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Role of Passing Leg Raising on Cerebral Oxygenation Assessed with Near-Infrared Spectroscopy (NIRS) in Sepsis Patients in the Intensive Care Unit (ICU) RSUP H. Adam Malik Medan

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Abstract:-

Objectives: To analyze the role of passive leg raising on cerebral oxygenation assessed with near-infrared spectroscopy (NIRS) in sepsis patients in the ICU RSUP H. Adam Malik using data from the mean value of cerebral oxygenation in sepsis patients and assessing the cerebral oxygenation difference before and after passive leg raising (PLR).

Methods: It is a cross-sectional study conducted at H. Adam Malik Hospital, Medan from June 2021 until the sample is sufficient. Research subjects were taken by consecutive sampling technique, a total of 27 samples. Samples that met the inclusion criteria were monitored and recorded their hemodynamics (blood pressure, heart rate, mean arterial pressure) and rSO2using NIRS before PLR (T0) was performed. Furthermore, PLR was performed by raising the patient's legs 45° for 1 minute, and then monitoring and re-recording hemodynamics and rSO2was done (T1). Monitoring and re-recording were carried out 5 minutes after the PLR (T2) was performed with the NIRS pad still attached to the patient.

Results: The results showed that there was a statistically significant difference between the right rSO2and the left rSO2before PLR and after 1-minute post-intervention with a p-value <0.05. The same results were also obtained in the comparison of right rSO2with left rSO2before PLR and after 5 minutes post-intervention where the p-value <0.05 showed a significant difference. Comparison between right rSO2and left rSO2at one-minute post-intervention and after five minutes, p-value > 0.05 showed that there was no statistically significant difference.

Conclusion: There was a significant change in cerebral oxygenation after passive leg raising action, while at 5 minutes there was no significant change in cerebral oxygenation.

Keywords: *passive leg raising, cerebral oxygenation, near-infrared spectroscopy*

I. INTRODUCTION

Non-invasive methods of monitoring tissue oxygenation can provide useful information about tissue oxygenation and microcirculation conditions. One technique for monitoring tissue oxygenation, near-infrared spectroscopy (NIRS), also known as cerebral oximetry, uses computer spectral analysis in the near-infrared range (680-800 nm) to estimate brain oxygenation by measuring infrared light absorption by tissue chromophores such as hemoglobin. After infrared light enters the tissue, the relative absorption of light of different wavelengths depends on the concentration of the hemoglobin species (unoxygenated vs. oxygenated). Based on the relative absorption of infrared light at different wavelengths, Specific hemoglobin concentrations can be assessed using a modification of the Beer-Lambert law. The NIRS can assess the oxygen saturation of somatic and cerebral tissues through sensors placed on the head or somatic areas (thenar muscle, nephral tissue). Research states that measurement of oxygen saturationcerebral (rSO2) using NIRS correlated with central venous saturation. Detection of rSO2 is also used as a surrogate to assess hemodynamic function. The value of rSO2 is associated with the severity of the disease and the prognosis of sepsis.[1]

In acute circulatory failure, Passive Leg Raising (PLR) is a test that predicts whether the cardiac output will increase with volume expansion. Adequate brain oxygenation depends on adequate cerebral blood flow and oxygen content. The factors that influence any of these will result in decreased brain oxygenation and decreased brain oximetry values. The PLR test reliably predicts the preload response. Because it has no side effects, PLR should be considered a substitute for the fluid challenge. Repeated fluid challenges can cause fluid overload. The goal of PLR is to increase preload and stroke volume. The PLR position causes hemodynamic changes (blood pressure, heart rate, MAP). The benefit of PLR is to increase stroke volume and cardiac output by as much as 12%. This has also been confirmed by Marik in his research entitled “Fluid Responsiveness by Passive Leg Raising”, at America's hospital, stating that there is an increase in cardiac output of 10-15%.[2,3]

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II. METHOD

This study is a cross-sectional study conducted at H. Adam Malik Hospital Medan, in June 2021 until the sample is sufficient. Research subjects were taken by consecutive sampling technique, a total of 27 samples. Samples that met the inclusion criteria were monitored and recorded hemodynamics (blood pressure, heart rate, mean arterial pressure) and rSO2using NIRS before taking PLR (T0). Furthermore, the PLR action was carried out by raising the patient's legs 45° after 1 minute of monitoring and re-recording hemodynamics and rSO2(T1). Monitoring and re-recording were carried out 5 minutes after the PLR (T2) was performed with the NIRS pad still attached to the patient. Inclusion criteria in this study were patients treated at H. Adam Malik Hospital, Medan, aged 18-65 years and with a qSOFA score of 2.

Exclusion criteria in this study were research subjects or their families refusing to sign the informed consent, study subjects with head trauma or intracranial problems, research subjects in treatment with immunosuppressants, glucocorticoids, cytostatics and a history of malignancy, study subjects with surgical causes of sepsis that were not sourced. control is contraindicated for passive leg raising. Drop-out criteria in this study were patients who experienced cardiac or respiratory arrest during observation and data collection.

