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Muscle and Cerebral Regional Oxygenation in Preterm Infants with Shock Using Near-Infrared Spectroscopy

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Abstract : Background: Shock is one severe condition that can be a major cause of morbidity and mortality in the Neonatal Intensive Care Unit. Preterm infants are very susceptible to shock caused by many complications such as asphyxia, patent ductus arteriosus, intra ventricle haemorrhage, necrotizing enterocolitis, persistent pulmonal hypertension of the newborn, and septicaemia. Limited hemodynamic monitoring for early detection of shock causes delayed intervention and comprises the outcomes. Clinical parameters still used in neonatal shock detection, such as Capillary Refill Time, heart rate, cold extremity, and urine production. Blood pressure is most frequently used to evaluate preterm's circulation, but hypotension indicates uncompensated shock. Near-infrared spectroscopy (NIRS) is known as a noninvasive tool for monitoring and detecting the state of inadequate tissue perfusion. Muscle oxygen saturation shows decreased cardiac output earlier than systemic parameters of tissue oxygenation when cerebral regional oxygen saturation is still stabilized by autoregulation. However, to our best knowledge, until now, no study has analyzed the decrease of muscle oxygen regional saturation ($mRSO_2$) and the ratio of muscle and cerebral oxygen regional saturation ($mRSO_2/cRSO_2$) by NIRS in preterm with shock. Purpose: The purpose of this study is to analyze the decrease of $mRSO_2$ and ratio of muscle to cerebral oxygen regional saturation ($mRSO_2/cRSO_2$) by NIRS in preterm with shock. Patients and Methods: This cross-sectional study was conducted on preterm infants with 28-34 weeks gestational age, admitted to the NICU of Dr. Soetomo Hospital from November to January 2022. Patients were classified into two groups: shock and non-shock. The diagnosis of shock is based on clinical criteria (tachycardia, prolonged CRT, cold extremity, decreased urine production, and MAP Blood Pressure less than GA in weeks). Measurement of $mRSO_2$ and $cRSO_2$ by NIRS was performed by the doctor in charge when the patient came to NICU. Results: We enrolled 40 preterm infants. The initial conventional hemodynamic parameter as the basic diagnosis of shock showed significant differences in all variables. Preterm with shock had higher mean HR (186.45±1.5), lower MAP (29.8±2.1), and lower SBP (45.1±4.28) than non-shock children, and most had a prolonged CRT. The patients' outcome was not a significant difference between shock and non-shock patients. The mean $mRSO_2$ in the shock and non-shock groups were 33,65 ± 11,32 vs. 69,15 ± 3,96 (p=0.001), and the mean ratio $mRSO_2/cRSO_2$ 0,45 ± 0,12 vs. 0,84 ± 0,43 (p=0,001), were significantly different. The mean $cRSO_2$ in the shock and non-shock groups were 71,60 ± 4,90 vs. 81,85 ± 7,85 (p 0.082), not significantly different. Conclusion: The decrease of $mRSO_2$ and ratio of $mRSO_2/cRSO_2$ can differentiate between shock and non-shock in the preterm infant when $cRSO_2$ is still normal.

Keywords : preterm infant, regional muscle oxygen saturation, regional cerebral oxygen saturation, NIRS, shock
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