Vem man sticka i ryggen? - spine abnormalities

Thierry Girard,
Basel Switzerland
Neuraxial techniques in patients with pre-existing back impairment or prior spine interventions: a topical review with special reference to obstetrics

M. Vercauteren\textsuperscript{1}, P. Waets\textsuperscript{2}, M. Pitkänen\textsuperscript{3} and J. Förster\textsuperscript{3}

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Vertebral column abnormalities

• Examples

• Neuraxial anaesthesia

• Malfusion (spina bifida)

• Trauma

• Scoliosis
CASE REPORT

Foot drop after spinal anesthesia in a patient with a low-lying cord

F. U. Ahmad, P. Pandey, B. S. Sharma, A. Garg

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DISCUSSION

With the introduction of atraumatic needles and the use of better anesthetic solutions, spinal anesthesia has become the most popular form of anesthesia for cesarean section. Several potentially devastating neurological complications can occur following spinal and epidural anesthesia, including spinal cord or nerve root injury from direct needle puncture, local anesthetic toxicity, spinal epidural or subdural hematoma, epidural abscess, bacterial or aseptic meningitis and anterior spinal artery syndrome. Fortunately, the incidence of such complications is rare. In the largest prospective study, Auroy et al. noted the total incidence of neurological sequelae to be 6 in 10,000 spinal anesthetics, with permanent deficits occurring in <1 in 10,000. Aromaa et al. reported a complication rate after epidural anesthesia of 0.35 in 10,000 and after spinal anesthesia to be 0.42 in 10,000.

There have been several reports of spinal cord damage after spinal anesthesia. Reynolds presented seven cases of conus medullaris damage following spinal anesthesia, collected over an eight-year period through medico-legal work from different parts of the UK. All patients were women, six obstetric and one surgical. All women experienced pain while inserting the needle, which was usually believed to be inserted at L2-3. Unilateral sensory loss persisted in all, six had foot drop and three had urinary symptoms. MRI showed a spinal cord of normal length in all, while six patients had a syrinx in the conus. She recommended that utmost care be taken in identifying the interspaces and that anesthetists need to relearn the rule that a spinal needle should never be inserted above L3.

Hamandi et al. reported five patients with damage to the distal spinal cord following spinal anesthesia. The patients developed leg weakness and sensory disturbances. MRI showed an abnormal area of high signal within the conus medullaris in all patients. Wegner et al. described an adult patient in whom previously undiagnosed diastematomyelia, a low conus and tethered cord were diagnosed only when neurological symptoms followed spinal anesthesia.

Though many anesthetists are confident that they can identify lumbar interspaces accurately, in a study with humbling results, Broadbent et al. found that when a group of experienced anesthetists believed that they...
Spina bifida, tethered cord and regional anaesthesia

- 25 weeks gestation, vaginal bleeding premature rupture of membranes
- Spina bifida occulta
- Bladder surgery @ age 4
- self-catheterised
- Regional anaesthesia considered possible (other hospital)

Tethered cord

«…spontaneous vaginal delivery a few hours later…»
«...Although the patient told us that she had spina bifida occulta, in fact she probably had occult spinal dysraphism. Confusingly, the terms spinal bifida occulta and occult spinal dysraphism are often used interchangeably, but spinal dysraphism is not a benign entity like spina bifida occulta...»
always be kept in mind. Patients with neurological abnormalities, cutaneous manifestations or involvement of more than one lamina may have a tethered cord and it is incumbent upon the anaesthetist to understand fully the terminology and extent of the defect before performing neuraxial anaesthesia [6].

L. Ali
G. M. Stocks
Queen Charlotte’s & Chelsea Hospital
London, UK
Accidental conus medullaris injury following combined epidural and spinal anesthesia in a pregnant woman with unknown tethered cord syndrome

XUE Ji-xiu, LI Bing and LAN Fei

Keywords: anesthesia, epidural; anesthesia, spinal; tethered cord syndrome; conus medullaris
Vertebral column abnormalities

• Anatomical difficulties
• Mechanical difficulties
• Injury to the conus medullaris
• Injury to the caudal equina
Vertebral column abnormalities

- Scoliosis
- Malfusion
- Trauma
Malfusion

Fetal Spina bifida education

Spina bifida

- Spina bifida occulta
- Spina bifida cystica
- Occult spinal dysraphism
Spina bifida occulta
Spina bifida cystica

Closure usually involves a decompressive laminectomy with dural opening until normal spinal cord is identified. The dura is then grafted with either native periosteum or a synthetic substance.

