International Journal of Surgery 22 (2015) 125–130

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.journal-surgery.net

Original research

Does base deficit predict mortality in patients with severe traumatic brain injury?

Hussain Shallwani [a], Muhammad Waqas [a], Shahan Waheed [b], Mubbashira Siddiqui [a], Asher Froz [c], Muhammad Ehsan Bari [a, *]

[a] Section of Neurosurgery, The Aga Khan University Hospital Karachi, Pakistan
[b] Department of Emergency Medicine, The Aga Khan University Hospital Karachi, Pakistan
[c] The Aga Khan University Hospital Karachi, Pakistan

HIGHLIGHTS

- BD has not been evaluated as a prognostic indicator in patients with isolated head injury.
- Study is a critical analysis of 108 patients with severe head injury and base deficit.
- BD on admission had a statistically significant negative correlation with Glasgow Coma Scale (GCS) on presentation ($r = -0.239$, $p = 0.025$) and Revised Trauma Score (RTS) ($r = -0.214$, $p = 0.046$).
- There was no statistically significant difference in means of BD between survivors and non survivors.
- Area under receiver operator curve (ROC) for BD as a predictor of mortality statistically non-significant.

ARTICLE INFO

Article history:
Received 11 April 2015
Accepted 4 May 2015
Available online 14 June 2015

Keywords:
Base deficit
Traumatic brain injury
Outcomes

ABSTRACT

Objective: Base Deficit (BD) is a marker of tissue hypoxia in polytrauma patients. It guides resuscitative measures, and predicts outcomes, complications and mortality. The aim of this study was to examine the presence of BD in patients with isolated severe traumatic brain injury (TBI), and to assess if it correlates with the outcomes in these patients.

Method: This was a retrospective observational study. All patients over the age of 16 years presenting to Aga Khan University Hospital from 2009 to 2013 with isolated TBI, were included. Data was extracted from 2009 to 2013. Glasgow Outcome Scale (GOS) of 4 and 5 at last follow up was categorized as favorable outcome. Data was analyzed using SPSS version 19 and receiver operative curve (ROC) was generated for BD as a predictor of mortality and unfavorable outcome.

Results: One hundred and eight patients were analyzed. Ninety-eight (90.7%) were males. Mean age was 36.69 ± 17.65. Eighty-eight (81.5%) patients had BD, while 20 (18.5%) patients had base excess. 62 (58.5%) of the patients had unfavorable outcomes. BD on admission had a statistically significant negative correlation with Glasgow Coma Scale (GCS) on presentation ($r = -0.239$, $p = 0.025$) and Revised Trauma Score (RTS) ($r = -0.214$, $p = 0.046$). However, there was no statistically significant difference in means of BD between survivors and non survivors. Area under receiver operator curve (ROC) for BD as a predictor of mortality statistically non-significant.

Conclusion: Although BD is correlated with GCS at presentation and RTS, it is not a reliable prognostic marker for outcome and mortality in patients with isolated TBI.

1. Introduction

Base excess and Base Deficit are measures of acid-base abnormality, described as the amount of acid or base required to bring 1 L of whole blood to a pH of 7.4, given that arterial partial pressure of CO_2 and temperature remain constant at 40 mm Hg and 37degress respectively [1]. In trauma patients, BD has been long established as

* Corresponding author.
E-mail addresses: hussainshallwani@hotmail.com (H. Shallwani), shaiq_waqas@hotmail.com (M. Waqas), docshahan83@hotmail.com (S. Waheed), mubbashira_siddiqui@hotmail.com (M. Siddiqui), asher.froz@aku.edu (A. Froz), ehsan.bari@aku.edu (M.E. Bari).

http://dx.doi.org/10.1016/j.ijsu.2015.05.054
1743-9191/

an important marker of tissue perfusion and hypoxia [2–5]. Apart from the usual markers including heart rate, blood pressure, hemoglobin and hematocrit, etc., BD at admission is an important index to guide resuscitative measures [5–9]. Several studies suggest that BD also has a notable role in predicting outcomes, risk of complications, and mortality [8–20], and is an important addition to prognostic scores such as Revised Injury Severity Classification (RISC) and RISC II [15,20].

Despite its importance as a predictive marker in polytrauma patients, BD has not been evaluated as a prognostic indicator in patients with isolated head injury. A study by Siegel et al. showed that arterial BD was associated with poor outcome when patients had other extracranial injuries along with blunt TBI [21]. Presence of TBI itself has been described as a marker of poor prognosis in trauma patients with high BD [9,10,15]. A recent study identified BD of greater that 4 as one of the greatest predictors of neurosurgical intervention in patients with mild TBI or intracranial injury [22]. However, data regarding BD at admission and its effect on outcome and mortality in patients with isolated TBI is scarce.

