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ASSESSMENT OF SPINAL ANESTHESIA INDUCED HYPOTENSION VIA PERFUSION INDEX IN PATIENTS PRESENTING FOR CAESAREAN SECTION AT TERTIARY CARE HOSPITAL IN PESHAWAR PAKISTAN

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Abstract

Background: The Perfusion Index (PI) is a revolutionary parameter that has been attempted to predict hypotension during spinal anesthesia for lower segment caesarean sections (LSCS). The purpose of this study was to look into the relationship between the incidence of hypotension after SAB in LSCS and the baseline perfusion index at tertiary care hospital in Peshawar. **Methods:** Descriptive cross sectional study was conducted in department of gynaecology at tertiary care hospital in Peshawar. We have

selected 100 sample sizes by convenient sampling technique. Our study inclusion criteria include age 20 to 40,single foetus, ASA 1 and 2 physical status, spinal anesthesia and exclusion criteria include diabetics patients, obese patients with BMI >40kg/m2, general anesthesia. All variables being categorical were analysed by frequency and percentage using SPSS version 29. **Results:** Our study found a notable correlation between baseline perfusion index (PI) exceeding 3.5 and an increased incidence of hypotension during spinal anesthesia for elective lower segment caesarean sections. In the third interval, 48% of patients exhibited a PI greater than 3.5, with 61% subsequently developing hypotension. These results emphasize the potential of PI as a valuable predictive tool in optimizing perioperative management and patient outcomes. **Conclusion:** A greater frequency of hypotension after spinal anesthesia in elective LSCS is linked to a baseline perfusion index greater than 3.5.

Keywords: Hypotension, perfusion index, pregnancy, spinal anesthesia

INTRODUCTION

Hypotension is generally defined as a systolic blood pressure below 90 mmHg or diastolic blood pressure below 60 mmHg (1). In pregnancy, reduced blood volume, dehydration, bleeding, cardiac conditions, and certain medications may contribute to hypotension (2). Spinal anesthesia can further cause hypotension through sympathetic blockade, reduced cardiac output, and vasodilation. Pregnant women are particularly sensitive to local anesthetics and may develop significant hypotension after spinal anesthesia for lower-segment cesarean section (3).

Non-invasive blood pressure monitoring is routinely used during surgery, but it cannot detect beat-to-beat changes in perfusion (3). Early prediction of spinal-induced hypotension may improve maternal and neonatal outcomes. The perfusion index (PI), obtained from a standard pulse oximeter, is a simple, non-invasive parameter that has shown potential for predicting post-spinal hypotension (4). Other predictive methods include cerebral near-infrared spectroscopy, point-of-care ultrasound, heart rate variability, and pleth variability index, although these are less widely available than pulse oximetry (4).

PI reflects peripheral perfusion by measuring the ratio of pulsatile to non-pulsatile blood flow and can indicate changes in vascular tone and sympathetic activity (5,6). Higher PI values may reflect vasodilation and have been associated with greater reductions in blood pressure following spinal anesthesia (7). Photoplethysmography (PPG) and PI are increasingly recognized as useful non-invasive tools for hemodynamic monitoring (8,9). Peripheral perfusion is influenced by sympathetic vasoconstriction, skin temperature, cardiac output, and vascular tone (10–13).

Spinal-induced hypotension results mainly from reduced venous return, decreased systemic vascular resistance, and sympathetic blockade. Although often tolerated in healthy patients, severe hypotension may increase the risk of myocardial ischemia, postoperative complications, and maternal or fetal adverse outcomes (14). Hypotension following spinal anesthesia can occur in up to 74.1% of cases and may cause nausea, vomiting, reduced placental perfusion, fetal acidosis, and lower Apgar scores (15).

Cesarean section is one of the most common surgical procedures, and spinal anesthesia is widely used because of its rapid onset, high success rate, reduced fetal drug exposure, and ability to keep the mother awake during delivery (16). However, hypotension remains the most common complication of spinal anesthesia, while bradycardia, nausea, and vomiting may also occur (17). Maternal hypotension can cause nausea, vomiting, dizziness, and, in severe cases, loss of consciousness, cardiac arrest, or death, while fetal compromise may also occur (18).

