RESEARCH

Base Deficit and Increased Lactate Level as A Predictor of Blood Transfusion in Trauma Patients with Acute Bleeding at the Emergency Department RSUP Prof. dr. I.G.N.G. Ngoerah

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ABSTRACT

Background: Bleeding caused by trauma is still a prominent factor in death and organ system complications. Base deficit and lactate levels are experiencing disturbances that result in hypoxic acidosis conditions at the tissue and cellular levels.

Objective: This study aims to determine the relationship between low base deficit levels and high lactate values, related to the need for blood transfusions in trauma patients with acute blood loss.

Methods: This research is an observational analytic study with a prospective cohort study design. The target population of this study was all trauma patients with acute bleeding admitted to the emergency room of RSUP Prof. dr. I.G.N.G Ngoerah, Denpasar.

Result: Age results showed a mean ± SD of 25.08 ± 6.38 years, the most gender was male, there were 36 subjects (72%), hemoglobin levels had an average of ± 10.47 ± 2.85 g/dL, body mass index (BMI) results had mean ± SD 23.47 ± 3.54 kg/m2, the most common type of trauma was multiple trauma, the injury severity score (ISS) was found to have a mean ± SD 23.38 ± 9.09. The results for the base level showed a mean ± SD of 4.08 ± 5.08 mmol/L in the transfusion group, with an average of -6.41 ± 4.65 mmol/L. Low base level <-3 mmol/L had a relative risk of 3.69 (95% CI 1.83-7.45; P<0.001) and an adjusted relative risk of 18.56 (95% CI 14.00-24.75; P = 0.002). The average lactate result was found to have a mean ± SD of 3.77 ± 2.29, and in the transfusion group, 4.78 ± 2.38 mmol/L, with high lactate levels (> 4 mmol/L) relative risk 5.53 (CI 95% 2, 25-13.64; P<0.001) and adjusted relative risk 41.21 (95% CI 35.05-57.74; p<0.001).

Conclusion: Low base deficit and high lactate levels are associated with the need for blood transfusions in patients with acute bleeding.

Keywords: base deficit level; bleeding; lactate; transfusion; trauma

INTRODUCTION

Bleeding caused by trauma is still a prominent factor in death and organ system complications. The loss of a certain amount of blood volume containing erythrocytes caused by major trauma not only results in acute intravascular volume depletion but also tissue hypoxia, which has an impact on tissue metabolism in the body's organ systems. Knowing the need for a blood transfusion so that adequate resuscitation management, volume adequacy, and tissue hypoxia can be immediately corrected. Transfusion based on hemoglobin levels is a conventional method. The restrictive transfusion threshold uses a lower hemoglobin concentration as a threshold for transfusion (most commonly 7.0 g/dL to 8.0 g/dL), and the liberal transfusion threshold uses a higher hemoglobin concentration as a threshold for transfusion (most commonly 9.0 g/dL to 10.0 g/dL). Guidelines suggest maintaining hemoglobin levels of 7-9 g/dL following transfusion, with a higher target (8-10 g/dL) considered in patients with cardiovascular disease. Hemoglobin levels in trauma patients who experience acute bleeding at the start can be within normal limits, with the base deficit and lactate levels already experiencing disturbances, which result in hypoxic acidosis conditions at the tissue and cellular levels.

Occult hypoperfusion syndrome (OHS) is a clinical condition where the amount of blood flow decreases, then develops into ischemia. OHS is characterized by persistent symptoms of cellular hypoxia, but with normal vital signs, serum lactate concentration of more than 2.5 mmol/L that persists for more than 12 hours. This refers to reversible risk factors for negative outcomes after traumatic injury in the evaluation of changes in high lactate levels, which influence base levels, hypoxic deficit, and metabolic acidosis, impacting the incidence of morbidity and mortality.[1]

Based on several previous studies, the number of trauma/multi-trauma patients who entered the emergency room with acute bleeding, ranging from class II bleeding requiring transfusion, was 41%, with the main cause of death in the first hour after trauma being bleeding, and around 40% of the causes of death are those caused by bleeding and its complications.[2] The American College of Surgeons has combined 4 classes of hypovolemic shock based on vital signs and base deficit levels in the 'Advanced Trauma Life Support' (ATLS) guidelines, 2018 edition.[3] This is because base deficit is considered to provide more accurate information on the presence of perfusion disorders at the cellular level in conditions of shock due to trauma that experience acute bleeding starting from class II bleeding, which then becomes a supporting diagnostic of physiological parameters for the emergence of vital sign responses.[4]

