Original Research Article

Perfusion Index as a Predictor of Hypotension Following Spinal Anaesthesia in Lower Segment Caesarean Section

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Abstract:

Introduction: Spinal anaesthesia is the technique of choice for elective caesarean section, because it avoids risks associated with general anaesthesia. Spinal block induced sympatholysis leads to hypotension. Perfusion Index (PI) is a new parameter tried to predict hypotension during spinal anesthesia in caesarean section. This study, aimed at investigating the correlation between baseline perfusion index and incidence of hypotension following spinal anaesthesia.

Method: In this prospective observational study,120 parturients were divided in two groups on the basis of baseline PI. Group I included parturients with PI>3.5 and group II parturients PI<3.5.Spinal anaesthesia was given using 10 mg hyperbaric bupivacaine at L2-L3 or L3-L4 space. Hypotension defined as decrease in systolic BP greater than 20 %of baseline treated with fluid bolus and inj mephentermine. Statistical analysis was performed using student's unpaired t-test.

Results: There is a significant correlation between baseline perfusion index and incidence of hypotension following spinal anaesthesia. The incidence of hypotension in group I(PI >3.5) is 71% compared to 41% in group II (PI <3.5).

Conclusion: We concluded that there is a significant correlation between baseline perfusion index and perfusion index after spinal anaesthesia. We also concluded that hypotension is more likely to develop after spinal anesthesia for caesarean section in parturient with higher baseline perfusion index and it can be used as an early non-invasive parameter for predict hypotension in healthy parturients undergoing elective caesarean section under spinal anesthesia.

Keywords: Hypotension; Spinal anesthesia; Pregnancy; Perfusion Index.

Introduction

Spinal anesthesia is the technique of choice for elective caesarean section, because it avoids risks associated with general anesthesia, such as risk of aspiration, difficult intubation and negative effects of general anesthesia on the fetus1. However certain side effects may also cause by spinal anesthesia, most common is hypotension. Hypotension following subarachnoid block results from the preganglionic sympathetic blockade and decreased cardiac output.

Spinal block –induced sympatholysis leads to vasodilatation and consequently causes hypotension in mothers [1].A decrease in systolic pressure can compromise uterine blood flow and foetal circulation2. Spinal anesthesia causes hypotension via several mechanisms, most significant being rapid onset of sympatholysis due to increased sensitivity of nerve fibres to local anesthetics during pregnancy [2]. Pregnant women are more sensitive to local anesthetics, less responsive to vasopressor. Higher sensitivity to local anesthetics combined with aortocaval compression of the pregnant uterus are the main reasons for increased incidence of hypotension in pregnant women, compared to non-pregnant patients [3]. Hence, parturients can develop profound hypotension following spinal anaesthesia for caesarean section. Pregnant patients also exhibit an increased level of sympathetic activity compared to parasympathetic activity.

Sympatholysis therefore leads to a higher degree of peripheral vasodilatation and a predominance of parasympathetic activity, consequently reducing the venous return and cardiac output resulting in bradycardia, nausea and vomiting [4]. The prevention and treatment of hypotension is administration of crystalloids and/or colloid before and during anesthesia [5], left lateral position or

wedge for displacement of uterus [6], administration of smaller doses of local anesthetics and administration of vasopressors. Perfusion index (PI) is defined as the ratio of pulsatile blood flow to non -pulsatile blood flow in the peripheral vascular tissue, measured using a pulse oximeter based on the amount of infrared light absorbed (940nm) and is indirect and noninvasive measure of peripheral perfusion.

Normal PI range is between 0.02% (very feeble pulse strength) to 20% (very strong pulse strength) [7-9] Change in sympathetic tone (as after spinal anesthesia) by affecting smooth muscle tone influences the blood vessel caliber and regional perfusion of blocked area increases.

PI is affected by amount of the blood as it is the ratio of pulsatile (arterial) to non-pulsatile (venous, capillary, tissue) component of the blood. Higher the vasomotor tone i.e vasoconstriction, lower is the PI. In case of vasodilatation, higher is the PI [10].

