

Non-Invasive Assessment Of Peripheral Perfusion Index (Ppi) In Newborn During Transitional Period

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Type of Publication: Original Research Paper

Conflicts of Interest: Nil

Abstract

Introduction: Perfusion index (PI) is becoming a part of clinical practice in neonatology to monitor peripheral perfusion non-invasively. Hemodynamic and respiratory changes occur in newborns during the transition period after birth in which peripheral perfusion may be affected. Tachypnea is a frequent symptom during this period. While some tachypneic newborns get well in less than 6 h and are diagnosed as “delayed transition”, others get admitted to the intensive care unit which transient tachypnea of the newborn (TTN) being the most common diagnosis among them.

Aim Of The Study: To compare perfusion index of neonates with Transient tachypnea of neonate and delayed transition with normal babies without distress, and assess its efficacy in determining the need for Neonatal care unit admission.

Materials & Methods: Term babies born by either Caesarean section or Normal Vaginal Delivery, Government Kilpauk Medical College & Hospital, Chennai in the year 2019. Pre ductal Perfusion Index, Heart Rate, and SpO₂ (Oxygen saturation) will be calculated at the 10th minute and 1 hour of postnatal life and documented after getting informed consent from the parents. The study included 150 neonates with 50 children TTN, 50 neonates with delayed transition, and 50 neonates with normal respiratory rates (controls)

Results: Most of the neonates born by normal vaginal delivery 88(59%)out of 150. The mode of delivery by cesarean delivery contributed to respiratory distress in the early transition period which was significantly higher in both the groups TTN and DT compared to Normal. The neonates with TTNwere treated with oxygen treatment (47/50), nasal CPAP ventilation (3/50). There is a significant difference between the control group and other groups in receiving oxygen treatment during the transition period. The RR at the 10th minute and 1st hour was significantly higher in delayed transition and TTN. Groups when compared with controls. The HR at the 10th minute was significantly higher in delayed transition 33.3%and TTN 66.7%Groups when compared with controls. The PI values were similar between the three groups that 10th minute and at 1st hour. We did not observe a significant change from 10th minute to 1st hour in each group. Perfusion index at 10th minute (a) and 1st hour (b) of control, delayed transition, and TTN groups. The p-value is not significant for PI measurements between groups and paired measurements within groups. The horizontal line indicates the 1.24 PI value. The lower and upper margin of each box represents 25th and 75th percentiles, horizontal lines in the middle of the boxes represent median value, and whiskers represent 10th and 90th percentiles.

Conclusions: PI assessment in the maternity unit does not discriminate neonates with TTN either from those with delayed transition or from healthy neonates. Furthermore, we suggest that newborns with TTN do have lower PI values when compared to healthy newborns. The main finding in the present study was that percent PI

response criterion achieved at five minutes 100% sensitivity in detecting the stress response to insertion of ET, On the other hand, MAP achieved sensitivity (90%) in detecting hemodynamic stress responses in this population

Keywords:

Introduction

The transition from fetal to extrauterine life needs multiple fast organ adaptations variations. The clearance of lung fluid of neonate, secretions of surfactants, and onset of steady respiratory cycle happen throughout pulmonary adaptation, and changes in blood flow cause increase of heart rate, cardiac output, and pulmonary vasodilation take place for cardiovascular transition ¹During transitional period newborns heart rate and oxygen saturations are being continuously observed for several years, whereas peripheral perfusion is not routinely monitored for assessing hemodynamic stability.² Incidence of respiratory distress varies from 0.7 – 8.3% of newborn babies in India as reported in various studies. Although respiratory distress may represent a benign self-limiting process, it may also be the first sign of serious cardiopulmonary disease. ³Tachypnea of a newborn is frequent respiratory distress that may be due to several causes. While some tachypneic newborns get well in less than 6 hours and are diagnosed as “delayed transition”, others get admitted to neonatal intensive care unit of which transient tachypnea of the newborn (TTN) being the most common diagnosis among them. Transient tachypnea of the newborn (TTN) is a benign self-limiting disease occurring usually in term neonates and is due to delayed clearance of lung fluid. ⁴ Perfusion index (PI) which is calculated as the ratio of the pulsatile signal of arterial blood flow to signals from static blood flow, skin, and other tissues which are referred as pulsatile signal, is an easy way of monitoring of peripheral perfusion. ⁵ Studies that assessed PI values throughout the transition period of newborns showed that PI values were extremely variable after birth were not associated with the mode of delivery and low PI values may predict histologic chorioamnionitis. The transient tachypnea of the newborn (TTN) and delayed transition are two different entities of the same pathology which differ

