Anaesthetic considerations for Scoliosis Surgery

Dr Paul Whiting
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Causes of Scoliosis

• Scoliosis is typically classified as either
  – **Congenital** (Vertebral anomalies present at birth)
  – **Idiopathic** (Sub-classified according to time of onset – adolescent or adult)
  – **Secondary** to neuromuscular conditions (Spina bifida, Cerebral palsy, Spinal muscular atrophy), Trauma, TB and Syndromes (Marfans)
Indications for Surgery for Scoliosis

• Surgical treatment for scoliosis is indicated, in general, for a curve exceeding 45 or 50 degrees by the Cobb's method
  – Curves larger than 50 degrees progress even after skeletal maturity.
  – Curves of greater magnitude cause loss of pulmonary function, and much larger curves cause respiratory failure
    • curves between 60 and 100 degrees, total lung capacity was 68% of predicted normal values
    • Nearly half of the patients with thoracic curve larger than 80° degrees had shortness of breath at the average age of 42 years
    • Vital capacity below 45% predicted and a Cobb angle greater than 110 degrees were risk factors to develop respiratory failure and earlier death [6].

• Larger the curve the more difficult to treat with surgery
• Sometimes patient's motivation to straighten her/his spine by surgery should be respected, especially for the patient with gray zone curve, Cobb angle of 40 to 45 degrees.
Indications for Surgery for Scoliosis

• The two main types of surgery are:
  – **Anterior fusion**: This surgical approach is through an incision at the side of the chest wall.
  – **Posterior fusion**: This surgical approach is through an incision on the back and involves the use of metal instrumentation to correct the curve.

• One or both of these surgical procedures may be needed and occur in one or two stages
Anaesthetic Considerations

• Pre-assessment
• Induction and Maintenance/Spinal Cord Monitoring
• Prone Position
• Monitoring
• Analgesia
• Few other bits and bobs!
Anaesthetic Considerations

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Pre-Assessment

– Syndromes and associated issues
– Spirometry
– ECHO if Cobbs angle significant
– Anticipated grade of intubation
– Neuropathies
– Vertebrobasilar insufficiency
Anaesthetic Considerations

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Induction and Maintenance/Spinal Cord Monitoring

Intraoperative spinal cord monitoring is used throughout the operation

- Two types of evoked responses, somatosensory evoked potentials (SSEPs) and motor evoked potentials (MEPs) are used
- The spinal cord may be at risk if the amplitude of SSEPs are reduced to <50% of baseline values. MEPs are generally described as being present or absent.

• Somatosensory Evoked Potentials
  - These are small-amplitude potentials measured over the sensory cortex from stimuli applied to the posterior tibial nerves.
  - SSEPs are transmitted via the posterior columns of the spinal cord, in the territory of the posterior spinal arteries which supply the posterior third of the cord.
  - They are affected by basal muscle tremor and the signal-to-noise ratio is improved by increasing the depth of muscle relaxation.
  - Their use is not significantly affected by therapeutic concentrations of anaesthetic vapours.

• Motor Evoked Potentials
  - A series of short-duration constant current stimuli of 300–700 V are applied to the motor cortex and measured via needle electrodes inserted typically in the tibialis anterior, abductor hallucis, and vastus medialis muscles.
  - Other needle electrodes are placed in selected small muscles of the hands for reference. MEPs rely on corticospinal tract integrity, which lies in the territory of the anterior spinal artery.
  - MEPs, therefore, complement SSEPs in their assessment of spinal cord function.
  - In contrast to SSEPs, MEPs are large-amplitude potentials and are incompatible with profound muscle relaxation. Neuromuscular blocking agents are, therefore, best given by infusion
Blood supply to the spinal cord: horizontal distribution

Posterior

Posterior spinal artery

Anterior spinal artery

Central

Peripheral

The central area supplied only by the anterior spinal artery is predominantly a motor area.
Induction and Maintenance/Spinal Cord Monitoring

• The Effect of Anaesthetics on MEPs
  – All anaesthetic vapours reduce MEP amplitude in a dose-dependent manner.
  – Anaesthetic vapour concentrations more than 0.5 MAC are generally not compatible with reliable monitoring.
  – As a result, total i.v. anaesthesia with propofol is the anaesthetic technique of choice when assessing MEPs.
  – Propofol also causes a dose-dependent depression of cortically evoked responses of a smaller magnitude, which affects the reliability of neurophysiological monitoring – Use BIS to titrate
Induction and Maintenance/Spinal Cord Monitoring

• Therefore.....
  – TIVA, if not for induction for maintenance
  – BIS monitoring
  – Prior to NMBA, Med Physics need to identify the posterior tibial nerve at the ankle (I use a normal intubating dose as there is at least an further 30 mins of things to do!)
  – Atracurium infusion (0.05-0.1 mg/kg/hr) – Med physics monitor TOF and will ask you to alter the rate accordingly
  – I suggest working around the Medical Physics guys as the monitoring can take quite a while to prepare!
  – Place a bite block – Stops the patient biting their tongue with stimulation!
  – Avoid Gabapentin pre med or therapy on the day of op as it can affect the MEP amplitude (Experience from SCH)
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Prone Position