Acute blood loss and hypotension due to trauma result in inadequate oxygen delivery, thereby accelerating the onset of anaerobic metabolism. Anaerobic metabolism then causes lactate accumulation, so that several studies also show that base deficit correlates with serum lactate levels in shock conditions.[5] In addition, monitoring base deficit has been recommended as an indicator of successful resuscitation. Base deficit examination using point-of-care testing (POCT) is also considered quick and easy to carry out in the emergency room.[6]

The level of base deficit is related to the need for blood transfusions, which contain erythrocyte components as an important element that carries oxygen to tissues.[7] An increase in the number of transfusions indicates an increasing severity of base and lactate deficit levels.[8] This study aims to determine the relationship between low base deficit levels and high lactate values related to the need for blood transfusions in trauma patients with acute blood loss starting from class II bleeding degrees, as well as a physiological evaluation assessment of the adequacy of the resuscitation.

METHOD

This research is an analytical observational study with a prospective cohort study design. The research was conducted in the emergency room at RSUP Prof. dr. I.G.N.G. Ngoerah, Denpasar, from January 2023 to June 2023.

Those included as research subjects in this study must meet the following inclusion criteria: Patients aged 18 – 35 years with acute bleeding class I, II, III, and IV, body mass index (BMI) of 18.5 – 35 kg/m2, and all trauma patients at RSUP Prof. dr. I.G.N.G. Ngoerah, Denpasar, during the study period. Samples are not included as subjects if they meet the following exclusion criteria: Patients under the influence of alcohol, a history of coagulopathy, severe liver cirrhosis, a history of chronic kidney failure, spinal shock caused by trauma, pregnancy, or patients who refused to be used as research samples.

The sample in this study was selected by consecutive sampling. The minimum sample size was 38. This is a value that is close to the previous study, which was 39 samples.[9] The need for transfusion in this study was divided into 2 groups: those who underwent transfusion and those who did not receive transfusion. Low base deficit levels are base deficit values ≤ -3 immmol/L. Divided into 2 categories, > (- 3 immmol/L) and ≤ (-3 immmol/L). High lactate levels are lactate levels with a value ≥ 4 mmol/L. Divided into 2 groups, ≥ 4 mmol/L and < 4 mmol/L. Acute bleeding is a trauma condition that experiences Class I, II, III, and IV acute bleeding from the estimated blood volume (EBV) value based on the estimated ideal body weight (IBW). Laboratory tests to determine the levels of base deficit and lactate, taken from peripheral arterial blood as much as 0.5 mL, then 7 mL of blood for hemoglobin examination purposes, within 10 minutes of arriving at the emergency room. A hemoglobin level value of <10 gr/dL is the standard in this study to determine whether a blood transfusion is necessary or not. The data are categorical, hemoglobin < 10 gr/dL and ≥10 gr/dL. Age is expressed in years based on the date, month, and year of birth listed on the identity card at the time of the study. Data were obtained using a numerical and categorical scale, which was divided into 2 groups (<30 years and ≥ 30 years). The male or female gender is determined as stated on the identity card. Categorical scale data for men and women. Injury severity score (ISS) is a score to assess the severity of an injury. Each injury will be assessed using the abbreviated injury scale (AIS). The AIS score is calculated for each body region; then, the highest AIS score for each body region will be used. The three areas of the body with the most severe injuries based on the AIS score will be squared, and each added to produce the ISS score. The ISS score has a range between 0 – 75. Bolorunduro et al. classify the ISS score as follows: a) ISS score < 9 = minor injury; ISS score 9 – 15 = moderate injury; score 16 – 24 = serious injury; score > 25 = very serious injury. The ISS score is divided into 2 groups:≥ 23, which is high, and < 23, which is low according to the division. Types of trauma are divided into 2 groups: single trauma and multiple trauma. Nutritional status is divided into 2 groups: normal nutritional status and excessive nutritional status-obesity, which is based on the value of BMI. The calculation of BMI to determine whether a person's body weight is normal or at the obesity level is as follows, with the formula and categories according to the body mass of Asian people, based on the World Health Organization (WHO).