Preventive measures include intravenous fluid administration, appropriate positioning, frequent blood pressure monitoring, and vasopressor therapy. However, fluid loading alone may not reliably prevent hypotension, and excessive fluid administration can cause complications (19). Vasopressors, particularly phenylephrine, are commonly recommended for preventing spinal-induced hypotension, although their use may be associated with bradycardia, tachycardia, nausea, and vomiting (19). Therefore, early identification of patients at risk of spinal-induced hypotension using simple and readily available measures such as perfusion index may be clinically valuable.

MATERIAL AND METHODS

Study design

Descriptive Cross-Sectional study

Study settings

Study was carried out at tertiary care hospitals in Peshawar Pakistan

Study duration

Study duration was 3 to 4 months.

Inclusion Criteria

- Patients admitted for caesarean section undergoing through spinal anesthesia,
- Patients age will be 20 to 40 years
- Pregnant females having Single foetus
- Gestational age 39 to 42 weeks
- Patients who have ASA 1 & 2 physical status.

Exclusion Criteria

- Diabetic patients having peripheral vascular disease. (having weak peripheral pulse)
- Obese patients with BMI>40 kg/m2.
- Caesarean section undergoing through GA.

Sample size

By using WHO sample size calculator, Total sample size was 115 by taking (50%) Population proportion from previous study with 95% confidence interval and margin error (5%).

$$N=\frac{p(1-p)\,z^2}{E^2}$$

P=Represent prevalence

Z= z-score for chosen level of confidence z-score is for 95% confidence intercval95%.

E-represent margin of error

n-represent population size

n=p (1-p) (z/e) 2

N=0.93(1-0.93) (1.96)2/0.0025

N=0.93(0.07) (3.8416)/0.0025

N=0.250088/0.0025

N= 100

Sampling Technique

Non- probability convenience-based sampling.

Analysis plan

We have used descriptive statistic analysis

RESULTS

A total of 100 participants were included in the study. The mean age of the participants was 28.90 years, with a standard deviation of 6.298. The median age was 30.00 years, indicating a relatively symmetric distribution.

The mean weight of the participants was 71.61 kg, with a standard deviation of 7.799. The median weight was 72.50 kg, reflecting a central tendency in the distribution. The gestational age of the participants had a mean value of 35.39 weeks, with a standard deviation of 3.601. The median gestational age was 36.00 weeks, suggesting a moderately skewed distribution. Age, weight and gestational age wise distribution is described in table 1.

Table 1 : *Age, Weight and Gestational age wise distribution*

	Age	Weight	Gestational Age
Mean	28.90	71.61	35.39
Median	30.00	72.50	36.00
Std. Deviation	6.298	7.799	3.601

Previous Spinal Induced Hypotension

The majority of participants (54.0%) reported a history of previous spinal anesthesia-induced hypotension, while 46.0% indicated no such history.

