# Colloid Co-load versus Colloid Pre-load in a Parturient Undergoing Caesarean Delivery with Spinal Anesthesia and Its Effects on Maternal Hemodynamics

**Thesis**

Submitted for Partial Fullfillment of MD Degree in Anesthesiology

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***Noha Mohamed Abd El Aziz***

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# List of Abbreviations

| | | |
|---|---|---|
| ACC | : | Aorto caval compression |
| ANOVA | : | Analysis of variance |
| AP | : | Arterial pressure |
| ASA | : | American Society of Anesthesiologists |
| BMI | : | Body Mass Index |
| BP | : | Blood pressure |
| CNS | : | Central nervous system |
| CO | : | Cardiac output |
| CSE | : | Combined spinal-epidural |
| CSF | : | Cerebrospinal fluid |
| CVP | : | Central venous pressure |
| DBP | : | Diastolic Blood Pressure |
| HES | : | Hydroxyethylstarch |
| HR | : | Heart Rate |
| IV | : | Intravenous |
| kD | : | Kilo Dalton |
| LE | : | Leg elevation |
| MAP | : | Mean Arterial Pressure |
| NS | : | Normal saline |
| PE | : | Phenylepherine |
| PSH | : | Post spinal hypotension |
| RL | : | Ringer's Lactate solution |
| SBP | : | Systolic Blood Pressure |
| SV | : | Stroke volume |
| SVR | : | Systemic vascular resistance |
| UOP | : | Urine out put |

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**Colloid Co-load versus Colloid Pre-load in a Parturient Undergoing Caesarean Delivery with Spinal Anaesthesia and Its Effects on Maternal Haemodynamics**

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**Abstract:**
**Background**: cesarean section is the surgical delivery of a baby that involves making an incision in the mother's abdominal wall and uterus. Spinal anesthesia is considered the "gold standard" technique for cesarean section. Hypotension is the most common side effect of neuraxial blocks in the obstetric patient with an incidence rate reported as high as 83%. This has remained a significant concern for the anesthesiologist during management of this patient.

**Aim of the work:**This study will be performed to compare the effects of colloid pre-load and colloid co-load on maternal haemodynamic changes during spinal anaesthesia for cesarean section.

**Patient's and Methods:** A comparative cross sectional study was conducted at Ain Shams Maternity Hospital. After obtaining approval of research ethical committee and patients' informed consents at which 105 women with full term singleton pregnancies were scheduled for elective cesarean section and received spinal anesthesia. The patient's age were between 18 -42 years, of ASA physical status. In our study 3 groups of patients were compared; each group is formed of 35 patients ***Group 1***; patients were pre-loaded with 500 ml of 6% HES(hydroxyethyl starch 130/0.4) 20 minutes before induction of anesthesia. ***Group2***; patients were co-loaded with 500ml of 6% HES (hydroxyethyl starch 130/0.4) during injection of bupivacaine. ***Group 3;*** patients were pre-loaded with 500ml lactated ringer solution 20 minutes before induction of anaesthesia.

**Results:** There was a decrease in SBP,DBP,MAP and HR in the 3 groups where the lowest values were recorded in group 3 between 6-15 minutes and there was a high statistical difference $p<0.0001$ while the intergroup comparison of the groups 1 and 2 showed no statistical significance as regards SBP,DBP,MAP and HR.

**Conclusion:**In this study it was found that colloid co-load was somewhat how equal to colloid pre-load in prevention of hypotension in a parturient undergoing cesarean section under spinal anesthesia in addition it was found that crystalloid pre-load was inferior to colloid co-load or pre-load in maintaining blood pressure during spinal anesthesia in parturients .

**Keywords**:

HES: Hydroxyethylstarch;ASA:American Society of Anesthesiologists, SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; MAP:Mean Arterial Pressure; HR:Heart Rate

# Introduction

Spinal anesthesia is the popular route of anesthesia for elective cesarean section. Maternal hypotension is a common complication after spinal anesthesia for cesarean delivery. Prevention and treatment of post spinal hypotension (PSH) in cesarean delivery have been frequently investigated **(Hasanin et al., 2017).**

This hypotension with or without bradycardia have detrimental effects on both the mother (nausea, vomiting, dyspnea etc) and fetus (acidosis, neurologic injuries, etc). This complication can be managed by several approaches like fluid therapy, use of vasopressor or simultaneous use of fluid therapy and vasopressor **(Chhandasi et al., 2013)**.

