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RESEARCH ARTICLE

A STUDY OF PERFUSION INDEX IN PRETERM AND TERM BABIES

Dr. Metta Saikiran (M.B.B.S), Dr. Gunukula Siva Manoj (M.B.B.S), Dr. Alavilli Suma Shanthi (M.B.B.S) and Dr. Metta Saikiran (M.B.B.S)

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Abstract

Background and objectives: PI is a numeric value that is obtained from the ratio between pulsatile signal, set by arterial blood flow, and non pulsatile signal generated by skin, venous blood flow, and other local issues. Perfusion index is easily applicable, non-invasive, and continuous parameter that reflects changes in the cardiac output and vasomotor tone.

Objectives: 1) To establish baseline PI values in healthy term and preterm infants .

2) Correlation of PI with birth weight .

3) Comparison of PI value for normal and sick newborns in both term and preterm.

Methodology: This is a prospective observational study done between August 2022 to August 2023 (12 months),with sample size of 69 . Median PI value are obtained from the average of PI values recorded at 6-second intervals for a minimum of 2 minutes, 2 times a day for a duration of 3 days.Thus PI values are obtained in both sick term and preterm babies were compared with the PI values obtained in healthy term and preterm.

Results: In the present study, the mean PI was 1.32 ± 0.82 with a range of 1.12 - 1.52.

The mean perfusion index among preterm was 0.98 ±0.49 and the term was 1.52 ±0.91. The perfusion index was greater among term newborns compared to preterm with statistical significance. (P=0.007)

Conclusion: PI values differed according to gestational age and to the presence of comorbidities, confirming that it might represent a valuable tool in the early identification of adverse outcomes in neonates.

Introduction:-

In practice, tissue perfusion, and oxygenation is assessed by non invasive techniques like blood pressure, heart rate, oxygen saturation, and echocardiography[1,2]. However, these methods are poor markers of microcirculatory function[2]. During circulatory failure, the mechanism of peripheral vasoconstriction diverts blood flow from less essential organs to essential organs; this points to the fact that, particularly in preterm newborns,techniques monitoring microcirculation in less vital tissues could allow early identification of critical tissue hypo-perfusion, before the setting in of hypotensive shock leading to organ failure[3,4]. Indirect measures used for estimation of microcirculation status, such as urine output, capillary refill time (CRT), and serum lactate levels, are insensitive markers of tissue perfusion in the first days of life when extrauterine life adaptation occurs. Thus, perfusion index

Corresponding Author:- Dr. Metta Saikiran (M.B.B.S)

(PI), translating the real-time variations of the pulse oximetry signal in the peripheral circulation, is an easily applicable, non-invasive, and continuous parameter that reflects changes in the cardiac output and vasomotor tone.PI is a numeric value that is obtained from the ratio between pulsatile signal, set by arterial blood flow, and non pulsatile signal generated by skin, venous blood flow, and other local issues. The value is based on signals derived from the amount of infrared light absorbed (940nm) by each component at any specific point of time and is correlative with pulse strength. Changes in perfusion index occur with changes in the volume of oxygenated blood flow in the skin microvascular[5,6,7]. The present study is aimed to evaluate and to establish baseline PI values in healthy term and preterm infants . Correlation of PI with birth weight . Comparison of PI value for normal and sick newborns in both term and preterm.

Materials and Methods:-

Study place

Department of Pediatrics at Maharajahs institute of medical sciences, Nellimarla,Vizianagaram. Study setting -Maharaja's institute of medical sciences, Vizianagaram.Study design –– It is a prospective observational study. Study strategy - convenient sampling, Sample size-69 ,study period- 12 months (august 2022 to august 2023)

Collection of data:

Gestational age is determined through antenatal USG scan.Birth weight is noted. Vitals: Heart rate, Respiratory rate, BP, MAP(mean arterial pressure), Temperature (both core and peripheral), post duct alert PI measured on the left foot. All are measured for 3times a day

Statistical analysis :

Pulse oximeter derived heart rate corresponding to heart rate derived from the cardiac electrode are considered valid for statistical analysis. Median PI values are obtained from the average of PI values recorded at 6second intervals for a minimum of 2minutes 2times a day for a duration of 3days. PI values obtained in both sick term and preterm babies were compared with the PI values obtained in healthy term and preterm.

