ORIGINAL RESEARCH PAPER

Paediatrics

KEY WORDS: Perfusion Index, Inotropes, mortality, hospital stay.

DIAGNOSTIC VALIDITY OF PERFUSION INDEX FOR PREDICTING CIRCULATORY COMPROMISE AND NEONATAL MORTALITY IN A TERTIARY CARE HOSPITAL.

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ABSTRACT

Background: Neonatal mortality continues to be a major global health challenge, in developing countries where healthcare resources are limited. Early recognition of circulatory compromise is vital in preventing progression to shock, multi-organ dysfunction, and death.

Objectives:

1. Assess Perfusion Index as an early predictor for need for Inotropic support
2. To study the neonatal outcome with Perfusion Index.
3. Correlation of Perfusion index with duration of NICU stay.

Methods: A Prospective observational study was conducted in Neonatal Intensive Care Unit of a tertiary care hospital over a period of two years. A total of 100 term and preterm neonates Perfusion index was measured on the day 1 of admission and again on Day 3 of admission, clinical course was monitored with attention to need for ionotropic support, duration of hospital stays and outcome of the patient. **Results:** Patients who required ionotropic support or died had low PI values than who did not, on both day 1 and day 3. Those on inotropes, the mean PI on day 1 was 1.29 ± 0.32 compared with 1.46 ± 0.39 ($p=0.001$), and on day 3 it was 1.31 ± 0.43 versus 1.32 ± 0.39 ($p<0.001$). Regarding outcomes, the mean PI on day1 was 1.37 ± 0.38 in non survivors compared with in survivors 1.40 ± 0.36 ($p<0.001$) and on day3 it was 1.34 ± 0.43 versus 1.28 ± 0.39, respectively ($p<0.001$). And also, there is an inverse correlation among duration of hospital stays and PI on day 3 ($r= -0.078$, $p= 0.043$). **Conclusion:** Perfusion index monitored during the NICU admission of Day 1 and Day 3 is helpful in predicting requirement of Inotropes, neonatal mortality and duration of hospital stay. Early identification and Prompt management can decrease mortality and morbidity.

INTRODUCTION:

The Early Neonatal period is the most vulnerable stage of life, accounting for highest number of newborn deaths, which are primarily caused by birth injuries, low birth weight, infections, hypoxia and preterm birth.[1]

The Perfusion Index is a simple, non-invasive measure that reflects the ratio of infrared light absorbed by pulsatile signal (arterial blood flow) to that absorbed by non-pulsatile components (venous, capillary blood, skin and connective tissue). Perfusion index helps identify impaired peripheral perfusion in critically ill newborns, and a low Perfusion Index is an indicator for severe disease in newborn.[2],[8]

It is continuous parameter and operator-independent monitored from the plethysmography signal produced by pulse oximeters and reflects real time changes in peripheral blood flow.[3]

Conventional bedside parameters blood pressure, heart rate, urine output, and capillary refill time are late indicators and influenced by external factors, may not accurately reflect tissue perfusion. this study explores Perfusion Index as a potential early warning tool to guide timely interventions and improve neonatal outcomes.[4]

During neonatal transition, there is significant respiratory and haemodynamic changes influences cardiac output as well as systemic and peripheral perfusion.[5]

Several severity indices for newborn have been used for predicting pre discharge mortality during the first hour, the CRIB II (Clinical risk index for babies) score is validated for severity of illness in very preterm neonates less than 32 weeks of gestational age.[9]

It has been demonstrated that in both term and preterm newborns preductal perfusion is superior to post ductal perfusion[10]. We took the preductal perfusion index in account to address these discrepancies.

AIMS & OBJECTIVES:

1. Assess Perfusion Index as an early predictor for need for Inotropic support.
2. To study the neonatal outcome with Perfusion Index.
3. Correlation of Perfusion index with duration of NICU stay.

MATERIALS AND METHODS:

Design: Prospective observational study.

Study Setting: NICU, Hi-Tech Medical College & Hospital, Bhubaneswar.

Duration: 2 years (January 2024 – December 2026)

Sample Size: 100 neonates.

