

UDC 61

THE RELATIONSHIP OF COMBINED HUNT AND HESS SCORE AND CT-SCAN (FISHER SCORE) COMPARED TO WFNS SCORE AND LACTIC ACID IN PREDICTING PROGNOSIS OF SPONTANEOUS SUBARACHNOID HEMORRHAGE PATIENTS

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ABSTRACT

The main predictor of mortality rate in SAH patients based on clinical presentation and CT scan, as measured by Hunt and Hess Score, WFNS Score, Fisher Score and Lactic Acid Level at the time of arrival in Emergency Room, which is an objective predictor in determining mortality rate. To Analyze the relationship of combined Hunt and hess score and Ct-scan (Fisher score) compared to WFNS score and Lactic acid in predicting prognosis of spontaneous subarachnoid hemorrhage patients in Emergency Room. This research using analytic observational study which data taken prospectively. There are 32 SAH patients who had a significant relationship to each variable that determined mortality rate. The Variable consist of Hunt and Hess Score, WFNS Score, lactic acid and Fisher Score had a significant relationship to the prognosis of SAH patients ($p < 0.05$). The WFNS score with lactic acid has a strong relationship to the prognosis ($r = 0.674$), while the Hunt and Hess Score variables with Fisher scores also have a strong relationship to the prognosis ($r = 0.626$).

KEY WORDS

Lactic acid, Hunt and Hess Score, WFNS score, Fisher score.

Spontaneous subarachnoid hemorrhage shows blood leakage to the subarachnoid space and a major cause of spontaneous subarachnoid hemorrhage is intracranial aneurysms rupture. Spontaneous subarachnoid hemorrhage contributes to a small percentage of strokes in which a number of patients with spontaneous subarachnoid hemorrhage is between 2% and 7% out of a total number of patients with stroke [1-4].

Total mortality rate due to subarachnoid hemorrhage is approximately 40% in 1 week; with 10% to 15% of deaths occurring in pra hospital and 25% within 24 hours after initial bleeding [5].

Most frequently scores used to determine mortality rate are Hunt and Hess scores and The World Federation of Neurological Surgeons (WFNS score); the latter is used mainly in scientific research. Hunt and Hess and WFNS scores are correlated to mortality and disability rate; higher scores predicted a higher mortality rate [5].

Hunt and Hess score are clinical scales commonly used to determine prognosis in spontaneous subarachnoid hemorrhage, but validity and reliability of these scores are suboptimal. It is difficult to evaluate or classify clinical symptoms in an objective manner, for example headache and level of consciousness. Glasgow Coma Scale (GCS) is a new scoring system as it is more objective and has higher validity and reliability value [1, 3, 5].

Computerized Tomography Scan (CT scan) is the first scanning method conducted when subarachnoid bleeding is suspected. There is a correlation between time when the CT scan is conducted after bleeding and the ability to detect bleeding in subarachnoid hemorrhage which 85% bleeding is detected after 5 days, 50% is detected after 1 week, 30% is detected after 2 weeks and no bleeding is detected after 3 weeks. CT scan has Fisher score that has been used widely to measure the amount of blood in basal cystem. Amount of blood extravasated on CT scan is related to the possibility of vasospasme, brain ischemia

and prognosis. Radiology score (Fisher score) is strongly correlated to the amount of bleeding and the risk of brain ischemia [6].

Very few studies discuss brain lactic acid metabolism in patients with subarachnoid hemorrhage. Lactic acid tends to increase in patients with spontaneous subarachnoid hemorrhage because of hyperglycolysis as compared to hypoxia.⁴ Increase of lactic acid in spontaneous subarachnoid hemorrhage patients has pivotal role to predict mortality rate since it is an objective predictor for patients with spontaneous subarachnoid hemorrhage [7, 8].

METHODS OF RESEARCH

This study is an analytical observational study of which data has been taken prospectively to determine prognosis for patients with spontaneous subarachnoid hemorrhage. Data taken was serum lactate, CT scan (Fisher score), Hunt and Hess scores, WFNS score, and Glasgow Outcome Scale (GOS) score at the time of arrival in Emergency Room, which is an objective predictor in determining mortality rate.

This study was conducted between May and August, 2018 in an Emergency Room of RSUD dr. Saiful Anwar (RSSA), Malang, East Java, Indonesia. The independent variables were Hunt and Hess scores, WFNS score, Fisher score, and Lactic acid levels. The dependent variable was the prognosis of patients with spontaneous subarachnoid hemorrhage evaluated on the 90th day after onset. Differences of each independent variable in predicting prognosis for patients with spontaneous subarachnoid hemorrhage was measured with a Chi-Square test where confidence level is 95%, $\alpha = 0.05$; significance if $p < 0.05$.