We conduct this study aimed to investigate the correlation between a baseline perfusion index and the development of hypotension after spinal anesthesia in parturient undergoing caesarean section.

Materials and Methods

Study Location: After getting approval from institutional ethical committee and informed written consent from the patients. This prospective randomized study was conducted in Department of Anesthesia, Jhalawar Medical College, Jhalawar, from February, 2021 to October, 2021.

Study Design: A double blinded, Prospective observational study, Based on the baseline perfusion index, pregnant patient are divided as follows:

Group I – Baseline perfusion index >3.5 - 60 cases

Group II – Baseline perfusion index ≤3.5 - 60 cases

Blinding:

Double blinded study: Baseline values including PI recorded in supine position by an anesthesiologist who was not involved in further intraoperative monitoring of the patient. Observer who is monitoring intraoperative parameters was blinded from baseline value.

Materials required

- Standard monitor to measure heart rate , non-invasive blood pressure, ECG and temperature
- Pulse oximeter for Perfusion Index (PI) or multipara monitor having PI
- Antiseptic solution (Betadine, surgical spirit) for skin disinfection
- 25G Quincke's spinal needle

- Sterile 5ml needle
- Cotton and Spirit for assessing the sensory level.

Drugs:

- Inj Ranitidine 50mg
- Inj Metoclopromide 10 mg
- Inj 0.5% Bupivacaine 10 mg
- Inj Mephentermine
- Inj Oxytocin
- All the emergency drugs:

Adrenaline, Atropine. Hydrocortisone, Dexamethasone, Sodium bicarbonate, Deriphylline, Chlorpheniramine, Frusemide, Ephedrine, Phenylephrin, Dopamine, Dobutamine, Noradrenaline.

Intravenous Fluids

- Normal saline
- Ringer lactate

Inclusion Criteria

1. Elective lower segment caesarean section who have given valid consent
2. Age 18 to 35 years
3. ASA grade II

Exclusion Criteria

1. Patients admitted with cardiovascular or cere-brovascular disease
2. Patient with gestational diabetes mellitus
3. Parturient with placenta previa.
4. Preeclampsia and eclampsia
5. Body mass index>40
6. Gestational age<36 or >41 weeks
7. ASA grade III or IV
8. Contraindicated to spinal anesthesia
9. Parturient those requiring emergency LSCS
10. Allergy to local anesthetics.
11. Skin infection in lumbar area.

Method

Pre-Operative Preparation: All the patients were thoroughly preanesthetically evaluated by taking history of present and past illness. General physical, systemic, local and airway examination were done thoroughly to detect any abnormality. All possible investigation like Hb, CBC, Random Blood Sugar, Blood Urea, Serum Creatinine, LFT, BT, CT & ECG were examined and finally ASA grading done.

Patients were kept nil orally for at least 6 hours preoperatively and 4 hours post operatively. During the preoperative visit, the patient was explained about the purpose of the study and about the possible complication that can occur and informed consent was obtained.

Procedure: On arrival to the operating room, the parturient were examined to confirm the finding of

pre-anesthetic check-up and enquired about the fasting status.

After shifting the patient to the operative room they randomly allocated into one of the two groups based on their baseline Perfusion index in supine position. Baseline parameter ECG, automated NIBP, and pulse oximetry (SpO2). The perfusion index was measured in supine position using pulse oximeter which was attached to left index finger of each parturient by an anesthesiologist who was not involved in the further intraoperative monitoring of the patient. IV access was established in both forearms using a 18 G canula. All parturient were pre medicated with inj. Ranitidine 50mg and inj. Metoclopromide 10mg i.v one hour prior to elective surgery. Each parturient were pre-hydrated with 500ml of Ringer Lactate over 20 min.

After prehydration, the baseline values recorded. PI was recorded after using pulse oximeter in the left index finger. While administering central neuraxial blockade, pulse oximeter disconnected to prevent observer bias.