Inclusion: 100 neonate irrespective of diagnosis till 28 days of life, from Gestation age 30 weeks to 40weeks admitted in NICU.

Exclusion:

- Neonates with major congenital malformations.
- Discharged against medical advice in less than 24hours.
- Gestation age <= 29weeks.

Data Collection:

Data were collected using a predesigned structured proforma. Information was obtained from direct clinical examination of the neonates and Perfusion Index serially monitored Day 1 and Day 3 values were noted.

NeonatalVariables:

(i) Post natal age on admission
(ii) Sex
(iii) Gestational age

(iv) Weight
(v) Use of inotropes
(vi) Duration of inotropes
(vii) Duration of hospital stay
(viii) outcome

Consent And Ethical Statement:
An oral informed consent was taken from legal guardians or parents of the patients before including in this study. Ethical approval was obtained from the Institutional Ethics Committee of Hi-Tech Medical College and Hospital, Bhubaneswar.

Statistical Analysis:
Data were analysed by SPSS v23. Continuous variables expressed as Mean, standard deviation. Numbers and percentages for qualitative variables. Student T test used appropriately for comparison. Correlation analysis using Spearman's rho was used for correlation between two quantitative variables. Receiver Operating characteristic curve (ROC) constructed to know the best cut off value, sensitivity, specificity, positive and negative predictive value and Area under Curve (AUC). The 95% Confidence interval and 5% margin of error was used. P value < 0.01 was considered highly statistically significant.

RESULTS:

Table 1: Predictive Ability Of Perfusion Index For Inotropic Requirement At Day 1 And Day 3.

Test Result	Area	Std. Error	Asymptotic Sig.	Asymptotic 95% CI		Best Cut of value	Sensitivity	Specificity	t test
				Lower Bound	Upper Bound				
PI_Day1	0.514	0.059	0.813	0.398	0.610	≤ 1.25	78.6%	65.2%	2.14%
PI_Day3	0.578	0.058	0.811	0.401	0.614	≤ 1.30	82.3 %	70.2%	2.47%

Observation:
Patients who required ionotropic support or died had low PI values than who did not, on both day 1 and day 3. Those on inotropes, the mean PI on day 1 was 1.29 ± 0.32 compared with 1.46 ± 0.39 (p=0.001), and on day 3 it was 1.31 ± 0.43 versus 1.32 ± 0.39 (p<0.001).

Table 2: Predictive Ability Of Perfusion Index With Neonatal Mortality At Day 1 And Day 3.

Test Result	Area	Std. Error	Asymptotic Sig.	Asymptotic 95% CI		Best Cutoff value	Sensitivity	Specificity	t test
				Lower Bound	Upper Bound				
PI_Day1	0.525	0.058	0.671	0.411	0.638	≤ 1.25	84.1 %	70.5%	2.62%
PI_Day3	0.540	0.058	0.298	0.326	0.553	≤ 1.30	88.7%	74.3%	2.95%

Observation:
Regarding outcomes, the mean PI on day1 was 1.37 ± 0.38 in non survivors compared with in survivors 1.40 ± 0.36 (p<0.001) and on day3 it was1.34 ± 0.43 versus 1.28 ± 0.39, respectively (p<0.001).

Table 3: Based On Perfusion Index Threshold Prediction Of Duration Of NICU Stay:

Group		Mean ± SD PI Day 1	Mean± SD PI Day 3
Inotropes	Yes (n=44)	1.29 ± 0.32	1.31 ± 0.43
	No (n=56)	1.46 ± 0.39	1.32 ± 0.39
Outcome	Died (n=52)	1.37 ± 0.38	1.34 ± 0.43
	Survived (n=48)	1.40 ± 0.36	1.28 ± 0.39
PPV		75.2%	72.1%
NPV		80.5%	82.3%
P-value		< 0.001	< 0.001
Median		1.43 (1.00- 1.74)	1.29 (1.05-1.69)
Range		0.80-1.99	0.32-1,99

