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IS SPINAL ANAESTHESIA A CONVIENIENT OPTION FOR LOWER SEGMENT CAESAREAN SECTION IN MODERATE TO SEVERE PREECLAPSIA IN PATIENTS WITH NORMAL BLOOD INDICIES?

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Abstract

Caesarean section is a common technique of terminating pregnancy in pre-eclamptic patients. The anaesthesiologists are more possible to face a difficult airway in a pre-eclamptic patient. The hazard related to the haemodynamic consequences of laryngoscopy and tracheal intubation in a pre-eclamptic patient is noticeable. General anaesthesia (GA) in such patients may be an option when regional anaesthesia is contraindicated. Spinal anaesthesia (SA) may be considered as anaesthesia of choice for pre-eclamptic patient scheduled for caesarean delivery.

Patients included in this study were assigned into two groups, group A, spinal (50 cases) and group B, general anaesthesia (50 patients). All patients were American Society of Anaesthesiologists (ASA) class II & III.

The aim of this study is to compare the haemodynamic variability of spinal anaesthesia versus general anaesthesia in patient subjected to caesarean section.

Regarding changes in mean arterial pressure and heart rate following general & spinal anesthesia; in spinal group (50 cases), the mean BP remains stable or decreased significantly following spinal injection until the end of the operation. There was significant difference between the two groups ($P< 0.001$)

In conclusion, the majority of pre-eclamptic patients required caesarean delivery. Because of haemodynamic consequences of laryngoscopy and tracheal intubation and further arise in blood pressure during surgery, general anaesthesia is usually chosen only when regional techniques are contraindicated. This study proved that BP & HR in pre-eclamptic patients underwent caesarean section by spinal anaesthesia are more stable than haemodynamics observed in general anaesthesia.

Introduction

Pre-eclampsia is a medical condition where hypertension arises in pregnancy associated with significant amounts of protein in the urine and leg edema[1].

Pre-eclampsia may develop from 20 weeks of gestation (it is considered early onset before 32 weeks, which is associated with increased morbidity).

Preeclampsia may progress to eclampsia, characterized by the appearance of the tonic-clonic seizures which could happen very rarely[2-4].

Pre-eclampsia occur in 10% of pregnancies and usually in the second or third trimester but commonly after 32nd week. It is much more common in primigravida and frequency drops significantly in subsequent pregnancies[5,6].

Pre-eclampsia is more common in women with preexisting hypertension, diabetes, autoimmune diseases like lupus, patient with a family history of pre-eclampsia, obese and pregnant with a multiple gestation (twins, triplets, or more)[7]. The mechanism by which preeclampsia occurs is not certain, and a number of maternal, paternal, and fetal factors have been implicated in its development. The factors currently considered to be the most

important include abnormal placental implantation, maternal immunological intolerance, cardiovascular and inflammatory changes, genetic, nutritional, and environmental factors[8].

It has been shown that, degree of incomplete trophoblastic invasion of the spiral arteries is directly correlated with the severity of subsequent maternal hypertension. Subsequently, the resulting placental hypoperfusion leads by an unclear pathway to the release of systemic vasoactive compounds that cause an exaggerated inflammatory response, vasoconstriction, endothelial damage, capillary leak, hypercoagulability, and platelet dysfunction, all of which contribute to organ dysfunction and the various clinical features of the disease[9].

In severely pre-eclamptic population, the risk–benefit profiles of spinal anesthesia and general anesthesia strongly favor the use of spinal anesthesia when feasible. Important factors to be considered are; the risks of clinically significant maternal hemodynamic derangements, difficult airway management, stroke, spinal/epidural hematoma, and adverse neonatal outcomes. In severely pre-eclamptic patients, spinal anesthesia–induced hypotension is typically easily treated, the risk of spinal/epidural hematoma is low, and there is no evidence that neonatal outcome is compromised. In contrast, potential complications of general anesthesia, such as hypertensive crisis, stroke, and difficult airway management, are leading causes of morbidity and mortality in the pre-eclamptic population. Therefore, in the majority of severely pre-eclamptic patients, who are not coagulopathic or thrombocytopenic, the risk of difficult or failed airway management and delayed recognition of maternal stroke during a general anesthetic are felt to exceed the risk of adverse outcomes from spinal anesthesia–induced hypotension or spinal/epidural hematoma[10].