Based on the results of recorded laboratory documentation, research subjects were divided into groups who received transfusions and those who did not receive transfusions in the first 24 hours.

RESULTS

In this study, there were 50 research subjects with patient data characteristics (Table 1). Or result? Are the results consistent with other studies? Or are there differences?

The age results obtained were mean ± SD 25.08 ± 6.38 years, with the largest gender being male; there were 36 subjects (72%), and 14 subjects (28%) were female. Hemoglobin levels had a mean ± SD of 10.47 ± 2.85 gr/dL, with a division of <10 gr/dL as many as 23 subjects (46%) and those with ≥ 10 gr/dL as many as 27 subjects (54%). The BMI results had a mean ± SD of 23.47 ± 3.54 kg/m2, which was divided into normal nutritional status as many as 41 subjects (82%), and those with excessive nutritional status-obesity as many as 9 subjects (18%).

The most common type of trauma was multiple trauma compared to single trauma. Multiple trauma was found in 31 subjects (62%) and single trauma in 19 subjects (38%). The ISS score value was found to have a mean ± SD of 23.38 ± 9.09, which was divided into mild in 5 subjects (10%), moderate in 21 subjects (4%), and severe in 24 subjects (48%). Bleeding class was obtained with class 1 results for 15 subjects (30%), class 2 for 15 subjects (30%), class 3 for 9 subjects (18%), and class 4 for 11 subjects (22%). The mean base value was 4.08±5.08 mmol/L. The average lactate result was 3.77 ± 2.29 mmol/L.

The data normality test with the Shapiro-Wilk test for numerical data (Table 2) with the results of the numerical data (age, hemoglobin level, BMI, ISS score, body level, and lactate level) showing a normal distribution (p>0.05).

Analysis of differences in proportions between bases and transfusions using Chi-Square analysis (Table 3) with the results that group of decreasing base content (≤-3.00 mmol/L) 24 subjects (80%) underwent transfusions and 6 subjects (20%) did not undergo transfusions, while the high base group (>-3.00 mmol/L), only 2 subjects underwent transfusion (10%) and 18 subjects did not undergo transfusion (90%) with the relative risk value obtained 3.69 (95% CI).1.83-7.45; P<0.001) which means that the lower the base level, the relative risk of transfusion is 3.69 times.

Analysis of different proportions of bases was carried out with other variable groups, with age, gender, hemoglobin levels, nutritional status, trauma, and ISS scores (Table 4). What is statistically significant in influencing alkaline levels is the hemoglobin value and ISS score. Based on the hemoglobin level value, it was found that the relative risk of having a low base level was 2.73 times (CI

95%1.58-4.73; P<0.001) while the ISS score is ≥23 were found to have an relative risk of 3.28 (CI 95%1.73-6.22; P<0.001), these results will then be carried out in a multivariate analysis to see the effect on the value of transfusion requirements.

Analysis of the difference in proportion between lactate levels and transfusion using Chi-Square analysis (Table 5) with the results that high lactate level group (>4.00 mmol/L) 24 subjects (85.7%) underwent transfusions and 4 subjects (14.3%) did not undergo transfusions, while the low lactate group (<4.00 mmol/L), only 2 subjects underwent transfusion (9.1%) and 20 subjects did not undergo transfusion (90.9%) with a relative risk value of 5.53 (95% CI).2.25-13.64; P<0.001) which means that the higher the lactate level, the relative risk of transfusion is 5.53 times.

An analysis of different proportions of lactate was carried out with other variable groups, such as age, gender, hemoglobin levels, nutritional status, trauma, and ISS scores (Table 6). The statistically significant influence on high lactate levels was the hemoglobin value and ISS score. Based on the hemoglobin level value, it was found that the relative risk of having high lactate levels was 2.47 times (CI 95%1.41-4.36; P<0.001), while the ISS score> 23 was found to have a relative risk of 2.11(CI 95%1.19-3.72; P=0.004); these results will then be carried out in a multivariate analysis to see the effect on the value of transfusion requirements.

In this study, to see whether there was a difference between whether a transfusion was carried out or not, the researcher carried out an independent t-test analysis for numerical scale data, a Chi-Square analysis for 2x2 categorical data, and the Mann-Whitney test for categories >2 (Table 7). The results show that hemoglobin levels, ISS scores, bleeding class, alkaline and lactate levels play a role in whether a transfusion is carried out.