Results:-

In the present study, the mean PI was 1.32 ± 0.82 with a range of 1.12 - 1.52. The mean perfusion index among preterm was 0.98 ±0.49 and the term was 1.52 ±0.91. The perfusion index was greater among term newborns compared to preterm with statistical significance. (P=0.007)
(Table 1).

Table 1: Perfusion index and Preterm/Term

	Preterm (n=25)	Term (n=44)	T value	P value
Perfusion index	0.98 ±0.49	1.52 ±0.91	2.74	0.007*

The perfusion index shows a positive correlation with the birth weight of newborns with statistical significance.(P=0.04)The perfusion index was greater among newborns with birth weight >2500 grams compared to birth weight <1000 grams with statistical significance. (P=0.00)
(Table 2)

Table 2: Association between perfusion index and Birth weight

Birth weight in kg	Perfusion index (Mean ± SD)
< 1000	0.50 ±0
1000 – 1500	0.69 ± 0.41
1500 – 2500	1.17 ±0.38
>2500	1.64 ± 1.08
ANOVA F value = 3.77, p=0.03*, Statistically significant	

The perfusion index showed no statistically significant association with term newborns clinical status. (P=0.08) (Table 3)

Table 3:- Normal and sick terms.

	Perfusion index
Normal term (n=16)	1.83 ± 0.47
Sick term (n=28)	1.34 ± 1.05
T value = 1.76 , p=0.08, Not statistically significant	

The perfusion index showed a statistically significant association with preterm newborns clinical status. (P=0.02) (Table 4)

Table 4:- Normal preterm and Sick preterm.

	Perfusion index
Normal preterm (n=6)	1.36 ± 0.43
Sick preterm (n=19)	0.86 ± 0.45
T value = 2.39 , p=0.02*, statistically significant	

Discussion:-

In the present study, the mean PI was 1.32 ± 0.82 with a range of 1.12 - 1.52. Granelli et al. found a median PPI of 1.68 in the right hand (IQR: 1.18–2.46) and 1.71 in any foot (IQR: 1.20–2.50) for newborns within 1 to 120hours of birth[8]. Our results were slightly lower, which may be explained by the greater range in the time of measurement in their study as compared to ours, with measurements being taken as early as 1 hour of age.The perfusion index showed no statistically significant association with term newborns clinical status. (P=0.08). The perfusion index showed a statistically significant association with preterm newborns clinical status. (P=0.02). Monteiro et al studied perfusion index in preterm newborns observed median PI values were found to be significantly lower in newborns with an adverse outcome.The perfusion index showed a statistically significant association with normal clinical status preterm and term newborns. (P=0.04). In previous studies, De Felice et al., Granelli and Ostman-Smith, and Laere et al. also described significantly lower PI values in infants with high severity diseases.The perfusion index showed no statistically significant association with sick clinical status preterm and term newborns. (P=0.06)

De Felice et al. suggested PI values <1.24 as an accurate predictor for severity of illness. Although in their study they do not compare the values of the healthy term cohort with sick infants at birth, so cannot confirm this cutoff value as approximately 25 % of our healthy preterm infants had a PI < 1.24, and none of these infants needed medical support or were admitted for medical care later on. Also, approximately 25 % of the infants had a PI above 3.5 during the same time points[9].

Conclusion:-

There are some limitations to this study. The study population was small and purposive. Further multi-center studies in different regions are needed to investigate the economic, geographical, and other factors of the population. PI values differed according to gestational age and to the presence of comorbidities, confirming that it might represent a valuable tool in the early identification of adverse outcomes in neonates.

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