Table 2: *Previous Spinal Induced Hypotension*

	Frequency	Percent
No	46	46.0
Yes	54	54.0
Total	100	100.0

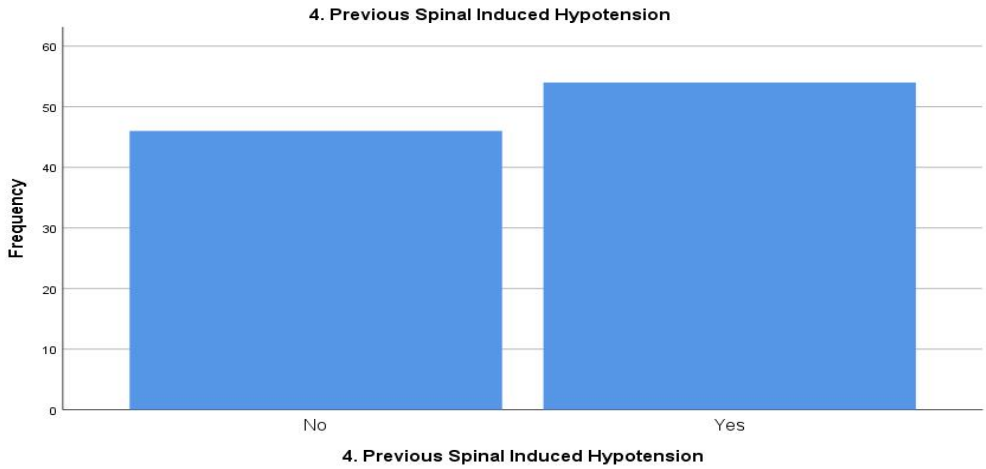


Figure 1 Previous Spinal Induced Hypotension

HB counts

The majority of participants (73.0%) presented with Hb levels below normal, while 27.0% had normal Hb levels.

Table 3: *Hb Count Distribution*

	Frequency	Percent
Hb Below Normal	73	73.0
Hb Normal	27	27.0
Total	100	100.0

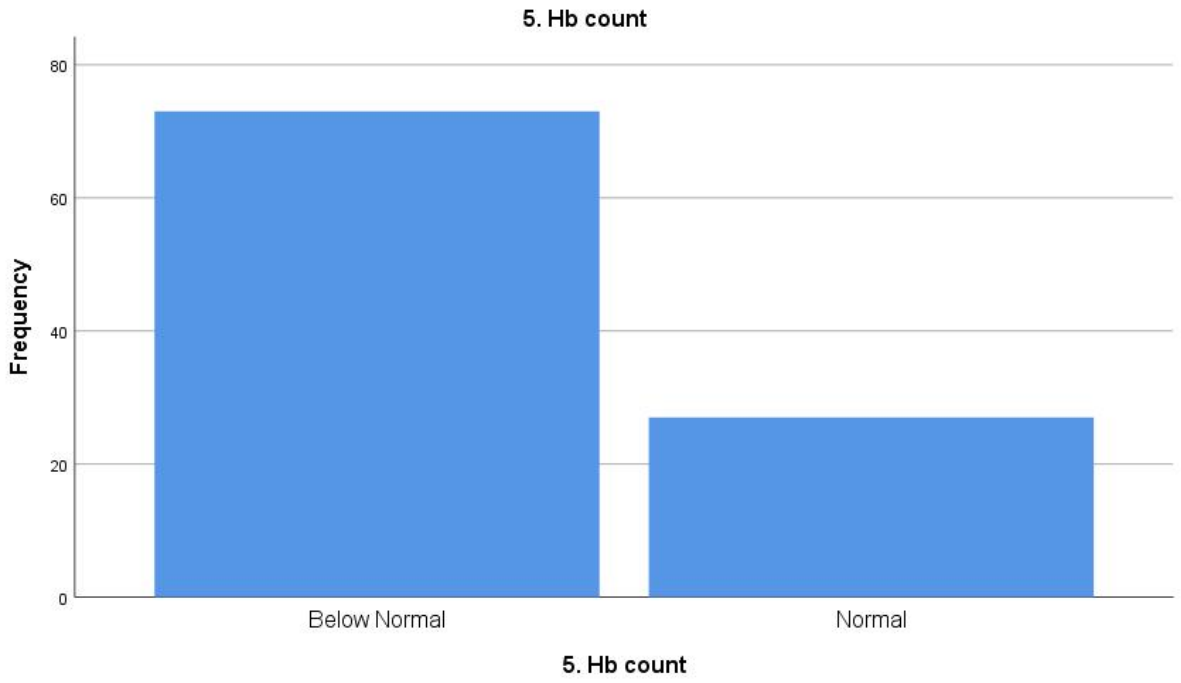


Figure 2 Hb Count Distribution

1st interval

We have taken 100 patients to evaluate the pi relation with hypotension. Those patients who have PI greater than 3.5 was 30% and those patients who develop hypotension was 31% during first interval as shown in the table 4 and 5.

