Anesthesia, I.C.U &Pain management Dep.

Anesthetic And Intensive Care Management of Patients With Traumatic Spinal Injury

An Essay
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In ***Anesthesiology***

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List of Abbreviations

- ARDS : Acute respiratory distress syndrome
- ASIA : American Spinal Injury Association.
- CBF : Cerebral blood flow.
- CT : Computed tomography.
- CTLX : Cross-table lateral X-ray.
- DVT : Deep venous thrombosis.
- FRC : Functional residual capacity.
- FVC : Forced vital capacity.
- GCS : Glasgow Coma Scale
- GCS : Glasgow coma score.
- GFAP : Glial fibrillary acidic protein.
- IPPV : Inspiratory positive pressure ventilation.
- MAC : Minimum alveolar concentration.
- MEP : Maximum expiratory pressure.
- MEPs : Motor evoked potentials.
- MILT : Manual in- line traction.
- MIP : Maximum inspiratory pressure.
- MRI : Magnetic resonance imaging.
- nAChR : Nicotinic acetylcholine receptors.
- NASCIS : National Acute Spinal Cord Injury Studies.
- NEXUS : North American Emergency X-Ray Usage.
- NMJ : Neuro muscular junction.
- PEEP : Positive end-expiratory pressure.
- SCBF : Spinal cord blood flow.
- SCI : Spinal cord injury.
- SCIWORA: SCI without radiographic abnormality.
- SSEPs : Somato-sensory evoked potentials.
- UTI : Urinary tract infection.
- Vt. : Tidal volume.

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INTRODUCTION

Spinal cord injury (SCI) often is one presentation in a patient with multiple traumas. The immediate role of anesthesiologist is in providing resuscitation and stabilization. Subsequently, the main goal of anesthesiologist involved in care of SCI is to prevent secondary damage to spinal cord by immobilizing the spine, airway management and promotion of cord perfusion and oxygenation with the appropriate level of hemodynamic and respiratory support **(Stevens et al., 2003)**.

In spinal cord injuries surgery should be performed for biomechanical reasons, i.e. to correct deformity and/ or to stabilize an unstable injury. Surgery for unstable injuries allows early mobilization and earlier discharge **(Sansam, 2006)**.

The outcome of these injuries depends not only on the primary injury that occurs at the time of accident but also on the meticulousness of management during immediate resuscitation, in the perioperative period and the intensive care unit. Attention to the associated multisystem sequelae forms the essence of the perioperative and critical care management of these patients. With a significant increase in survival in recent years, there is a possibility of some of the patients of chronic spinal injury presenting for elective surgery. Urological procedures and procedures for treatment of pressure sores are common. Other incidental procedures

include abdominal surgery, fixation of fractures and electroconvulsive therapy for depression **(Umamaheswara, 2008)**.

Aim of The Work

The purpose of this essay is to discuss the mechanism, classification, patho-physiology and management of spinal injuries, strictly from the anesthetic and intensive care point of view.

Pathophysiology of Traumatic Spinal cord injury

I. Anatomy of vertebral column & spinal cord(figure1-1:3):

The vertebral column is made up of 24 separate (pre-sacral) vertebrae, 5 fused vertebrae of the sacrum and 4 coccygeal vertebrae. Of the pre-sacral vertebrae there are;7 cervical,12 thoracic and 5 lumbar vertebrae. The vertebral column forms a double C due to two anteriorly convex curvatures in the cervical and lumbar regions. Ventrally the vertebral bodies and inter-vertebral disks are connected and supported by the anterior and posterior longitudinal ligaments. Dorsally, the ligamentum flavum, interspinous ligament, and supraspinous ligaments provide further stability **(Boon et al., 2004)**.