The results of the logistic regression analysis (Table 8 and Table 9). The results show that the factors that play the most role in the dependent variable was the need for blood transfusions, are based on the values of low alkaline levels and high lactate which are the independent variables with results at low base obtained adjusted relative risk 18.56 (CI 95%14.00-24.75; p=0.002) and at high lactate, adjusted relative risk is obtained 41.21(CI 95%35.05;-57.74; p<0.001). The results of hemoglobin levels, ISS, and bleeding were not significant in influencing the need for blood transfusions.

Table 1. Characteristics of research data

Variable	Mean±SD	n=50 (%)
Age (mean ± SD) years	25.08±6.38	
Gender		
Man		36 (72)
Woman		14 (28)
Hb (gr/dL)	10.47±2.85	
< 10 gr/dL		23 (46)
≥ 10 gr/dL		27 (54)
BMI (mean±SD) kg/m2	23.47±3.54	
Normal nutritional status		41 (82)
Excessive nutritional status-obesity		9 (18)
Trauma		
Multiple		31 (62)
Single		19 (38)
ISS (mean±SD)	23.38±9.09	
Mild		5 (10)
Moderate		21 (42)
Severe		24 (48)
Bleeding class		
Class 1		15 (30)
Class 2		15 (30)
Class 3		9 (18)
Class 4		11 (22)
Average base (mmol/L)	-4.08±5.08	
Mean lactate (mmol/L)	3.77 ± 2.29	

SD: Standard deviation; Hb: Hemoglobin; BMI: body mass index; ISS: injury severity score

Table 2. Data normality test results

Variable	p-value	Information
Age	0.200	Normal
Hemoglobin levels	0.133	Normal
BMI	0.200	Normal
ISS	0.125	Normal
Base levels	0.200	Normal
Lactate levels	0.115	Normal

*Data is normally distributed with p-value>0.05. Test normality with the Shapiro-Wilk test

Table 3. Analysis of different base proportions on transfusion needs

Variable	Base level group		RR	CI 95%	p-value
	Low ≤-3.00 mmol/L n=30 (%)	Tall >-3.00 mmol/L n=20 (%)			
Transfusion					
Yes	24 (80)	2 (10)	3.69	1.83-7.45	<0.001*
No	6 (20)	18 (90)			

*Significant from Chi-Square test p<0.05

Table 4. Results of the analysis of different base proportions with other variables

Variable	Base group: Low ≤-3.00 n=30 (%)	Base group: Tall >-3.00 n=20 (%)	RR	CI 95%	p-value
Age					
< 30 years	18 (60.0)	10 (50.0)	1.88	0.96-3.67	0.126
≥ 30 years	12 (40.0)	10 (50.0)			
Gender					
Man	22 (73.3)	14 (70.0)	1.06	0.63-1.81	0.797
Woman	8 (26.7)	6 (30.0)			
Hb					
<10gr/dL	21 (70.0)	2 (10.0)	2.73	1.58-4.73	<0.001*
≥ 10 gr/dL	9 (30.0)	18 (90.0)			
Nutritional status					
over-obesity	5 (16.7)	4 (8.0)	1.09	0.58-2.06	0.764
Normal	25 (83.3)	16 (80.0%)			
Trauma					
Multiple	19 (63.3)	12 (60.0)	1.06	0.66-1.70	0.812
Single	11 (36.7)	8 (40.0)			
ISS					
≥23	23 (76.7)	2 (10.0)	3.28	1.73-6.22	<0.001*
<23	7 (23.3)	18 (90.0)			

Hb: Hemoglobin; ISS: Injury Severity Score;*Significant from Chi-Square test p<0.05

Table 5. Results of analysis of different proportions of lactate on transfusion needs

Variable	Lactate level group: High ≥4.00 mmol/L n=28 (%)	Lactate level group: Low <4.00 mmol/L n=22 (%)	R	CI 95%	p-value
Transfusion					
Yes	24 (85.7)	2 (9.1)	5.53	2.25-13.64	<0.001*
No	4 (14.3)	20 (90.9)			

Table 6. Results of analysis of different proportions of lactate with other variables