Table 4: *1st Interval PI*

		Frequency	Percent
Valid	3.5	4	4.0
	Greater than 3.5	30	30.0
	less than 3.5	66	66.0
	Total	100	100.0

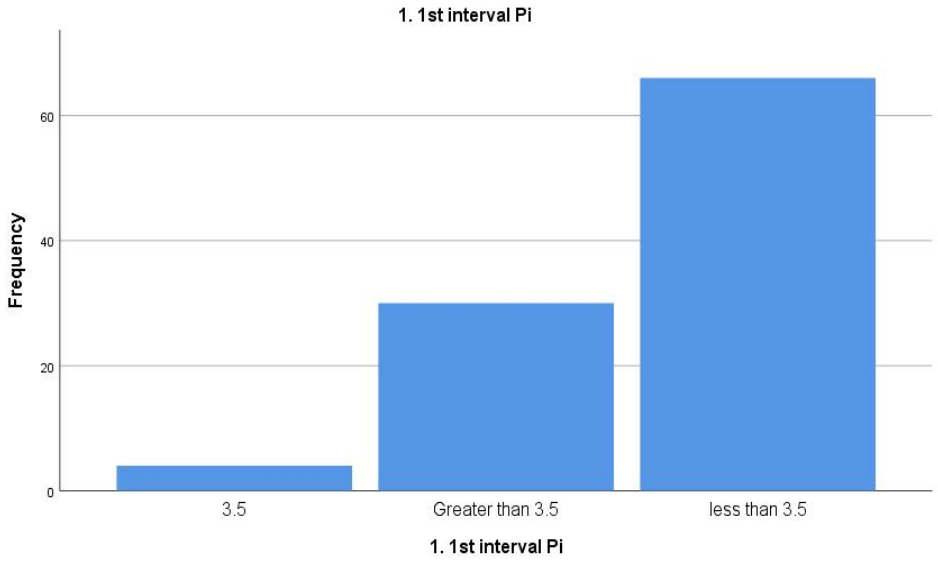


Figure 3 1st Interval PI

Table 5: *1st Interval NIBP*

		Frequency	Percent
Valid	High Bp	51	51.0
	Lower Bp	31	31.0
	Normal Bp	18	18.0
	Total	100	100.0

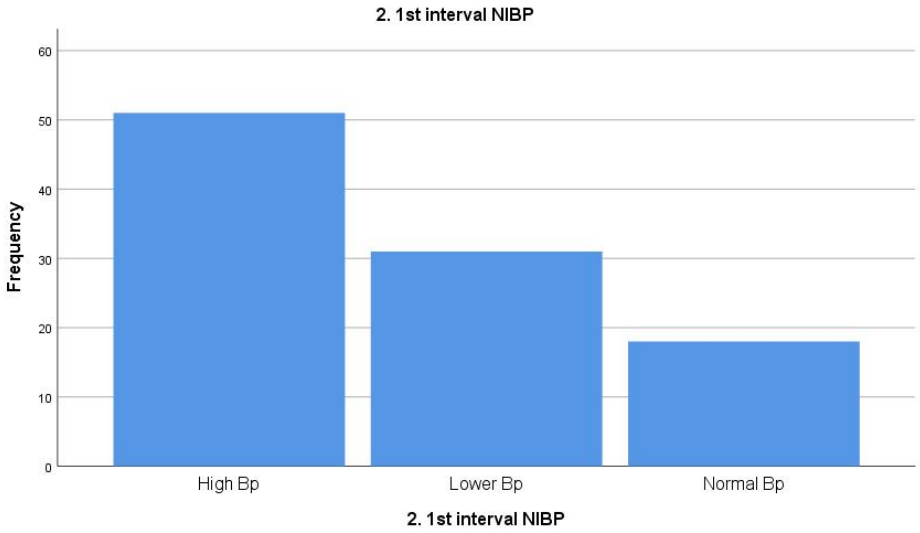


Figure 4 1st Interval NIBP

2nd interval

In 2nd interval 45% patients out of 100 patients have PI value greater than 3.5 and those patients who have develop hypotension during second interval was 50% which is shown in the table 6 and Figure 7.