In addition, it is important to also evaluate other body systems, namely the cardiac, gastrointestinal, musculoskeletal, and genitourinary systems, because these are commonly affected when this defect is present. Although only 15% of babies with myelomeningoceles will display signs of hydrocephalus at the time of birth, approximately 90% of them will subsequently develop it, making it necessary to undergo CSF shunt procedures such as a VP shunt. These procedures often require revisions throughout the course of life at an average incidence of 0.44 revisions per year.

Alternatively, early antenatal diagnosis of myelomeningocele is now possible with subsequent intrauterine surgical closure. The results of such surgical intervention have been mixed with a lower incidence of subsequent CSF shunt dependence.
Spina bifida cystica

occult spinal dysraphism

Spinal dysraphism

• Skin abnormalities (midline)

• Tethered cord in 35-85 %
Objectives  After completing this article, readers should be able to:

1. Explain the difference between open and closed neural tube defects.
2. Describe the characteristics of spinal skin dimples that warrant further evaluation.
3. Describe the characteristics of spinal skin dimples that do not warrant further evaluation.
4. Discuss the evaluation of spinal skin dimples and name the findings that suggest occult spinal dysraphism.
5. Discuss the neurosurgical treatment of occult spinal dysraphism.
6. Explain the natural history and clinical manifestations of occult spinal dysraphism.

Figure 1. Solitary dimple whose location greater than 2.5 mm above the anus indicated the need for further evaluation, which revealed an occult spinal dysraphism requiring neurosurgical intervention.
Folic acid – the pregnancy vitamin

\[ C_{19}H_{19}N_{7}O_{6} \]

Spinal anaesthesia for caesarean section: an ultrasound comparison of two different landmark techniques

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Department of Anaesthesia, National Maternity Hospital, Dublin, Ireland

ABSTRACT

Background: Spinal anaesthesia performed at levels higher than the L3–4 intervertebral space may result in spinal cord injury. Our aim was to establish a protocol to reduce the chance of spinal anaesthesia performed at or above L2–3.

Methods: One hundred and ten consenting patients at 32 weeks of gestation or greater scheduled for non-emergency caesarean section under spinal anaesthesia were randomly allocated to have needle insertion performed at an intervertebral space determined by one of two landmark techniques. In Group A, if the intercristal line intersected an intervertebral space, this space was selected or if the intercristal line intersected a spinous process the space immediately above was selected. In Group B, if the intercristal line intersected an intervertebral space or a spinous process, the intervertebral space immediately below was chosen. The actual intervertebral space chosen was identified using ultrasound by a blinded investigator.

Results: In Group A, an intervertebral space at or above L2–3 was marked in 25 (45.5%) patients compared with 4 (7.3%) in Group B ($P < 0.001$). In 5/55 (9.1%) patients in Group A, the intervertebral space initially chosen was L1–2 whereas this occurred in no patient in Group B. There was no difference between groups in number of needle passes or attempts, onset of block at 5, 10 and 15 min or need for rescue analgesia.

Conclusion: Our data suggest that when performing spinal anaesthesia in pregnant patients, if the intercristal line intersects an intervertebral space then the space below should be chosen and if the intercristal line intersects a spinous process then the intervertebral space below should be chosen. This will reduce the incidence of spinal anaesthesia performed at or above L2–3.
5 (9%)
10 (36%)
27 (49%)
3 (5%)
0

0
4 (7%)
31 (56%)
14 (25%)
6 (11%)
Table 6 Level at which spinal anaesthesia was performed

