INTRODUCTION

Spinal anesthesia can be initiated with the patient in either the sitting or the lateral position, and each position has its advantages and disadvantages. The sitting position appears to be optimal for the placement of spinal anesthesia as identification of landmark, particularly midline, is much easier. However, maintaining the sitting position is often difficult for patients. On the other hand, the lateral position is generally considered easy to maintain for patients. However, the identification of anatomical landmark is difficult ***(Shahzad and Afshan, 2013).***

Spinal anesthesia is frequently accompanied by hypotension, which may be defined in absolute terms as a systolic blood pressure of 90 or 100 mmHg or in relative terms as a percentage (25% fall from baseline). The severity of hypotension depends on the height of the block, the position of the patient and the volume status.

Spinal anesthesia induced hypotension is caused by an increase in venous capacitance because of sympathectomy causing venodilation in the lower part of the body. Hypotension caused by a reducion in systemic vascular resistence is physiologically compensated by an increase in cardiac output. However, a high level of spinal block can inhibit the cardioaccelerator fibers leading to a fall in the heart rate and hence, instead of a compensatory increase, cardiac output usually decreases. The combined effect of reduced cardiac output and decreased systemic vascular resistence accounts for the high incidence of hypotension after spinal anesthesia ***(Mitra et al., 2013).***

Aim of the Work

To compare the effect of performing spinal anesthesia in sitting versus lateral position on patient hemodynamics (blood pressure and heart rate).

ANATOMY RELATED TO SPINAL ANESTHESIA

History:

The first spinal analgesia was administered in 1885 by James Leonard Corning, a neurologist in New York. He was experimenting with cocaine on the spinal nerves of a dog when he accidentally pierced the dura mater ***(Corning, 1960)***.

The first planned spinal anesthesia for surgery in man was administered by August Bier (1861–1949) on 16 August 1898, in Kiel, when he injected 3 ml of 0.5% cocaine solution into a 34-year-old laborer. Intraoperatively, the patient felt no pain at all. Some vomiting and headache were present after surgery. After using it on 6 patients, he and his assistant each injected cocaine into the other's spine. They recommended it for surgeries of leg ***(Bier, 1962)***.

Anatomy of vertebral column:

The spine is a flexible column formed by a series of bones known as the vertebrae which provide support to the head and trunk.

The vertebral column is made up of 33 vertebrae: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral vertebrae fused into one structure, and 4 coccygeal vertebrae also fused into one structure **(Fig.1)**.

Each vertebra consists of two major parts -an anterior solid segment, or body, and a posterior segment, or arch. The cervical vertebrae are smaller than those in any other region of the spine.

The thoracic vertebrae are intermediate in size, becoming larger as they descend in the vertebral column. These vertebrae may be easily identified by the presence of costal facets on the sides of the body and a transverse process which articulates with corresponding facets of the ribs **(Fig.2)**.

The lumbar vertebrae are the largest segments in the spine and are easily recognized by their size and by the absence of costal facets**.**

The sacrum is a collection of five fused vertebrae. It is described as an upside down triangle, with the apex pointing inferiorly. On the lateral walls of the sacrum are facets, for articulation with the pelvis at the sacro-iliac joints.

The coccyx is a small bone, which articulates with the apex of the sacrum. It is recognised by its lack of vertebral arches. Due to the lack of vertebral arches, there is no vertebral canal, and so the coccyx does not transmit the spinal cord ***(Gianino, 1996).***