Table 6: *2nd Interval PI*

		Frequency	Percent
Valid	3.5	3	3.0
	Greater than 3.5	45	45.0
	Less than 3.5	52	52.0
	Total	100	100.0

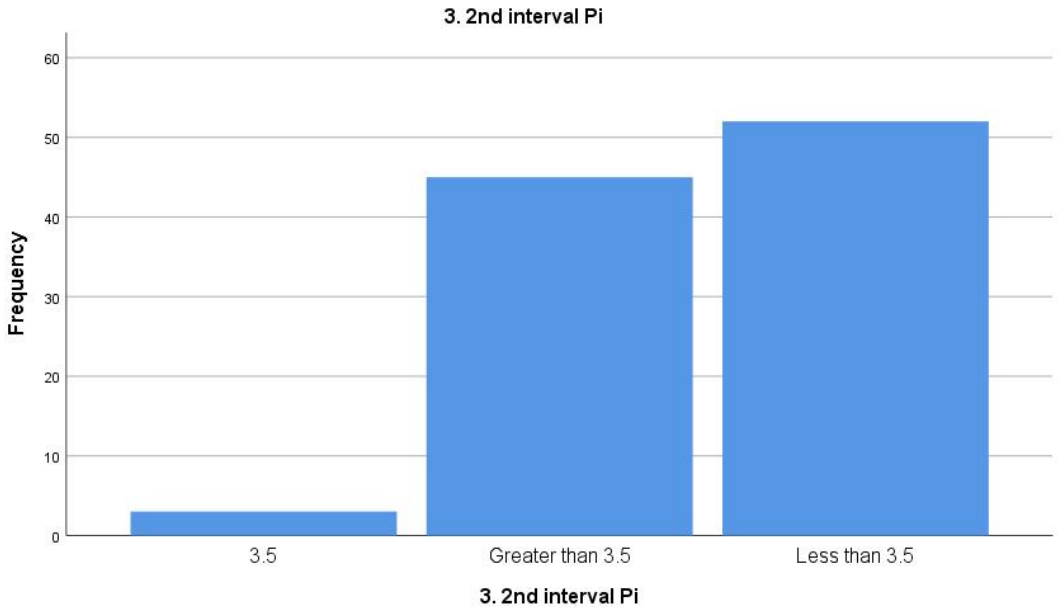


Figure 5 2nd Interval PI

Table 7: *2nd Interval NIBP*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High Bp	32	32.0	32.0	32.0
	Low Bp	50	50.0	50.0	82.0
	Normal Bp	18	18.0	18.0	100.0
	Total	100	100.0	100.0	