Fluid infused before or at the time of induction of anesthesia is referred to as pre-loading and co-loading respectively. Early reports suggested that this problem could be prevented by infusing a bolus of fluid before induction of anesthesia, but this strategy has met with limited success. Recently, some authors have suggested that fluid administration should take place at the time of induction of anesthesia for cesarean delivery **(Banerjee et al., 2010).**

The type of fluids given include crystalloid or colloid. Crystalloids have a short intravascular half life due to its rapid distribution into the interstitial space due to lack of intrinsic colloid osmotic pressure. In contrast to crystalloid, colloid remains for a longer period within the intravascular space with little expansion of the interstitial space **(Singh et al., 2017).**

Other methods to prevent hypotension have been used these include: patient positioning, leg wrapping and vasopressor administration. The use of vasopressors is more widely accepted as an effective method for decreasing post spinal hypotension (PSH). Phenylepherine and ephedrine have been used to prevent maternal hypotension after spinal anesthesia. Phenylepherine is widely considered as the vasopresor of choice due to its alpha agonistic action thus it addresses low systemic vascular resistance (SVR) following spinal anesthesia. Ephedrine is associated with fetal acidosis and it is more likely to cross the placenta, however it should not be removed from operating theatres for its usefulness in treating hypotension with decreasing heart rate before and after labor **(Butwick et al., 2015)**.

# Aim of the work

This study was performed to compare the effects of colloid pre-load and colloid co-load on maternal hemodynamic changes during spinal anesthesia for cesarean section.

# Pathophysiology of Hypotension following Spinal Anesthesia in a parturient

Regional anesthesia is undoubtedly the most popular technique of anesthesia for cesarean section. Spinal anesthesia is popular because it is a simple technique which produces fast and highly effective anesthesia whilst avoiding general anesthesia. Besides being economical, the advantages include rapid onset of action, better quality of sensory and motor block, ease of administration compared to epidural anesthesia and avoiding complications and risks associated with general anesthesia like failed intubation, risk of aspiration of gastric contents, depressant effects of general anesthetics on neonates. It has been shown to block the stress response to surgery, decreases intra operative blood loss, lower the incidence of post-operative thrombo-embolism, and decrease morbidity and mortality in high risk patients **(Rodgers et al., 2000).**

Hypotension following spinal anesthesia is a common physiological complication with an incidence ranging from 25-75% among general population and a little higher in patients undergoing caesarean section. Occasionally, spinal anesthesia induced hypotension can be significantly severe, more so in pregnant females, which can increase intra-op and post-op morbidity **(Bajwa et al., 2012).**

Hypotension and bradycardia are common side effects of spinal anesthesia. The incidence of hypotension in the supine pregnant patient after spinal anesthesia may be as high as 90% **(Sen et al., 2013)**.

## Anatomy of the spinal cord:

The cephaled aspect of the spinal cord is continuous with the brainstem through the foramen magnum. The spinal cord most often terminates as the conusmedullaris at the level of the lower border of the first lumbar vertebral body. The conusmedullaris is attached to the coccyx by means of a neural-fibrous band called the filumterminale, which is surrounded by the nerves of the lower lumbar and sacral roots, known as the cauda equine (Figure 1) **(Nathan and Wong, 2015).**

Within the bony vertebral column are three membranes: the pia mater, the arachnoid mater, and the dura mater. The pia mater is a highly vascular membrane that closely invests the spinal cord. The arachnoid mater is a delicate, nonvascular membrane closely adherent to the third and outermost layer, the dura. The subarachnoid space, located between the pia mater and arachnoid mater, contains (1) cerebrospinal fluid (CSF), (2) spinal nerves, (3) a trabecular network between the two membranes, (4) blood vessels that supply the spinal cord, and (5) lateral extensions of the pia mater—the dentate ligaments. The dura mater is a membrane composed of collagen that encapsulates the spinal cord, the deeper meningeal layers, and the subarachnoid space. This layer forms a connective tissue sheath along the vertical axis of the central nervous system (CNS) that is contiguous with connective tissue covering the lateral extension of spinal nerve roots as they exit the intervertebral foramina.. Although the spinal cord ends at the level of the bodies of L1 and L2 in most patients, the subarachnoid space and caudaequina continue to the S2 level **(Reynolds, 2001).**