Spinal anesthesia was performed by an anesthesiologist blinded to baseline PI. Using 25G Quincke's spinal needle in lateral position using 10 mg of 0.5%hyperbaric bupivacaine at L3-L4 or L2-L3 interspace.

The parturient returned to supine position with a left lateral tilt of 15 degree to facilitate left uterine displacement. The pulse oximeter reconnected to monitor the patient till the end of surgery. Oxygen was given through face mask @ 4l/min. Ringer Lactate administrated at 100ml/10 min. The level of sensory block was checked 5 min after spinal block. If a T 6 sensory block level not achieved, the parturient were excluded from the study Maximum cephalad spread checked 20 min after subarachnoid block (SAB). NIBP, heart rate (HR), SpO2, PI were recorded at 2 min interval for 20 min & then at 5 min interval till the end of surgery Adverse effects noted and treated accordingly.

Hypotension defined as decrease in systolic blood pressure greater than 20% of baseline, treated with 100 ml of Ringer Lactate and 6mg of bolus dose of inj. Mephentermine. Bradycardia defined as heart rate < 55 beats/min and treated with Inj. Atropine 0.6mg IV bolus. Inj Oxytocin 10 units given as uterotonic following baby extraction via infusion. Patient requiring additional oxytocin/surgical

intervention excluded from the study. Incidence of nausea and vomiting if observed recorded.

Primary Outcome:

- The relation of Perfusion index and development of hypotension after onset of effect of spinal block.
- Correlation between baseline perfusion index and perfusion index after spinal block.

Secondary Outcome:

- Total doses of vasopressor needed.

Statistical analysis and interpretation: The study subjects were described according to their age, height and weight. Statistical analysis has been done by using chi-square and student's unpaired t-test. The P-value less than 0.05 (P≤0.05) were considered to be significant.

Complications:

- Incidence of hypotension
- Episodes of bradycardia
- Incidence of nausea and vomiting

The mean age of PI≤3.5group was 24.75 years. The mean age of PI ≥3.5 group was 25.3years.The difference between the ages of the two groups was not statistically significant (P=0.05). The mean height of PI≥3.5group was 157.15±6.1cm. The mean height of PI ≤3.5 group was 159.9±7.3cm.The difference between heights of the two groups was not statistically significant (P>0.05). The mean weight of PI≥ 3.5 group was 78.65±7.90 kg. The mean height of PI ≤ 3.5was 72.4±10.96 kg. The difference between weight of the parturient in two groups was not statistically significant (P>0.05).