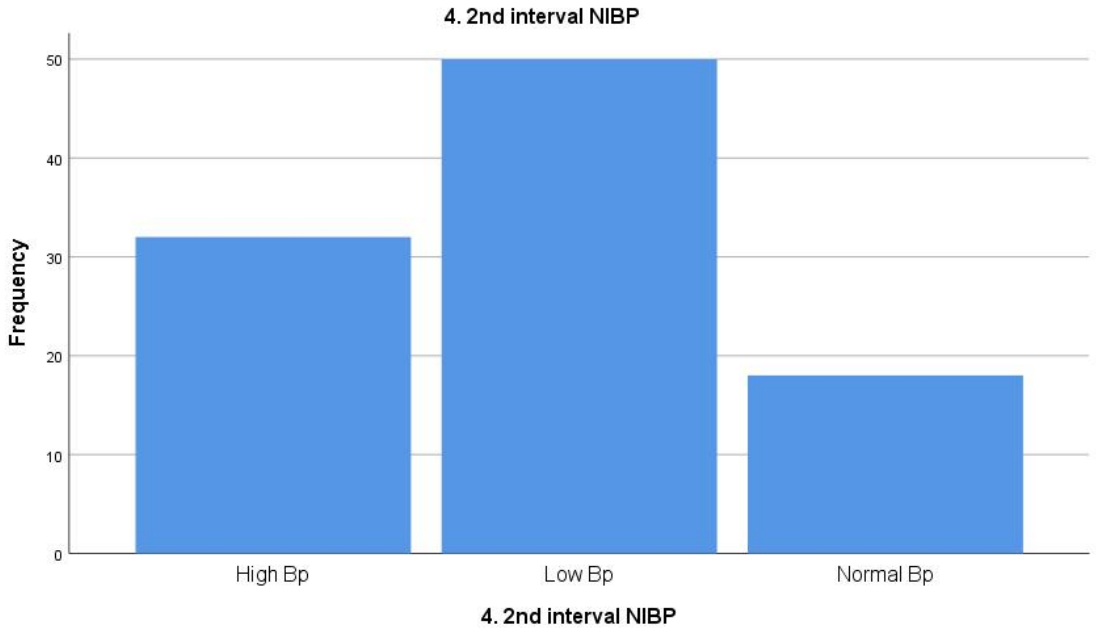


Figure 6 2nd Interval NIBP

3rd interval

During our last interval we have find out 48% patients have pi value greater than 3.5 and 61% patients develop hypotension during 3rd interval which is shown in table 8 and 9.

Table 8 : *3rd Interval PI*

		Frequency	Percent
Valid	3.5	14	14.0
	Greater than 3.5	48	48.0
	Less than 3.5	38	38.0
	Total	100	100.0

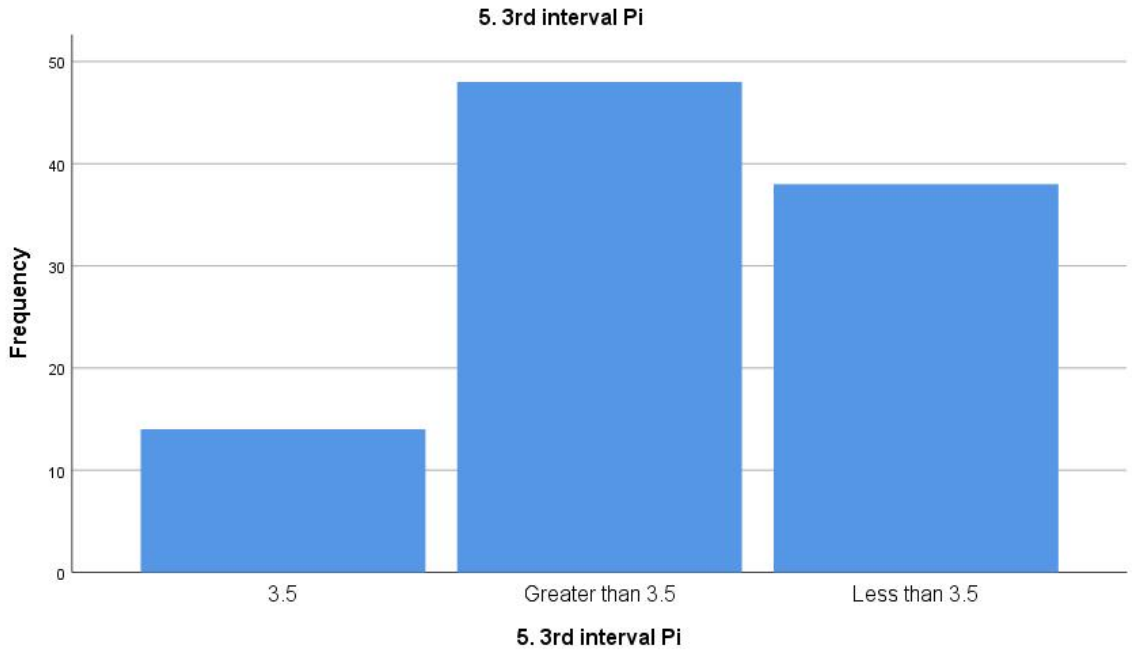


Figure 7 3rd Interval PI

Table 9 : *3rd Interval NIBP*

		Frequency	Percent
Valid	High Bp	13	13.0
	Low Bp	61	61.0
	Normal Bp	26	26.0
	Total	100	100.0

