Anesthetic Management for Spine Surgery
Recent advances and new trends in monitoring

Essay
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الجديد فى المعالجة التخديرية للعمليات الجراحية بالعمود الفقري

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INTRODUCTION

The spectrum of spinal surgery in adult life is considerable. Anaesthesia for major spinal surgery, such as spinal stabilization following trauma or neoplastic disease, or for correction of scoliosis, presents a number of challenges. The operations of spine surgery represents in the last two decades a great percentage of orthopedic & neurosurgical operations all over the world. So this great percentage requires increasing care with recent advances in anesthetic management for these operations ***(Bradford, 2004)*.**

The type of patients who would have declined surgery ٢٠ yr ago for medical reasons are now being offered extensive procedures. They commonly have preoperative co-morbid conditions such as serious cardiovascular and respiratory impairment, more over Airway management may be difficult. Surgery imposes further stresses of significant blood loss, prolonged anaesthesia, and problematical postoperative pain management ***(Kawakami, et al., 1995)*.**

The perioperative management of these patients is discussed in the review. The advent of techniques to monitor spinal cord function has reduced postoperative neurological morbidity in these patients. The anaesthetist has an important role in facilitating these methods of monitoring ***(Bradford, 2004)*.**

The scope of spinal surgery is considerable as both adult and paediatric patients present for surgery, which may be elective or urgent. They mainly present with one of five pathologies: trauma; e.g. unstable vertebral fracture, infection; e.g. vertebral abscess, malignancy (metastatic or primary disease with spinal instability, pain, and neurological compromise), congenital/idiopathic; e.g. scoliosis or degenerative disease.

Surgery may be required at any site in the spine from cervical to lumbosacral. Procedures range from minimally invasive microdiscectomy, to prolonged operations involving multiple spinal levels with significant blood loss ***(Bradford, ٢٠٠٤).***

The challenge to the anaesthetist is to provide optimal surgical conditions whilst ensuring adequate oxygenation to the brain and spinal cord, and facilitating the use of intraoperative spinal cord monitoring techniques if appropriate.

ANATOMY OF THE VERTEBRAL COLUMN

The vertebrae:

The vertebral column consists of ٧ cervical, ١٢ thoracic ٥ lumbar, ٥ sacral and ٤ or ٥ coccygeal vertebrae. The sacral and coccygeal vertebrae are fused in adult life ***(Richard, 1999).***

Vertebral column:

It has four curves, cervical and lumber curves are concave posteriorly, thoracic and sacral curves are concave anteriorly lumbar curves are obliterated. In the supine position the ٣rd lumbar vertebra marks the highest point of the lumbar curve, where as the ٥th thoracic vertebra is the lowest point of the dorsal curve. In cases of kyphosis, scoliosis, lordosis may distort the curves and make lumbar puncture difficult. The direction of the spinous processes determines the direction in which the spinal needle must be inserted ***(deGroot and Chusid, 1999).***

The spinous processes of the cervical, the first two thoracic, and the last four lumbar vertebrae are all practically horizontal and opposite the bodies of the respective vertebrae. The other spinous processes are inclined downwards, their tips are opposite the bodies of the vertebrae next below, except the tip of the first lumbar is opposite the intervertebral disc ***(Richard, 1999)***.

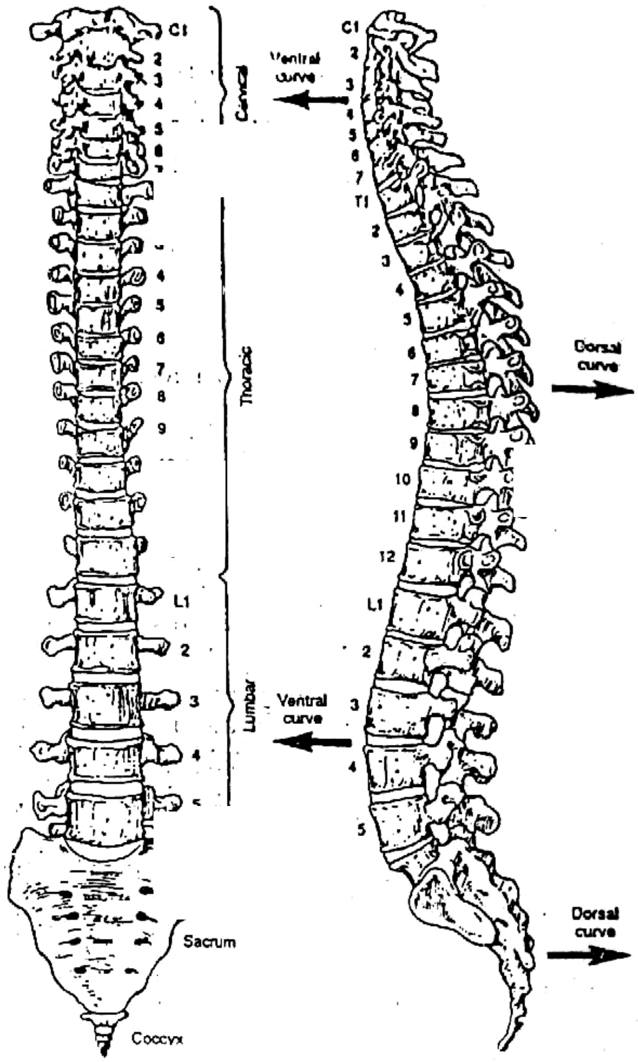

Figure (١): The vertebral column. (coated from ***deGroot and Chusid, 1999***)

The intervertebral discs:

These are secondary cartilaginous joints each is made of a peripheral ring of fibrous tissue (annulus fibrous) which is able to withstand strain in any direction, and a central bulb of a semiliquid gelatinous substance (Nucleus pulposus) which allows alteration of its thickness to confirm with the movement of the bodies. Annulus fibrosus acts as a shock absorber to minimize jarring of the skull ***(Richard, 1999)***.

