

Relationship between Morbidity and Mortality in Elderly Trauma Patients with Base Deficit**Ashok Kumar Anand****I.C.M.O, Murli Bhedi Jha Community and Trauma Center, Araria Sangram, Jhanjharpur, Madhubani, Bihar, India****Received: 01-06-2026/Revised: 15-07-2026 / Accepted: 21-08-2026****Corresponding author: Dr. Ashok Kumar Anand****Conflict of interest: Nil****Abstract**

Background: Trauma is one of the world's most serious medical issues. Complications and mortality from elderly trauma are common. This study sought to investigate the relationship between Base Deficit and morbidity and death in older trauma patients.

Methods: This cross-sectional study was conducted at MurliBhedi Jha Community Health and Trauma Center, Araria Sangram, Jhanjharpur, Madhubani, Bihar from March 2025 to February 2026. Our inclusion criteria included being older than 65, not having a history of kidney disease or diabetes mellitus, abstaining from alcohol and aspirin, and not having a history of illnesses that induce severe dehydration or volume loss. Based on the Abbreviated Injury Scale, the Injury Severity Score calculates the degree of trauma. The Venous Blood Gas test was used to retrieve the patient's BD findings. 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: 154 patients (mean age: 80.65 ± 7.28 ; male/female ratio: 1.02) were included in this study. The BD mean was 7.58 ± 0.63 mmol/L. The BD groups' levels of consciousness differed statistically (P -value=0.001). The BD level was significantly correlated with the mean injury severity score ($P < 0.001$). Additionally, the length of stay in the intensive care unit increased considerably with rising BD levels (P -value=0.001).

Conclusion: The degree of traumatic injury in the elderly can be predicted by BD. BD can be a trustworthy predictor of outcomes in elderly trauma patients when combined with other accessible variables like serum lactate.

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

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Introduction

Trauma is one of the world's most serious health problems. With around 6 million deaths each year, it is also acknowledged as one of the top causes of death globally.[1] According to World Health Organization data, trauma was the leading cause of death for people aged five to 29 worldwide for the previous five years, particularly in low- and middle-income nations.[1] Early intervention is thought to be the key to lowering trauma-related mortality and disability.[2]

The severity of the injury is described by a number of scales and grading systems, which can aid in promptly determining the appropriate course of treatment for these patients and lower their mortality.[3] Compared to the younger population, the elderly have a significantly greater rate of morbidity and mortality from trauma.[4, 5] The biochemical indicator of shock, injury severity, and fatality has been proposed to be lactate. [6] A serum

laboratory indicator of systemic acidity, Base Deficit (BD) rises quickly and extensively in hypoxemia or shock. BD is linked to adult mortality, multiorgan failure risk, and the need for blood transfusions in trauma, particularly in adults with brain injury [7, 8].

BD assists in determining shock and if trauma patients require resuscitation by measuring tissue hypoperfusion.[9, 10] Lactate clearance and BD have been linked to the volume needed for resuscitation, the requirement for blood transfusions, and death, according to studies.[7, 10] Additionally, BD is employed in reaction to resuscitation. Prior research has demonstrated that following the resuscitation process, BD improves more than pH.[11] Prior research has also demonstrated that most patients with severe base shortage are at risk for shock from bleeding.[8, 12, 13] Absolute values of BD greater than six were

found to be linked to higher mortality in people over 55.[14] Patients' outcomes can be improved by using a preset regimen for early assessment and quick recovery.[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.

Material and Methods

This cross-sectional study was conducted at Murli Bhedi Jha Community Health and Trauma Center, ArariaSangram, Jhanjharpur, Madhubani, Bihar from March 2025 to February 2026. Our inclusion criteria included being older than 65, not having a history of kidney disease or diabetes mellitus, abstaining from alcohol and aspirin, and not having a history of illnesses like gastroenteritis that induce substantial volume loss and dehydration. Convenience sampling, a non-probability sampling technique, was employed in this investigation. 77 participants were expected to attend the study based on Cochran's sample size formula, defaults of $P=0.09$, $d=0.06$, and a missing rate of 11.5% (6). A comprehensive history and demographic data, including the Glasgow Coma Scale (GCS), cause of trauma, comorbidities, drug history, and alcohol consumption, were extracted following the acquisition of informed written consent. In order to assess the degree of loss of consciousness (LOC), patients were categorized according to their GCS scores into three groups: mild (13–15), moderate (12–9), and severe (3–8). The patient's BD data were extracted, and we also assessed the initial laboratory testing. The patient's BD data were taken from their Venous Blood Gas (VBG) test, and we also assessed the first laboratory testing. Patients were categorized into four groups based on their BD results: normal, mild (<5), moderate, and severe (>10).[6–9]. Additional factors were assessed, including the degree of the injury as determined by the Injury Severity Score (ISS), the patient's mortality and morbidity (including hospitalization in the intensive care unit (ICU) or trauma ward), the duration of hospital stay, and the requirement for mechanical breathing. [16] The Abbreviated Injury Scale (AIS) is the basis for the

Injury Severity Score, which gages the severity of damage. [12] The AIS is an anatomical scoring system that assigns a number between 0 (none) and 6 (un-survivable) to each bodily region.