RESULTS OF STUDY

Total sample is 32 patients with spontaneous subarachnoid hemorrhage whom met both inclusion and exclusion criteria. Patient characteristics in this study were sex, lactic acid level, Hunt and Hess scores, WFNS score, Fisher score, and GOS score. Out of 32 patients, 19 patients were male (59.4%) while 13 patients were female (40.6%). The highest distribution of frequency from Hunt and Hess score is at the fourth degree (18 patients or 56.3%) and the lowest frequency was at the third degree (1 patient or 3.1%).

Table 1 – Characteristics of Patients with Spontaneous Subarachnoid Hemorrhage

| No. | Characteristic | Total | Percentage (%) |
|-----|------------------------|-------|----------------|
| 1. | Sex | | |
| | Male | 19 | 59.4 |
| 2. | Female | 13 | 40.6 |
| | Lactic Acid Level | | |
| 3. | < 2 | 10 | 31.3 |
| | ≥ 2 | 22 | 68.8 |
| 3. | Hunt and Hess Scores | | |
| | 1 st Degree | 3 | 9.4 |
| | 2 nd Degree | 5 | 15.6 |
| | 3 rd Degree | 1 | 3.1 |
| | 4 th Degree | 18 | 56.3 |
| 4. | 5 th Degree | 5 | 15.6 |
| | WFNS Score | | |
| | 1 st Degree | 5 | 15.6 |
| | 2 nd Degree | 3 | 9.4 |
| | 3 rd Degree | 2 | 6.3 |
| 5. | 4 th Degree | 13 | 40.6 |
| | 5 th Degree | 9 | 28.1 |
| | Fisher Score | | |
| | 1 st Degree | 2 | 6.3 |
| | 2 nd Degree | 7 | 21.9 |
| 6. | 3 rd Degree | 10 | 31.3 |
| | 4 th Degree | 13 | 40.6 |
| | GOS Score | | |
| | Death | 9 | 28.1 |
| | Vegetative State | 3 | 9.4 |
| 6. | Severe Disability | 4 | 12.5 |
| | Mild Disability | 7 | 21.9 |
| | Total Recovery | 9 | 28.1 |

In terms of WFNS score, the highest distribution of frequency is at the fourth degree (13 patients or 40.6%) and the lowest frequency was at the third degree (2 patients or 6.3%). In terms of Fisher score, the highest distribution of frequency is at the fourth degree (13 patients or 40.6%) and the lowest frequency was at the first degree (2 patients or 6.3%). In terms of lactic acid level, there are 68.8% patients of which lactic acid levels are equivalent to or greater than 2 mmol/l and 31.3% of which lactic acid levels are less than 2 mmol/l.

Table 2 – Relationship between Sex and GOS

| Sex | GOS | | | | P |
|--------|------------|------|------------|----|-------|
| | Poor (1-3) | | Good (4-5) | | |
| | N | % | N | % | |
| Female | 5 | 15.6 | 8 | 25 | 0.280 |
| Male | 11 | 34.3 | 8 | 25 | |

Table 2 showed that based on Chi Square test, $p = 0.280$ ($p > 0.05$) which means there is no significant relationship between sex and prognosis measured with GOS.

Table 3 – Combination between Hunt and Hess and Fisher Scores and GOS Score

| Hunt and Hess Scores | GOS | | | | p | R |
|------------------------|------------|-------|------------|-------|-------|-------|
| | Poor (1-3) | | Good (4-5) | | | |
| | N | % | N | % | | |
| 1 st Degree | 0 | 0 | 3 | 9.4% | 0.000 | 0.626 |
| 2 nd Degree | 0 | 0 | 5 | 15.6% | | |
| 3 rd Degree | 0 | 0 | 1 | 3.1% | | |
| 4 th Degree | 11 | 34.4% | 7 | 21.9% | | |
| 5 th Degree | 5 | 15.6% | 0 | 0% | | |

| Fisher | GOS | | | | p | R |
|------------------------|------------|------|------------|------|-------|-------|
| | Poor (1-3) | | Good (4-5) | | | |
| | N | % | N | % | | |
| 1 st Degree | 0 | 0 | 2 | 6.2 | 0.000 | 0.626 |
| 2 nd Degree | 0 | 0 | 7 | 21.9 | | |
| 3 rd Degree | 7 | 21.9 | 3 | 9.4 | | |
| 4 th Degree | 9 | 28.1 | 4 | 12.5 | | |

| Combination between Hunt and Hess and Fisher | GOS | | Total | p | r |
|---|---|------------|-------|---|---|
| | Poor (1-3) | Good (4-5) | | | |
| | Poor (<i>Hunt and Hess 4-5, Fisher 3-4</i>) | 16 | | | |
| Good (<i>Hunt and Hess 1-3, Fisher 1-2</i>) | 0 | 9 | 9 | | |
| Total | 16 | 16 | 32 | | |

