Birjand University of Medical Sciences

Journal of Surgery and Trauma

Original Article

Evaluation of the predictive role of base deficit in morbidity and mortality in elderly trauma in birjand, iran in 2018-2019

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Abstract

Introduction: Trauma is one of the most critical health problems worldwide. In the trauma of the elderly, the rate of complications and mortality is high. This study aimed to investigate the relationship between Base Deficit and morbidity and mortality in elderly trauma patients.

Methods: This cross-sectional study was performed on elderly trauma patients who were referred to the emergency department of Imam Reza Hospital in Birjand from 2018 to 2019. Our inclusion criteria were age over 65 years, no history of diabetes mellitus and kidney diseases, no alcohol and aspirin consumption, and no history of conditions that cause severe volume loss and dehydration. The Injury Severity Score measures trauma intensity based on the Abbreviated Injury Scale. The Patient's BD results were extracted from their Venous Blood Gas test. Data were analyzed in SPSS Statistics software (Version. 23) using the Chi-square test, Kruskal-Wallis test, and Mann-Whitney (P<0.05) was considered significant.

Results: This study, 77 patients were enrolled (the mean age of individuals: (80.65±7.28) male/female ratio: 1.02). BD mean was (7.58±0.63 mmol/L). The level of consciousness was statistically different between BD groups (P-value=0.001). The injury severity score mean had a significant association with the BD level (P<0.001). Also, with increasing BD level, the length of hospitalization in the ICU increased significantly (P-value=0.001).

Conclusion: BD can predict the severity of traumatic injury in the elderly. Along with other available factors such as serum lactate, BD can be reliable predictor of outcomes in trauma elderly patients.

Keywords: Acid-Base Imbalance, Aging, Injuries, Injury Severity Score, Mortality

Citation: Khojasteh-Kaffash S, Kazemi Motlaq A, Amouzeshi A, Foogerdi M. Evaluation of the predictive role of base deficit in morbidity and mortality in elderly trauma in birjand, iran in 2018-2019. J Surg Trauma. 2023; 11(1): 28-34.

Received: June 25, 2022 ***Revised: August 13, 2023*** ***Accepted: March 11, 2023***

Introduction

Trauma is one of the most critical health problems worldwide. With nearly 6 million deaths each year, it is also known as a major cause of death globally (1). The World Health Organization reports show that in the last five years, trauma was the greatest cause of death in ages five to 29 globally, especially in low- and middle-income countries (1). Early intervention is considered the main principle in reducing the mortality and disability caused by trauma (2). Several scales and scoring systems are developed to describe the severity of the injury, which can help to quickly determine the right type of care provided for these patients and reduce their mortality (3). In the trauma of the elderly, the rate of complications and mortality is much higher than the young population (4, 5).

Lactate has been discussed as the biochemical marker of shock, injury severity, and mortality (6). Base Deficit (BD) is a serum laboratory marker of systemic acidosis that increases rapidly and widely in hypoxemia or shock. In trauma, BD is associated with the need for blood transfusions, the risk of multi-organ failure, and mortality in adults, especially adults with brain injury (7, 8). With the assessment of tissue hypoperfusion, BD helps to evaluate shock and the need for resuscitation of trauma patients (9, 10). Studies have shown that lactate clearance and BD are associated with the volume required for resuscitation, THE need for blood transfusion, and mortality (7, 10).

BD is also used as a response to resuscitation. Previous study has shown a greater improvement in BD than pH after the resuscitation procedure (11). Previous studies have also shown that in cases of severe base deficiency, most patients are prone to experience shock due to bleeding (8, 12, 13). It was found that in individuals over 55 years of age, absolute values of BD greater than six were associated with higher mortality (14). Using a pre-determined program for initial evaluation and rapid recovery of patients can improve patient's fate (15). This study aimed to investigate the relationship between BD and morbidity and mortality in elderly trauma patients who were referred to the emergency department from 2018 to 2019.