Variable	Lactate group: High ≥4.00 mmol/L n=28 (%)	Lactate group: Low <4.00 mmol/L n=22 (%)	RR	CI 95%	p-value
Age					
< 30 years	18 (64.2)	11 (50.0)	1.16	0.49-4.64	0.116
≥ 30 years	10 (35.8)	11 (50.0)			
Gender					
Man	20 (71.4)	16 (72.7)	0.97	0.56-1.67	0.919
Woman	8 (28.6)	6 (27.3)			
Hb					
< 10 gr/dL	19 (67.9)	4 (18.2)	2.47	1.41-4.36	<0.001*
≥ 10 gr/dL	9 (32.1)	18 (81.8)			
Nutritional status					
Over-obesity	2 (7.1)	7 (31.8)	2.85	0.82-9.90	0.124
Normal	26 (92.9)	15 (68.2)			
Trauma					
Multiple	20 (71.4)	11 (50.0)	1.53	0.85-2.76	0.121
Single	8 (28.6)	11(50.0)			
ISS					
≥23	19 (67.9)	6 (27.3)	2.11	1.19-3.72	0.004*
<23	9 (32.1)	16 (72.7)			

Hb: Hemoglobin; ISS: Injury Severity Score;*Significant from Chi-Square test p<0.05

Table 7. Comparison of demographic data and laboratory results for transfusion and non-transfusion procedures

Variable	Transfusion group: Transfusion n=26 (%)	Transfusion group: No transfusion n=24 (%)	p-value
Age	23.92±6.29	26.33±6.38	0.185
< 30 years	20 (76.9)	14 (58.3)	0.159
≥ 30 years	6 (23.1)	10 (41.7)	
Gender			
Man	18 (69.2)	18 (75.0)	0.650
Woman	8 (30.8)	6 (25.0)	
Hb	8.69±2.11	12.39±2.24	<0.001*
<10 gr/dL	19 (73.1)	4 (16.7)	<0.001**
≥ 10 gr/dL	7 (26.9)	20 (83.3)	
BMI kg/m2	23.33±3.35	23.62±3.79	0.778
Nutritional status			
Over-obesity	3 (11.5)	6 (25.0)	0.216
Normal	23 (88.5)	18 (75.0%)	
Trauma			
Multiple	17 (65.4)	14 (58.3)	0.608
Single	9 (34.6)	10 (41.7)	
ISS	26.73±8.74	19.75±8.15	0.005*
≥23	19 (73.1)	6 (25.0)	0.001**
<23	7 (26.9)	18 (75.0)	
Bleeding			
Class 1	5 (19.2)	10 (41.7)	0.009***
Class 2	6 (23.1)	9 (37.5)	
Class 3	6 (23.1)	3 (12.5)	
Class 4	9 (34.6)	2 (8.3)	
Base Level	-6.41±4.65	-1.55±4.32	<0.001*
Lactate Levels	4.78±2.38	2.67±1.60	0.001*

Hb: Hemoglobin; ISS: Injury Severity Score;*Independent t test;** Chi-Square test, *** Mann-Whitney

Table 8. Multivariate analysis results with low base

Variable	*B*	*S.E*	*Adj RR*	CI 95%	p-value
			Step 1		
Low base	3.278	1.098	26.516	8,085-42,905	0.003
Bleeding	1.849	1.007	6.352	0.882-45.732	0.066
Hb <10 g/dL	0.287	0.578	1.333	0.429-4.139	0.619
ISS ≥ 23	-0.252	1.315	0.777	0.059-10.231	0.848
			Step 2		
Low base	3.221	1.053	25.064	12,184-32,287	0.002
Hb <10 g/dL	1.795	0.976	6.021	0.889-40.791	0.066
ISS ≥ 23	0.347	0.494	1.415	0.537-3.727	0.482
			Step 3		
Low base	2.921	0.929	18.568	14,004-24,757	0.002
Hb <10 g/dL	1.495	0.845	4.460	0.852-23.357	0.077