Isolated head injury patients may not experience significant blood loss and hypovolemia given the nature of restricted space in the cranial cavity. Consequently, the body may not experience hypoperfusion and hypoxia, and the patients may have normal values of BD. The aim of this study was to examine the trend in BD values in patients with isolated severe TBI, and to assess if it correlates with the outcomes in these patients. As a secondary objective, we aim to analyze the predictive value of BD as an indicator of mortality in patients with isolated severe TBI.

2. Methods

This was a retrospective observational study, conducted at the section of neurosurgery, department of surgery at The Aga Khan University Hospital (AKUH) Karachi. AKUH is a JCIA accredited, ISO certified tertiary care hospital with over 43 specialties, including a well-established section of neurosurgery and emergency medicine. Chart review was done over a 4-month period from March 2014 to June 2014. Data was extracted from the previous 5 years (2009–2013).

2.1. Inclusion criteria

We included all the patients over the age of 16 years, either male or female, presenting to AKUH with isolated TBI.

2.2. Exclusion criteria

We excluded patients with pre-existing central nervous system (CNS) pathology like stroke, seizures or any congenital CNS pathologies, polytrauma, major systemic injuries and patients with pre-existing congestive heart failure, endocrine disorders or renal disease before presentation.

2.3. Data Collection

A pro forma was used as a data-collecting tool, which was filled by the investigator after identifying the patients fulfilling the inclusion criteria. The data collection tool was tested before the start of the study and the investigator was trained on how to fill the questionnaire. The data collection pro forma consisted of following five components:

I. Demographics;
II. Information of events and presentation;
III. Laboratory and radiological findings;
IV. Hospital course;
V. Outcome

2.4. Data collection instrument

The following data was recorded in the data collection instrument:

1. Demographic data (age, gender and co-morbids) that was later coded for confidentiality and analysis;
2. Mechanism of injury;
3. Time of the event, and pre-hospital delays, and hospitalization information for the event;
4. Severity of injury according to the Glasgow Coma Scale (GCS), Revised Trauma Score (RTS), other systemic injures, and pupil reaction;
5. Laboratory data including pH, pCO_2, pO_2, O_2 sat, bicarbonate, base excess and BD
6. Radiological data including characteristic of basal cistern, midline shift, presence/absence of epidural hematoma and/or intraventricular/subarachnoid hemorrhage;
7. Length of ICU stay and length of hospital stay
8. Follow-up and outcome, measured with the Glasgow Outcome Scale (GOS); scores of 4 and 5 were categorized as favorable outcome.

2.5. Data analysis

Data analysis was done using SPSS version 19. Continuous variables with normal and non-normal distributions were reported as mean ± SD and median [inter-quartile range (IQR)], respectively. Categorical variables were presented as frequencies and percentages. Data was further analyzed for correlation of BD at admission with presenting GCS and outcome. A receiver operator curve (ROC) was generated for BD as a predictor of mortality or unfavorable outcome, and area under the curves was calculated.

3. Results

A review of hospital medical record database yielded a total of 164 patients with head injury during the study period. Files of these 164 patients were examined for eligibility, and 108 patients were found eligible for final inclusion and analysis; thirty patients were below the age of 16, ten patients were excluded due to incomplete records, fifteen patients due to their major systemic injuries, and 1 patient had a history of chronic renal failure. Demographic and clinical characteristics of the study population are provided in Table 1. The median follow-up was 4.0 months (IQR: 2.0–12.0 months); two patients were lost to follow up.

Of the 108 patients included in the study, BD was present in 88 patients, while 20 patients had base excess. Other arterial blood gas parameters are summarized in Table 2.

Forty-four (41.5%) of the patients had favorable outcome of GOS 4 or 5, while 62 (58.5%) of the patients had unfavorable outcomes.

Correlation analysis showed that age of the patient was negatively correlated to the GOS of patient on follow-up ($r = -0.458$, $p < 0.001$). Similarly Rotterdam CT scores also had a negative correlation with the GOS ($r = -0.238$, $p = 0.02$). BD on admission had a statistically significant negative correlation with GCS on presentation ($r = -0.239$, $p = 0.025$) and RTS ($r = -0.214$, $p = 0.046$). However, BD did not reach statistically significant correlation with Rotterdam CT score, length of ICU stay, length of hospital stay, or