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Crystalloid Preload versus Coload in Prevention of Hypotension Following Spinal Anesthesia in Cesarean Section

Thesis

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Mary Nady Hanna

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List of Abbreviations

Abb.		Full Term
ANP	:	Atrial Naturitic peptide
BP	:	blood pressure
CO	:	cardiac output
CSE	:	combined spinal epidural
CVP	:	Central venous pressure
DBP	:	Diastolic blood pressure
ECG	:	Electrocardiogram
GA	:	general anesthesia/ gestational age
HR	:	heart rate
IV	:	Intravenous
IU	:	International unit
LE	:	Leg elevation
MAP	:	mean arterial pressure
NE	:	nor epinephrine
PACU	:	Post anesthetic care unit
PE	:	Phenylephrine
PSH	:	post spinal hypotension
RCT	:	randomized control trial
SAB	:	subarachnoid block
SAP	:	Systolic arterial pressure
SBP	:	systolic blood pressure
SIH	:	spinal induced hypotension
SPO2	:	Saturated pressure of o2
SV	:	stroke volume
SVR	:	systemic venous resistance

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Abstract

CONTEXT: Preloading of crystalloid is a traditional practice to prevent spinal anesthesia induced hypotension. But coloading seems to be more physiological and rational approach as effect was achieved during the time of spinal anesthesia.

AIMS: To compare crystalloid preload and coload for the prevention of spinal block induced hypotension in lower limb surgeries. Secondary outcomes included no. of dose of ephedrine, bradycardia, nausea, vomiting, total volume of infusion, blood loss & urine output.

MATERIALSAND METHODS: Total 82 patients , aged 20 to 40 years, scheduled for elective cesarean section under spinal anesthesia were randomized into preload and coload group, 41 patients in each group. In preload group, 20 ml/kg of Ringer lactate was preloaded 20 minutes before commencement of spinal anesthesia. In Coload group, 20 ml/kg of Ringer lactate was coloaded in 20 minutes just after lumbar puncture.

RESULTS: patient characteristics were comparable in bothgroups ($p>0.05$). Mean baseline value and trends at various time intervals of heart rate, Systolic blood pressure, diastolic blood pressure, and mean blood pressure were comparable in both groups. Total incidence of hypotension and bradycardia were higher in preload group. Incidence of vomiting, blood loss and uop were higher in Preload group but it was statistically insignificant. Number of patients required ephedrine for treatment of hypotension was higher in preload group but with no statistical difference.

CONCLUSIONS: Coloading with 20 ml/kg of Ringer's lactate was as effective as preloading of same amount 20 minute before lumber puncture to prevent spinal induced hypotension.

Keywords:
Preload, coload, ringer lactate, hypotension, spinal anesthesia. Ephedrine infusion, Crystalloid, Caesarean Section, fluid timing, obstetrics.

Introduction

Spinal anesthesia is a form of regional anesthesia, has been in use for obstetrics anesthesia since the beginning of the 20th century. Over the years regional anesthesia has evolved markedly, It has become a preferred anesthetic technique for cesarean section, internationally regional anesthesia when used for cesarean section has been proven to have mortality rate that is 17 times less than general anesthesia (GA) **(Rout et al, 2012).**

The rise in regional anesthesia during labor, the use of mixtures of local anesthetic and opiates and the desire to avoid fetal exposure to depressant medications and to allow the mother to remain awake during delivery have been instrumental to these changes. The mother and her child can share the birth with all the accompanying emotional implications deriving from this if regional anesthesia is used. The need for using systemic opiates during the postoperative period becomes reduced and the risks described for the general technique are avoided (**Bajwa et al, 2012**).

General anesthesia is less desirable for cesarean delivery because the mother is unconscious, thus unable to interact with her newborn. Two potential serious complications associated with general anesthesia are failed

intubation and pulmonary aspiration of gastric contents. Airway reflexes are compromised by the loss of consciousness that occurs with induction of general anesthesia. An advantage of regional anesthesia is that the parturient is awake and airway reflexes are maintained. However, aspiration may also occur during regional anesthesia if airway reflexes are compromised by injudicious sedation **(Hawkins et al, 2011)**.