• **Complications**
  – Pulling stuff out!
  – Oedema – Cerebral, facial and oropharyngeal
  – Neck alignment
  – Occular injury
    • Ischaemic Optic Neuropathy (Not associated with direct pressure rather \( \downarrow \) perfusion and \( \uparrow \) IOP = Maintain Hct and MAP
    • Central retinal artery occlusion – Direct pressure
  – Musculoskeletal
  – Endobronchial intubation
  – Re-supining (Decreased CO and associated hypotension)
Anaesthetic Considerations

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• **Monitoring**
• Analgesia
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Monitoring

- BIS
- Arterial line
- CVC Line
- +/- Cardiac Output monitoring – In an attempt to not overhydrate
- TOF (Now integrated into the Spinal Monitoring package)
Anaesthetic Considerations

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Analgesia

- **Incisional Pain** – Long incision over multiple dermatomes

- **Musculoskeletal Pain** - arises from damage to bone, ligaments, muscles, intervertebral disks
  - periosteal pain is believed to be the most severe
  - periarticular tissues are richly innervated and give rise to continuous deep somatic pain and bouts of severe reflex spasms of muscles supplied by the same or adjacent spinal cord segments.

- **Spasmodic Pain** – Related to the realignment of the spine
Beyond Opioid Patient-Controlled Analgesia
A Systematic Review of Analgesia After Major Spine Surgery

Sonal Sharma, MD,* Ravi K. Balireddy, MBBS,† Kevin E. Vorenkamp, MD,‡
and Marcel E. Durieux, MD, PhD†

Abstract: Postoperative pain control in patients undergoing spine surgery remains a challenge for the anesthesiologist. In addition to incisional pain, these patients experience pain arising from deeper tissues such as bones, ligaments, muscles, intervertebral disks, facet joints, and damaged nerve roots. The pain from these structures may be more severe and can lead to neural sensitization and release of mediators both peripherally and centrally. The problem is compounded by the fact that many of these patients are either opioid dependent or opioid tolerant, making them less responsive to the most commonly used therapy for postoperative pain (opioid-based intermittent or patient-controlled analgesia). The purpose of this review was to compare all published treatment options available that go beyond intravenous opiates and attempt to find the best possible treatment modality.

Methods
This systematic analysis was performed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta Analyses) statement recommendations.³

Literature Search
The National Library of Medicine’s PubMed database was searched using the MeSH (Medical Subject Headings) terms, "analgesia, anesthesia, analgesia and postoperative pain," combined with the binary operator OR. Using the binary operator AND, this search result was then combined with results of a search using the MeSH terms, "spine surgery, laminectomy, disectomy, spinal fusion, and each of the following items: nonsteroidal anti-inflammatory drugs (NSAIDs), gabapentinoids, ketamine, methadone, local anesthetics (LAs), or steroids." Other electronic databases (Ovid/MEDLINE, and MD Consult) were searched using similar terms. The reference lists of the articles were scrutinized to identify further relevant studies. The search results were subsequently limited to articles in the English language and randomized controlled trials (RCTs) performed in humans. No abstracts, correspondences, or unpublished observations were included. Authors were not contacted for original data.

Selection
We included randomized trials completed before 2011 that reported postoperative pain scores and/or opioid consumption in patients undergoing spine surgery. We placed no limitations on patient age, sex, race, and ethnic origin. All types of pharmacologic analgesic interventions were considered, and we included data on NSAIDs, methadone, ketamine, dextromethorphan, LAs, gabapentinoids, clonidine, and steroids administered by the oral, intravenous, intramuscular, rectal, subcutaneous, or spinal/epidural route. However, we excluded studies incorporating use of nonpharmacologic interventions (such as transcutaneous electrical nerve stimulation) or wound infiltration of drugs as a part of an analgesic regimen.

Quality Assessment
All studies selected were read independently by 2 reviewers (S.S. and R.K.B.), who assessed the validity by calculating a Jadad score.¹ Discrepancies were resolved by consensus. The minimum score of any included trial was 2, and the maximum score was 5.

Data Extraction
The following data were collected for each trial: number of patients; type of surgery; type, dose, and route of administration...
Consider…

• Telling them it really hurts beforehand!
• Regular Paracetamol
• Oxycodone and PCA thereafter (Just seems to be better!)
• Consider an NSAID
• Gabapentin has a role, but not as pre-emptive analgesia
• Intraoperative Ketamine has been used with good effect (0.5 mg/kg intravenous bolus +/- infusion)
• Intrathecal diamorphine (0.3 -0.5mg)
• Regular/PRN Diazepam/Midazolam for spasmodic pain
• Consider Pleural catheter and ‘bombs’ for anterior repairs
• Post op Methadone has also been shown to be helpful
Bits and bobs

- Cell salvage – Wash swabs
- Tranexamic Acid unless contraindicated
  - (Loading of 10mg/kg and then infusion at 1mg/kg/hr)
- Avoid overhydration
- Sit them up for a period prior to extubation
- Oedema – May need to wait to assess cognitive function and airway
- Oh …. They need critical care!
  - +/- NIV
  - Pain issues
  - Cerebral oedema
  - Spasms
  - +/- ICD
  - Massive transfusion
It works!
Any questions?