ISS is computed using the AIS values of five body regions: general, head and neck, thorax, abdomen, and extremities. ISS is calculated by squaring and adding the AIS of the three most badly damaged areas. The ISS has a range of 0 to 75, and it automatically assigns 75 if just one region has an AIS of 6. This grading method is useful for predicting patient outcomes because prior research has demonstrated a correlation with morbidity, mortality, and inpatient time following trauma.[17]

The quantitative and qualitative variables were described by central indicators (mean $\pm$ 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, nonparametric 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

154 patients (mean age: 80.65 ± 7.28 years, male/female ratio: 1.02) were included in this study. The mean GCS level was 13.32 ± 2.70 , and 56 patients (72.7%) had a modest GCS decline. At our trauma center, 96 patients (62.3%) were admitted, and 14 patients (9.1%) passed away as a result of serious injuries. The mean BD was 7.58 ± 0.63 mmol/L, with 54 patients (35.1%) having a normal BD and 16 patients (10.4%) having a severe base deficit. According to ISS, the average length of hospital stay and injury severity were 2.82 ± 3.45 days and 26.17 ± 21.25 days, respectively. Table 1 displays all participant clinical features and demographic information.

Table 1: Demographic and clinical characteristics

Variables		No. (%)	Mean $\pm$ SD
Sex	Male	78 (50.6%)	-
	Female	76 (49.4%)	
Age	-	-	80.65 ± 7.28
LOC severity	Mild	112 (72.7%)	13.32 ± 2.70
Moderate	15 (19.5%)		
Severe	6 (7.8%)		
Morbidity and mortality	Hospitalization	22(14.3%)	-
ICU Admission	48 (62.3%)		
Ventilator Dependent	11(14.3%)		

	Death	14 (9.1%)	
Base Deficit	Normal	54 (35.1%)	7.58 ±0.63
Mild	20 (26.0%)		
Moderate	22 (28.6%)		
	Severe	16 (10.3%)	

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

The chi-square test revealed that the severity of BD did not significantly differ between boys and females (P-value=0.21). According to the findings, 10 patients (25.6%) and 17 patients (44.7%) in the male and female groups, respectively, had normal BD levels. The level of consciousness was

statistically different between BD groups based on the GCS mean, according to Table 2's Kruskal-Wallis test results (P-value=0.001).

Patients with severe BD had a lower mean GCS than those with mild BD (9.37 vs. 14.22, respectively).

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.

According to the ISS, the mild BD group's injury averages were 17.29±15.33, whereas the severe BD group's were 64.37±11.48. According to our study, there was a significant correlation between the BD level and the injury severity score mean because more severe injuries were associated with higher base deficit (P<0.001).

There was a significant difference in the mean length of hospital stay between the BD groups (P-value=0.03).

The findings indicated that longer hospital stays were associated with higher BD levels (5.63 days vs. 8.73 days in the normal and moderate BD groups, respectively). Additionally, the length of stay in the intensive care unit increased considerably with rising BD levels (P-value=0.001). In this study, mortality-related markers (severe to mild, respectively) included length of hospital stay, mechanical ventilation, and death. The GCS level was substantially lower in the

severe BD group compared to the mild, moderate, and normal levels, according to the two-by-two comparison of groups using the Mann-Whitney test. However, no significant correlation with mild BD was found in participants with a normal GCS mean (P=0.32).

All groups had significantly different mean injury severity scores (P<0.05), with the exception of the mild and normal groups (P=0.95). Additionally, compared to the normal and mild levels of BD, the length of hospital stay in the moderate level was considerably longer (P=0.005). Additionally, compared to the normal and mild BD groups, the length of ICU stay was considerably longer in the moderate and severe BD groups (P<0.05).

Table 3 shows that when BD levels rose, so did the need for critical care, mechanical ventilation, and mortality. The severe and mild BD groups had the highest rates of death and hospitalization (50.0% and 95.0%, respectively).

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
No. (%)				
Hospitalization, N(%)	20 (37.0%)	2 (5.0%)	0 (0.0)	0 (0.0)
ICU admission, N(%)	30 (55.6%)	38 (95.0%)	28 (63.6%)	0 (0.0)
Mechanical ventilation, N(%)	2 (3.7%)	0 (0.0)	12 (27.3%)	8 (50.0%)
Death, N(%)	2 (3.7%)	0 (0.0)	4 (9.1%)	8 (50.0%)
P-value	<0.001*			

*Based on Fisher exact test.