Table 4: Spearman's Correlation of Perfusion Index Vs Conventional Parameters

Variable Pair	Spearman's rho	P Value
PI Day 1 vs Duration of stay	-0.078	0.04
PI Day 3 vs Duration of stay	-0.04	0.001
PI Day 1 vs Ionotrope Use (Yes/No)	-0.225	0.025
PI Day 3 vs No Ionotrope Use (Yes/No)	-0.013	0.899
PI Day 1 vs Mortality (Survived/Died)	-0.034	0.734
PI Day 3 vs Mortality (Survived/Died)	-0.078	0.004

Observation: Inverse Correlation was found between duration of hospital stay and perfusion index on Day 3 of admission with (r= -0.078, p= 0.004).

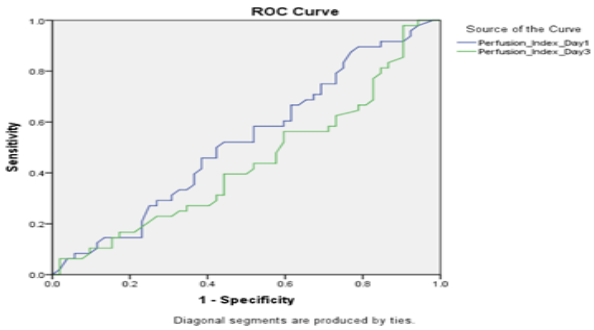

Figure-1 : Roc Curve For Validation Of Perfusion Index With Neonatal Mortality

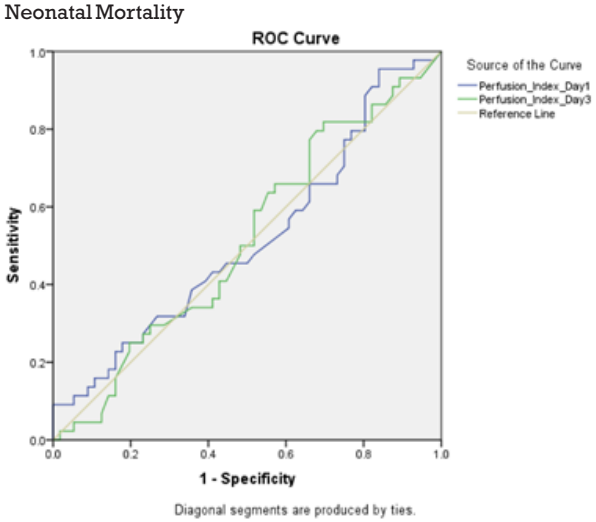

Figure 2: ROC Curve For Validation Of Perfusion Index And Ionotrope Requirement At Day-1 And Day-3

DISCUSSION:
The Present study highlights the prediction of patient's mortality and outcome correlating with perfusion index and helps to evaluate and decide the management plan[6].

In neonates, skin perfusion typically surpasses oxygen demand. However, in the presence of disease, cardiac output is preferentially redistributed to vital organs such as heart, brain and adrenal glands. Consequently, monitoring the perfusion index is crucial for determining whether a neonate is healthy or ill.[7]

In this prospective observational study, total hospital course of 100 neonates have been studied along with perfusion index measured in day 1 and day 3 of admission. A low perfusion index indicates decreased peripheral perfusion which signifies circulatory compromise.

Neonates who died had a low perfusion index than those who

survived in both Day 1 and Day 3. A cutoff value of <1.25 for Day 1 and <1.30 for Day 3 obtained from Receiver Operating Characteristic curve indicates poor outcome and grave prognosis and prolonged hospital stay among neonates admitted in NICU.

CONCLUSION:

High negative Predictive Value suggests Perfusion Index can effectively used as a triage tool in resource limited settings. Strong predictive value for inotrope requirement and mortality. Correlation with other clinical parameters reinforces its bedside utility, limiting the window for timely intervention. While it cannot replace standard hemodynamic monitoring, it may serve as an early warning indicator to guide timely interventions, thereby improving neonatal survival.

Limitations:

- Single-center study.
- Influence of external factors.
- Device and site variability.

Future Scope:

- Integration with multimodal monitoring.
- Application in resource-limited settings.

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