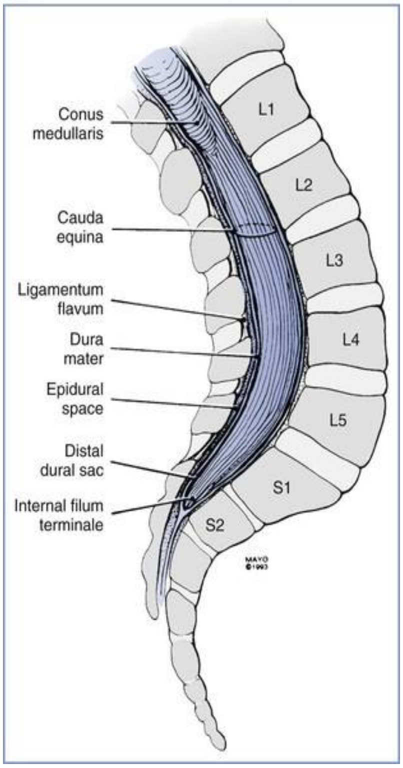


**Fig (1):** Distal neuraxial anatomy. In pregnant women, the spinal cord usually ends at the lower border of the first lumbar vertebral body. The subarachnoid space continues to the second sacral vertebral level **(Nathan and Wong, 2015)**.

The ligamentum flavum lies posterior to the epidural space (Figure 2). The lamina, the spinous processes of the vertebral bodies, the interspinous ligaments lie posterior to the ligamentum flavum. Posterior to these structures are the supraspinous ligament (which extends from the external occipital protuberance to the coccyx), subcutaneous tissue, and skin **(Nathan and Wong, 2015).**

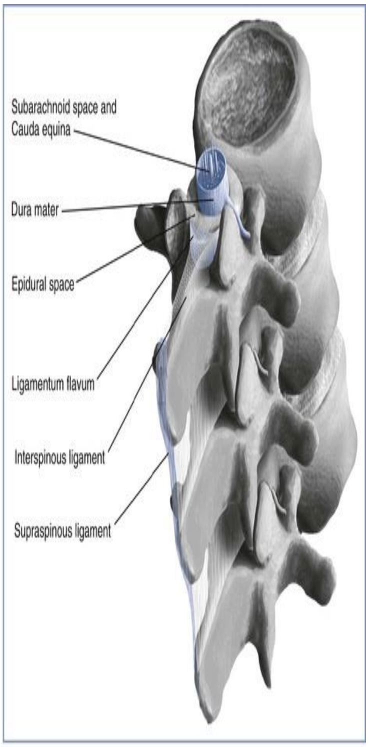


**Fig (2):**Central neuraxial anatomy. Note the variable thickness of the ligamentum flavum, which is greatest in the midline and decreases as it fans out laterally. (Drawing by Naveen Nathan, MD, Northwestern University Feinberg School of Medicine, Chicago, IL.) **(Nathan and Wong, 2015)**.

## Anatomic changes during pregnancy:

Obstetric patients present unique challenges in providing neuraxial (spinal or epidural) blockade. Neuraxial anesthesia offers analgesia and anesthesia for labor, vaginal delivery, cesarean section, and is considered the gold standard because of its limited effects on both the mother and fetus. Neuraxial analgesia/anesthesia relies primarily on the palpation of anatomical landmarks, which can be obscured in the setting of obesity, edema, and anatomical variation **(Shaikh et al., 2013).**

Uterine enlargement and vena caval compression will cause engorgement of the epidural veins. Unintentional intravascular cannulation and injection of local anesthetic are more common in parturients than in nonpregnant patients. In addition, the vertebral foraminal veins, which are continuous with the epidural veins, are enlarged and obstruct one of the pathways for anesthetic exit from the epidural space during administration of epidural anesthesia. The enlarged epidural veins also may displace cerebrospinal fluid (CSF) from the thoracolumbar region of the subarachnoid space as does the greater intra-abdominal pressure of pregnancy; this displacement partly explains the lowered dose requirement for spinal anesthesia in pregnant women **(Hogan et al., 1996).**

Subarachnoid dose requirements are also affected by the lower specific gravity of CSF in parturients than in nonpregnant patients **(Richardson and Wissler, 1996).**

The hormonal changes of pregnancy affect the perivertebral ligamentous structures, including the ligamentum flavum. The ligamentum flavum may feel less dense and ‘‘softer’’ in parturients than in non pregnant patients. It may also be more difficult for a pregnant woman to achieve flexion of the lumbar spine. Progressive accentuation of lumbar lordosis alters the relationship of surface anatomy to the vertebral column **(Nathan and Wong, 2015).**

At least three changes may occur. First, a parturient’s pelvis rotates on the long axis of the spinal column; thus, the line joining the iliac crests takes a more cephalad relationship to the vertebral column (e.g., this imaginary line might cross the vertebral column at the L3 to L4 inter space rather than the L4 to