Discussion

One of the most frequent reasons why people visit the emergency room is trauma. To reduce the danger of death, a quick and accurate way to assess trauma injuries and forecast their results is essential. Our findings demonstrated that the degree of BD might be considerably altered by the severity of the injury. There is a substantial correlation between BD and the length of hospital or ICU stay. The mortality of trauma patients with BD was likewise significantly correlated with GCS levels. As a result, the degree of BD rose as the trauma became more severe.

Our findings are supported by a 2018 study by Davis et al. that looked at lactate and BD in 1191 trauma patients between 2014 and 2016. The degree of trauma has a high correlation with both lactate and BD.

As a definite variable, higher BDs were linked to worse outcomes, higher ISS, lower blood pressure, and a greater requirement for blood transfusions.[18] Cheddie et al.'s study, which looked at BD as the main marker of coagulopathy in trauma patients from 2007 to 2008, similarly found a substantial association between BD, ISS, and INR.[19] In 2016, Lam et al. compared the Base Excess Injury Severity Scale (BISS), a base deficit-based prediction model, against TRISS and ASCOT using data from 3737 trauma patients between 2003 and 2007. BISS showed similar performance to TRISS and ASCOT and may also provide a more straightforward computational method for this matter.[20]

However, primary BD and lactate were investigated as mortality predictors in 136 trauma patients in a 2005 study by Park et al., and their findings were unable to forecast mortality in these patients.[21] While the current study took into account the severity of the injury, Park et al.'s study simply looked at patient death. Park et al. reported that 77% of their subjects experienced head trauma, which suggests that the trauma mechanism differed between these two investigations in addition to the age of the participants.

The current study's findings demonstrated that the length of hospital stay might be considerably altered by the various BD grades. Additionally, there were notable differences in the distribution of morbidity and death amongst BD levels. According to the Davis et al. study, people over 55 who had absolute BD values more than 6 mmol/L were linked to increased mortality.[22] The usefulness of BD as a predictor of death in geriatric trauma was examined by Behdad et al. in 2006. Even fluctuations within the normal range of BD (2/55-3 mmol/L) may suggest a decrease in latent tissue perfusion and an increased risk of death, according to their data analysis of 300 elderly people with

trauma in Isfahan. The connection between BD and patients' GCS was also one of the study's most significant conclusions.[23] In order to assess the shock severity of 387 patients with multiple traumas, Kariman et al. (2016) looked at the agreement between the shock index and BD. They discovered that when it came to estimating the shock intensity of several trauma patients, the shock index and BD criteria agreed fairly well.[24] A further study conducted in 2017 by Raux et al. looked at the predictive significance of BD and primary blood lactate in 1,075 trauma patients. Although lactate was a stronger predictor of mortality, their findings indicated a correlation between blood lactate and BD.[25] In 2016, Gale et al. examined primary lactate and BD as predictors of death following severe blunt trauma in 1829 patients; BD and lactate insufficiency were considerably higher in those who did not survive. The overall mortality of these patients was found to be reliably predicted by both factors.[26]. BD could rule out serious abdominal injuries and indicate patients' need for a diagnostic laparotomy for levels less than 6.85 mmol/L, according to a 2015 study by Ojuka et al. that looked at BD as an indicator of blunt abdominal trauma in 132 patients.[27]

BD less than or equal to -6 strongly suggests intraabdominal damage, hemorrhage, and a higher requirement for blood transfusion in a study conducted by Mofidi et al. on 400 trauma patients between 2007 and 2008.[28] The current study demonstrated that the length of stay in the intensive care unit at various BD levels differed significantly from one another. Rex et al. demonstrated that BD was superior to blood lactate in predicting trauma patients' long-term ICU stay.[25]

Additionally, numerous research on trauma patients have demonstrated that BD condition is linked to a lengthy ICU stay and the emergence of a variety of comorbidities.[29] The results of our investigation likewise showed a substantial correlation between GCS and changes in BD. A substantial correlation between GCS, BD, and ISS was discovered by Soffer et al. when they examined ultrasonography results in 7952 trauma patients with low GCS (30). However, there was no discernible difference between patients' GCS with BD>4 mmol/L and BD<4 mmol/L in a 2016 study by Abdulmalak et al. on 154 trauma patients (13). Their disparate outcomes may be due to the lower mean age of their subjects and the variation in BD status classification.

Conclusion

To sum up, BD can predict hospitalization, ICU admission, mortality, and the severity of catastrophic damage in older persons. When paired with other pertinent factors like serum lactate, BD

can be a reliable predictor of outcome in older trauma patients.

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