The vertebral canal:

Bounded anteriorly by bodies of the vertebrae and intervertebral discs posteriorly by the laminae, ligamenta flava and the arch, which bears spinous process, and the interspinous ligaments, laterally by pedicles and laminae. Size and shape of the vertebral canal are variable, but are larger in cervical and lumbar regions ***(deGroot and Chusid, 1999).***

Contents of vertebral canal:

١- Roots of spinal nerves.

٢- Spinal vessels.

٣- Fat.

٤- Areolar tissue of extradural space ***(deGroot and Chusid, ١٩٩٩).***

The vertebral ligaments bounding the canal (Fig. ٢):

١- Supraspinous ligament.

٢- Interspinous ligament.

٣- Ligamenta flava.

٤- Posterior longitudinal ligament.

٥- Anterior longitudinal ligament.

Midline spinal puncture pierces the first three of those ligaments, in lateral approach only ligamenta flava are encountered ***(deGroot and Chusid,1999).***

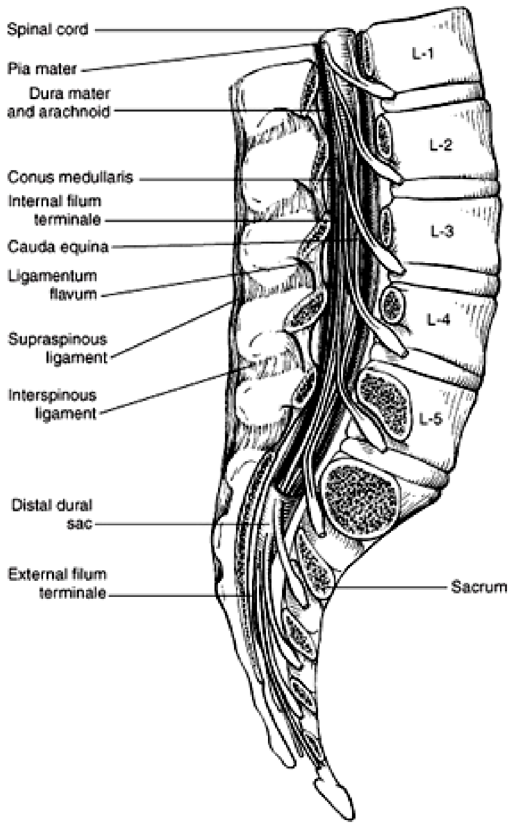

Fig. (٢): Anatomy of the spinal cord and meninges in the lumbar region. (Coated From ***Miller, 2005***)

Articulation between vertebrae:

Adjacent vertebrae are held together by strong ligaments, these ligaments allow greater range of movement between the neural arches than between bodies ***(Turck, 1984)***.

Articulation between the bodies:

The bodies of adjacent vertebrae are held together by the strong intervertebral discs and by the anterior and posterior longitudinal ligaments ***(Turck, 1984)***.

Articulation between the neural arches:

Adjacent neural arches are articulated by synovial joints and ligaments.

Spinal cord:

It is the elongated part of the central nervous system It continues from the medulla oblongata at the level of the foramen magnum, occupying upper two-thirds of vertebral canal, it is ٤٥cm long. It extents from the upper border of the ١st cervical vertebra (atlas) to the upper border of the ٢nd lumbar vertebra. In infants, it ends at the upper border of ٣rd lumbar vertebra. Inferiorly it terminates in a conically shaped apex called the conus medullaris. The obliquity is most marked for the lumbar and sacral nerve roots which are known collectively as the cauda equina. These, with the filum terminale, lie within subarachnoid space.

The spinal cord is ensheathed by three membranes or meninges:

١- **Dura mater:** The cerebral dura mater represents only the inner layer of the spinal dura mater. The outer layer being represented by the periosteum lining the vertebral canal which is separated from the spinal dura by the extradural space. It is connected by fibrous slips to the posterior longitudinal ligament especially near the lower end of the vertebral canal.

٢- **Arachnoid:** It is a thin transparent sheath closely applied to the dura.

٣- **Pia mater:** It is separated from the arachnoid by the subarachnoid space filled with cerebrospinal fluid ***(Richard, ١٩٩٩).***

Spinal segments:

The cord is divided into segments by the pairs of spinal nerves, which airse from it. These pairs are ٣١ in number as follows: ٨ cervical, ١٢ throacic, ٥ lumbar, ٥ sacral and one coccygeal ***(Last., 1984)***.

Blood supply of the spinal cord:

A) Arterial supply: