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PERFUSION INDEX DERIVED FROM A PULSE OXIMETER AS A PREDICTOR OF HYPOTENSION FOLLOWING SUB-ARACHNOID BLOCK (SAB) FOR BELOW UMBILICAL SURGERIES

Anaesthesiology

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ABSTRACT

Perfusion Index (PI) is a relatively new parameter tried for predicting hypotension . This study aimed at investigating correlation between baseline PI and incidence of hypotension following Sub-arachnoid block (SAB) . In this prospective & observational study , patients were divided into 2 groups on the basis of baseline PI. Group I with PI < 3.5 and Group II PI > 3.5. SAB performed with 15 mg of 0.5% (H) bupivacaine at L3-L4 intervertebral space. The incidence of hypotension in group I (PI< 3.5) was 10.71% compared to 68.97% in group II (PI > 3.5). There was significant correlation between baseline PI and number of episodes of hypotension . The ROC (Reciever Operating Characteristic) curve analysis revealed that baseline PI was suitable for detecting patients at risk for hypotension . For predicting hypotension , perfusion index (PI) can be used as a tool in patients undergoing below umbilical surgeries for SAB . Patients with baseline PI >3.5 have higher chances of developing hypotension than patients with PI <3.5.

KEYWORDS

Perfusion index (PI) , Subarachnoid block (SAB) , Hypotension

INTRODUCTION-

Perfusion index (PI) is relatively a new parameter estimating the pulsatility of blood in the extremities , calculated using infrared spectrum as part of plethysmography waveform processing . PI is determined by the percentage of pulsatile to nonpulsatile blood flow in the extremities . PI indicates the status of the microcirculation , densely innervated by sympathetic nerves , and therefore , is affected by multiple factors responsible for vasoconstriction or vasodilatation of the microvasculature.

[1] Also purported to be an indicator of systemic vascular resistance (SVR) . [1] PI is said to be useful in assessing hypotension following SAB , monitoring depth of anaesthesia , hypothermia , successful epidural placement and response to fluid therapy in intra-operative & critically ill patients . [2-4] PI value is inversely related to the vascular tone ; though not in a linear fashion . Therefore , vasodilatation reflecting higher baseline PI has been associated with reductions in blood pressure (BP) following spinal anaesthesia . [5] The resting SVR can influence incidence and severity of post-spinal hypotension in patients . It is a simple , cost-effective and non-invasive method of assessing peripheral perfusion.

Hypotension is frequently observed after spinal anesthesia for below umbilical surgeries . It results from decreased vascular resistance owing to sympathetic blockade and decreased cardiac output as blood pools in the lower extremities . Changes in baseline peripheral vascular tone may affect the degree of hypotension , and patients with low baseline vascular tone may be at an increased risk of hypotension . The perfusion index (PI) derived from a pulse oximeter is used to assess peripheral perfusion dynamics due to changes in peripheral vascular tone.

The Aim was to correlate changes in the perfusion index with incidence of hypotension following SAB in below umbilical surgeries and to find whether baseline perfusion Index can help determine chances of hypotension following SAB and also determine a new baseline cut-off point to assess the chances of developing hypotension.

MATERIALS AND METHODS

In this prospective study sixty adult patients under ASA (American Society of Anesthesiologists' physical status) I/II between 18 to 60 years posted for below umbilical surgeries under SAB in Peoples medical college and research centre , Bhopal were included . After clearance from RAC and IEC (from November 2017 to march 2019) ; oral and written informed consent patient was shifted into OT , Only those who were under inclusion criteria were included and those in exclusion criteria were already excluded.

Sixty patients were enrolled and divided into two groups , I and II (Group I PI ≤3.5 [thirty patients] and in group II PI >3.5 [thirty patients]) . Standard monitoring with electrocardiography , automated NIBP and pulse oximetry (SpO_2) was attached for baseline values and intraoperative monitoring . The perfusion index was measured in the supine position using specific pulse oximeter probe attached to the left index finger of all patients to ensure uniformity in measured PI values . Each patient was given an infusion of 500 ml of ringer lactate for pre-hydration before spinal anaesthesia via an 18G IV cannula . After pre-hydration , the baseline values were recorded . Spinal anaesthesia performed by an anaesthesiologist blinded to the baseline PI values , using Quincke's 25-gauge spinal needle in sitting position with 15 mg of injection bupivacaine 0.5% (hyperbaric) at L3–L4 interspace . The pulse oximeter was reconnected to monitor the patient till the end of surgery . Oxygen was given through anatomical face mask at 4 L/min.

