  - Reported to 10 liters for tumors
- Neurological disasters
  - Acute cord infarction
  - Accidental severance of the cord
- Fatal adverse events
  - MI
  - Pulmonary complications
    - Tension pneumothorax

GENERAL NOTES....

- LONG SPINE FUSIONS ARE EXTREMELY DEVASTATING OPERATIONS....
- ALL THE MUSCLES FROM THE SCALPULA TO THE SACRUM ARE STRIPPED...
- ANTERIOR SURGERY ADDS ANOTHER PAIN COMPONENT
- THE INABILITY TO MOVE DUE TO PAIN CAUSES ATELECTASIS. PNEUMONIA...DVT ....PE ...DEATH!

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