Spinal anesthesia involves administration of local anesthetic agent with, without an opioid into the cerebrospinal fluid located into subarachnoid space. This results in interruption of neural transmission in the sensory, motor and autonomic fibers. However spinal anesthesia, may results in many complications, which cause significant rise in maternal morbidity and mortality. The most common and possibly fatal complication is hypotension. Other complications include perioperative nausea and vomiting, bradycardia, high motor block, shivering, postdural punctural headache, parasthesia, residual back pain **(Brown et al, 2009).**

The hypotension that develops as a result of spinal anesthesia can produce profound cardiovascular instability, which could in turn rapidly progress to cardiac arrest, if not

adequately monitored and timeously treated. Thus, it is essential that vigilant monitoring of both heart rate and blood pressure is undertaken throughout the administration of spinal anesthesia **(Rollins & Lucero et al, 2012).**

So, over the last decades several interventions, such as pelvic tilt and the prophylactic administration of fluids or vasopressors like ephedrine, have been proposed to decrease the incidence of maternal hypotension. Nonetheless, maternal hypotension and its symptoms, nausea and vomiting still present, despite the efforts to improve their treatment and prevention, Rapid administration of crystalloid solutions before spinal anesthesia has been recommended to prevent hypotension. Although controversy still exists, there is accumulating evidence that crystalloids solutions are particularly ineffective in preventing hypotension after extensive sympathetic block associated with spinal anesthesia **(Cluver et al, 2013)**.

Aim of the Work

The aim of the study is to compare the effect of crystalloid preloading versus co-loading in elective cesarean section comparing its efficacy and to compare its advantages& disadvantages in respect to;

- Reducing the incidence of maternal hypotension.
- Reducing other hemodynamic changes.
- Minimizing requirements of vasopressors.
- Decreasing neonatal adverse outcome.

Review of Literature

Definition of post spinal hypotension

Spinal-induced hypotension (SIH): The decrease in blood pressure that occur following the intrathecal injection of local anesthetic and opioid mixture. It is defined as a reduction in blood pressure (SBP) 20% or more from baseline values, and/or SBP of less than or equal 90 mmHg or mean arterial blood pressure (MAP) reduction of 20%or more **(Montiskelelo, 2016).**

Pathophysiology of Spinal-induced Hypotension (SIH) & Hemodynamic Disturbance

Spinal anesthesia is produced by the injection of local anesthetic, often together with an opioid adjunct, into the subarachnoid space, with the objective of blocking conduction in afferent sensory fibers that transmit pain impulses to the brain. However, conduction block from local anesthetics is non-specific and preganglionic fibers to the sympathetic chain are also affected, resulting in sympathetic block and hypotension which can cause hypo perfusion of the uterus and placenta. The extent to which the sympathetic chain is blocked is related to the degree of cephalic spread of local anesthetic in the subarachnoid space **(Kim et al, 2006).**

In pregnant women, greater sensitivity to local anesthetics results in higher blocks, and compounded by the effects of aortocaval compression, hypotension occurs with greater frequency and severity. To understand how spinal anesthesia affects the cardiovascular system, it is important to understand the basic principles of cardiovascular physiology. Blood pressure (BP) is determined by the following equation;

Mean arterial pressure (MAP) = Cardiac output (co) × Systemic vascular resistance (SVR).

Cardiac output CO is the volume of blood pumped by the heart per minute, and is equal to the product of the heart rate (HR) and stroke volume (SV), the latter of which is determined by preload, afterload and contractility. During spinal anesthesia, hypotension occurs as a result of a decrease in SVR and/or CO **(Reynolds et al, 2005).**

Effects of spinal anesthesia on preload

Starling's law of the heart states that the force of contraction of the cardiac muscle fibers is directly proportional to their initial resting length, or preload. Stretching sensitizes the myofibrils to calcium and increases the force of cardiac contraction. In the intact heart, preload is determined by the end-diastolic volume which is dependent

on venous return. The sympathectomy that accompanies spinal anesthesia causes vasodilatation which causes pooling of blood peripherally and reduces venous return and preload. The decrease in preload reduces CO and thus contributes to hypotension. Clinically, left ventricular end diastolic volume cannot easily be measured, and preload is assessed by measuring central venous pressure (CVP) or the pulmonary artery wedge pressure **(Sharwood et al, 2006).**

Effects of spinal anesthesia on Afterload

Afterload is the resistance against which the left ventricle must contract and is determined mainly by the systemic vascular resistance (SVR). SVR is dependent largely on arteriolar vasomotor tone which is decreased by the sympathectomy caused by spinal anesthesia. Vasodilatation and a decrease in SVR occurs which contributes to hypotension. Although vasodilatation may improve peripheral blood flow, it may also cause shunting which can result in regional tissue hypoxia. Initially, vasodilatation may lead to an increase in CO due to improvement in cardiac performance but excessive vasodilatation invariably leads to hypotension **(Hanss et al, 2005).**