*Significant with p<0.05

Table 9. Multivariate analysis results with high lactate

Variable	*B*	*S.E*	*Adj RR*	CI 95%	p-value
			Step 1		
High lactate	3.717	0.992	41.141	25.889-77.431	0.003
Hb <10 g/dL	1.448	1.223	4.256	0.387-46.809	0.066
Bleeding	-0.007	0.639	0.993	0.284-3.473	0.619
ISS ≥ 23	0.907	1.474	2.476	0.138-4.553	0.848
			Step 2		
High lactate	3.221	1.053	25.064	30.890-67.431	0.000
Hb <10 g/dL	1.795	0.976	6.021	0.409-44.474	0.225
ISS ≥ 23	0.347	0.494	1.415	0.245-25.456	0.439
			Step 3		
High lactate	3.719	0.979	41.214	35.050-57.737	<0.001
Hb <10 g/dL	2.019	0.955	7.532	1.158-48.999	0.077

DISCUSSION

Age showed that the mean ± SD was 25.08 ± 6.38 years and was found not to be related to the incidence of transfusion. The results of this study are in accordance with Abdel Razik et al.[10] who found that the highest age for trauma incidents coming to the emergency room was in the range of 20-30 years, with a total of 114 subjects (38%) with an overall average age of 27.3 ± 9.1 years. Age was not related to transfusion procedures, which were also found in research with the results of p=0.789.[11] The results are also in accordance with data in Saudi Arabia, with a mean age of 29.56 ± 9.34 years for patients who received transfusions due to road accidents. An older mean age was found in a study in Pakistan, with a mean of patients who received transfusions of 47.9 ± 13.1 years and those who did not receive transfusions of 46.3 ± 18.2 years, p=0.503.[12] Older mean results were also found in research conducted with a median of 56,[13] range 39-64; older age >65 years was associated with mortality rates in patients who received transfusions due to organ failure, sepsis, and infection, which were also found to be higher compared to young people.[6,14,15]

The most common gender was male, there were 36 subjects (72%), and female, with 14 subjects (28%), with the highest incidence of multiple trauma was 31 subjects (62%), and it was not related to transfusion events. This is in accordance with data from WHO 2020, which showed that multiple trauma occurs more often in men, about 78.6%, with an average patient age of 32.5 years. This is because the majority of multiple traumas occur in young men due to traffic accidents.[16] The results of other studies are also the same as[10,17,18,19] where it is most common in men. Gender was found to have no effect on transfusion procedures.

Hemoglobin levels had a mean ± SD 10.47 ± 2.85 gr/dL with a division of <10 gr/dL as many as 23 subjects (46%) and those with ≥ 10 gr/dL as many as 27 subjects (54%), hemoglobin levels <10 gr/dL were known to have an effect on the incidence of transfusions and also the risk of having low base and high lactate levels. Giving blood transfusions in accordance with the recommendations of clinical practice guidelines at RSUP Prof. dr. I.G.N.G. Ngoerah, Denpasar, is carried out when hemoglobin is <8 gr/dL. Research resuscitation transfusion with blood if hemoglobin levels were found to be 7-9 gr/dL.[2] The mortality rate decreases with an OR of 2.56 (95% CI 0.45-5.69; P <0.001) if blood transfusion resuscitation is carried out at hemoglobin ≤10 gr/dL.[20]

The BMI results had a mean ± SD of 23.47 ± 3.54 kg/m2, which was divided into normal nutritional status in as many as 41 subjects (82%) and those with excessive nutritional status-obesity in as many as 9 subjects (18%). These BMI results were not related to transfusions or the results of base and lactate levels. Abdel Razik obtained a mean BMI of 23.89 ± 5.87 in patients who received transfusions and those who did not receive transfusions, with a mean BMI of 24.37 ± 7.89, p = 0.897, which was not significantly different.[10] In obesity, the need for transfusions in research conducted was found to be not significantly related to transfusion administration.[21]

The most common type of trauma is multiple trauma compared to single trauma. This is in accordance with several studies conducted by[3,22,23] that the incidence of trauma on the road is, in the first place, where trauma sufferers enter the emergency room. Most cases are motorbike accidents because the rider is not wearing a protective helmet, so head trauma and fractures to the body and extremities can occur. Single-accident cases are most often caused by falling from stairs or being hit by a vehicle. Cases of road accidents in Indonesia continue to increase every year; in 2016, there was an increase of up to 3.93% from the previous number, 506,747 accidents, which had been reported before COVID-19 occurred, and there was a decrease in 2020 due to COVID-19 to 1.96%.[24,25,26]

