Comparing between the Effect of volume preload versus Ephedrine infusion for prevention of hypotension due to spinal anesthesia for cesarean section.

Thesis presented for partial fulfillment of Master degree in anesthesiology

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Abstract

Spinal anesthesia is a type of neuroaxial block that used for procedure involving lower limbs and lower abdomen

Spinal anesthesia for cesarean section is associated with lower mortality when compared with general anesthesia . Hypotension during spinal anesthesia is the most common complication.

Fifty patients divided randomly into two groups. Group F received crystalloid preload and Group E received prophylactic IV ephedrine infusion.

Incidence of hypotension was lower in E group compared with F group.

Prophylactic Ephedrine infusion is better than fluid preload in prevention of hypotension due to spinal anesthesia in parturients undergoing cesarean section.

Keywords

Spinal anesthesia, Cesarean section, Hypotension, Ephedrine

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List of abbreviations

ACTH: adrenocorticotrophic hormone

ADRs : Adverse Drug Reactions

AMP: adenosine monophosphate

ASA: American society of anesthesia

BMI: Body mass index

BP: blood pressure

CC: closing capacity

CNB: central neuroaxial block

CNS: central nervous system

CS: cesarean section

CSF: cerebrospinal fluid

CVS: cardiovascular system

EBP: epidural blood patch

ECG: electrocardiography

ETCO2: endtidal CO2

FDA: food and drug administration

FRC: functional residual capacity

GA: general anesthesia

GFR: glomerular filtration rate

GMP: guanisine monophosphate

GIT: gastrointestinal tract

HR: heart rate

IV: intravenous

IM: intramuscular

LP: Lumbar puncture

MAC: Minimum alveolar concentration

MAO: monoamine oxidase

p value: probability value

PaCO2: Arterial carbon dioxide tension

PaO2: arterial oxygen tension

PDPH: post dural puncture headache

SBP: systolic blood pressure

SD: standard deviation

SpO2: oxygen saturation

α: Alpha

β: beta

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Introduction

A caesarean section (cesarean section AE), or C-section, is a form of childbirth in which a surgical incision is made through a mother's abdomen (laparotomy) and uterus (hysterotomy) to deliver one or more babies. It is usually performed when a vaginal delivery would lead to medical complications. The anesthetic plan for cesarean delivery should take into account the well-being of two patients: the mother and the fetus. Regional anesthesia is the most common method of anesthesia for delivery because it allows the mother to be awake and immediately interact with her baby. It is also safer for the mother than general anesthesia.[1] Regional anesthesia is used for 95 percent of planned cesarean deliveries in the United States.[2]

Spinal anesthesia provides a fast, profound, and symmetrical sensory and motor block of high quality in patients undergoing lower abdominal and lower limbs surgeries.[3-4] Spinal anesthesia have fewer side effects and risks than general anesthesia (asleep and pain-free). Patients usually recover much faster and can go home sooner.

Spinal anesthesia is often used for genital, urinary tract, or lower body procedures.[5,6] A successful regional anaesthesia effectively suppresses many of the pain mediated stress responses to surgery such as rise in blood pressure, heart rate and increase in plasma concentrations of catecholamines, cortisol and glucose. Spinal block is also associated with lesser amount of surgical haemorrhage. [7] Spinal anaesthesia produces few adverse effects on the respiratory system as long as unduly high blocks are avoided.[8]

As control of the airway is not compromised, there is a reduced risk of airway obstruction or the aspiration of gastric contents, Spinal anaesthesia provides excellent muscle relaxation for lower abdominal and lower limb surgery.[9] Post-operative deep vein thromboses and pulmonary emboli are less common following spinal anaesthesia.[10]

Hypotension is the most common complication of spinal anaesthesia for cesarean section .[11-14]

Hypotension during spinal anaesthesia can cause significant morbidity and mortality.[15-17] and it could be associated with severe nausea and vomiting. It leads to serious risk to the mother (unconsciousness and pulmonary aspiration) and baby (hypoxia, acidosis, and neurological injuries). [18] which is due to sympathetic nervous system blockade. As a result, decreased systemic vascular resistance and peripheral pooling of blood occurs which decreases cardiac output.[19] The incidence of hypotension and high spinal anaesthesia is higher in cesarean sections due to a decrease in the amount of cerebrospinal fluid (CSF) in the lumbosacral area and higher cephalad spread of local anesthetics. This is due to compression of inferior venacava by hypertrophic uterus and developing of collateral venous plexus circulation in the epidural space .[20]