<table>
<thead>
<tr>
<th></th>
<th>Group A (n=55)</th>
<th>Group B (n=55)</th>
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<tbody>
<tr>
<td>L2-3</td>
<td>22 (40.0%)</td>
<td>8 (14.5%)</td>
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<tr>
<td>L3-4</td>
<td>30 (54.5%)</td>
<td>27 (49.1%)</td>
</tr>
<tr>
<td>L4-5</td>
<td>3 (5.5%)</td>
<td>15 (27.3%)</td>
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<tr>
<td>L5-S1</td>
<td>0 (0%)</td>
<td>5 (9.1%)</td>
</tr>
</tbody>
</table>

Data are number (%)
Ability of anaesthetists to identify a marked lumbar interspace

C. R. Broadbent,¹ W. B. Maxwell,¹ R. Ferrie,¹ D. J. Wilson,² M. Gawne-Cain³ and R. Russell⁴

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**Inability of anaesthetists to identify a marked lumbar interspace**

<table>
<thead>
<tr>
<th>Actual level</th>
<th>Anaesthetists’ opinions</th>
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<tr>
<td></td>
<td>$T_{12}-L_1$</td>
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<tr>
<td>$T_{11-12}$</td>
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<tr>
<td>$T_{12}-L_1$</td>
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<tr>
<td>$L_{1-2}$</td>
<td>1</td>
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<td>$L_{2-3}$</td>
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<tr>
<td>$L_{3-4}$</td>
<td>13</td>
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<tr>
<td>$L_{4-5}$</td>
<td>2</td>
</tr>
<tr>
<td>$L_{5-S_1}$</td>
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</tr>
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</table>
Table 3  Percentage of spinal cords ending lower than L₁ or L₂ in studies spanning more than

<table>
<thead>
<tr>
<th>No. of subjects</th>
<th>Percentage of cords ending below body of L₁</th>
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<tbody>
<tr>
<td>Thomson, 1895 [9]</td>
<td>198</td>
</tr>
<tr>
<td>Reimann &amp; Anson, 1944 [12]</td>
<td>129</td>
</tr>
<tr>
<td>Broadbent, 2000</td>
<td>100</td>
</tr>
</tbody>
</table>
Damage to the conus medullaris following spinal anaesthesia

F. Reynolds

Emeritus Professor of Obstetric Anaesthesia, Department of Anaesthetics, St Thomas’ Hospital, London SE1 7EH, UK

«anaesthetists need to relearn the rule that a spinal needle should not be inserted above L3»
Vertebral column abnormalities

- Scoliosis
- Malfusion
- Trauma
Is spinal anaesthesia at L2–L3 interspace safe in disorders of the vertebral column? A magnetic resonance imaging study

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Compared with the disease-free cohort [mean CMT = 6.50 (1.85), corresponding to the M1/3 and L1/3 of L1], the position of the CMT in lumbar disc disorders such as lumbar intervertebral disc extrusion, herniation, and bulging was not shown to be significantly different. Likewise, for patients with spondylolisthesis, acquired degenerative scoliosis, and lumbar vertebral compression fractures, no significant difference compared with the normal population was found. The mean CMT position value in thoracic vertebral compression fracture patients [7.5 (2.56), corresponding to the L1/3 of L1 and the L1–L2 intervertebral disc], however, was significantly different (t = 2.068, P < 0.05) from that in the disease-free cohort (Table 2 and Fig. 2). In anatomical terms, thoracic vertebral compression fracture patients presented with lower positions of the CMT than normal patients by approximately one-third of a vertebral body length.

On the basis of gender, some significant differences in the location of the CMT also appeared for certain diseases. Female patients with thoracic vertebral compression fractures, lumbar intervertebral disc herniation, and disc bulging had