The ISS score value was found to have a mean ± SD of 23.38 ± 9.09, which was divided into mild in 5 subjects (10%), moderate in 21 subjects (42%), and severe in 24 subjects (48%), and was found to have a significant relationship with transfusion and also has a relative risk of low base and high lactate levels. The research results of Tonglet showed that the highest number of ISS who received transfusions was ISS≥23.[27] Research by Griggs shows that ISS had a median of 33 (95% CI 23.5–43.0) compared to those who did not receive transfusions, with a median of 22 (95% CI 13-33), and is statistically significant with a P value <0.001.[6]

A mortality rate of 18.7% (95% CI 35-38%; P=0.003) was found in multiple trauma with an ISS value ≥16.[28] Research with higher ISS results was found in research by Maegele, which showed that multiple trauma patients had a mean ISS of 30 (±SD 15), while the mean ISS score in patients without coagulopathy was 21 (±SD 12). Coagulopathy occurs in 26% of patients with ISS 16-24, in 42% of patients with ISS 25-49, and in 70% of patients with ISS >50.[29]

Bleeding class was found to be significantly related to transfusion, with the result P=0.009. The results of this study are similar to research conducted by those who received class 3-4 bleeding, which affected transfusion compared to bleeding class 1-2[24], but the results were different from research[14], which obtained class score values. Bleeding was not significantly related to transfusion with a p-value of 0.303. Bleeding in class 2 has clinical significance in that it shows a fairly clear sympathetic compensatory response to the blood loss that occurs; the confounding factor is that the patient still has a clinically stable response to the administration of crystalloid fluids, so that the decision to give a blood transfusion is often delayed. However, as long as the evaluation of tissue damage due to trauma is not corrected to stop the bleeding, the acute bleeding process will continue, so that the patient's bleeding class status from the beginning of class 2 can continue to increase in monitoring at the hospital's surgical triage. Because the source of bleeding due to trauma is stopping the bleeding.

The results of the mean ± SD value of base deficit levels were found to be -4.08 ± 5.08 mmol/L, and it was found that there was a difference between eating and transfusion, with p < 0.001; the transfusion group with a mean of -6.41 ± 4.65 mmol/L, and the group without transfusion -1.55 ± 4.32 mmol/L. The results of this study are similar to those obtained in[6] patients who received a transfusion had an average base level of -6.78 ± 4.56, and those who did not receive a transfusion had a higher base level, 1.34 ± 3.42.

Lactate was found to have a mean ± SD of 3.77 ± 2.29, and the difference in eating was found with a p-value < 0.001 in the transfusion group, 4.78 ± 2.38 mmol/L, and the group without transfusion, 2.67 ± 1.60 mmol/ L. Similar results were obtained in research conducted by[6] who obtained lactate levels in transfusion administration with a mean of 4.60 ± 2.4 mmol/L, while in the non-transfusion group, it was obtained with a mean of 3.5 ± 3.5 mmol /L. The limit value for lactate levels is with a cutoff point of 4, which has a sensitivity of 50.34%, specificity 82.95%, LR+ 3.30, LR- 0.52 with a correlation area of 73.5, whereas if you use a cutoff point of 3, you get a value of sensitivity 69.01%, specificity 62.78%, LR+ 1.85, LR – 0.49 with an area of 65%. If the lactate value is >6 mmol/L, the patient must receive a transfusion, while the lactate level value of 2.5-6 mmol/L is still under observation with the possibility of transfusion, whereas if the lactate level is low <2.5 mmol/L, no transfusion will be carried out.[30]

The "fluid challenge" technique to evaluate the effectiveness and safety of administering fluids is considered to immediately administer a transfusion when high lactate and low base levels are found, but if the hemodynamic status improves with fluid administration, further fluid administration can be considered. Fluid administration must be stopped if the response to fluid administration does not provide further effects, and the patient is immediately given a transfusion using blood adapted to the patient's needs.[31]