Materials and Method

This cross-sectional study was performed on elderly trauma patients who referred to the emergency department of Imam Reza Hospital in Birjand from 2018 to 2019. This study was approved by the Ethics Committee of Birjand University of medical sciences, Birjand, Iran (Ethics code: IR.BUMS.REC.1398.283). Our inclusion criteria were age over 65 years, no history of diabetes mellitus and kidney diseases, no alcohol and aspirin consumption, and no history of conditions that cause severe volume loss and dehydration such as gastroenteritis. In this study, a non-probability sampling method (convenience sampling) was used and based on the Cochran's sample size formula, and defaults of P=0.09, d=0.06, and a missing rate of 11.5%, 77 people were estimated to enter the study (6). After obtaining informed written consent, a complete demographic information and history including Glasgow Coma Scale (GCS), mechanism of trauma, Comorbidities, drug history, and alcohol consumption were extracted. In this study, to evaluate the severity of loss of consciousness (LOC), patients were divided into mild group (13-15 score), moderate group (12-9 score) and severe group (3-8 score) based on GCS score. We also evaluated the initial laboratory tests, and patient's BD results were extracted. We also evaluated the initial laboratory tests, and patient's BD results were extracted from their Venous Blood Gas (VBG) test. Based on BD results, patients were divided into Normal group, mild group (<5), moderate group and severe group (>10) (6-9). Other variables such as the severity of the injury according to Injury Severity Score (ISS), patient's mortality and morbidity (including hospitalization in trauma ward or intensive care unit (ICU), length of hospital stay, and the need for mechanical ventilation) were also evaluated (16). The Injury Severity Score measures trauma intensity based on the Abbreviated Injury Scale (AIS) (12). AIS, an anatomical scoring system that classified injury severity for each body region, ranges from 0 (none) to 6 (un-survivable). The AIS results of 5 body regions (general, head and neck, thorax, abdomen, and extremities) are used to calculate ISS. The AIS of the three most severely injured regions are squared and added together to form ISS. The ISS ranges from 0 to 75, and if only one region has the AIS of 6, ISS automatically assigns to 75. Previous studies proved that this scoring system correlates with morbidity, mortality, and hospitalization time after trauma, which is valuable in predicting patients outcomes (17).

The quantitative and qualitative variables were described by central indicators (mean ± standard deviation (SD), and frequency percentage, respectively). Normality of quantitative data was checked with the Kolmogorov-Smirnov test, and due to the abnormal distribution of data, non-parametric tests were used. Chi-squared test was used to compare the two qualitative variables. Kruskal-Wallis and Mann-Whitney statistical tests were used to evaluate the significance of differences of quantitative dependent variables in more than two independent groups or two independent groups, respectively. Data analysis was performed using the SPSS Statistics (Version 23). In this study, P-values less than or equal to (0.05) were considered significant.

Results

In this study, 77 patients were enrolled (the mean age of individuals: 80.65±7.28 years, male/female ratio: 1.02). Fifty-six patients (72.7%) had a mild GCS drop, and GCS level mean was 13.32±2.70. Forty-eight patients (62.3%) were admitted to the ICU, and seven patients (9.1%) died due to severe injuries. Twenty-seven patients (35.1%) had a normal BD, and 8 patients (10.4%) had severe base deficiency, and BD mean was 7.58±0.63 mmol/L. The mean of length of hospitalization and severity of the injury, according to ISS, were 2.82±3.45 days, and 26.17±21.25, respectively. All demographic data and clinical characteristics of participants have shown in Table 1.

Chi-square test showed that there was no significance difference between males and females in BD severity (P-value=0.21). Based on results, in male and female groups, 10 patients (25.6%) and 17 patients (44.7%) had a normal BD level, respectively. According to Table 2, the results of the Kruskal–Wallis test showed that based on GCS mean, the level of consciousness was statistically different between BD groups (P-value=0.001). The mean of GCS was lower in patients with severe BD in comparison with normal BD groups (9.37 vs. 14.22, respectively).

The severity of the injury means, which measured by ISS, was 17.29±15.33 for mild BD group and 64.37±11.48 for severe BD group. Our analysis showed that, the injury severity score mean had a significant association with the BD level, as more severe injuries were accompanied by increased base deficiency (P<0.001).

