Anaesthesia for spine surgery

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Spinal trauma

• **Goals:**
  
  • To prevent secondary injury to spine
  
  • Ischaemia, hypoxia, inflammation, etc.
  
  • → Cord oedema, Cell death

  • To provide other organ support
Focus

1. Airway management
2. Intraoperative measures to prevent secondary injury
3. Positioning
4. Neurophysiological monitoring
1. Airway Management

- Primary survey in ATLS guideline
  - A- Airway maintenance with cervical spine protection
  - B- Breathing and ventilation
  - C- Circulation with hemorrhage control
  - D- Disability (Neurological evaluation)
  - E- Exposure and Environment (Temperature)

- SCI in up to 2-5% of all major trauma cases

- Cervical SCI in 10% of head injured patients

- Level of injury? Neck stable or unstable? Urgency of intubation?
Airway management

• Neck immobilization

Neck Collars
Spinal board with head restraints
Halo Brace
How to intubate?
Neck extension and head elevation (pillow)

Greatest motion in occiput-C1 and C1-2
Minimal motion below C4
Minimize neck movement during intubation

- Manual in-line stabilization
- Awake fibreoptic intubation
- Videolaryngoscope
Manual in-line stabilization

- Head and neck in neutral position

- Assistant
  - Head of bed: Grasp the mastoid process with the fingertips and cradle the occiput in the palms of their hands
  - Side of bed: Cradle the mastoids and grasp the occiput

- When MILS is in place, the anterior portion of the cervical collar can be removed.

- Reaplication of neck collar when airway interventions are complete.
Awake fibreoptic intubation
• Advantages:
  • Minimal neck movement
  • For patients wearing stabilization devices such as halo vests
  • Difficult airway
  • Allows post-intubation neurological assessment

• Disadvantages
  • Blood in airway
  • Uncooperative/ combative patient
  • Requires expertise/ equipment
  • Time constraints
  • Increase ICP if gag or cough
• Topicalization of airway
  • LA
  • Regional block
• +/- Sedation
Videolaryngoscope
• Improved laryngeal visualization

• Less force used; Less cervical spine movement
Cricoid pressure

- To prevent aspiration
- Efficacy controversial
- In cadavers with C-spine injuries, cricoid pressure did not distract the injured segment.
Choice of muscle relaxant

- Succinlycholine/ Suxamethonium
  - Avoid if spine injury >48 hours
  - Hyperkalaemia
Extubation/ Post-op placement

- Individualized decision
  - Level of injury/ surgical intervention
    - C3-5 → diaphragm innervation
  - Difficult airway
  - Prone position → facial oedema
  - Type of operation/ intraoperative events
    - Anterior spinal fusion → risk of recurrent laryngeal nerve injury, neck haematoma
    - Long operating time
    - Massive blood loss
  - Other co-morbidities/ pre-op status
Cook Airway Exchange catheter can also be used for extubation and re-intubation. It allows ventilation either with a standard 15 mm connector or a dedicated connector for jet ventilation.
2. Secondary injuries

- Hypoxia – Oxygenation, Haemoglobin
- Ischaemia – BP control
- Hyperglycaemia
- Hypothermia, Hyperthermia
BP control

- Spinal cord perfusion pressure
  \[ \text{SCPP} = \text{MAP} - \text{CSFP} \]
- MAP \( \geq \) 85mmHg
- Spinal shock (Acute phase, 4-6 weeks)
  - Flaccid paralysis, loss of reflexes below the level of lesion, paralytic ileus, loss of visceral and somatic sensation, vascular tone and vasopressor reflex
  - Neurogenic shock: Bradycardia, Hypotension
    - High cervical lesion
    - First 2 weeks
    - Medication (fluid, vasopressor/inotrope)
• Autonomic hyperreflexia (chronic phase)
  • Appear 1-3 weeks after injury
  • Stimulation from bladder, bowel, surgical stimulation
    → massive sympathetic response
    → Vasoconstriction below lesion, Hypertension
    → Vasodilatation above lesion, bradycardia, ventricular dysrhythmia, heart block
  • 85% of patient with **spinal cord transections above T6**
  • Medications, Arterial line
Blood loss
## Risk factors

| Procedure characteristics          | Surgery for tumour excision  
|                                    | Surgery for trauma of spine   
|                                    | Surgery for infection (TB, osteomyelitis, etc.) 
|                                    | Revision surgery              
|                                    | ≥ 3 vertebral segments fusion 
|                                    | instrumentation               |
| Patient characteristics            | Age >70 years old             
|                                    | Obesis                        
|                                    | Patients with known clotting defects |
|                                    | Children with neuromuscular scoliosis |
Minimizing blood loss/blood transfusion

