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Anesthesia for spine surgery

- 764.8 M years lived with disability is caused by low back pain.
- 21.7/million had spinal cord injury in global.
- 9.02% had degenerative lumbar spine in Chinese.
- 9,184 spine surgery within 10 years in single department, 2,200 beds hospital.


Epidemiology and contemporary risk profile of traumatic spinal cord injury in Switzerland. Inj Epidemiol 2016.


Introduction

- The spectrum of spine surgery
- Considerations/assessment
- General or regional anesthesia
- Intraoperative neuro-monitoring
- Blood conservation
- Positioning related complications
Infection

- **Aims**
  - Get rid of source
  - Stabilization?

- **Consideration**
  - Chronic illness
  - Muscle relaxant effect

<table>
<thead>
<tr>
<th></th>
<th>Recurrent infection</th>
<th>Revision</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation</td>
<td>5.6% (7/126)</td>
<td>0.8% (1/126)</td>
<td>1.6% (2/126)</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>7.7% (24/312)</td>
<td>3.6% (11/312)</td>
<td>7.4% (23/312)</td>
</tr>
</tbody>
</table>


Malignancy

- **Aims**
  - Pain relief
  - Excision
  - Prevent neurological deterioration

- **Considerations**
  - Pulmonary infection, effusion, toxicity
  - Myocardial injury
  - Metabolic derangement
  - Pain killers
  - Massive bleeding

Congenital/idiopathic

- 70% Idiopathic scoliosis
- Muscular dystrophy
- Cobb angle >40-50

Aims
- Prevent further progression

Considerations
- Restrictive lung
- Hyperkalemia
- Cardiomyopathy

Operative treatment of scoliosis: Preoperative planning, intraoperative monitoring, and postoperative management.

Orthopade 2015.
Trauma

Considerations

- Spinal shock
- Airway management
- Respiratory failure (C3-5)
- Bradycardia (T2)
- Hypotension (T6)
- Associated injury
- Autonomic dysreflexia (T6)


Degenerative

- Consideration
  - Thromboembolism
  - Blood lost
  - Age related physiology
- Instrumentation
- Minimal invasive spine surgery
  - Endoscopic
  - Navigation
  - Transforaminal lumbar interbody fusion (TLIF)

Monitored anesthetic care, general or regional anesthesia?

- Propofol
- Dexmedetomidine

11 studies were identified
- 4 RCTs
- 3 Case control
- 2 prospective cohort
- 2 retrospective analyses

RA: reduced HRs and MAPs
RA: lower post-operative analgesic requirement
Both RA and GA are safe and effective.

Airway manipulation

- **Airway assessment**
  - Denis classification (2/3)
  - Jefferson fracture
  - Odontoid fracture

Manual in-line stabilization?

Awake or sleep?

Conventional or advanced laryngoscopy?
Intubation algorithm in cervical spine patients

Cervical/upper thoracic surgery proposed

Spine stable

Direct laryngoscopy expected to be easy

Risk of aspiration

No

I.V. induction NDNMB
Direct laryngoscopy

Yes

RSI i.v. succinylcholine
Direct laryngoscopy

Spine unstable

Direct laryngoscopy expected to be difficult*

Risk of aspiration

No

Consider Asleep FO
ILMA

Yes

Awake FO

Direct laryngoscopy impossible without neck manipulation

Direct laryngoscopy thought to be possible without neck manipulation

Consider Direct laryngoscopy with manual stabilization of spine
Asleep FO
ILMA

*e.g. presence of: halo vest
severe kyphoscoliosis
anatomical variance: micrognathia, restricted mouth opening

Intraoperative neuromonitoring

- **Stagnara wake up test**
  - Evaluate gross motor pathways
- **Technique**
  - Propofol infusion
  - Midazolam/flumazenil
  - Remifentanil
  - Volatile based