The mean length of hospitalization had a significance difference between BD groups (P-value=0.03). Results showed that increased levels of BD caused longer hospitalization (5.63 days vs. 8.73 days in normal and moderate BD groups, respectively). Also, with increasing BD level, the length of hospitalization in the ICU increased significantly (P-value=0.001). In this study, length of hospitalization, ICU admission, mechanical ventilation, and death were used as mortality-related indicators (severe to mild, respectively). Based on the two-by-two comparison of groups with the Mann-Whitney test, the GCS level was significantly lower in severe BD group than in mild, moderate and normal levels. However, in patients with normal GCS mean, no significant association with mild BD was observed (P=0.32). The mean injury severity score was significantly different in all groups (P<0.05), except between the mild and normal groups (P=0.95). Also, the duration of hospitalization in the moderate level of BD was significantly higher than the normal and mild level (P=0.005).

The duration of ICU stay was also significantly higher in moderate and severe BD groups than in normal and mild groups (P<0.05).

According to Table 3, with an increase in BD level, the need for intensive care, mechanical ventilation and mortality increased. The highest mortality and hospitalization in ICU were seen in severe and mild BD groups (50.0% and 95.0%, respectively).

Table 1. Demographic and clinical characteristics

Variables		N (%)	Mean (SD)
Sex	Male	39 (50.6)	-
	Female	38 (49.4)	
Age	-	-	80.65 (7.28)
LOC severity	Mild	56 (72.7)	13.32 (2.70)
Moderate	15 (19.5)		
Severe	6 (7.8)		
Morbidity and mortality	Hospitalization	11 (14.3)	-
ICU Admission	48 (62.3)		
Ventilator Dependent	11 (14.3)		
	Death	7 (9.1)	
Base Deficit	Normal	27 (35.1)	7.58 (0.63)
Mild	20 (26.0)		
Moderate	22 (28.6)		
	Severe	8 (10.3)	

(LOC = loss of consciousness, ICU = Intensive care unit)

Table 2. Comparison of the loss of consciousness (LOC), Injury severity, Duration of hospitalization, and ICU stay according to base deficit.

Variables	Base Deficit mean (SD)				P-value
	Normal	Mild	Moderate	Severe	
LOC (GCS)	14.22 (1.91)	14.40 (0.88)	12.68 (2.85)	9.37 (3.66)	0.001*
Injury severity	17.29 (15.33)	13.90 (5.71)	34.32 (19.92)	64.37 (11.84)	<0.001*
Duration of Hospitalization (day)	5.63 (2.73)	5.45 (1.60)	8.73 (5.46)	8.00 (7.19)	0.03*
Duration of ICU stay (day)	1.78 (3.02)	1.70 (0.98)	4.09 (4.03)	5.62 (4.68)	0.001*
*Based on Kruskal–Wallis test.					

Table 3. Comparison of morbidity and mortality frequencies according to base deficit severity in elderly patients.

Base deficit	Morbidity and mortality			
	Normal	Mild	Moderate	Severe
	N (%)			
Hospitalization, N (%)	10 (37.0)	1 (5.0)	0 (0.0)	0 (0.0)
ICU admission, N (%)	15 (55.6)	19 (95.0)	14 (63.6)	0 (0.0)
Mechanical ventilation, N (%)	1 (3.7)	0 (0.0)	6 (27.3)	4 (50.0)
Death, N (%)	1 (3.7)	0 (0.0)	2 (9.1)	4 (50.0)
P-value	<0.001*			
*Based on Fisher exact test.				

Discussion

Trauma is one of the most common causes of patients referring to the emergency department. A fast and reliable method to evaluate trauma injuries and predict their outcomes is vital to mitigate the mortality risk. Our results showed that the injury severity could significantly change the level of BD. The duration of hospital or ICU stay is strongly correlated with BD. There was also a significant correlation between GCS levels and mortality of trauma patients with BD. Therefore, with increasing severity of trauma, the level of BD increased. Consistent with our results, Davis et al., in a study in 2018, examined BD and lactate in 1191 trauma patients from 2014 to 2016. BD and lactate were strongly correlated with the severity of trauma. Higher BDs, as a definite variable, were associated with lower blood pressure, higher ISS, increased need for blood transfusion, and worse outcomes (18). There was also a significant correlation between BD, ISS, and INR in the study of Cheddie et al., which examined BD as the primary indicator of coagulopathy in trauma patients from 2007 to 2008 (19). Lam et al. in 2016 examined a base deficit-based prediction model {Base Excess Injury Severity Scale (BISS)} on 3737 trauma patients from 2003 to 2007 and compared this scale to TRISS and ASCOT. BISS showed similar performance to TRISS and ASCOT and may also provide a more straightforward computational method for this matter (20).

