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Original Research Article

To find the role of per fusion index in early identification of shock in neonates

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Abstract

Background & Methods: The aim of the study is to find the role of perfusion index in early identification of shock in neonates. Blood pressure was measured in supine position with an appropriate size cuff in a quiet environment, in the right upper limb, when the baby was not agitated. The width of the cuff was 60 to 70% of the arm length.

Results: About 28% had birth weight less than 1.75 kg. Mean birth weight is 2.01 kg and standard deviation is 0.86 kg. The chi-square statistic is 9.5584. The *p*-value is .04199. The result is significant at $p < .05$. The majority of the neonates who had shock have perfusion index less than 0.9.The association is statistically highly significant. (P<0.05).

Conclusion: Clinical shock in neonates can be reasonably predicted when perfusion index is less than 0.91. Perfusion index displayed in newer pulse oximeters may be a useful added parameter for the assessment of peripheral per fusion. Additionally it has association with serum lactate which also helps in predicting shock.

Keywords: per fusion, index, shock & neonates.

Study Design: Observational Study.

Introduction

Even now, neonatologists and paediatricians face the clinical challenge of treating shock. For various reasons, it is common in infants in intensive care. The clinical syndrome known as "shock" is characterised by an acute failure of the circulatory system to maintain adequate perfusion of tissue and organs[1]. It causes tissues to receive an insufficient supply of oxygen and nutrients. Blood pressure, heart rate, capillary refill time, and urine output are all indirect parameters of systemic blood f low that can be used to estimate a newborn's hemodynamic status[2].

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE1, 2024

Perfusion index (PI) is defined as the ratio of pulsatile blood flow to non-pulsatile blood flow in a patient's peripheral tissue, such as in a fingertip, toe, or ear lobe. It is measured using a pulse oximeter depending on the differential absorption of infrared light. The normal perfusion index (PI) ranges from 0.02% to 20%. If the perfusion index is at or below 0.4% showing weak pulse strength, then the oximeter reading can be unreliable. Peripheral artery diseases, diabetes, obesity, blood clots, etc. are the reasons for poor perfusion.

Symptoms of a weak and fast pulse (heart rate over 180 beats per minute), prolonged capillary refill time (greater than 3 seconds), and cold extremities; lack of reaction to stimulation, drowsiness, and pallor[3]. Changes in Heart rate increasing the heart rate in a neonate are the most effective way to increase cardiac output. This is because increasing the stroke volume in a neonate is difficult. Multiplying the heart rate by the stroke volume will result in the calculation of the cardiac output[4]. When tachycardia is present, it is likely that the blood flow throughout the body is inadequate. An increase in heart rate to compensate for a decrease in cardiac output will only be successful if the end diastolic volume is maintained at the same level throughout the process. A higher heart rate shortens the amount of time spent filling during diastole, which may result in decreased contractility[5-7]. Therefore, tachycardia in newborns is an accurate indicator of hypotension and circulatory insufficiency.

Material and Methods

Present study was conducted at Amaltas Institute of Medical Sciences, Dewas for 01 Year on 200 Neonates admitted to NICU who needed hemodynamic monitoring were enrolled into the study after getting consent from parents.

Hemodynamic monitoring was be done by the investigator for the recruited neonates from the time of enrollment for 48 hours in stable neonates and for 72 hours in sick neonates. Perfusion Index was measured using pulse oximetry in right upper limb. Treatment of the primary condition, shock and choice of inotropes were done as per unit policy.

Inclusion criteria

1. All Neonates admitted to Neonatology department who is under hemodynamic monitoring in conditions like shock, hypoglycemia, perinatal asphyxia, respiratory distress, seizure and sepsis.

Exclusion criteria

1. Major congenital anomaly

2. Life threatening illness diagnosed in the antenatal period.

Result

Table 1: Gestational age at the time of delivery

Gestational age in weeks	Frequency	Percentage	Mean ±S.D
≤34 weeks	66	33	35.88±2.23
>34 weeks	134	67	

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In the present study about 67% were above 34 weeks of gestational age and 33% were below 34 weeks of gestational age. Mean gestational age is 35.88 and standard deviation is 2.23.

Table 2: Mode of delivery of study participants

Mode of delivery	Frequency	Percentage	P Value
NVD	**94**	**47**	.205886
LSCS	**106**	**53**	
Total	**200**	**100**	

About 47% were normal deliveries and 53% were LSCS. The chi-square statistic is 0.0604. The *p*-value is .205886. The result is *not* significant at $p < .05$.

Table 3: Birth weight among study participants

	Frequency	Percentage	P Value
≤1.75 KG	**58**	**29**	.04199
>1.75 kg	**142**	**71**	

About 28% had birth weight less than 1.75 kg. Mean birth weight is 2.01 kg and standard deviation is 0.86 kg. The chi-square statistic is 9.5584. The *p*-value is .04199. The result is significant at $p < .05$.

Table 4: Association between perfusion index and shock

PI	Shock present	Absent	P Value
≤0.9	**41**	**09**	<0.0001
>0.9	**03**	**147**	
Total	**44**	**156**	

The majority of the neonates who had shock have perfusion index less than 0.9.The association is statistically highly significant. (P<0.05)

Discussion

Shock is a complex clinical syndrome characterized by acute failure of the circulatory system to maintain adequate tissue and organ per fusion. This leads to inadequate oxygen and nutrient substrate delivery to body tissues. The hemodynamic status of newborns is usually estimated by the interpretation of indirect parameters of systemic blood flow, like blood pressure, heart rate, capillary refill time and urine output[8].

Serum bicarbonate, serum chloride, and a history of pulmonary disease are the factors most significantly linked to normal serum lactate levels. High lactate levels, on the other hand, are linked to liver illness, aspartate transaminase, and serum sodium levels. The relationship between heart rate and blood pressure and serum lactate levels is substantially less. Increased ICU and hospital mortality is linked to elevated serum lactate. The part lactate plays in health and disease, a potentially hazardous oversimplification, equates hyper-lactatemia with "hypoperfusion"[9].

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE1, 2024

In the ICU, normal serum lactate levels are present in about 50% of the critically sick septic patients. Uncertainty surrounds the pathobiology of why some critically ill ICU patients have normal serum lactate levels. Even among patients who rank among the sickest in the highest quartile, serum lactate is a reliable predictor of mortality. When a patient presents to the emergency department (ED) in septic shock, the initial serum lactate level is independently correlated with mortality. Measurement of the first serum lactate level may therefore be a reliable indicator of prognosis in septic shock patients[10].

Perfusion index (PI) is an indicator of vasoconstriction. So a decrease in perfusion index indicates increase in sympathetic tones which occur in many conditions like pain, stress and in shock. In our study, we constructed ROC curve (receiver operating characteristic curve) to predict future shock by percentage of change in perfusion index (PI) [11]. This result should be interpreted cautiously because pain, stress and hypothermia also decrease the PI.

Van Genderen et al[12]. did a study in 25 healthy volunteers to detect the peripheral perfusion index changes during central hypovolemia. They monitored stroke volume, heart rate, MAP (Mean Arterial Pressure) and PI by pulse oximeter in adults. They found that PI would detect central hypovolemia and shock very early and well before the occurrence of cardiovascular deterioration.

Conclusion

Clinical shock in neonates can be reasonably predicted when perfusion index is less than 0.91. Perfusion index displayed in newer pulse oximeters may be a useful added parameter for the assessment of peripheral per fusion. Additionally it has association with serum lactate which also helps in predicting shock.

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ISSN: 0975-3583, 0976-2833 VOL15, ISSUE1, 2024

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