<table>
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<tr>
<th>Number</th>
<th>Frequency (%)</th>
<th>Age</th>
<th>CMT Mean (SD)</th>
<th>Kolmogorov–Smirnov P-value</th>
<th>Mean (SD)</th>
<th>tP-value</th>
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</thead>
<tbody>
<tr>
<td>Normal</td>
<td>65</td>
<td>6.21</td>
<td>38 (9.7)</td>
<td>0.458</td>
<td>0.985</td>
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<tr>
<td>Intervertebral disc extrusion</td>
<td>31</td>
<td>2.96</td>
<td>48 (14.4)</td>
<td>0.685</td>
<td>0.736</td>
<td>2.180 0.241</td>
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<tr>
<td>Intervertebral disc herniation</td>
<td>130</td>
<td>12.42</td>
<td>54 (13.9)</td>
<td>0.747</td>
<td>0.632</td>
<td>0.161 0.872</td>
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<tr>
<td>Intervertebral disc bulging</td>
<td>643</td>
<td>61.41</td>
<td>56 (12.6)</td>
<td>1.354</td>
<td>0.051</td>
<td>2.1.355 0.175</td>
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<tr>
<td>Scoliosis</td>
<td>21</td>
<td>2.00</td>
<td>65 (15.2)</td>
<td>0.958</td>
<td>0.317</td>
<td>0.412 0.681</td>
</tr>
<tr>
<td>Spondylolisthesis</td>
<td>56</td>
<td>5.35</td>
<td>62 (11.4)</td>
<td>1.098</td>
<td>0.179</td>
<td>0.451 0.653</td>
</tr>
<tr>
<td>Thoracic vertebral compression fracture</td>
<td>33</td>
<td>3.15</td>
<td>58 (16.0)</td>
<td>0.733</td>
<td>0.656</td>
<td>2.068 0.044</td>
</tr>
<tr>
<td>Lumbar vertebral compression fracture</td>
<td>68</td>
<td>6.49</td>
<td>58 (15.9)</td>
<td>1.059</td>
<td>0.212</td>
<td>0.440 0.661</td>
</tr>
<tr>
<td>Total</td>
<td>1047</td>
<td>100</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
Conclusions. When performing spinal anaesthesia, anaesthesiologists should be aware of potential differences of the CMT location, particularly in female patients with thoracic vertebral compression fractures, who may have a lower CMT than normal, extending to the level of L2. Performing spinal anaesthesia at the L2–L3 interspace would seem to be ill-advised in this patient population.
Vertebral column abnormalities

- Scoliosis
- Malfusion
- Trauma
Scoliosis
Scoliosis

- Idiopathic
- Congenital
  - Incomplete formation of vertebrae (hemivertebrae)
  - Failure of separation of vertebrae (fusion)
- Neuromuscular
  - cerebral palsy
  - spina bifida
  - myopathies
category 1 caesarean section?

Succinylcholine

all volatile aesthetics
Pulmonary function

- Restrictive lung disease
- Increased pulmonary resistance (hypoxic)
- Increased minute ventilation in pregnancy
- Aggravated in patients with neuromuscular disease (weakness)
Cardiac function

• Structural cardiac changes

• Increased pulmonary resistance (hypoventilation, hypoxic pulmonary vasoconstriction).

• Right heart failure!
An approach to neuraxial anaesthesia for the severely scoliotic spine

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¹ Department of Anesthesiology and ² Department of Orthopaedic Surgery and Rehabilitation, Vanderbilt University School of Medicine, Nashville, TN, USA

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«As the vertebral body rotates towards the convex-side of the scoliotic curve, a direct path to the neuraxial spaces occurs on the convex-side when using a paramedian approach.»

«...a paramedian approach could be attempted on the convex-side of the curve. If a midline approach is used, the spinal needle should be angled in the transverse (axial) plane towards the convex-side of the curve.»
paresthesias were elicited. Loss of resistance occurred at 4.5 cm. The epidural catheter was advanced 5 cm past the tip of the needle and secured 9.5 cm at the skin. Administration of a test dose (3 ml of 1.5% lidocaine with 1:200K epinephrine) was negative for intravascular and intrathecal injection. The patient was taken to the operating room where her surgical procedure was performed without complication. At the conclusion of the case, fluoroscopy was done with Omnipaque contrast dye, which revealed correct placement of the catheter at the L1–2 epidural space. More of the dye distributed to the left than the right, and clinically the patient's block was greater on the left than the right. However, the patient had excellent pain control while the epidural catheter was in place. The catheter was discontinued on postoperative day three without sequelae.