However, in a study by Park et al. in 2005, primary BD and lactate were examined in 136 trauma patients as predictors of mortality, and their results were unable to predict mortality in these patients (21). Although Park et al. study only examined the mortality of patients and did not consider the severity of the injury, as the present study did. In addition to the age of the individuals, the trauma mechanism seems to be different in these two studies as Park et al. stated that 77% of their subjects had head trauma. The present study results showed that the different grades of BD could significantly change the length of hospital stay. Also, the distribution of morbidity and mortality were significantly different between levels of BD. In the Davis et al. study, it was found that individuals over 55 years of age with absolute values of BD>6 mmol/L were associated with higher mortality (22). Behdad et al. in 2006 investigated the value of BD as a predictor of mortality in geriatric trauma. Their data analysis of 300 elderly subjects with trauma in Isfahan revealed that even changes within the normal range of BD (2/55-3 mmol/L) could indicate a decrease in latent tissue perfusion and an increased chance of mortality. Also, one of the most important findings of this study was the relationship between BD and patients GCS (23). Kariman et al. in 2016 examined the agreement of shock index and BD in determining the shock intensity of 387 patients with multiple traumas. They found that the shock index and BD criteria had an acceptable agreement in predicting shock intensity of multiple trauma patients (24). In another study by Raux et al., primary blood lactate and BD's prognostic value was examined on 1,075 trauma patients in 2017. Their results showed that blood lactate is correlated with BD, although lactate was a better predictor for mortality (25). Gale et al. also investigated primary lactate and BD as predictors of mortality after severe blunt trauma on 1829 patients in 2016; BD and lactate deficiency were significantly higher in non-living individuals. Both parameters proved to be reliable predictors of the overall mortality in these patients (26). A study in 2015 by Ojuka et al. examined BD as an indicator of blunt abdominal trauma in 132 patients and found that BD could rule out significant abdominal injuries and predict patients need for diagnostic laparotomy for values less than 6.85 mmol/L (27). In Mofidi et al.'s study on 400 trauma patients from 2007 to 2008, BD less than or equal to -6 strongly indicates intraabdominal injury, bleeding, and increased need for blood transfusion (28).The present study showed that the duration of hospitalization in the ICU at different levels of BD was significantly different from each other. Rex et al. showed that BD was better than blood lactate in predicting long-term hospitalization of trauma patients in the ICU (25). Also, many studies in trauma patients have shown that BD disorder is associated with a prolonged hospitalization in the ICU and the development of a wide range of complications (29). Our study results also revealed that GCS is significantly correlated with BD changes. Soffer et al. investigated ultrasound findings in 7952 trauma patients with low GCS, and they found a significant association between GCS, BD, and ISS (30). However, in a study by Abdul-malak et al. on 154 trauma patients in 2016, there was no significant difference between patients GCS with BD>4 mmol/L or BD <4 mmol/L (13). The lower mean age of their participants and difference in BD status classification could be the reason for their contrast conclusions.

Conclusion

In conclusion, BD can predict the severity of traumatic injury (including mortality, ICU admission, and hospitalization) in the elderly. Along with other available factors such as serum lactate, BD can be reliable predictor of outcomes in trauma elderly patients.

Acknowledgments

The authors wish to thank the Deputy of Research and Technology of Birjand University of Medical Sciences for support (Grant No.: 455756).

Funding

This study was performed with the financial support of Birjand University of Medical Sciences (Grant No.: 455756).

Conflicts of interest

The authors have no conflicts of interest. Authors also indicate that they did not have a financial relationship with the organization that sponsored the research and had full control of all primary data and agree to allow the journal to review their data if requested.

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