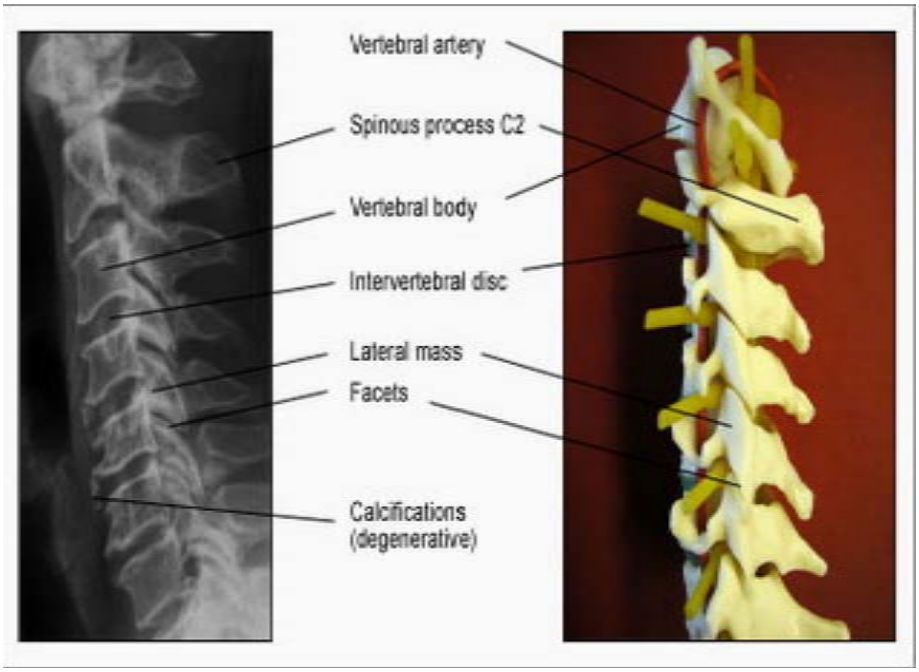

Figure 1-1 :Verteberal column

The body of a typical cervical vertebra (C3-7) is wider side to side than anteroposteriorly. The vertebral foramen is large and triangular. The articulating surfaces between superior facets point almost vertically, Spinous processes are short and bifid in the cervical region, *the most prominent cervical spinousprocess is C7* ***(Boon et al., 2004).***

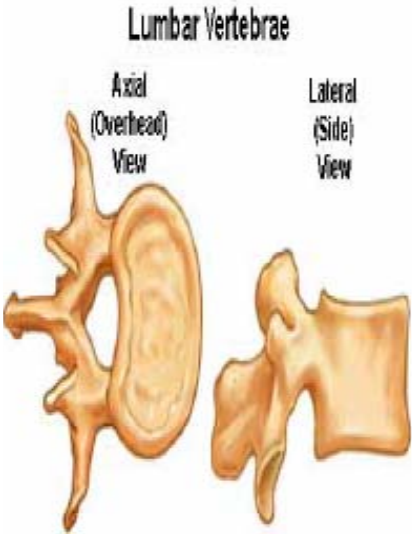

Figure 1-2: Lumbar vertebrae

The body of a lumbar vertebra is massive and kidney-shaped upon axial view.The vertebral foramen is triangular and smaller than in the c-spine.The transverse processes are long and slender with accessory processes on the posterior surface of base of each process. The spinousprocesses are short and sturdy ***(Boon et al., 2004).***

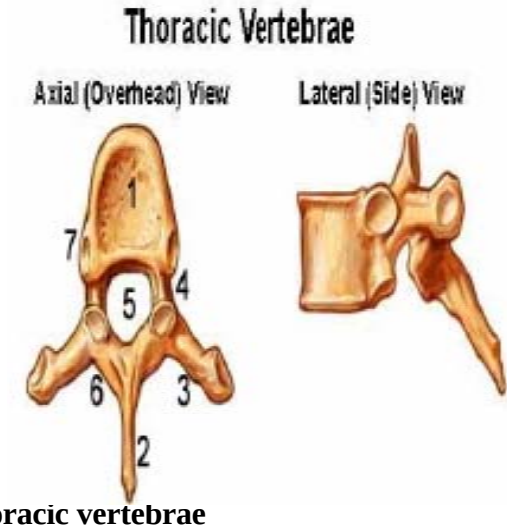

Figure 1-3: Thoracic vertebrae

The body of a typical thoracic vertebrae (1) is somewhat heart-shaped with one or two costal facets for articulation with rib. The vertebral foramen (5) is smaller and more circular than those of the c-spine and l-spine. The transverse processes (3) are strong, long with the length diminishing as one moves caudally. The spinousprocesses (2) are long and slope posteroinferiorlywith the tip extending to level of vertebral body below ***(Boon et al., 2004).***