in severity and duration. ⁶ The incidence of TTN is 7– 9.7 % of term newborns during the transitional period accounts for the majority of respiratory morbidities requiring neonatal intensive care unit (NICU) admission in term infants and is a diagnosis of exclusion. It is characterized by delayed resorption and clearance of fetal alveolar fluid Newborns with TTN classically present with increased work of respiratory effort that leads to tachypnea (respiratory rate >60 beats/min) during the first hours of delivery. ⁷ Other respiratory signs include nasal flaring, intercostal and subcostal retractions, and expiratory grunting. Symptoms generally resolve within 12 to 24 hr but may persist for as long as 72 hr in severe cases. ⁸ If respiratory distress in these neonates resolves within 6 h of birth, it is called delayed transition of newborn The extracellular volume, pulmonary arterial pressure, and N-terminal pro B natriuretic peptide were shown to increase in TTN which all may contribute to mild cardiac systemic dysfunction in children. ⁹ Cardiac output of left ventricle is a predictor of tissue perfusion and Perfusion index. Therefore peripheral perfusion index of neonates with TTN is more affected than comparison with neonates with the delayed transition. It is noted in clinical practice that some tachypneic neonates who are admitted to the intensive care unit, actually have delayed transition and become clinically stable very soon after admission. ¹⁰ Thus we aimed at detecting peripheral perfusion of neonates by using the Perfusion Index and assess its value on discrimination of delayed transition and TTN to determine if PI assessment in maternity unit would be useful to identify which tachypneic neonates who will need NICU admission for continuous monitoring.

Materials & Methods

Term babies born by either Caesarean section or Normal Vaginal Delivery, Government Kilpauk Medical College & Hospital, Chennai in the year 2019. Pre ductal Perfusion Index, Heart Rate, and

SpO₂ (Oxygen saturation) will be calculated at the 10th minute and 1 hour of postnatal life and documented after getting informed consent from the parents. The study included 150 neonates with 50 children TTN, 50 neonates with delayed transition, and 50 neonates with normal respiratory rates (controls)

Inclusion Criteria 1.Term newborns of 37-40 weeks
2. Birth weight more than 2.5 kg
3.Babies with APGAR >7 at 1 min.

Exclusion Criteria: 1.preterm<37 weeks.birth weight < 2.5 kg &> 4kg.babies with congenital anomalies and sepsis 4.meconium-stained liquor – vigorous babies.5.mothers with any risk factors like gestational hypertension, gestational diabetes mellitus.Term babies without distress, delivered either by Normal vaginal delivery or Caesarean section are enrolled. Term babies with respiratory distress, delivered either by Caesarean section or Normal vaginal delivery are enrolled. Tachypnic newborns get well in less than 6hrs diagnosed as a delayed transition. Transient tachypnea of the newborn (TTN) is a benign self-limiting disease occurring usually in term neonates and is due to delayed clearance of lung fluid. It is characterized by early onset of tachypnea, sometimes with retractions or expiratory grunting and occasionally cyanosis that is relieved by minimal oxygen supplementation .symptoms generally resolve within 24 hrs. Pre ductal Perfusion Index, Heart Rate,

and SpO₂ (Oxygen saturation) will be calculated at the 10th minute and 1 hour of postnatal life and documented after getting informed consent from the parents. At the end of 6hours, the babies will be grouped as 1.Normal babies without distress.2.Delayed transition. 3.Transienttachypnea of newborn. The index will be compared among three groups and decisions for further management will be taken accordingly.