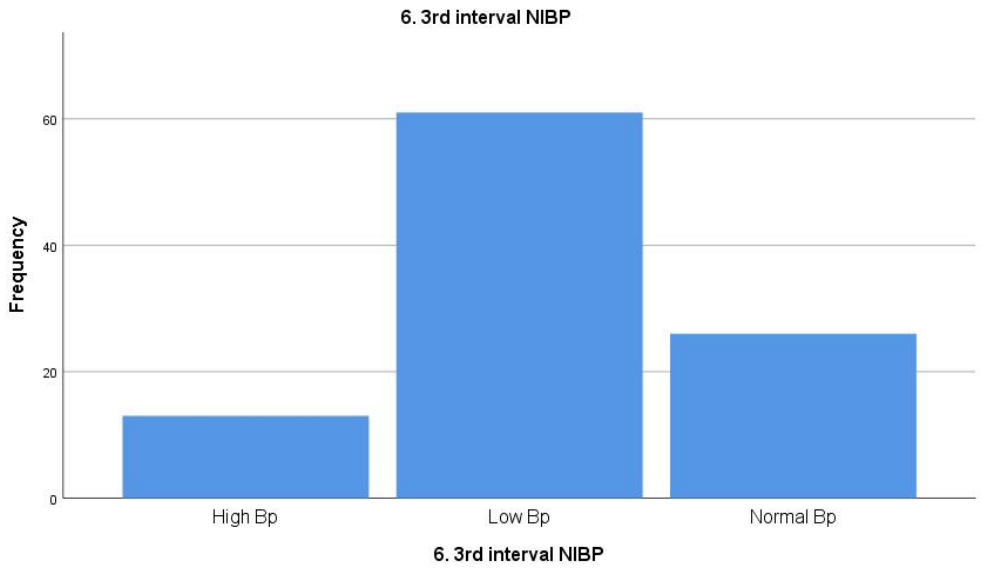


Figure 8 3rd Interval NIBP

DISCUSSION

Our study delves into the assessment of spinal anesthesia-induced hypotension among patients undergoing caesarean sections at a tertiary care hospital in Peshawar, Pakistan. The primary focus is on utilizing perfusion index (PI) as a predictive indicator for hypotensive episodes. The demographic characteristics of the participants provided a comprehensive overview of the study population. With a mean age of 28.90 years, an average weight of 71.61 kg, and a mean gestational age of 35.39 weeks, the cohort represents a relatively young and gravid group.

Notably, more than half of the participants (54.0%) reported a history of previous spinal anesthesia-induced hypotension, emphasizing the significance of understanding and predicting such occurrences. This finding prompts an exploration of potential predisposing factors and underscores the need for preemptive measures in this population.

Our investigation into the correlation between PI and hypotension revealed compelling results. In the first interval, 30% of patients with a PI greater than 3.5 subsequently developed hypotension. This aligns with the work of Toyama et al., who demonstrated the predictive value of PI derived from a pulse oximeter in anticipating hypotension during spinal anesthesia for caesarean delivery [5]. The association between an elevated PI and subsequent hypotension supports the concept of PI as an early warning sign.

Moving to the second interval, our results showed an increased proportion, with 45% of patients exhibiting a PI greater than 3.5 and a corresponding 50% incidence of hypotension. This strengthens the argument for PI as a predictive tool, corroborated by the findings of Duggappa et al. [3] and Nandini et al. [4], who identified PI as a reliable predictor of hypotension following spinal anesthesia for caesarean section.