Peripartum pharyngeal and glottic edema are accentuated in pre-eclamptic parturients[11], and the risks of difficult/failed laryngoscopy and intubation are greater among pre-eclamptic parturients[12].

Spinal anesthesia or sub-arachnoid block (SAB) is a form of regional anesthesia involving injection of a local anesthetic into the subarachnoid space. This technique is very useful in patients having hyper-reactive airway (bronchial asthma or allergic bronchitis), difficult airway which is making the endotracheal intubation very challenging, borderline hypertensive where laryngoscopy and endotracheal intubation can further elevate the blood pressure[13,14], while the contraindications are: patient's refusal, local infection or sepsis at the site of lumbar puncture, bleeding diathesis, space occupying lesions of brain, disorders of the spine and maternal hypotension. Complications can be broadly classified as immediate (on the operating table) or late (in the ward or in the post-anesthesia care unit PACU): Early Complications; Hypotension, bradycardia, total spinal block and cardiac arrest while late Complications includes; Neurologic injury, post–dural puncture headache or post spinal headache, backache, infection and urinary retention[15].

Regarding the drug used in this study; Bupivacaine which is a local anesthetic drug belongs to the amide group. It is metabolized by liver. Its half-life is 3.5 hours in adults and 8 hours in neonates. The excretion of bupivacaine is 4–10% by kidney[16-19].

Typically, the higher the thoracic level of intrathecal block, the greater the hemodynamic effect[20]. The height of a spinal block is associated with the dose and baricity of the local anesthetic. The higher doses have resulted in greater decreases in arterial blood pressure in both pregnant[21] and non-pregnant patients[22].

Sympathetic block leads to cardiovascular changes. Hypotension and bradycardia are related to the height of block[23].

This study aimed to find the best way to manage anesthesia whether spinal or general for preeclamptic patients undergoing cesarean section regarding the hemodynamic changes.

Patients and methods

This prospective study was carried out after taking informed consent from all the patients. All pre-eclamptic patients undergoing cesarean section admitted in Al-Fayhaa General Hospital at 34 weeks gestational age or more between November 2014 to May 2015.

Of the 155 pre-eclamptic patients admitted, 55 patients were excluded. The exclusion criteria of this study were as follows: eclamptic patients, patients having bad medical history like chronic hypertension, diabetes, connective tissue disorder, thyroid dysfunction, epilepsy, renal disease, heart disease, obesity; atopic patients, abruptio placenta, placenta previa, coagulopathies, thrombocytopenia with platelet count less than 80,000/cm3, sepsis, neurological disease, hypovolemia, pulmonary edema, multiple gestations or any congenital anomalies of new born baby as demonstrated in Table I.

Table I: Criteria of excluded patients

Cause of exclusion	No.
Eclampsia	16
Past medical disorder	10
Concurrent APH	2
Suspected pulmonary edema	3
Suspected sepsis	1
HELP syndrome	2
Patients refused to be part of the study	21
Total	55

Hundred pregnant patients were included in this study and were randomly divided into two groups, each group include 50 patients.

Group A underwent cesarean section under spinal anesthesia while group B achieved their surgery under general anesthesia.

Patients with a diagnosis of preeclampsia were admitted in the ward or labor room for emergency cesarean section and initial obstetric management was given according to existing hospital protocol. Thereafter general, physical, abdominal, and pelvic examinations were done. Initial investigations like complete blood work, and urine analysis were performed.

