

ANAESTHETIC CONSIDERATIONS IN SPINAL CORD INJURIES

An Essay

Submitted for Partial Fulfillment of Master Degree of Anaesthesia

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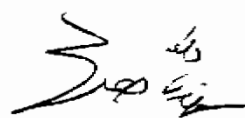
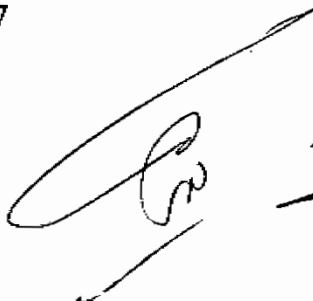
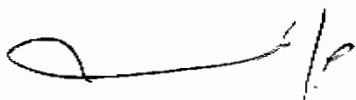
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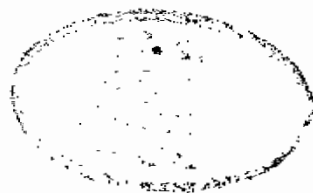
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INTRODUCTION

INTRODUCTION

Although patients with spinal cord injuries are small percentage of all trauma victims , yet the associated high rate of death is a concern.

The anaesthesiologist may be invoved in resuscitation and stabilization of the acutely injured patient beside their role in providing anaesthesia for such patients.

This assay will discuss the great problems which will face the anaesthesiologist and the possible adequate management for such patients aiming to minimize the complications and the high death rate associated with such patients.

**REVIEW
OF
LITERATURE**

ANATOMY OF THE SPINAL CORD

ANATOMY OF THE SPINAL CORD

The spinal cord is a cylinder elongated somewhat flattened from front to back. Its average length is 45 cm, its weight is about 30 gms. It extends from the level of the upper border of atlas vertebra to that of lower border of the first lumbar vertebra or upper border of the second lumbar vertebra. Its position varies with the movement of the vertebral column being raised slightly when the column is flexed.

Above, the spinal cord is continuous with the medulla oblongata. Below, it tapers off rapidly into a conical extremity termed conus medullaris, from the apex of which, filum terminale descends to the back of first segment of the coccyx (Davies and Davies, 1962).

Enlargements:

The spinal cord possesses two symmetrical enlargements which occupy the segments of the limb plexuses.

The cervical enlargement occupies the segments of the brachial plexus C_5 to T_1 . It lies roughly corresponding to the vertebrae C_3 to T_1 and maximum circumference at C_6 .

The lumbar enlargement occupies the segments of lumbo-sacral plexus L_2 to S_3 . It lies corresponding to the vertebrae T_9 to L_1 and with maximum circumference at T_{12} (Last, 1981).

Fissures and Sulci:

Ventrally spinal cord possesses a deep midline groove, the anterior median sulcus, and dorsally it shows a shallow sulcus, from which posterior median septum of neuroglia extends into its substance. The posterior median septum within the spinal cord is attached to the incomplete posterior median septum of arachnoid in the subarachnoid space.

On each side of posterior median sulcus and at a short distance from it, the dorsal nerve roots are attached along a vertical furrow, termed the posterolateral sulcus (Davies and Davies, 1962).

The Spinal Nerves And Nerve Roots:

Thirty one pairs of spinal nerves spring from the spinal cord at intervals along its length, each nerve has a ventral and a dorsal root. The pairs of spinal nerves are grouped as follows: cervical 8 , thoracic 12, lumbar 5, sacral 5 and coccygeal 1 . The spinal cord is divided into cervical, thoracic, lumbar and sacral regions corresponding with the attachments of the different groups of nerves (Davies and Davies, 1962). Within the subarachnoid space the anterior and posterior nerve roots are attached to the spinal cord by series of rootlets. Each anterior root is formed by three or four rootlets which emerge irregularly along the antero-lateral surface of the spinal cord. Each posterior root is formed by several rootlets, attached vertically to the posterolateral surface of the cord . The rootlets combine into a single root, the anterior and posterior root and pass from the cord to their appropriate intervertebral foramina, where each

evaginates the dura mater separately before uniting to form the mixed spinal nerve (Last, 1981).

The ventral nerve root consists of somatic and splanchnic efferent fibres which are the axons of cells in the spinal cord, while the dorsal nerve root consists almost entirely of afferent fibres which arise from pseudo-unipolar nerve cells of the corresponding spinal ganglion, which lies in the intervertebral foramen within little tubular evagination of dura mater immediately proximal to the point of union of anterior and posterior nerve roots (Davies and Davies, 1962).

The uppermost spinal nerve roots cross the subarachnoid space nearly horizontally but the remainders pass more and more obliquely downwards so that the roots of the lumbar and sacral nerves form together with the filum terminale of pia mater the cauda equina (Davies and Davies, 1962).