The level of sensory block was checked 5min after the SAB with a cold swab . If a T8 sensory block level not achieved , these were excluded from the study and managed accordingly. Maximum cephalad spread was checked 20min after SAB . Then the values recorded at 2 min interval for 20mins and then at 5 min interval for rest 40mins . Hypotension defined as a decrease in MAP of 20% of baseline and treated with IV bolus of 6 mg injection mephentermine and 100 ml of Ringer lactate . The first 60 min following spinal anaesthesia considered for anaesthesia-induced hypotension . Bradycardia defined as HR <55 beats/min and treated with injection atropine 0.6 mg IV bolus.

Statistical analysis done using Version 21.0 of the Statistical Package for Social Sciences (IBM Corporation , Armonk , New York , USA) . Data was entered in Microsoft excel 2016 for Windows . Frequency , percentages , mean , and standard deviation (SD) of variables in different groups were calculated . P value <0.05 was considered statistically significant.

OBSERVATIONS

A total of 60 patients were included in the study . Three patients were excluded due to an inadequate level of the spinal blockade , twenty eight patients in Group I and twenty nine patients were in Group II for final analysis .

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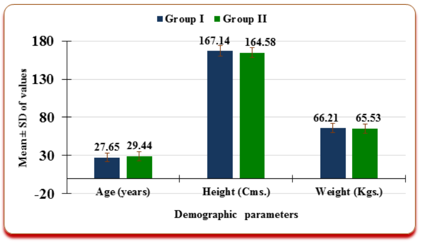
Shapiro-Wilk test showed that age , height , weight , duration of surgery , SBP , SBP and MAP values in both the groups followed normal distribution . Hence parametric test , unpaired t-test was applied for comparison between different groups . For comparison of categorical variables (frequency and percentages) , Pearson's chi-square test was applied . Receiver operating characteristic (ROC) curve was plotted for baseline PI and occurrence of hypotension among study subjects.

Demographic parameters	Group I (Mean ± SD)	Group II (Mean ± SD)	Unpaired t-test
Age (years)	27.65 ± 5.18	29.44 ± 6.03	t = 1.200, P = 0.235 (>0.05)
Height (Cms.)	167.14 ± 6.85	164.58 ± 6.19	t = 1.481, P = 0.144 (>0.05)
Weight (Kgs.)	66.21 ± 5.77	65.53 ± 6.09	t = 0.432, P = 0.667 (>0.05)

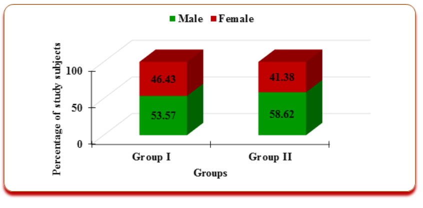
The demographic parameters such as age , weight and height were comparable between the two groups [Table 1].



Graph 1- Comparison of demographic parameters between two groups . The above histogram depicts demographic parameters which shows that there was no significant difference between the groups as P>0.05 which is insignificant.

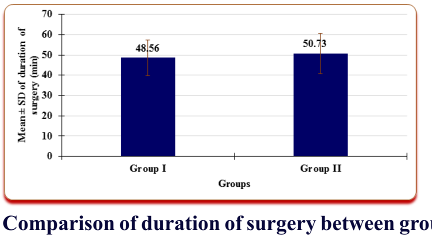
The median level of cephalad spread of sensory block achieved in both groups was T8 (interquartile range [IQR] –T8-T10).

Intra operatively , the HR was comparable between the two groups.



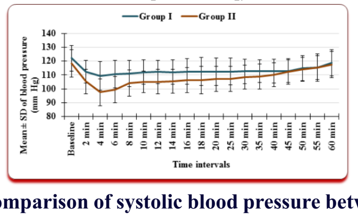
Graph 2- Comparison of gender distribution between group I and group II.

In the above graph , gender distribution was comparable in both the groups.



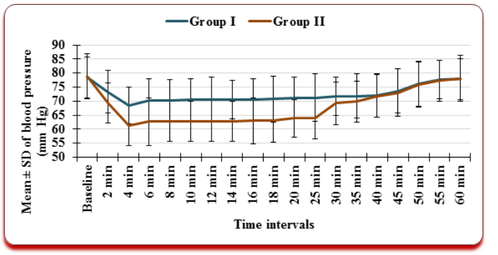
Graph 3- Comparison of duration of surgery between group I and group II.

The above histogram shows the average duration of surgery which is comparable in both the groups as p > 0.05 (Group I – 48.56 ± 8.79 min and Group II – 50.73 ± 9.87 min [P = 0.385]).



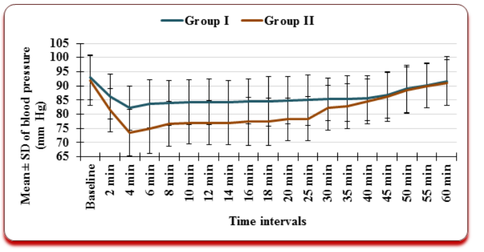
Graph 4 : Comparison of systolic blood pressure between the two groups.