Table 4 – Combination between Lactic Acid Level and WFNS Score and GOS

| WFNS | GOS | | | | p | R |
|------------------------|------------|------|------------|------|-------|-------|
| | Poor (1-3) | | Good (4-5) | | | |
| | N | % | N | % | | |
| 1 st Degree | 0 | 0 | 5 | 15.6 | 0.000 | 0.674 |
| 2 nd Degree | 0 | 0 | 3 | 9.4 | | |
| 3 rd Degree | 0 | 0 | 2 | 6.2 | | |
| 4 th Degree | 7 | 21.9 | 6 | 18.8 | | |
| 5 th Degree | 9 | 28.1 | 0 | 0 | | |

| Lactic Acid Level | GOS | | | | p | R |
|-------------------|------------|-----|------------|------|-------|-------|
| | Poor (1-3) | | Good (4-5) | | | |
| | N | % | N | % | | |
| <2 mmol/l | 0 | 0 | 10 | 31.2 | 0.000 | 0.674 |
| ≥2 mmol/l | 16 | 50% | 6 | 68.8 | | |

| Combination between WFNS and Lactic Acid Level | GOS | | Total | p | R |
|--|--|------------|-------|---|---|
| | Poor (1-3) | Good (4-5) | | | |
| | Poor (WFNS 4-5, Lactic Acid ≥2 mmol/l) | 16 | | | |
| Good (WFNS 1-3, Lactic Acid <2 mmol/l) | 0 | 10 | 10 | | |
| Total | 16 | 16 | 32 | | |

Nominal data were analyzed using Chi Square test. The result is $p=0.000$ and $r= 0.626$, which shows a significant relationship between combination of Hunt and Hess Scores and Fisher Score to prognosis for patients with Glasgow Coma Score (GOS). The relationship is quite strong in which $r= 0.626$ ($r= >0.5$) so that Hunt and Hess score and Fisher score, combined or uncombined, are able to predict prognosis for patients with spontaneous subarachnoid hemorrhage.

In this study, Hunt and Hess scores are classified into two groups, A and B. This classification has remained a controversy since Hunt and Hess scores at the third degree have sustainability level of 50%. Some previous studies categorized Hunt and Hess scores into two groups with good and poor outcomes. Hunt and Hess scores are divided into two groups, 1 to 3 (good grade) and 4 to 5 (poor grade). It is based on De Marchis et al (2014)'s study to describe risk for hypertension towards recurrent bleeding in patients with spontaneous subarachnoid hemorrhage, which increases mortality and morbidity rate [11].

Based on Table 4, nominal data are analyzed with Chi Square test and the result is $p=0.000$ and $r= 0.674$, which shows a strong relationship between in the combination of WFNS score and lactic acid level with a prognosis on patients with spontaneous subarachnoid hemorrhage. Therefore, WFNS score and lactic acid level, combined or uncombined, can be used to predict prognosis for patients with spontaneous subarachnoid hemorrhage.

DISCUSSION OF RESULTS

Out of 32 samples, the total of male and female samples is similar. The percentage of female samples is 40.6%, while that of male samples is 59.4%, which can be associated to steroids, sex hormone that influence a response to inflammation based on Turan et al.,(2016)'s study in 2015. The risk of spontaneous subarachnoid hemorrhage increases in females, which may occur due to lack of estrogen and menopause [10].

Hunt and Hess scores and Fisher score has significant influence towards prognosis for patients with spontaneous subarachnoid hemorrhage. The p of each variable, where Hunt and Hess score is $p = 0.000$ and Fisher score is $p=0.000$. The relationship strength between each of the independent variables towards prognosis shows that there is a significant relationship between Fisher score and Hunt and Hess scores with prognosis ($r =0.626$). The Combination of Fisher score and Hunt and Hess scores is a good indicator for predicting prognosis in patients with spontaneous subarachnoid hemorrhage where $p = 0.000$ and $r= 0.626$. Higher Hunt and Hess scores result in a higher mortality due to spontaneous subarachnoid hemorrhage. Higher Hunt and Hess score, is an independent predictor towards prognosis [11].