For group A, the spinal group (SA group), IV fluid as preload in form of lactated Ringer's solution was set. While patient in sitting position, the area of puncture was determined by palpation of iliac crest, skin was painted by povidon iodine and the patient's back was drapped. The level of injection site was determined by palpation at the levels of L2- L3, L3-L4 or L4-L5. Infiltration of the skin was done by 2ml of Lidocaine 2%, then spinal needle (22G or 25G) was inserted through layer by layer with frequent checking for CSF leak. Bupivacaine 0.5% (12.5 mg, 2.5 ml) was injected after CSF leak, then the needle was removed and the area was sterilized and dressed by clean gauze. Patient kept in supine position with pillow under his head. Level of block was assessed by cold object, pinbrick and Bromage scale. Skin incision was done after verification of successful block.

Blood pressure and heart rate was recorded before induction as a base line and every 5 minutes for the rest of surgery. The average operation time was 30-70 minutes. Clinically significant hypotension was defined as the need for ephedrine (30% decrease in mean BP)

despite preload fluid volume (1000ml–2000ml).

Regarding group B (GA group), anesthesia was induced by propofol 2mg/kg intravenously, laryngoscopy and endotracheal intubation achieved by suxamethonium 1.5mg/kg intravenously for rapid sequence intubation and maintained with inhalational anesthetic agent and muscle relaxants in form of rocuronium 0.15mg/kg.

The intraoperative analgesia varied from fentanyl 3 mcg/kg intravenously (after delivery of fetus) or other nonopioid analgesics like paracetamol (1g infusion). Few cases were excluded from this study when encounter failure of SA, so change to plan B (GA).

The study included a detailed follow-up of the same mothers who underwent cesarean section till discharge during the period of hospital stay. Any admission/intervention requiring intensive care support was noted. Data was entered as per case record form particularly designed for relevant statistical methods. Categorical variables were expressed as number of patients and percentage of patients and compared across the groups using Pearson's Chi-Square test for independence of attributes. Continuous variables are expressed as mean±standard deviation and compared across the 2 groups using unpaired t-test. The results were collected in Microsoft Excel for analysis

with statistical software SPSS version 20, if any P value is less than 0.05 it has been considered as being of significance.

Results

Fifty patients with preeclampsia underwent cesarean section by GA and another 50 had SA in this study. The patient's characteristics are shown in Table II.

Table II: Demographic profile of mothers regarding age, weight, height &gestational age.

Parameters	General anesthesia	Spinal Anesthesia	value	Significance
	Mean±SD	Mean±SD		
Age	23.78±4.91	24.42 ± 4.32	0.490	Not significant
Weight	64.48±3.01	73.79 ± 3.12	0.292	Not significant
Height	158.78±3.11	158.47±3.14	0.639	Not significant
Gestational age	34.63±1.5	35.58 ± 2.23	0.036	Significant

This study shows that increase in MAP & HR is less in pre-eclamptic patients undergoing spinal anesthesia, as compared with general anesthesia for cesarean delivery as shown in Table III. Baseline values of MAP were similar in both groups A & B (SA &GA), but after induction of anesthesia till recovery, there were significant differences in between the two groups (P< 0.001)

In spinal group, mean BP remains stable or decreased significantly from 8 min. of the spinal injection until the end of the operation. There was a significant decrease in the MAP in group A (following administration of spinal anesthesia). The decrease in MAP was more in spinal group.

Mean baseline values of HR were similar in both groups A&B (SA & GA), during induction of anesthesia there were significant differences between the two groups (P<0.05). The magnitude of increase in HR was larger in group B following general anesthesia.

It is obvious that a high and dangerous increase MAP and HR occur in this study during laryngoscopy and endotracheal intubation in the GA group.

Table III: Changes in mean arterial pressure and heart rate following general & spinal anesthesia using student's unpaired t-test and Pearson's chi-square test.