The above graph depicts Unpaired t-test showing that SBP in group I was significantly higher than group II from 2 min to 25 min.



Graph 5: Comparison of diastolic blood pressure between the two groups.

Unpaired t-test showed that DBP in group I was significantly higher than group II from 4 min to 25 min.



Graph 6: Comparison of mean arterial pressure between the two groups.

Unpaired t-test showed that MAP in group I was significantly higher than group II from 2 min to 25 min.

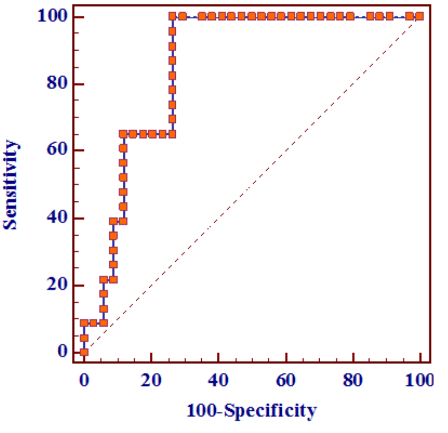


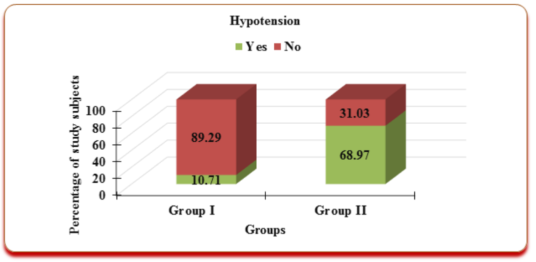
Figure 1: ROC curve depicting baseline PI against incidence of hypotension.

The above figure shows ROC curve depicting baseline PI against incidence of hypotension . The ROC analysis revealed that baseline PI was suitable for detecting risk for hypotension (AUC = 0.854 , P < 0.001). The baseline PI cut-off point that predicted hypotension as determined by the ROC analysis was 3.1 with a sensitivity of 100% (95% CI= 85.20% - 100.00%) , a specificity of 73.53% (95% CI = 55.60–87.10%) , a positive predictive value of 71.88% (95% CI= 59.34% - 81.74%) , and a negative predictive value of 100.00% (95% CI = NA).

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.854 (95% CI= 0.736 – 0.934)
P value	0.000 (<0.001)

Parameters	Values at Baseline PI >3.1
Sensitivity	100.00% (95% CI= 85.18% - 100.00%)
Specificity	73.53% (95% CI = 55.64–87.12%)
Positive predictive value	71.88% (95% CI= 59.34% - 81.74%)
Negative predictive value	100.00% (95% CI = NA)



Graph 7- Comparison of incidence of hypotension between group I and II.

The above graph shows that incidence of hypotension in group II (68.97%) is more than group I (10.71%) which is highly significant.

DISCUSSION

In our study , the incidence and severity of hypotension was higher in patients in group II whose baseline PI values were greater than 3.5.

The ROC curve revealed that PI discriminated well between patients who developed hypotension versus those who did not ; it yielded a new baseline PI value of 3.1 as the cut-off point for predicting hypotension in patients under sub-arachnoid block.

In our study we found that higher the PI higher will be the chances of hypotension in sub-arachnoid block for below umbilical surgeries with new cut-off point of 3.1 whereas study conducted by Duggapa , Toyama , Kuwata and Yokose was done in caesarean sections and in study of Lima , it stated that perfusion index can be used as noninvasive indicator for peripheral perfusion.

The cut-off value of baseline perfusion index for prediction of hypotension following spinal anaesthesia was chosen as 3.5 based on a study conducted by Toyama *et al* .[7] 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 patients at risk for such hypotension . An attempt was made to explore the predictive ability of this value in the Indian population , in this study . Further , only the baseline value was considered for analysis , since we didnot try to explore the correlation between changes in serial PI values with the incidence of hypotension. In this study , the baseline PI >3.5 and probability of hypotension were significantly correlating , a finding similar to study by Toyama *et al*.

Since PI is dependent on the vascular tone of digital vessels , its role in predicting hypotension in conditions where the tone of these vessels is affected is questionable and more studies regarding its use in other patients needs to be done before it can be accepted as a universal non-invasive tool to predict hypotension following spinal anaesthesia . In addition, further studies comparing PI with invasive and accepted tools of haemo-dynamic monitoring may throw more light regarding its utility.

CONCLUSION

Perfusion Index (PI) can be used as a tool for predicting hypotension in healthy patients undergoing elective surgeries under SAB for below umbilical surgeries . Patients with baseline PI >3.5 (Group II) are at higher risk of developing hypotension following SAB compared to those with baseline PI ≤3.5 (Group I).

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