The third interval unveiled an even higher correlation, with 48% of patients having a PI greater than 3.5 and a substantial 61% subsequently developing hypotension. This resonates with the observations of Ginosar et al., who highlighted the utility of pulse oximeter perfusion index as an early indicator of sympathectomy after epidural anesthesia [6].

Comparative analysis with existing literature on hypotension during pregnancy and anesthesia provides a broader contextual understanding. Sources such as Mayo Clinic [1] and MedicineNet [2] underscore the importance of monitoring and managing low blood pressure during pregnancy to ensure the well-being of both the mother and the fetus. Coutrot et al.'s comprehensive review provides a foundational understanding of PI, elucidating its physical principles, physiological meanings, and clinical implications in the realms of anesthesia and critical care [8]. Their work underscores the multifaceted nature of PI and its potential as a valuable parameter in predicting hemodynamic changes.

Mostafa et al. explored the utility of peripheral perfusion index and heart rate variability as early predictors for intradialytic hypotension in critically ill patients [9]. While their focus extends beyond spinal anesthesia, the study contributes to the broader understanding of PI's predictive capabilities in dynamic clinical scenarios. The findings may provide insights into the versatility of PI as a predictor of hemodynamic instability in various clinical contexts.

Jabarulla et al.'s prospective observational study specifically investigated the role of PI as a predictor of hypotension during spinal anesthesia in lower segment cesarean section [10]. This aligns closely with our study's objective and adds depth to the evidence supporting PI as a predictive tool in the specific context of obstetric anesthesia. Abdelnasser et al. explored the use of pulse oximeter perfusion index in predicting successful supraclavicular brachial plexus block [11]. While not directly related to spinal anesthesia, their findings contribute to the broader understanding of PI's role in predicting regional anesthesia success. This suggests the potential applicability of PI in diverse anesthesia settings.

Godai et al. conducted a randomized pilot study assessing the effects of hemodynamic management using the trend of the perfusion index and pulse pressure variation on

tissue perfusion [12]. Although not directly focused on spinal anesthesia, their investigation into the hemodynamic implications of PI trends adds valuable insights into its dynamic use for managing perfusion.

Van Genderen et al. examined the peripheral perfusion index as an early predictor for central hypovolemia in awake healthy volunteers [13]. While not specific to anesthesia, their work sheds light on the broader implications of PI in predicting hypovolemia, which may have relevance in the perioperative setting.

In the context of spinal anesthesia-induced hypotension, systematic reviews and meta-analyses by Chang et al. [14] and Hung et al. [15] contribute a comprehensive analysis of the predictive efficacy of the perfusion index. Their work synthesizes evidence from multiple studies, reinforcing the significance of PI in anticipating hypotension following spinal anesthesia in different clinical scenarios.

Finally, the ongoing research on the dose-effect relationship of metaraminol before spinal anesthesia in preventing hypotension in parturients undergoing caesarean section [16] suggests a continuing effort to optimize strategies for preventing hypotension. This aligns with the broader goal of refining perioperative care and leveraging tools such as PI for improved patient outcomes.

IMPLICATION

Clinicians should consider a baseline PI threshold of 3.5 as a reliable predictor for the subsequent development of hypotension. Incorporating PI assessment into anesthesia protocols has the potential to enhance proactive management, mitigate the risk of hypotensive episodes, and ultimately improve the overall safety and outcomes for patients undergoing elective LSCS.

CONCLUSIONS

We have concluded from our study that underscores the important role of baseline perfusion index (PI) as a predictive parameter for hypotension during spinal anesthesia in elective lower segment caesarean section (LSCS). The study, conducted at a tertiary care hospital in Peshawar, revealed a consistent association between baseline PI values exceeding 3.5 and a higher incidence of subsequent hypotension. This compelling correlation underscores the potential clinical utility of PI monitoring in optimizing patient outcomes during LSCS procedures, offering a valuable contribution to the field of obstetric anesthesia.

Further research and validation studies are encouraged to explore the broader applicability of PI monitoring in diverse clinical settings.

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