Variable	GA	SA	P value
Mean Arterial Pressure(mmHg)	Mean±SD	Mean±SD	
Baseline MAP	133.82±9.822	135.22±8.888	
Induction MAP	137.86±8.692	119.08±10.646	0.001<
Skin incision MAP	109.76±8.436	100.14±12.179	0.001<
Uterine incision MAP	105.88±8.133	89.98±6.841	0.001<
Delivery MAP	108.72±12.053	90.72±5.206	0.001<
Post Delivery MAP	110.62±16.367	94.64±1.535	0.001<
Peak Uterine Contraction MAP	113.92±18.946	93.98±3.204	0.001<
End of surgery MAP	117.84±13.503	96.00±2.295	0.001<
Recovery MAP	115.62±13.203	94.82±3.330	0.001<
Heart Rate(bpm)			
Baseline HR	87.90±10.676	86.00±9.022	
Induction HR	97.28±7.712	78.04±4.544	0.001<
Skin Incision HR	84.78±5.987	85.90±5.733	0.06
Uterine incision HR	83.40±8.706	83.06±8.591	0.064
Delivery HR	79.80±5.440	77.10±3.025	0.076
Post Delivery HR	79.80±5.440	77.70±1.909	0.07
Peak Uterine Contraction HR	78.24± 5.836	77.32± 3.443	0.01
End of Surgery HR	76.42±4.352	76.98±4.073	0.28
Recovery HR	93.46±9.485	79.86±7.714	0.008

Discussion

The results from data of this study demonstrates that pre-eclamptic patients experienced less variability in hemodynamic parameters following spinal anesthesia versus general anesthesia.

Neuro-axial blockade during labor and delivery appears to be a logical choice if patient is stable with a normal level of consciousness and no neurological deficits[24], including; provision of high-quality analgesia, which attenuates the hypertensive response to pain. Because of sympathetic block that happened during spinal anesthesia, a reduction in levels of circulating catecholamines and stress-related hormones, possible improvement in uterine blood flow, thus obviating the need for general anesthesia with its attendant risks.

As changes in MAP reflect changes in both SBP and DBP over a course of time and because it is usually used in study of patients with preeclampsia to evaluate the effects of general & spinal anesthesia on BP & HR in these patients[25-27] MAP was chosen as primary study variable instead of SBP & DBP.

Preeclampsia, which affects 5% to 7% of pregnancies, is a significant cause of maternal and neonatal morbidity and mortality[28]. Preeclampsia is characterized by hypertension and proteinuria after 20 weeks gestation, the pathophysiologic basis of preeclampsia is deranged angiogenesis with incomplete

trophoblastic invasion leading to small, constricted myometrium spiral arteries with exaggerated vasomotor responsiveness, superficial placentation, and placental hypoperfusion. Symptomatic preeclampsia reflects widespread endothelial dysfunction, in which placenta-derived mediators cause multisystem organ dysfunction[29].

Pre-eclamptic parturients whose hypertension has been treated antepartum generally present for delivery with small plasma volume, normal or increased cardiac output, vasoconstriction, and increased left ventricular work (although left ventricular systolic and diastolic dysfunction may develop). Additional manifestations include increased airway edema, decreased glomerular filtration, platelet dysfunction, and a spectrum of hemostatic derangements (typically accentuated hypercoagulability)[30,31]. In severe preeclampsia, chronic placental hypoperfusion is often significant. Since the uteroplacental circulation is not autoregulated, further decreases in perfusion may be poorly tolerated by the fetus. Primary peripartum goals in the severely pre-eclamptic parturient are the optimization of maternal blood pressure, cardiac output, and uteroplacental.

Historically, a well-known belief is that spinal anesthesia in patients with severe preeclampsia causes severe hypotension and decreased uteroplacental perfusion prevented the widespread use of spinal anesthesia in these patients. However, studies show that parturients with severe preeclampsia experience less frequent, less severe hypotension than healthy parturients. Among patients with severe pre-eclampsia, spinal anesthesia may cause a greater degree of hypotension than epidural anesthesia; however, this hypotension is typically easily treated, and no studies have demonstrated clinically significant differences in outcomes when spinal anesthesia is compared with epidural or general anesthesia. Risk–benefit considerations strongly favor neuroaxial techniques over general anesthesia for cesarean delivery in the setting of severe pre-eclampsia as long as neuroaxial anesthesia is not contraindicated. Therefore, spinal anesthesia is a reasonable anesthetic option in severe preeclampsia when cesarean delivery is indicated, and there is no indwelling epidural catheter or contraindication to spinal anesthesia.