The incidence of hypotension in group I PI >3.5 was 71% compared to group II PI <3.5 was 41.6%.The differences between two groups were statistically highly significant (P<0.001).Incidence of hypotension is much less in group II PI<3.5 when compared with the group I PI >3.5. Fourty one patients in group II had no incidence of hypotension, 17 patients had one incidence, and 2 patients had two incidence. Whereas in group I PI >3.5 13 patients had no incidence, 12 patients had one episode, 19 patients had two episodes, and 4 patients had four incidence of hypotension.
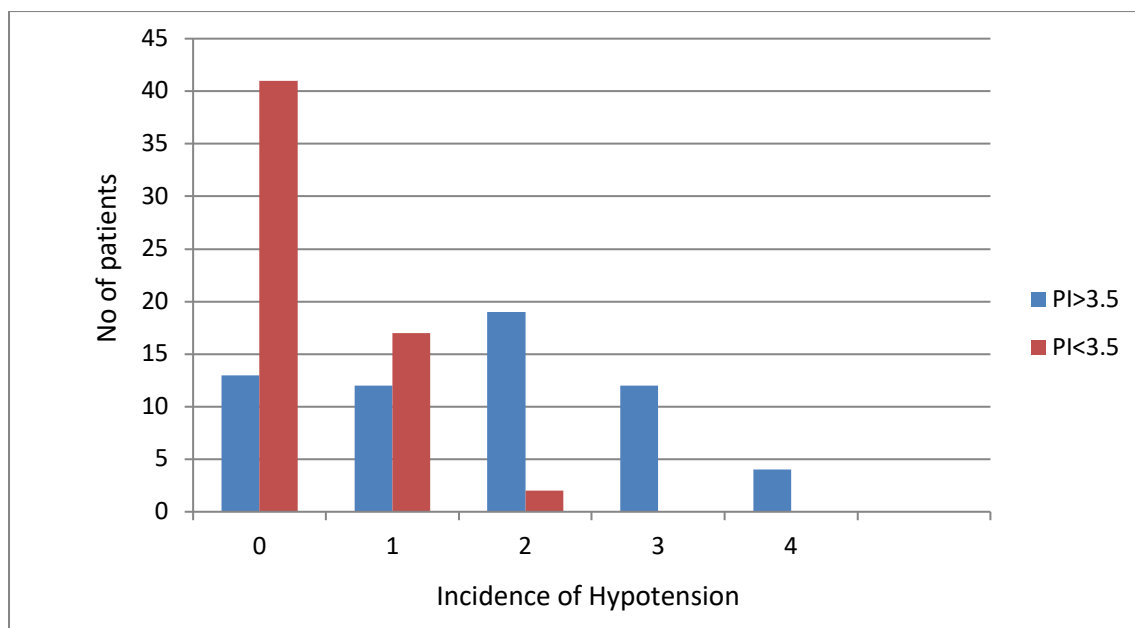
Figure 1: Comparison of hypotension between the two groups

The perfusion index at base through 20 min were statistically highly significant differed between two groups (P<0.01).
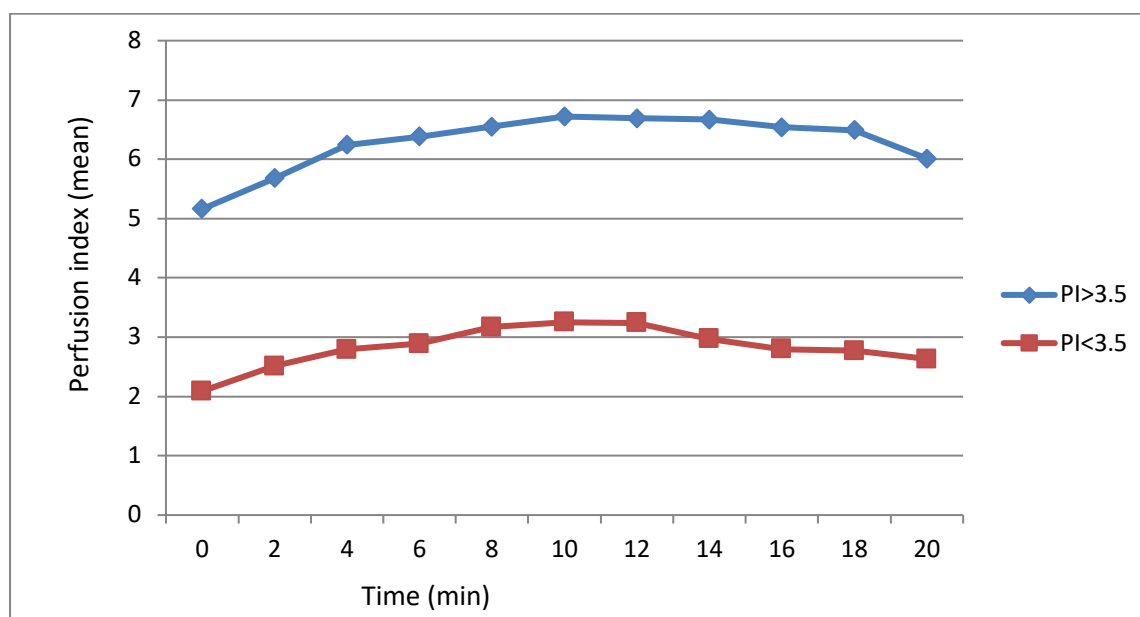