Spinal Meninges:

The spinal cord is invested by 3 membranes which from without inwards are dura mater, arachnoid and pia mater. It lies with its coverings in the spinal canal which is a smooth tubular space closed anteriorly by the vertebral bodies, the intervertebral discs and the posterior longitudinal ligament, posteriorly by the laminae and the ligamentum flavum, laterally by the pedicles and the intervertebral foramina.

The spinal canal is lined with a layer of extradural fat in which lies the internal vertebral plexus of veins (Last, 1981).

I- Spinal Dura Mater:

It is a prolongation of the fibrous layer of the dura mater of the posterior cranial fossa. It represents only the inner layer of the cerebral dura mater. The outer layer ceases at foramen magnum, its place being taken by the periostium lining the vertebral canal which is separated from spinal dura mater by extradural space. It extends downwards through the foramen magnum to the level of the second sacral vertebra. It is attached to the margins of foramen magnum, to the posterior surfaces of the bodies of the second and third cervical vertebrae and by fibrous slips to the posterior longitudinal ligament of the vertebrae. The spinal dura mater is pierced segmentally by the anterior and the posterior roots of the spinal nerves and is prolonged over these roots to form a series of lateral projections, one entering each intervertebral foramen. Thus the loose theca is stabilized within the spinal canal (Last, 1981).

Epidural space : It is a potential space within the bony cavity of the spinal canal and outside the dural sac. It is bounded anteriorly by the bodies of the vertebrae and the posterior longitudinal ligaments, and posteriorly by vertebral arches and the ligamenta flava. Superiorly it is closed by fusion of dura and periostium at the foramen magnum, and inferiorly by the sacrococcygeal ligament at sacral hiatus. It communicates via the intervertebral foramina with the paravertebral spaces. Fibrous strands anchoring the dura posteriorly partly divide the epidural space in the midline (Reynolds, 1984). The epidural space contains quantity of loose fat, areolar tissue and plexus of veins. The 31 pairs of spinal nerves with

their dural cuffs traverse the space on their way to the intervertebral foramina, the lower ones travelling at an increasingly oblique angle (Reynolds, 1984).

Subdural space : It is a potential space between the dura mater and the arachnoid mater. It contains a film of serous fluid which moistens the smooth surfaces of the opposed membranes. It does not communicate with subarachnoid space (Davies and Davies, 1962)

II- Spinal Arachnoid:

It is a delicate membrane enveloping the spinal cord lying between pia mater internally and dura mater externally. It is separated from the dura mater by the subdural space. It sends many delicate web-like processes across the subarachnoid space to the pia mater on the cord. They are well developed in the posterior midline forming incomplete posterior median septum (Last, 1981).

subarachnoid space : this is between the arachnoid and the pia mater and in lumbar region it occupies more than half the antero-posterior diameter of the vertebral canal. It communicates with the ventricular system at the base of the brain. It contains spinal nerve roots, the denticulate ligaments and CSF.

Cerebrospinal Fluid : It is clear colourless fluid with Sp. G. at 37° C is 1003-1009. Its volume is 100-160 ml and the spinal cerebrospinal fluid about 75 ml. Its pressure is 60-180 mmH₂O in lateral position and

300-500 mmH₂O in vertical position, Its pH in 7.4-7.6, protein content 20-40 mg% and glucose 50-80 mg% (Reynolds, 1984).

It acts as a fluid cushion to protect the brain and spinal cord from trauma. It has a role in metabolic exchanges of nervous tissue.

Cerebrospinal fluid is secreted by the choroid plexuses of the two lateral ventricles, 3rd and 4th ventricles. It is absorbed into the venous sinuses of the brain via the arachnoid villi (Davies and Davies, 1962).

III-Spinal Pia Mater:

It is a vascular membrane which closely invests the spinal cord and enters to line the anterior median sulcus. It is prolonged over the spinal nerve roots and blends with their epineuria. It is projected below the apex of the conus medullaris, where it extends, as filum terminale to perforate the spinal theca at S₂ and extends to be attached to the back of first segment of coccyx. A lateral projection of pia mater on each side forms ligamentum denticulatum which crosses the subarachnoid space and pierces the arachnoid, connects the side of spinal cord to the dura mater. It is attached in an unbroken line along the spinal cord from the foramen magnum to the conus medullaris, but its lateral edge is connected to the spinal dura by series of teeth which are attached to the spaces between the issuing spinal nerves. The ligamentum denticulatum, the filum terminale and the attached nerve roots serve to stabilize the loose fitting spinal cord within the spinal dura mater (Last, 1981).