Statistical Analysis

Data will be entered into a Microsoft Excel spreadsheet. Appropriate statistical analysis will be applied. SPSS17 software will be used. Fit to the normal distribution of the variables was investigated using visual (histograms, probability plots) and analytical methods (Kolmogorov- Smirnov/Shapiro-Wilk’s test). Kruskal-Wallis test with Bonferonnicorrection was conducted to compare the parameters between three groups (control, delayed transition, and TTNgroups); p < 0.05 was considered for statistical significance. Wilcoxon test was used to compare pairwise measurements PI within each group. Associations between PI, HR, RR, and temperature were investigated.

Results & Analysis

The study included 150 neonates with 50 children TTN, 50 neonates with delayed transition, and 50 neonates with normal respiratory rates (controls),

Table 1: Mode of Delivery

	Total	NORMAL	DT	TTN
MOD	No			
Normal Vaginal delivery	88(59%)	36 (41)	26(29.5%)	26(29.5%)
LSCS	62	14 (22.6)	24 (38.7)	24 (38.7)
Total	150	50	50	50

Table :1 Most of the neonates born by normal vaginal delivery 88(59%)out of 150. The mode of delivery by cesarean delivery contributed to respiratory distress in the early transition period which was significantly higher in both the groups TTN and DT compared to Normal. The sex of neonates was comparable in three groups. Males contributing for more in a normal group than females compared to another group.

Table 2: Treatment given

Treatment Given	Total	NORMAL	DT	TTN
	No	N (%)	N (%)	N (%)
No treatment given	50	50 (100)	0	0
Oxygen via hood	35	0	35 (100)	0
Oxygen via prongs	97	0	50(52)	47(48)
CPAP	3	0	0	3
Total	150	50	50	50

Table:2 All Neonates diagnosed with delayed transition received oxygen treatment only during the observation period in the maternity unit. The neonates with TTN were treated with oxygen treatment (47/50), nasal CPAP ventilation (3/50). There is a significant difference between the control group and other groups in receiving oxygen treatment during the transition period.

Table 3: Respiratory rate in 10 min

Treatment Given	Total	NORMAL	DT	TTN
	No	N (%)	N (%)	N (%)
Normal	50	50 (100)	0	0
Tachypnea	100	0	50 (50)	50 (50)
Total	150	50	50	50

Table :3 The RR at the 10th minute and 1st hour was significantly higher in delayed transition and TTN Groups when compared with controls.

Table 4: Spo2 in 10min

Impression	Cases	
	No	%
Normal	150	100.0
Mean	94.1	
SD	0.6	

Range	93-6	
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Table:4 NewbornsSpO2 at 10 min & 1 were similar between the three groups. All had normal spo2.

Table 4: Heart rate in 10 min

	Total	NORMAL	DT	TTN	P VALUE
HR	No				<0.05*
Normal	132	50 (37.8)	44 (33.3)	38 (28.9)	
Tachycardia	18	0	6 (33.3)	12 (66.7)	
Total	150	50	50	50	

Table:4 The HR at the 10th minute was significantly higher in delayed transition 33.3%and TTN 66.7%. Groups when compared with controls.

Table 5: Heart rate in 1 hr

	Total	NORMAL	DT	TTN	P VALUE
HR	No				>0.05
Normal	148	50 (33.8)	50 (33.8)	48 (32.4)	
Tachycardia	2	0	0	2 (100)	
Total	150	50	50	50	

Table:5 The HR at 1st hour was not found to be significant in TTN (2/2) group when compared with delayed transition and controls.

Table 6: Perfusion index in 10 minutes

	Total	NORMAL	DT	TTN	P VALUE
Perfusion Index	No				>0.05
Normal	109	35 (32.1)	35 (32.1)	39 (35.8)	
Low	41	15 (36.6)	15 (36.6)	11 (26.8)	

Total	150	50	50	50	
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Table:6 The PI values were similar between the three groups that 10th minute and at 1st hour. We did not observe a significant change from 10th minute to 1st hour in each group as seen in the above table

Table 7: Perfusion index rate in 1 hr

	Total	NORMAL	DT	TTN	P VALUE
Perfusion Index	No				>0.05
Normal	115	37 (32)	39 (34)	39 (34)	
Low	35	13(37.2)	11 (31.4)	11 (31.4)	
Total	150	50	50	50	