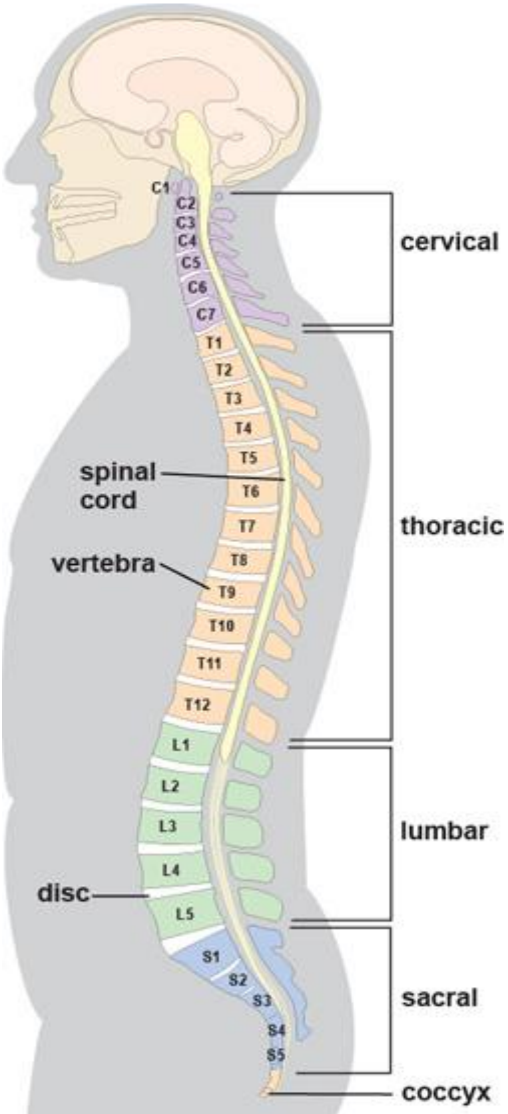

Figure (1): The five regions of the spinal column ***(Gianino, 1996).***

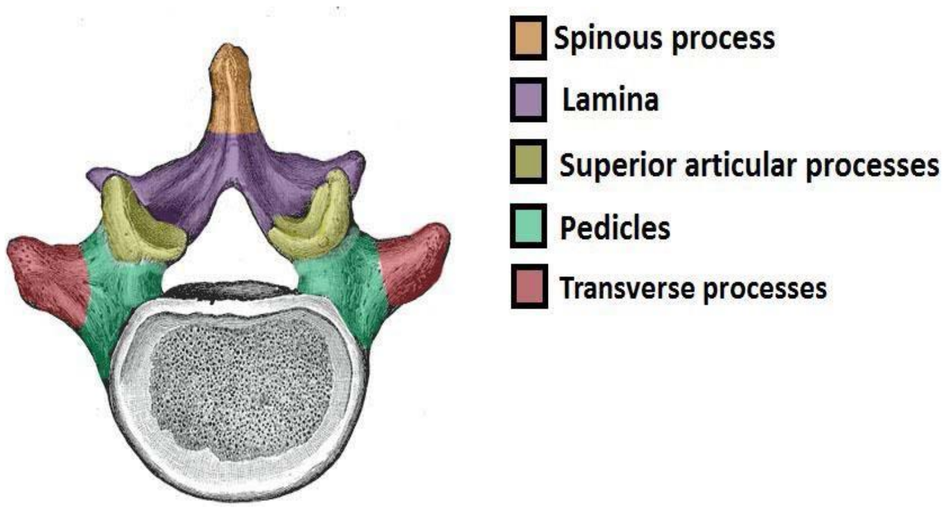

Figure (2): General stracture of the vertebrae ***(Gianino, 1996).***

Anatomical points:

- C7 is the bony knob at the bottom of the neck.
- T7-8 is at the lower limits of the scapulae.
- Terminal point of 12th ribs is at L2.
- The line across the iliac crests crosses L4.
- Posterior iliac spines are at S2 (caudal limit of dural sac in adults) ***(Gianino, 1996).***

Anatomy of the spinal cord:

The spinal cord is the most important structure between the body and the brain. It extends from the foramen magnum at the base of the skull where it is continuous with the medulla to the level of the first or second lumbar vertebrae. It is a vital link between the brain and the body, and from the body to the brain.

The spinal cord is a cylindrical structure of nervous tissue composed of white and gray matter.