Figure 2: Comparison of perfusion index after spinal anaesthesia between two groups

Discussion

In this prospective observational study we proved that perfusion index as a parameter that early indicates hypotension following spinal anaesthesia in caesarean section. In our study we also found that the incidence and severity of hypotension was higher in parturients whose baseline PI values were greater than 3.5. Hypotension is most common following spinal anaesthesia for caesarean section and there is no definite monitoring system which can predict the likelihood of developing hypotension so that additional precaution may be taken. A normal healthy pregnancy is characterised by a decreased in systemic vascular resistance, increased total blood volume and cardiac output. This decrease in vascular tone corresponds to higher perfusion index values due to increase in pulsatile component due to vasodilatation.

Spinal anaesthesia causes sympathetic blockade that will cause a further decrease peripheral vascular tone and increase pooling of blood and hypotension. Ginosar et al [20] demonstrated that increase in PI following epidural anesthesia is a clear and reliable indicator of sympathectomy. The

cut-off value of baseline perfusion index for prediction of hypotension following spinal anesthesia was chosen as 3.5 based on a study conducted by Toyama et al [22]. who did regression analysis and ROC curve analysis and concluded that a baseline perfusion index cut-off point of 3.5 could be used to identify parturients at risk for such hypotension. In our study, the baseline PI >3.5 and probability of hypotension were significantly correlating, a finding similar to study by Toyama et al [22]. In our study we used inj mephentermine and fluid bolus to treat hypotension while Toyama et al [22] used only inj. Phenylephrine to treat hypotension. So in our study the consumption of IV fluid was higher than that in a study of Toyama et al [22].

Our findings are similar to study done by Duggappa et al [23] in which they studied PI is a new parameter tried for predicting hypotension during spinal anaesthesia for the lower segment caesarean section (LSCS). This study aimed at investigating the correlation between baseline perfusion index and incidence of hypotension following SAB in LSCS. The incidence of hypotension in Group I (PI <3.5) was 10.5% compared to 71.42% in Group II (PI >3.5) They concluded that baseline perfusion index >3.5 is associated with a higher incidence of hypotension following spinal anaesthesia in elective LSCS. In our study we also found that similar correlation between baseline perfusion index and incidence of hypotension following spinal anaesthesia in caesarean section. The incidence of hypotension in Group I (PI >3.5) is 71% compared to 41% in Group II (PI <3.5).

Similar study done by Mallawaarachchi et al [27], Pradhan P et al [28], George J et al [25], and Regimol V et al [24] concluded that PI can be useful tool to early predictor of hypotension following spinal anesthesia for LSCS. Mallawaarachchi et al [27] also observe that response to ephedrine can be quickely assessed by the change in the PI which helps to decide further doses of ephedrine. The cut-off point of PI for predicting hypotension in George J et al [25] study is 3.6. They concluded that baseline PI >3.6 is associated with a higher incidence of hypotension following spinal anaesthesia in LSCS.

A higher requirement of vasopressor was seen in parturients with baseline PI>3.5, in our study. Mowafi et al [21] used PI to detect intravascular injection of the ephedrine containing epidural test dose, hence its reliability to detect vasoconstriction has been demonstrated successfully. Duggappa et al [23] also observe that parturients whose SBP drops have symptoms of hypotension such as dizziness , nausea and vomiting during the procedure .In our study we also found that

incidence of nausea and vomiting is more in Group I (PI >3.5)compare to Group II (PI< 3.5).

Conclusion

PI increases in response to vasodilation as a result of sympathetic blockade after spinal anesthesia. We concluded that there is a significant correlation between baseline perfusion index and perfusion index after spinal anesthesia. We also concluded that hypotension is more likely to develop after spinal anesthesia for caesarean section in parturient with higher baseline perfusion index and it can be used as an early non-invasive parameter for predict hypotension in healthy parturients undergoing elective caesarean section under spinal anesthesia.

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