Various attempts have been made to reduce the incidence and severity of hypotension including expansion of intravascular volume with up to 2liters of fluids.[21] The use of lateral uterine displacement is a routine procedure to prevent hypotension.[22] Fluid loading has been shown to reduce risk of hypotension but doesn't eliminate it[23]. it also takes time to achieve and many

patients still need vasopressor treatment to correct hypotension.[24] An infusion of ephedrine may be an effective alternative .[25] Ephedrine is a non-catecholamine sympathomimetic agent that stimulates alpha and beta adrenergic receptors directly and predominantly indirectly, producing its effects by releasing norepinephrine from nerve endings in the autonomous nervous system. Traditionally it is the vasopressor of choice in spinal anesthesia despite the lack of confirmation of its superiority over other vasopressors.[26,27]

The aim of this study is to evaluate the efficacy of ephedrine infusion without preblock crystalloid administration in reducing the incidence of hypotension during spinal anaesthesia.

Chapter 1 : Maternal and fetal physiology

Introduction:

The challenges presented by a parturient requiring anesthesia or analgesia, or both, make the role of the obstetric anesthesiologist both challenging and rewarding. Those providing anesthetic services to the labor and delivery suite must be familiar with the unique physiology of the parturient and the effects of numerous drugs and techniques on the parturient and fetus.

Appreciation of the roles of the obstetrician, anesthesiologist, pediatrician, and other personnel who care for the mother and child will facilitate the highest level of care. Communication between the various members of the labour and delivery team is paramount.

Physiologic Changes of Pregnancy:

Maternal physiologic changes in pregnancy occur as a result of hormonal alterations, mechanical effects of the gravid uterus, increased metabolic and oxygen requirements, metabolic demands of the fetoplacental unit, and hemodynamic alterations associated with the placental circulation. Such changes become more significant as pregnancy progresses, and they have major implications for anesthetic management, especially in high-risk parturients.[28]

Cardiovascular System:

Table (1): Cardiovascular Changes in Pregnancy:

Parameter	Change	Amount (%)
Heart rate	Increased	20-30
Stroke volume	Increased	20-50
Cardiac output	Increased	30-50
Contractility	Variable	±10
Central venous pressure	Unchanged	
Pulmonary capillary wedge pressure	Unchanged	
Systemic vascular resistance	Decreased	20
Systemic blood pressure	Slight decrease	Midtrimester 10 - 15 mmHg, then rises
Pulmonary vascular resistance	Decreased	30
Pulmonary artery pressure	Slight decrease	

The cardiovascular system adjusts throughout pregnancy to meet the changes that occur. Hemodynamic and maternal cardiovascular changes in pregnancy are outlined in Table [28]. Although the physiologic changes in the cardiovascular system appear to begin in the first trimester, these changes continue into the second and third trimesters, when cardiac output increases by approximately 40% of non-pregnant values. Cardiac output increases from the fifth week of pregnancy and reaches its maximum levels at approximately 32 weeks, after which there is

only a slight increase until labor, delivery, and the postpartum period . Approximately 50% of the increase in cardiac output has occurred by the eighth week of pregnancy[29]. Although this increase in cardiac output is due to an increase in both stroke volume and heart rate, the more important factor is stroke volume, which increases by 20% to 50% at term from non-pregnant values. Changes in heart rate are extremely difficult to reliably quantify, but it is thought that the approximately 20% increase in heart rate is present by the fourth week of pregnancy[30]. Tachyarrhythmias are more common, especially later in pregnancy as a result of both hormonal and autonomic factors[31].

The blood pressure (BP) typically falls early in gestation and is usually 10mmHg below baseline in the second trimester, declining to a mean of 105/60 mmHg. In the third trimester, the diastolic blood pressure gradually increases and may normalize to non- pregnant values by term[33].

The factors responsible for the vasodilatation are incompletely understood, but one of the major findings is decreased vascular responsiveness to the pressor effects of angiotensin II and norepinephrine. Several additional mechanisms for the fall in the systemic vascular resistance have been proposed:

- Increased endothelial prostacyclin
-Enhanced nitric oxide production
-Reduced aortic stiffness[33].

Because of the decrease in peripheral vascular resistance, arterial blood pressure does not change in a normal pregnant woman inspite of the increase in cardiac output and blood volume.