- Medication history: Aspirin, NSAID, Plavix, LMWH, Chinese medicine (ginkgo, ginseng, etc.)
- Careful positioning to avoid impediment of venous drainage and engorgement of the epidural veins
- Staged operation, pre-op embolization, meticulous haemostasis, etc.
- Transamine (Tranexamic acid), NovoSeven (recombinant activated factor VII)
- Rarely: Controlled hypotension, acute normovolemic haemodilution, erythropoietin
• Cell Saver
  • Collection of blood shed
  • Anticoagulated
  • Filtered for debris and clots
  • Centrifuged
  • Re-suspended in saline
3. Positioning
• Supine, prone, lateral

• Can be accomplished in different ways
  • Different surgery/ Adequate surgical exposure
  • Level of intervention
  • Different tables/ support devices
  • Intraoperative X-ray

• Safe!
Principles

- Head and neck support
Head and neck support devices
• Space for endotracheal tube

• Avoid pressure on eyes
  • Postoperative visual loss
    • Spine, cardiac, head and neck surgeries
    • Uncommon (0.3% in spine surgery)/Rare
    • Increased intraocular pressure from prone position, hypotension, anaemia, blood loss >1 L, duration >6 hours
      • Frequent checking, Head up 10°

• Avoid pinching of the ears

• Headrest may cause pressure injury of supraorbital nerve

• Lack of lubrication or coverage of eyes: corneal abrasion
# Post-operative visual loss

<table>
<thead>
<tr>
<th></th>
<th><strong>Ischemic Optic Neuropathy (ION)</strong></th>
<th><strong>Central Retinal Artery Occlusion (CRAO)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Etiology</strong></td>
<td>Intraop ↓ BP</td>
<td>Direct external pressure</td>
</tr>
<tr>
<td></td>
<td>Prolonged surgery</td>
<td>Emboli</td>
</tr>
<tr>
<td></td>
<td>↑ Blood loss</td>
<td></td>
</tr>
<tr>
<td></td>
<td>↑ Crystalloid infusion</td>
<td></td>
</tr>
<tr>
<td><strong>Mechanism</strong></td>
<td>Ischemia</td>
<td>↓ Ocular perfusion pressure</td>
</tr>
<tr>
<td></td>
<td>Orbital edema → stretch and compression of ON</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical Features</strong></td>
<td>Painless</td>
<td>Painless</td>
</tr>
<tr>
<td></td>
<td>Bilateral</td>
<td>Unilateral</td>
</tr>
<tr>
<td></td>
<td>↓ Light perception</td>
<td>Periorbital swelling or ecchymosis</td>
</tr>
<tr>
<td></td>
<td>↓ Visual fields</td>
<td></td>
</tr>
</tbody>
</table>
• Thoracic compression
  • Increase airway pressure, affect ventilation
  • Decrease venous return, decrease cardiac output
• Abdominal compression
  • Vertebral venous engorgement
  • More bleeding
• Nerve injury
  • Brachial plexus stretch or compression
    • the arms at the shoulders must be in 90 degrees or less abduction
    • the elbow in 90 degrees flexion
    • the forearms pronated
  • Ulnar nerve compression: pressure to the olecranon
  • Peroneal nerve compression: pressure over the head of the fibula
  • Lateral femoral cutaneous nerve trauma: pressure over the iliac crest

• Soft tissue compression injury
  • face, breasts, and genitalia
4. Neurophysiological monitoring

- SSEP (Somatosensory evoked potential)
- MEP (Motor evoked potential)
- Wake up test
Anatomy and Blood Flow

**Dorsal Columns:**
- Sensory, Ascending
- Well supplied by paired Posterior Spinal Arteries
- **SSEP**

**Ventral Columns:**
- Motor, Descending
- Supplied by single ASA (large watershed area)
- Sensitive to ischemia
- **MEP**
SSEP

Electrophysiologic response to stimulation

Amplification $\alpha \sqrt{N}$

$1\mu V$
MEP
Anaesthetic implications

- Maintain perfusion pressure
- Stable physiology
  - Avoid
    - Hypothermia
    - Hypotension
    - Hyperventilation
    - Hypoxia
- SSEP
  - Propofol
  - Inhalational agents (< 1MAC)
- MEP
  - Avoid inhalational agents; no muscle relaxation
  - Bite block
Bite Block
Wake up test

- Preoperative counseling
- Careful titration of anaesthetics
- Bite block
Summary

1. Airway management
   - Different ways to perform intubation

2. Intraoperative measures to prevent secondary injury
   - BP, O₂, H’stix, Temp, Hb

3. Positioning
   - Prone

4. Neurophysiological monitoring
   - May affect choice of anaesthetics
The End

Thank You