III. RESULTS

This study was a cross-sectional study to determine the relationship between passive leg raising and cerebral oxygenation in the treatment of sepsis patients.

Characteristics	Amount	P-Value
Gender		
Man	15 (50%)	
		0.67
Woman	15 (50%)	
Age	47.33±12.053	0.58
Ethnic group		
Aceh	2(6.7%)	
Batak	14(46.7%)	
Java	10(33.3%)	0.76
Malay	4 (13.3%)	
Religion		
Islam	14(46.7%)	
Catholic	2(6.7%)	0.77
Christian	14(46.7%)	

Table 1: Sample Characteristics

Based on Table 1, research with sample characteristics based on gender, namely male and female sex with the same number of samples, namely 15 people. The mean age in this study was 47.33 ± 12.053. Based on the ethnic group, it can be divided into 2 Acehnese (6,7%), 14 Batak (46.7%), 10 Javanese (33.3%), and 4 Malay (13.3%)). Based on religious groups, 14 people can be divided into Islam (46.7%), 2 Catholics (6.7%), and 14 Christians (46.7%), it can be concluded that the variables on the characteristics are normally distributed.

Characteristics	Amount		P-Value
Systolic (T0)	86.93±	4.98	0.068
Diastolic (T0)	62,20±	6.57	0.078
MAP (T0)	70,40±	4.92	0.1
HR(T0)	116.77±	11.46	0.071
RR (T0)	23.67±	2.04	0.082
SpO2 (T0)	97.40±	1.45	0.089
rSO2 Left (T0)	58.03±	7.75	0.091
rSO2 Right (T0)	58.76±	7.68	0.11

Table 2: Pre Test Frequency Distribution (T0)

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Based on table 2, it was found that the mean value of the pre-PLR systolic value was 86.93 ± 4.98 mmHg. The mean value of the pre-PLR diastolic value was 62.20 ± 6.57. The mean value of pre-PLR MAP is 70.40 ± 4.92. The mean value of HR pre-PLR is 116.77 ± 11.46. The mean value of RR pre PLR was 23.67 ± 2.04. The mean SpO2 value of pre-PLR was 97.40 ± 1.45. The mean value of left pre-PLR rSO2 was 58.03 ± 7.75. The mean value of rSO2 right of pre-PLR was 58.76 ± 7.68. With p-values> 0.05, it can be concluded that the variables in table 2 are normally distributed.

Characteristics	Amount	P-Value
Systolic (T1)	84.90 ±5.12	0.084
Diastolic (T1)	61.47 ± 7.30	0.098
MAP (T1)	69.27 ±5.18	0.077
HR (T1)	115,70 ±10.70	0.071
RR (T1)	23.53 ±2.11	0.099
SpO2 (T1)	98.10 ±1.09	0.12
Left rSO2 (T1)	60.76 ±7.23	0.086
rSO2 Right (T1)	60.03 ±8.97	0.063

Table 3: Distribution of 1 Minute Post Frequency (T1)

Based on Table 3, the mean systolic value at the post-1-minute PLR frequency was 84.90 ± 5.12. The mean diastolic value at 1-minute post frequency is 61.47 ± 7.30. The mean value of MAP at1-minutes post frequency was 69.27 ± 5.18.The mean value of HR at 1-minute post frequency was 115.70 ± 10.70. RR mean valueat 1-minute post frequency was 23.53 ± 2.11. Mean value of SpO2 at the ost. frequency1 minute is 98.10 ± 1.09. The mean value of left rSO2 at 1-minute post frequency was 60.76 ± 7.23. The mean value of right rSO2 at 1-minute post frequency was 60.03 ± 8.97. With values> 0.05, it can be concluded that the variables in table 3 are normally distributed.

Characteristics	Amount	P-Value
Systolic (T2)	86.07± 4.88	0.085
Diastolic (T2)	60.17± 5.77	0.074
MAP (T2)	68,80± 4.82	0.091
HR (T2)	116,80± 11.26	0.17
RR (T2)	23.57 ± 2.112	0.083
SpO2 (T2)	98.03± 1.32	0.075
Left rSO2 (T2)	58.76± 7.68	0.093
rSO2 Right (T2)	57.46± 9.22	0.17

Table 4: Distribution of 5 Minute Post Frequency (T2)

Based on Table 4, the mean systolic value at the post-5-minute PLR frequency was 86.07 ± 4.88. The mean diastolic value at 5 minutes post frequency was 60.17 ± 5.77. The mean value of MAP at 5 minutes post frequency was 68.80 ± 4.82. The mean value of HR at 5 minutes post frequency is 116.80 ± 11.26. The average valueThe RR at 5 minutes post frequency was 23.57 ± 2.112. The mean value of SpO2 at the 5-minute post frequency was 98.03 ± 1.32. The mean value of left rSO2 at a post frequency of 5 minutes was 58.76 ± 7.68. The mean value of right rSO2 at the p5-minutenute frequency is 57.46 ±9.22. With p-values> 0.05, it can be concluded that the variables in table 4 are normally distributed.