Two enlargements of the spinal cord can be visualized: The cervical enlargement, which extends between C3 to T1, and the lumbar enlargements which extends between L1 to S2.

Dorsal and ventral roots enter and leave the vertebral column respectively through intervertebral foramen at the vertebral segments corresponding to the spinal segments. These nerve roots join distally to form 31 pairs of spinal nerves. These nerves are divided into 8 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal nerve.

The spinal nerve contains motor and sensory nerve fibers to and from all parts of the body. Each spinal cord segment innervates a dermatome.

Because the spinal cord is approximately 25 cm shorter than the vertebral columns, the lower segments of the spinal cord are not aligned opposite corresponding vertebrae. Thus, the lumbar and sacral spinal nerves have long roots, extending from their respective segments in the cord to the lumbar and sacral intervertebral foramina. These roots descend from the conus in a bundle known as the cauda equina. The non neural filament referred to as the filum terminale continues caudally until it attaches to the second segment of the coccyx **(Fig.3)** ***(Maton and Anthea, 1993).***

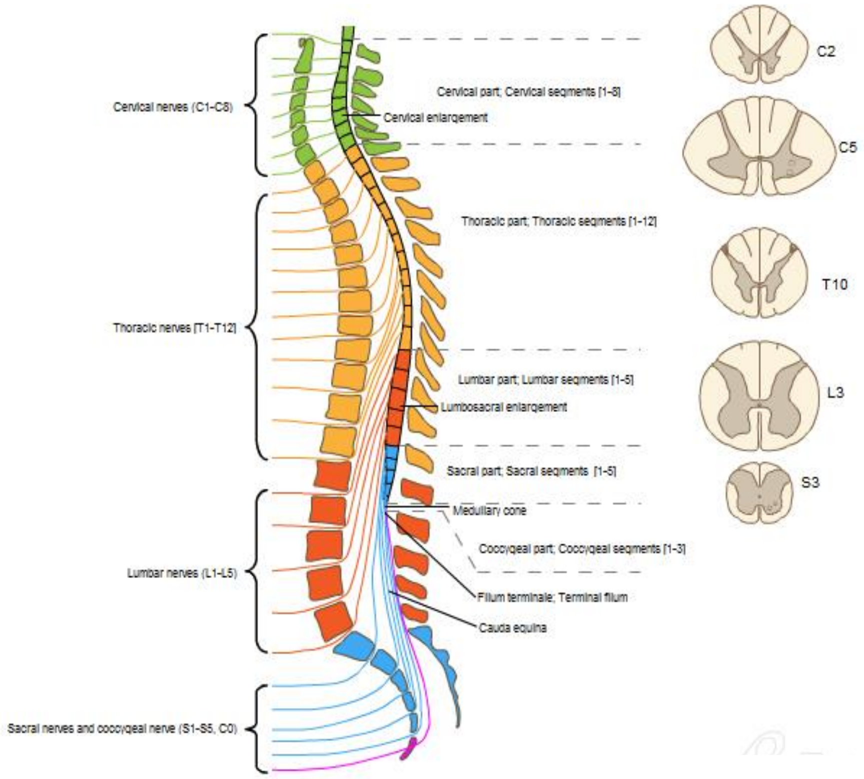

Figure (3): Spinal cord ***(Maton and Anthea, 1993).***

Meninges:

The meninges are three connective tissue sheathings that encircle the spinal cord and brain. The spinal meninges surround the spinal cord and are continuous with the cranial meninges, which encircle the brain **(Fig.4)**.

The most superficial of the three spinal meninges is the dura mater (which is Latin for tough mother), is composed of dense, irregular connective tissue. It forms a sac from the level of the foramen magnum in the occipital bone, where it is continuous with the dura mater of the brain, to the second sacral vertebra.

The spinal cord is also protected by a cushion of fat and connective tissue located in the epidural space, a space between the dura mater and the wall of the vertebral cavity.