The relative risk of transfusion with low base levels <-3 mmol/L was found to be 3.69 (95% CI 1.83-7.45; P<0.001) and adjusted relative risk 42.40 (95% CI 3.41- 526.97.1; p=0.004). The results of this study are similar to those conducted by[14] who obtained the results of the relative risk of transfusion with a low base <-3 mmol/L, with a relative risk of 17.4 (95% CI 1.11-271.1, p=0.042). Low base levels of -3 mmol/L in 103 patients compared with normal base levels in 130 patients were found to be given immediate transfusions and had significantly better organ dysfunction scores compared to the control group, with shorter hospital stays and reduced cardiovascular complications such as cardiac arrest, hypotension, and lower levels of acute respiratory failure.[29]

Patients with low baseline transfusions were found to undergo transfusions with levels of -3.2 (-1.4-5.4) mmol/L, while the values obtained were higher with results for those who did not receive transfusions of 2.2 (1.4-3 .3) mmol/L; relative risk was found to be 2.32 (95% CI 1.32-4.10; P=0.004).[32]

Lactate levels had a relative risk of 5.53 (95% CI 2.25-13.64; P<0.001), and adjusted relative risk 69.51 (95% CI 5.94-813.3; p=0.001) when transfusion was carried out. The results of the study are similar to those carried out by Lo et al. (2021), who obtained the results of the relative risk of undergoing transfusion if the lactate level value was ≥5 mmol/L, relative risk 1.86 (95% CI 0.66-5.22).

In 103 patients who received transfusion therapy due to high lactate levels ≥4, organ dysfunction scores were found to be significantly better compared to the control group of 130 subjects. It is also associated with shorter hospital stays and lower rates of cardiovascular complications such as cardiac arrest, hypotension, and acute respiratory failure.[31] Elevated lactate is an independent predictor of mortality, which correlates with increased transfusion 2-29 times compared to normal lactate levels. Lactate levels > 5 mmol/L have an OR of 5.69 times transfusion.[32]

Base deficit values and arterial lactate concentration at admission were correlated; however, lactate levels are a different predictor and are not related in parallel to base deficit. Worsening of base deficit levels and lactate concentrations after shock is related to an imbalance in oxygen transport at the cellular level. Persistent low arterial base deficit values are associated with impaired oxygen use, so serial base deficit monitoring is useful to assess the adequacy of oxygen transport during resuscitation. If acidosis continues, it will cause dangerous effects on the body, including vasodilation, myocardial depression, hyperkalemia, shift of oxyhemoglobin dissociation to the right, confusion, and stupor. When using base deficit to guide fluid resuscitation in trauma patients, base deficit should be monitored serially along with the patient's clinical response.[33]

There is still a huge risk of death due to hemorrhagic shock caused by acute bleeding due to trauma at 64%, with a death presentation rate that is even greater if the patient has experienced acid-base disorders.[4] This is a big concern and a challenge that must be addressed quickly. Stopping the source of bleeding and carrying out appropriate and adequate blood replacement, which is the aim of maintaining adequate oxygenation of tissue perfusion. There is a need for rapid and accurate initial physiological diagnostic modalities to determine the patient's initial condition, whether or not there is tissue oxygenation disturbance in trauma patients upon arrival, so that diagnostic and trauma management decisions can be taken immediately. The hemodynamic response to the replacement of crystalloid or colloid fluids given does not have any significant effects on the adequate oxygenation of tissue perfusion in trauma patients with acute bleeding. Where the physiology of cellular metabolism is greatly influenced by the adequate quality of content in blood vessels (erythrocytes, hemoglobin, oxygen bonds), conduit, and the heart. So, the patient is in acid-base stability. Acute bleeding, which removes a number of blood which disrupts acid-base stability in the body, so that cellular metabolism becomes anaerobic. Checking the status of base and lactic acid is the main option in this condition in the future, with the hope that researchers can use it as a basic reference in the emergency department at RSUP Prof. dr. I.G.N.G. Ngoerah, Denpasar, and the emergency rooms of all hospitals in Indonesia.

A limitation of this study was that it did not record mortality or survival in patients who were given transfusions with low base and high lactate levels. Researchers also did not include the use of the transfusion fluid used to carry out the transfusion (for example, packed red blood cells or whole blood). The relatively small sample size may limit the statistical power and generalizability of the findings.

CONCLUSION

Low base deficit and high lactate levels are associated with the need for blood transfusion in patients with acute bleeding. Clinicians can provide additional transfusions immediately if low base and high lactate values are found. Further research could be recommended with more subjects with a variety of different cases other than trauma, for example, in cases of non-traumatic operative procedures.

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