Parameter	rSO2 T0	rSO2 T1	p Nilai value
left rSO2	58.03 ± 7.75	60.76 ± 7.23	0.001
rSO2 right	56.70±9.40	60.03 ± 8.97	0.001

Table 5: rSO2 before PLR with Post 1 minute (T0-T1)

Based on the results of the analysis in Table 5, the mean value before PLR rSO2 left T0 is 58.03 ± 7.75 and rSO2 T1 is 60.76 ± 7.23 and the mean value of right rSO2 T0 is 56.70 ± 9.40 and rSO2 T1 is 60.03 ± 8.97. There was a statistically significant difference between right rSO2 and left rSO2 before PLR and after a 1-minute post with p <0.05.

Parameter	rSO2 T0	rSO2 T2	p Nilai value
left rSO2	58.03 ± 7.75	58.76 ± 7.68	0.38
rSO2 right	58.76 ± 7.68	57.46 ± 9.22	0.22

Table 6: rSO2 before PLR with Post 5 minutes (T0-T2)

Based on the results of the analysis in Table 6, the mean value of rSO2 before left PLR T0 is 58.03 ± 7.75 and rSO2 T1 is 58.76 ± 7.68 and the mean value of right rSO2 T0 is 58.76 ± 7.68 and rSO2 T1 is 57.46 ± 9.22. There was a statistically significant difference between the right rSO2 and the left rSO2 before PLR and after 5 minutes post with p <0.05.

Parameter	rSO2 T1	rSO2 T2	p Nilai value
left rSO2	60.76 ± 7.23	58.76 ± 7.68	0.45
rSO2 right	60.03 ± 8.97	57.46 ± 9.22	0.42

Table 7: rSO2 Post 1 minute with Post 5 minutes (T1 -T2)

Based on the results of the analysis in Table 7, the mean value of rSO2 before left PLR T0 is 60.76 ± 7.23 and rSO2 T1 is 58.76 ± 7.68 and the mean value of right rSO2 T0 is 60.03 ± 8.97 and rSO2 T1 is 57.46 ± 9.22. There was no statistically significant difference between the right rSO2 and the left rSO2 at the 1-minute post and after 5 minutes post with a p-value> 0.05.

	Pearson correlation	P
RSO2 (T0) RSO2(T1)	0.012	0.03

Table 8: Pearson Correlation Before and After Liquid Loading and PLR

From the results of the analysis in table 8 with the Pearson correlation, it is found that the P-value is 0.03 (<0.05), which means that there is a relationship between before and after loading the fluid and PLR with the RSO number.2, and the Pearson value of 0.012 results with a positive score which means PLR action and fluid loading can increase RSO2and because it is close to zero so it has a strong relationship.

IV. DISCUSSION

Passive leg raising actions can affect cerebral autoregulation. Passive leg raising action increased rSO2 [52% (51-59.5%) in the pre-PLR measurement and 57% (54-63.5) in the second measurement, with significant results with p-value< 0.001]. Near-infrared spectroscopy (NIRS), otherwise known as cerebral oximetry, is a non-invasive device that uses infrared light to estimate brain tissue oxygenation (rSO2). Cerebral oxygenation plays an important role as a parameter in evaluating the management of septic patients. Real-time and noninvasive measurements provide convenience and convenience in monitoring hemodynamic changes in septic patients so that management and intervention can be given quickly and optimally. Another study assessed cerebral oxygenation levels using NIRS in septic shock patients and found a significant relationship between cerebral oxygenation levels, MAP, lactate levels, and central venous saturation in septic patients.[4,5] Theoretically, the normal basal value of rSO2 should be around 70%. Ruzman et al. showed that the mean basal values of rSO2 on the left and right sides were 71.42 7.92% and 72.98 7.94%, respectively, which were much closer to the results, but they found no correlation with age. The results showed that the baseline values were related to the patient's age, hemoglobin concentration, and sensor position, but were not significantly related to the patient's height, weight, gender, and head circumference. However, enrolled patients were mainly limited to adults and the elderly.[6,7]

V. CONCLUSION

- There is a significant relationship between passive leg raising with cerebral oxygenation assessed by near-infrared spectroscopy (NIRS) in septic patients in the ICU Haji Adam Hospital.
- The mean value of cerebral oxygenation in septic patients after passive leg raising was 60.76 ± 7.23 for the left rSO2 and 60.03 ± 8.97 for the right rSO2.
- There was a significant change in cerebral oxygenation after passive leg raising action, while at 5 minutes there was no significant change in cerebral oxygenation.

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