The middle meninx is a vascular sheath called the arachnoid mater (which translate to ‘similar to a spider’ in Latin) because of its spider’s web arrangement of delicate collagen fibers and some elastic fibers. It is deep to the dura mater and is continuous with the arachnoid mater of the brain.

Between the dura mater and the arachnoid mater is a thin subdural space, which contains interstitial fluid.

The innermost meninx is the pia mater (delicate), which is a thin transparent connective tissue layer that adheres to the surface of the spinal cord and brain. It consists of interlacing bundles of collagen fibers and some fine elastic fibers. Within the pia mater are many blood vessels that supply oxygen and nutrients to the spinal cord.

Between the arachnoid mater and the pia mater is the subarachnoid space, which contains cerebrospinal fluid **(Fig.5)** ***(Dalley, 2009).***

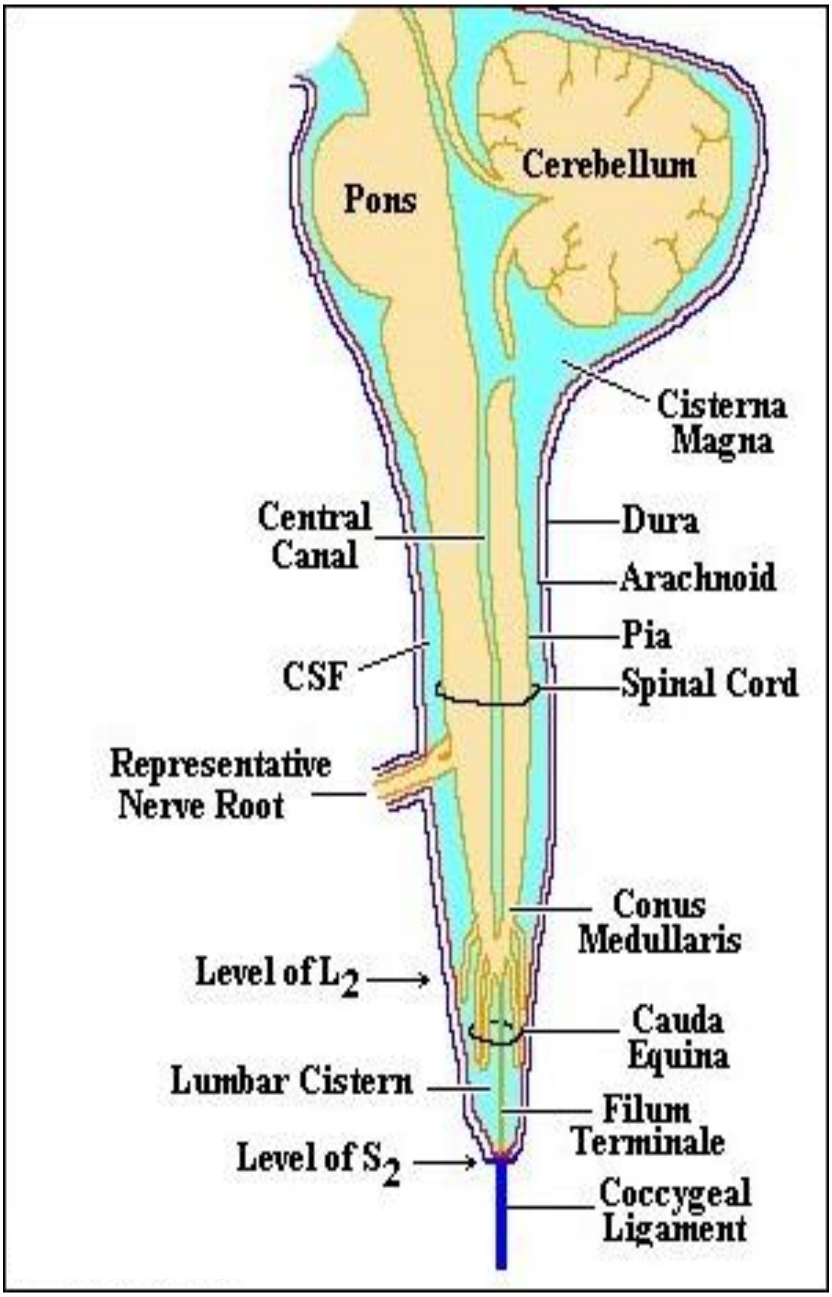

Figure (4): The meninges ***(Dalley, 2009).***

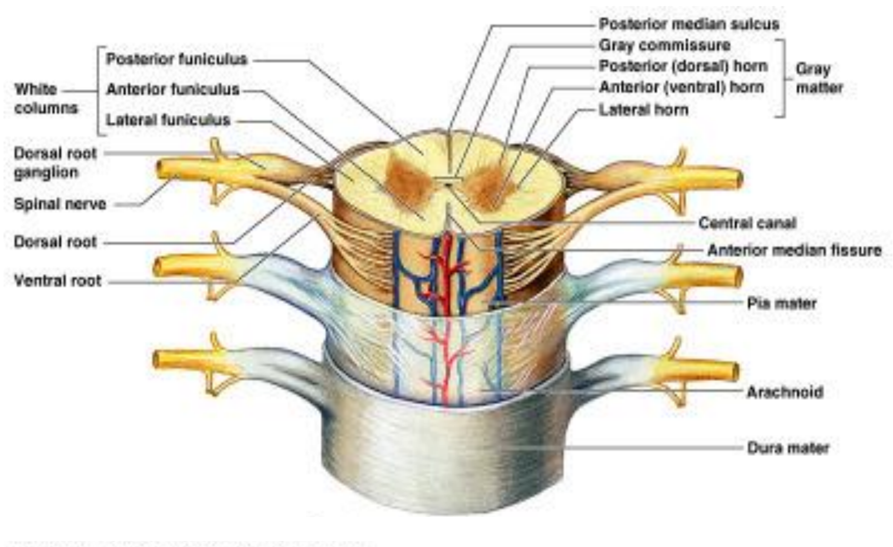

Figure (5): Meninges of the spinal cord ***(Dalley, 2009).***

Cerebrospinal fluid (CSF):

CSF is clear, colorless fluid produced from arterial blood by the choroid plexuses of the lateral and fourth ventricles by a combined process of diffusion, pinocytosis and active transfer. A small amount is also produced by ependymal cells. It bathes and protects the central nervous system (the brain and the spinal cord) ***(Chuder, 2012).***

The CSF is produced at a rate of 0.2 - 0.7 ml per minute or 600-700 ml per day. The circulation of CSF is aided by the pulsations of the choroid plexus and by the motion of the cilia of ependymal cells.

CSF is absorbed across the arachnoid villi into the venous circulation and a significant amount probably also drains into lymphatic vessels around the cranial cavity and spinal canal. The arachnoid villi act as one-way valves between the subarachnoid space and the dural sinuses. The rate of absorption correlates with the CSF pressure.

CSF acts as a cushion that protects the brain from shocks and supports the venous sinuses (primarily the superior sagittal sinus, opening when CSF pressure exceeds venous pressure). It also plays an important role in the homeostasis and metabolism of the central nervous system.

A sample of CSF can be taken via lumbar puncture. This can reveal the intracranial pressure, as well as indicate diseases including infections of the brain or its surrounding meninges ***(Ballabh et al., 2004).***

SPINAL ANESTHESIA

Spinal anesthesia also called spinal block, subarachnoid block, intradural block and intrathecal block, is a form of regional anesthesia involving injection of local anesthetic in subarachanoid space.