Measure at a precise moment

Intraoperative neuromonitoring

- Somatosensory evoked potential
- Motor evoked potential
- Electromyography


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### Evoked potential

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Spinal Area or Condition</th>
<th>No. of Procedures Monitored</th>
<th>SSEPs</th>
<th>MEPs</th>
<th>EMG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuwer et al., 1995</td>
<td>scoliosis</td>
<td>51,263</td>
<td>92%</td>
<td>98.9%</td>
<td></td>
</tr>
<tr>
<td>Kelleher et al., 2008</td>
<td>cervical-thoracic spine</td>
<td>1055</td>
<td>52%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Gunnarson et al., 2004</td>
<td>lumbar spine</td>
<td>213</td>
<td>28.6%</td>
<td>98.7%</td>
<td>46%</td>
</tr>
<tr>
<td>Paradiso et al., 2006</td>
<td>tethered cord</td>
<td>44</td>
<td>50%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Multimodality Monitoring: Combined SSEPs, MEPs, EMG**

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Spinal Area or Condition</th>
<th>No. of Procedures Monitored</th>
<th>Overall Sensitivity</th>
<th>Overall Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sutter et al., 2007</td>
<td>all spine</td>
<td>1017</td>
<td>89%</td>
<td>99%</td>
</tr>
<tr>
<td>Quraishi et al., 2009</td>
<td>all spine</td>
<td>102</td>
<td>100%</td>
<td>84.3%</td>
</tr>
</tbody>
</table>
Effect of anesthetic agents

<table>
<thead>
<tr>
<th>Agent</th>
<th>Type of Stimulus</th>
<th>Stimulus Paradigm</th>
<th>Median Amplitude (µV)</th>
<th>Amplitude (%) of Baseline</th>
<th>Patients With Responses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N2O</td>
<td>TcE</td>
<td>1 pulse (60)</td>
<td>401</td>
<td>88</td>
<td>100</td>
</tr>
</tbody>
</table>

Inhalational halogenated anesthetics & nitrous oxide lead to a dose-dependent reduction in MEP signal amplitude, limiting the ability to detect significant neurological changes. Use of TIVA can minimize the need for halogenated anesthetics. TIVA regimens can include a combination of propofol, synthetic narcotics, & N-methyl-d-aspartate receptor antagonists (that is, ketamine) neuromuscular blockade & hypothermia also suppress MEP recording. Opioids have minimal impact on MEP recording. Regardless of regimen used, it is crucial to maintain a stable concentration of the inhalational or intravenous anesthetic, because sudden changes in dosage can cause MEP changes, making interpretation difficult.

Hypothermia, hypoxia, hypotension, ischemia, hypo/hypercarbia

Blood conservation

- **Decrease bleeding**
  - Hemodynamics
    - Controlled hypotension
    - Local vasoconstrictors
  - Chemical
    - Tranexamic acid
    - Bone wax
    - Hemostatic sponges
    - Fibrin sealants

- **Decrease transfusion**
  - Hemodynamics
    - Acute hemodilution
    - Planned autologous transfusion
    - Cell saving
  - Chemical
    - Erythropoietin
    - Substitutive oxygen carriers

An overview of blood sparing techniques used in spine surgery during the perioperative period. Eur Spine J 2004.
Tranexamic acid

Positioning related complications


Brachial plexus injury following spinal surgery. J Neurosurg Spine 2010

- Abdominal compression
- Restrict blood flow to IVC
- Paravertebral, epidural vein engorgement

- 0.2% after spine surgery
- Ischemic optic neuropathy
- Central retinal artery occlusion

- 0.03% after spine surgery
- Neurapraxia

- 2-6 hours, obesity, age, steroids
Ventilation
- Free abdominal movement
- Wilson frame or chest roll

Neck
- Carefully place in midline or rotated line

Endotracheal tube and line
- Secure

Airway edema
- Head up 10-15 degree

Brachial plexus
- Never abduct arm >90 degree
- Shoulders support, flex elbows
- Arms below shoulders
- Pulse checked and elbow free

2 Table setting
and turn as single unit

Peroneal nerve
- Padding
Anesthesia for spine surgery


THANK YOU FOR YOUR ATTENTION

QUESTION?

IF SO … PLEASE ASK A GUY NEXT TO ME

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