Discussion

The study included 150 neonates with 50 neonates TTN, 50 neonates with delayed transition, and 50 neonates with normal respiratory rates (controls). Most of the neonates were born by normal vaginal delivery 88(59%)out of 150. The mode of delivery by cesarean delivery contributed to respiratory distress in the early transition period which was significantly higher in both the groups TTN and DT compared to Normal ¹¹. In our study Male children were contributing more in a normal group than females compared to another group. Birth weight of newborns with the delayed transition was significantly higher than controls but similar to neonates with TTN. All Neonates diagnosed with delayed transition received oxygen treatment only during the observation period in the NICU. The neonates with TTNwere treated with oxygen treatment (47/50), nasal CPAP ventilation (3/50). The RR at the 10th minute and 1st hour was significantly higher in delayed transition and TTN groups when compared with controls ¹². The HR at the 10th minute and 1st hour were significantly higher in delayed transition and TTN groups when compared with controls for few neonates. The Spo2 at the 10th minute and 1st hour were similar in delayed transition and TTN groups when compared with controls. The PI values were similar between the three groups that 10th minute and

at 1st hour.¹³ Our results were found to be lower [1.41 (1.17–1.78)] than the authors’ at10th minute [2.0 (1.4–3.1)] We evaluated the second PI measurements at 1st postnatal hour of life, we did not observe either a change in PI overtime or a difference between groups¹⁴ Another cut-off value was demonstrated to be 1.24 in NICU patients as a predictor for severity of illness by De Felice et al. [20]. About %33 of included neonates in our study had either one of PI values below 1.24 and their proportion did not differ between groups. ¹⁵ Those observations emphasize the importance of consideration of infants’ activity during the PI assessment. There are some limitations of our study. Firstly, we did not include the neonates with congenital pneumonia As known, initial symptoms of infants with TTN and congenital pneumonia are indistinguishable and the presenceof maternal risk factors supports the diagnosis of pneumonia .¹⁶ If there were a fourth group of neonates with pneumonia, PI values among TTN and congenital pneumonia could have also been evaluated which can be further investigated in future studies with a larger patient population. Another limitation is the small sample size which was decided by power analysis to detect a 30 % difference (one standard deviation) in PI values. ¹⁷ These changes include but are not limited to increased pulmonary blood flow, closure of intrauterine shunts, fluid shifts between intracellular

and extracellular compartments, and clearance of lung fluid. An increase in left ventricular output and a decrease in the proportion of right to left shunts are important components of this period.¹⁸ In some newborns these changes may occur less smoothly than others and in some babies may require NICU admission due to delayed adaptation to birth. Peripheral perfusion assessment has been considered to be potentially helpful for circulatory failure determination. We wanted to see whether peripheral was different in healthy newborns and newborns with delayed transition or TTN. Both of these conditions theoretically are not expected to cause any overt circulatory problems however the microcirculatory pattern is not that clear.¹⁹ The fact that we did not differentiate neonates with delayed transition or controls from those with TTN by determining PI was following the accepted approach once again proving that TTN or delayed transition in otherwise healthy newborns does not affect peripheral perfusion. The similar in all groups might be because the differences in the cardiopulmonary transition process among groups were not abundant to affect the PI assessments.²⁰

Conclusion

Tachypnea of a newborn is a frequent respiratory problem that may be due to several causes. Perfusion index (PI) is a way of monitoring peripheral perfusion non-invasively. The study was conducted to compare PI of newborns with and without tachypnea within the 1st hour of life. Low PI may be associated with various pathological conditions. The fact that we did not differentiate neonates between delayed transition or controls from those with TTN by determining PI was following the accepted approach once again proving that TTN or delayed transition in otherwise healthy newborns does not affect peripheral perfusion. The similarity in all groups might be because the differences in the cardiopulmonary transition process among groups were not abundant to affect the PI assessments. The results of this study suggest that if the newborn has only transient tachypnea the PI remains normal which might be helpful for the clinician to decide about further management in clinical settings.

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