After the catheter was removed, an ultrasound examination was performed. A portable ultrasound machine (MicroMaxx, SonoSite, Bothell, WA, USA) and a 2–5 MHz curved array probe (C60, SonoSite, Bothell, WA, USA) was used for the evaluation. Longitudinal paramedian and transverse views of the L1–2 interspace were obtained. The ultrasound images displayed anatomy that was consistent with the computed tomograms, including the rotation of the vertebral body and the depth of the epidural space (Fig. 4).

**Fig 1** Chest radiograph demonstrating dextrorotatory thoracic scoliosis with a Cobb angle of 60°.

**Fig 2** Coronal computed tomogram demonstrating a compensatory lumbar curve with a Cobb angle of 40°.

**Fig 3** Transverse computed tomogram demonstrating L2 vertebral body rotation and pathway for paramedian approach to the epidural space.

**Fig 4** Transverse ultrasound image depicting anatomy consistent with the transverse computed tomogram. LF-D, ligamentum flavum-dura mater complex; PVB, posterior vertebral body.
Three years later, the patient presented for a left total hip arthroplasty after being diagnosed with left hip avascular necrosis, and femoral neck and acetabular fractures secondary to radiation necrosis. The patient's scoliosis had progressed, with the thoracic curve Cobb angle measuring 72°. She was taken to the operating room where only an ultrasound machine was utilized to facilitate placement of a spinal at the L3–4 level. Using a 22G Quincke needle, two passes of the needle were needed to enter the spinal space using a convex-side paramedian approach, no paresthesias were elicited. Free flow of cerebrospinal fluid was observed at the needle hub and 3 ml of isobaric 0.5% bupivacaine was injected. The spinal anaesthetic was adequate for the surgery, with sedation provided by a propofol infusion. There were no postoperative complications.

Discussion

The scoliotic spine poses a unique challenge for the anaesthetist, and may complicate general or regional anaesthesia. Scoliosis is broadly classified into three categories: congenital, neuromuscular, or idiopathic. Scoliosis is defined as lateral curvature of the spine of 10°. The degree of lateral curvature is determined by the Cobb angle. The Cobb angle is measured between the most tilted vertebral bodies in the coronal plane. A line is drawn parallel to the superior end plate of the cephalad vertebrae with the greatest angulation. A second line is drawn parallel to the inferior end plate of the caudal vertebrae with the greatest angulation. A perpendicular line is drawn from each of these lines, which creates the Cobb angle (Fig. 1).

In addition to the lateral curvature in idiopathic scoliosis, there is also rotation of the vertebral column. The Cobb angle helps to guide the selection of neuraxial techniques in scoliotic patients. A flowchart is provided to guide neuraxial techniques in scoliotic patients.

*History and physical*

*Review radiologic studies*

*Idiopathic scoliosis*

*Congenital scoliosis*

*Neuromuscular scoliosis*

*Nonstructural or anatomy well defined*

*Structural*

*Cobb angle <25°*

*Consider other technique*

*Cobb angle 25° – 50°*

*Cobb angle >50°*

*Consider imaging, convex-side paramedian approach, convex-side angulation midline approach*

*Ultrasound*

*Fluoroscopy*

*Good positioning*

*Good positioning*

*Good positioning*

*Good positioning*

*Good positioning*

*Good positioning*
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In addition to the lateral curvature in idiopathic scoliosis, there is also rotation of the vertebral column. This rotation can make it difficult to place a spinal needle in the correct plane. Ultrasound can be used to guide the needle, but fluoroscopy may also be helpful in some cases. If the Cobb angle is less than 25°, good positioning of the patient may be sufficient. If the Cobb angle is between 25° and 50°, imaging may be considered to confirm the location of the needle. If the Cobb angle is greater than 50°, a more lateral approach may be necessary to avoid the vertebral body.