Based on the data analysis, higher Hunt and Hess scores result in a higher mortality rate. Patients with spontaneous subarachnoid hemorrhage whose Hunt and Hess scores are categorized as the fourth degree have poor prognosis. Number of patients whose Hunt and Hess scores are categorized as a fourth degree and have a good GOS score of eleven and the number of patients with poor GOS score is seven. Bailes et al's study reported a 77% survival rate and a 54.3% good outcome rate; Gumprecht et al. Reported a 64% good outcome in patients whose Hunt and Hess score is categorized as the fourth degree; and Le Roux et al reported a 57% survival rate with approximate 38.3% rate of good outcome. With accurate and aggressive preliminary management, survival rate and prognosis of patients whose Hunt and Hess scores are categorized as the 4th and 5th degree are improving [12].

Based on the combination between Hunt and Hess scores and Fisher score, it can be concluded that the combination is a good indicator for predicting prognosis for patients with spontaneous subarachnoid hemorrhage where $p = 0.000$ and the strength of variables to prognosis is high ($r=0.626$). This shows that the combination of both between Hunt and Hess scores and Fisher score and the combination between WFNS score and lactic acid levels can be used to predict prognosis. In conclusion, all variables mentioned previously can predict prognosis accurately.

Relationship between the Combination of Lactic Acid Levels and WFNS Score in Predicting the Prognosis of Spontaneous Subarachnoid Hemorrhage. Lactic acid levels and WFNS score have significant influence towards prognosis for patients with spontaneous subarachnoid hemorrhage. The p value for lactic acid is $p = 0.000$ while that of WFNS score is $p = 0.000$. The strength of the relationship between each of the independent variables and prognosis is high ($r = 0.674$).

The combination of lactic acid level and WFNS score is a good indicator for predicting prognosis for patients with spontaneous subarachnoid hemorrhage where $p = 0.000$ and the strength of the relationship is high ($r = 0.674$).

There is a significant relationship between lactic acid level and mortality rate of patients with spontaneous subarachnoid hemorrhage, even though production of lactic acid is influenced by several factors, including an endogenous factor which cannot be predicted and is different between individuals. Patients whose lactic acid level exceeds the normal level have higher mortality rate. Out of the 32 patients with spontaneous subarachnoid hemorrhage, 68.8% (22 samples) experienced increase of lactic acid level $> 2\text{mmol/l}$.

Higher WFNS score indicates a higher mortality rate due to spontaneous subarachnoid hemorrhage. A higher WFNS score based on clinical presentation measured with Glasgow Coma Scale is an independent predictor of prognosis [5, 11].

This study showed that WFNS score, lactic acid levels and a combination of WFNS score and lactic acid levels are indicators that predict prognosis since all of the variables mentioned above have a high capability to predict prognosis.

The findings of this study supported by Pegoli et.al (2015) study where fourth degree of WFNS score, which is formerly predicted to have poor prognosis, has good prognosis after prompt treatment. There are nine patients with spontaneous subarachnoid hemorrhage in the fifth degree of WFNS score and poor GOS score [5, 11, 14].

Previous studies have not mentioned any ability of lactic acid level as a biomarker for prognosis in a patient with spontaneous subarachnoid hemorrhage. Data show that there is a relationship between lactic acid levels and the prognosis of patients in spontaneous subarachnoid hemorrhage and provides useful information about severity and mortality. High WFNS score is an indicator of clinical severity. This score has several limitations, for instance, several clinical presentations cannot be described efficiently or this score does not take the comorbidity of the patients into account [5, 11, 14].

Very few literatures have been studied about lactic acid metabolism in spontaneous subarachnoid hemorrhage. There are two mechanisms of increased lactic acid in patients with spontaneous subarachnoid hemorrhage which are hypoxia and hyperglycolysis. The pathophysiology mechanism of increased lactic acid in patients with subarachnoid bleeding are still unknown, however it can be concluded that hyperglycolysis or hypoxia or both had a role in increased lactic acid [7, 8, 15, 16].

This study concluded that all scores have a good capability to predict mortality rate of patients with spontaneous subarachnoid hemorrhage, and thus, all of them can be used to predict the mortality rate of patients with spontaneous subarachnoid hemorrhage. CT-scan is still widely used for diagnosis. The result of a CT-Scan can be used to predict mortality rate with Fisher score, which based on this study can predict mortality rate as accurately as the other scores.

CONCLUSION

The four types of modality have significant influence towards prognosis for patients with spontaneous subarachnoid hemorrhage. WFNS or Hunt and Hess scores, can be used mainly for health service in public health centres or type D,C and B hospitals where neither CT-scan nor lactic acid serum is available. Fourth degrees of WFNS and Hunt and Hess scores have good prognoses that differ from previous studies in which these scores had poor prognosis. This study shows that prompt and accurate treatment in the first 24 hours could have good prognosis.

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