Generally, it is done through a fine needle, usually 9 cm (3.5 inches) long. For obese patients longer needles are available (12.7 cm / 5 inches). The tip of the spinal needle has a point or small bevel. Recently, pencil point needles have been made available (Whitacre, Sprotte, Gertie Marx and others) **(Fig.6).**

Subarachnoid (spinal) block is a safe and effective alternative to general anesthesia when the surgical site is located on the lower extremities, perineum (e.g., surgery on the genitalia or anus), or lower body wall (e.g., inguinal hernia).

Because of the technical challenges of readily identifying the epidural space and the toxicity associated with the large doses of local anesthetics needed for epidural anesthesia, spinal anesthesia was the dominant form of neuraxial anesthesia well into the 20th century ***(Bronwen and Kathleen, 2011)***.

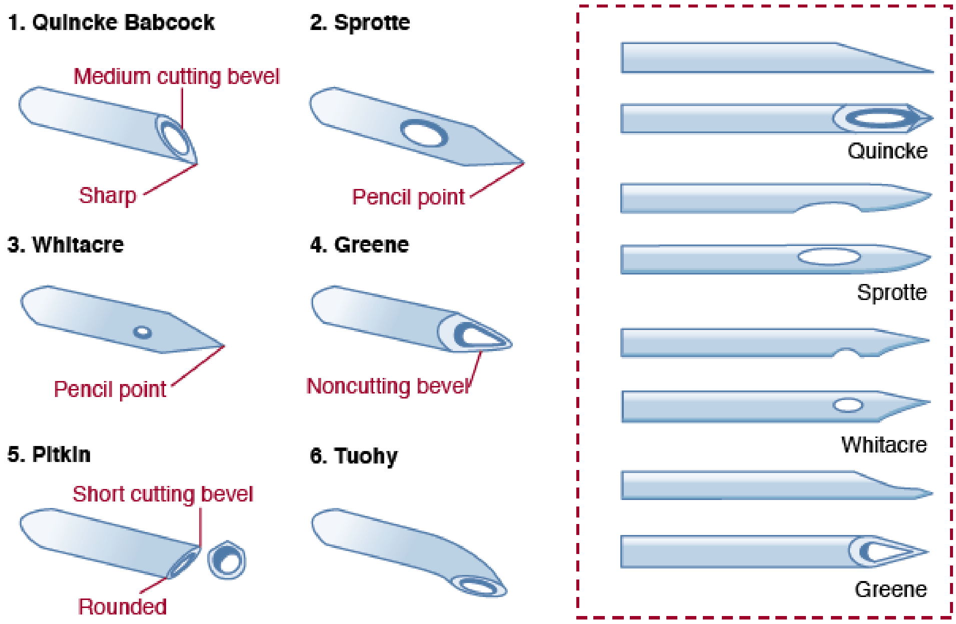

Figure (6): Spinal needles shapes ***(Bronwen and Kathleen, 2011)***.

The structures that the needle will pierce before reaching the CSF:

- The skin.
- Subcutaneous fat, this of course is of variable thickness. Identifying the intervertebral spaces is far easier in thin patients.
- The supraspinous ligament which joins the tips of the spinous processes together.
- The interspinous ligament which is a thin flat band of ligament running between the spinous processes.

- The ligamentum flavum is quite thick, up to about 1 cm in the middle and is mostly composed of elastic tissue. It runs vertically from lamina to lamina. When the needle is within the ligaments, it will feel gripped and a distinct (give) can often to be felt as it passes through and into the epidural space.

- The epidural space contains fat and blood vessels. If blood comes out of the spinal needle instead of CSF when the stylet is removed, it is likely that an epidural vein has been punctured. The needle should simply be advanced a little further.

- The dura, After feeling a (give) as the needle passes through the ligamentum flavum, a similar sensation may be felt when the needle is advanced a short distance further and pierces the dural sac.

- The subarachnoid space, This contains the spinal cord and nerve roots surrounded by CSF. An injection of local anaesthetic will mix with the CSF and rapidly block the nerve roots with which it comes in contact **(Fig.7)** ***(Casey, 2000).***