Nonstructural or anatomy well defined

Good positioning

Cobb angle <25°

Cobb angle 25° – 50°

Consider other technique

Cobb angle >50°

Neuromuscular scoliosis

Congenital scoliosis

Idiopathic scoliosis

Structural

Review radiologic studies

History and physical

Three years later, the patient presented for a left total hip arthroplasty after being diagnosed with left hip avascular necrosis, and femoral neck and acetabular fractures secondary to radiation necrosis. The patient's scoliosis had progressed, with the thoracic curve Cobb angle measuring 72°.

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In addition to the lateral curvature in idiopathic scoliosis, there is also rotation of the vertebral bodies.

**Algorithm to guide neuraxial techniques in scoliotic patients.**

- **History and physical**
- **Review radiologic studies**
  - **Idiopathic scoliosis**
    - Nonstructural or anatomy well defined
      - Good positioning
    - Structural
      - Cobb angle <25°
      - Cobb angle 25° – 50°
  - **Congenital scoliosis**
  - **Neuromuscular scoliosis**
    - Consider other technique
      - Cobb angle >50°
      - Poor visualization

Three years later, the patient presented for a left total hip arthroplasty after being diagnosed with left hip avascular necrosis, and femoral neck and acetabular fractures secondary to radiation necrosis. The patient's scoliosis had progressed, with the thoracic curve Cobb angle measuring 72°. She was taken to the operating room where only an ultrasound machine was utilized to facilitate placement of a spinal at the L3–4 level. Using a 22G Quincke needle, two passes of the needle were needed to enter the spinal space using a convex-side paramedian approach, no paresthesias were elicited. Free flow of cerebrospinal fluid was observed at the needle hub and 3 ml of isobaric 0.5% bupivacaine was injected. The spinal anaesthetic was adequate for the surgery, with sedation provided by a propofol infusion. There were no postoperative complications.

Discussion

The scoliotic spine poses a unique challenge for the anaesthetist, and may complicate general or regional anaesthesia. Scoliosis is broadly classified into three categories: congenital, neuromuscular, or idiopathic. Scoliosis is defined as lateral curvature of the spine of ≥10°. The degree of lateral curvature is determined by the Cobb angle.

The Cobb angle is measured between the most tilted vertebral bodies in the coronal plane. A line is drawn parallel to the superior end plate of the cephalad vertebrae with the greatest angulation. A second line is drawn parallel to the inferior end plate of the caudal vertebrae with the greatest angulation. A perpendicular line is drawn from each of these lines, which creates the Cobb angle (Fig. 1).

In addition to the lateral curvature in idiopathic scoliosis, there is also rotation of the vertebral bodies. MRI, consult...

Fig 5

Algorithm to guide neuraxial techniques in scoliotic patients.

Neuraxial anaesthesia in scoliosis

Three years later, the patient presented for a left total hip arthroplasty after being diagnosed with left hip avascular necrosis, and femoral neck and acetabular fractures secondary to radiation necrosis. The patient's scoliosis had progressed, with the thoracic curve Cobb angle measuring 72°. She was taken to the operating room where only an ultrasound machine was utilized to facilitate placement of a spinal at the L3–4 level. Using a 22G Quincke needle, two passes of the needle were needed to enter the spinal space using a convex-side paramedian approach, no paresthesias were elicited. Free flow of cerebrospinal fluid was observed at the needle hub and 3 ml of isobaric 0.5% bupivacaine was injected. The spinal anaesthetic was adequate for the surgery, with sedation provided by a propofol infusion. There were no postoperative complications.

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In addition to the lateral curvature in idiopathic scoliosis, there is also rotation of the vertebral column. Good positioning and good visualization are essential for neuraxial techniques. Ultrasound is recommended for Cobb angles up to 25°, while fluoroscopy is preferred for Cobb angles greater than 50°. Other techniques may be considered for intermediate Cobb angles.