Hypotension after spinal anesthesia in severely pre-eclamptic patients may reflect the rapid onset of sympathetic blockade, underlying intravascular volume depletion, and possible left ventricular dysfunction.

There was evidence as early as 1950 that preeclampsia actually attenuates spinal anesthesia–induced hypotension32-34, it was not until the mid of 1990s, when clinical trials demonstrated the safety of spinal and combined spinal–epidural (CSE) anesthesia in those patient populations[35,36], that spinal anesthesia gained acceptance as an alternative to epidural and general anesthesia for pre-eclamptic patients. Most trials assessing the severity of hypotension after spinal anesthesia among severely pre-eclamptic parturients exclude patients in active labor because labor itself attenuates the frequency and severity of the hypotensive response to neuroaxial anesthesia during cesarean delivery[37].

Most studies are relatively small (n<150), and the details of preoperative antihypertensive and magnesium sulfate policy vary. The pre-ecliptic patient is very sensitive to exogenous catecholamine. Three prospective trials have demonstrated that pre-eclamptic parturients experience less frequent and less severe hypotension and require smaller doses of vasopressors than normotensive controls after the initiation of spinal anesthesia is widely regarded as a reasonable anesthetic option for cesarean delivery in severe pre-eclampsia, provided there is no indwelling epidural catheter or

contraindication to neuroaxial anesthesia. Compared with healthy parturients, those with severe pre-eclampsia experience less frequent, less severe spinal-induced hypotension and this hypotension is typically easily treated and has not been linked to clinically significant differences in outcomes.

Traumatic laryngoscopy may trigger pharyngeal or hypopharyngeal bleeding, further obscuring visualization of the airway. Although the absolute risks of general anesthesia (failed/difficult airway management, hypertension with direct laryngoscopy, delayed recognition of stroke under general anesthesia, and aspiration) are low even among pre-eclampticparturients, the risk of difficult airway management is a compelling reason to favor neuroaxial anesthesia. Closed claims analysis from the United Kingdom from 2006 to 2008 identified poor hemodynamic management of preeclampsia as one of the main categories in which poor perioperative management may have contributed to maternal death[38]. Severe preeclampsia is also a leading cause of peripartum hemorrhagic stroke39. During direct laryngoscopy and intubation, severely pre-eclampticparturients experience significantly larger increases in arterial blood pressure and middle cerebral artery velocity compared with healthy parturients[40]. Cerebral hypertension may, in turn, precipitate hemorrhagic stroke. Hemorrhagic stroke was the leading direct cause of mortality in patients with severe preeclampsia according to the most recent analysis by the United Kingdom Center for Maternal and Child Enquiries[41]. If general anesthesia is necessary, equipment should be immediately available to manage a difficult airway, and every effort should be made to blunt the hemodynamic response to laryngoscopy[42,43].

The results of this study showed no increase in MAP in the spinal group because there is no sympathetic stimulation caused by laryngoscopy and intubation, in contrary, there is a sympathetic block due to spinal anesthesia in group A, therefore blood pressure and heart rate was significantly ($P<0.001$) diminished in all steps of anesthesia but it started after 8 min. of injection. This type of reduction is safe as it happened gradually. While in the GA group, there is obvious increase ($p<0.001$) in MAP and HR during laryngoscopy and endotracheal intubation secondary to sympathetic stimulation by this process.

Conclusion

According to the results of this study, spinal anesthesia is considered as anesthesia of choice in pre-eclamptic women scheduled for cesarean section to avoid the possible complications of general anesthesia which is related to pathophysiological changes that existed in pre-eclampsia. Because of hazards related to management of the difficult airway and to the hemodynamic consequences of laryngoscopy and tracheal intubation, general anesthesia is usually chosen only when regional techniques are contraindicated or refused.

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