The central nervous system consists of the brain and spinal cord. The spinal cord extends downward from the base of the brain and is made up of nerve cells and groups of nerves called tracts, which go to different parts of the body the spinal cord tapers into the conus medullaris, from which a glistening thread, the filum terminale, continues down to become attached to the coccyx.Below this region is a group of nerve roots called the cauda equinea. Tracts of the spinal cord carry messages between the brain and the rest of the body. Motor tracts carry signals from the brain to control muscle movement. Sensory tracts carry signals from body parts to the brain relating to heat, cold, pressure, pain and the position of the limbs (figure1-4:6) **(Wuermser, 2007)**.

The spinal cord lies within the spinal canal of the vertebral column and is made up of its coverings (meninges), fatty tissue, and a venous plexus. In the full term newborn, it extends down to the lower border of L3; in late adolescence, the spinal cord attains its adult position, terminating at the level of the inter-vertebral disk between L1 and L2 **(Wuermser, 2007)**.

The meninges are composed of three layers: the pia, arachnoid, and duramater. Three spaces are created around these layers:The subarachnoid is located between the pia and arachnoid maters and contains CSF (location of anesthetic injection for spinal block), The subdural space is located

between the closely adherent arachnoid and duramater and is poorly defined lastly the epidural space is located within the spinal canal between the dura-mater and the ligamentum flavum (locations of anesthetic injection for neuraxial anesthesia) (figure1-7) **(Boon et al., 2004)**.

The anterior and posterior nerve roots at each spinal level join and exit the inter-vertebral foramina forming spinal nerves from C1 to S5. At the cervical level, nerves arise above their respective vertebrae, but at T1 they start exiting below their vertebrae. There are 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 or 2 coccygeal-spinal nerves (fig;1-8).Autonomic sympathetic outflow is thoraco-lumbar(T1-L2)while the parasympathetic outflow is cranio-sacral(cranial and sacral nerves) **(Wuermser, 2007)**.

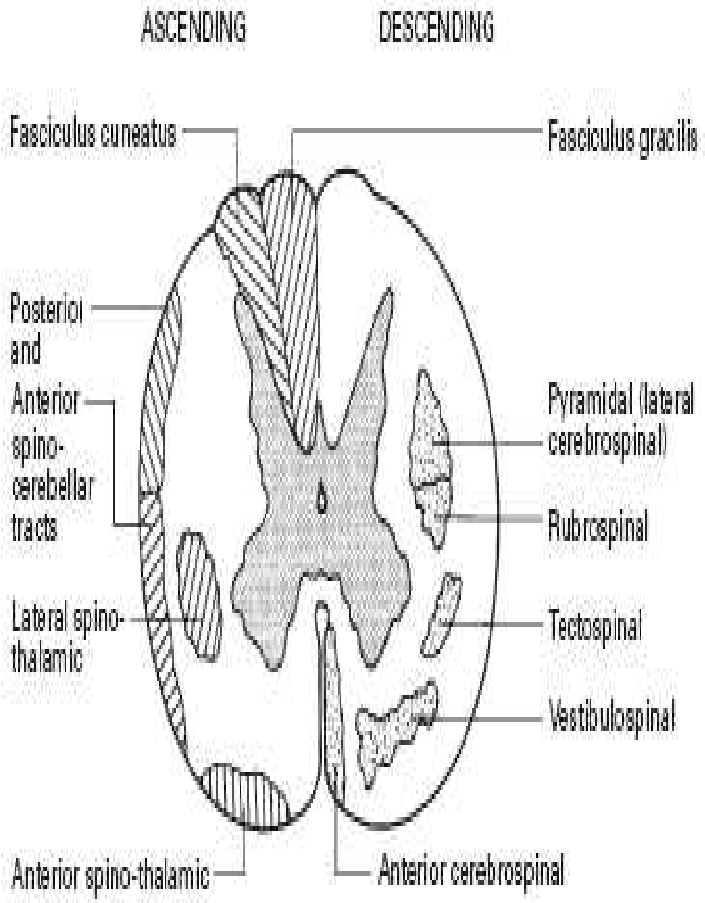

Figure 1-4: The spinal tracts shown diagrammatically in a transverse section of the thoracic cord (Ellies et al., 2004).