**History and Physical Review**

**Idiopathic scoliosis**
- Nonstructural or anatomy well defined
- Good positioning
- Proceed with caution

**Congenital scoliosis**
- Structural
- Consider other technique
- Ultrasound
- Poor visualization

**Neuromuscular scoliosis**
- Structural
- Consider other technique
- Fluoroscopy
- Poor visualization

**Algorithm to guide neuraxial techniques in scoliotic patients.**

Three years later, the patient presented for a left total hip arthroplasty after being diagnosed with left hip avascular necrosis, and femoral neck and acetabular fractures secondary to radiation necrosis. The patient's scoliosis had progressed, with the thoracic curve Cobb angle measuring 72°. She was taken to the operating room where only an ultrasound machine was utilized to facilitate placement of a spinal at the L3–4 level. Using a 22G Quincke needle, two passes of the needle were needed to enter the spinal space using a convex-side paramedian approach, no paresthesias were elicited. Free flow of cerebrospinal fluid was observed at the needle hub and 3 ml of isobaric 0.5% bupivacaine was injected. The spinal anaesthetic was adequate for the surgery, with sedation provided by a propofol infusion. There were no postoperative complications.

**Discussion**

The scoliotic spine poses a unique challenge for the anaesthetist, and may complicate general or regional anaesthesia. Scoliosis is broadly classified into three categories: congenital, neuromuscular, or idiopathic. Scoliosis is defined as lateral curvature of the spine of \( \geq 10^\circ \). The degree of lateral curvature is determined by the Cobb angle. The Cobb angle is measured between the most tilted vertebral bodies in the coronal plane. A line is drawn parallel to the superior end plate of the cephalad vertebrae with the greatest angulation. A second line is drawn parallel to the inferior end plate of the caudal vertebrae with the greatest angulation. A perpendicular line is drawn from each of these lines, which creates the Cobb angle (Fig. 1). In addition to the lateral curvature in idiopathic scoliosis, there is also rotation of the vertebral

**Algorithm to guide neuraxial techniques in scoliotic patients.**

- **Idiopathic scoliosis**
  - Nonstructural or anatomy well defined
    - Good positioning
    - Proceed with caution
  -structural
    - Cobb angle <25°
      - Good positioning
      - Proceed with caution
    - Cobb angle ≥25° – 50°
      - Consider imaging, convex-side paramedian approach, convex-side angulation midline approach
    - Cobb angle >50°
      - Ultrasound
      - Poor visualization
  - Congenital scoliosis
    - Consider other technique
  - Neuromuscular scoliosis
    - Fluoroscopy
Analysis of Vertebral Morphology in Idiopathic Scoliosis with Use of Magnetic Resonance Imaging and Multiplanar Reconstruction

By Ulf R. Liljenqvist, MD, Thomas Allkemper, MD, Lars Hackenberg, MD, Thomas M. Link, MD, Jörn Steinbeck, MD, and Henry F.H. Halm, MD

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reveal any morphometric differences between the patients with type-II scoliosis and those with type-III and IV scoliosis. In the thoracolumbar and lumbar spine, the smallest pedicle width was found at the first lumbar level. Our measurements of the endosteal pedicle width on the convex side of the curve were consistently smaller than the measurements of pedicle width that have been reported in previous studies on the morphology of normal spines.\(^{14,15,17-19,33,37,38}\) Some investigators have measured the outer cortical pedicle width,\(^{14,15,17,18}\) and Zindrick et al.\(^{19}\) did not differentiate between inner and outer cortical width. Other investigators have measured the endosteal pedicle width as the effective pedicle diameter.\(^{22,37}\) In the present study, we measured the endosteal pedicle width because we believe that it corresponds more accurately to the effective pedicle diameter with respect to pedicle-screw instrumentation than the outer cortical width of the pedicle does.\(^{22,37,39,40}\) The thickness of the cortex of the thoracic pedicles measures approximately 0.5 to 1.5 mm, with the medial wall...
Scoliosis - anaesthetic management

- Antepartum consultation
  - Respiratory function
  - Cardiac function
  - Neuromuscular disorder
  - Anatomy, Surgery
- Antenatal MRI ? Ultrasound ?
- Technical difficulties, increased failure rate
Learning points

- Stay below L3 (and you frequently don’t know where that is)

- Spina bifida occulta ≠ Occult spinal dysraphism
  - Beware of ‘sacral dimples’
  - Generous indication for MRI

- Scoliosis
  - Congenital and neuromuscular scoliosis: heart and lung
  - Convex side

- Multidisciplinary