Dynamics of neutrophil-to-lymphocyte ratio can be associated with clinical outcomes of children with moderate to severe traumatic brain injury: A retrospective observational study

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Abstract

Background

The neutrophil to lymphocyte ratio (NLR) has been reported to be associated with clinical outcomes of patients with severe traumatic brain injury (TBI). This study aimed to evaluate the correlation between the dynamics of NLR and clinical outcomes of pediatric patients with moderate to severe TBI.

Methods

We retrospectively evaluated the clinical data of a total of 374 pediatric patients with moder-ate to severe TBI who were treated in our department between May 2016 and May 2020.

Clinical and laboratory data including the NLR upon admission and the NLR on hospital day four were collected. Poor clinical outcome was defined as Glasgow Outcome Scale (GOS) of 1–3. Multivariable logistic regression analyses were performed to investigate the correlation between the dynamics of NLR and clinical outcome.

Results

Three hundred seventy-four pediatric patients (mean age 7.37 ± 3.11, 52.7% male) were evaluated. Based on the ROC curves, a value of 5 was determined as the NLR cut-off value. The corresponding cutoff value for delta NLR was 1.

The Glasgow Coma Scale (GCS) (OR, 3.42; 95% CI: 1.88–5.28; *P* <0.001), the light reflex (OR, 1.79; 95% CI: 1.34- 2.84; *P* = 0.027), the Rotterdam CT score (OR, 2.71; 95% CI: 1.72–4.13; *P* = 0.021), and delta NLR (OR, 1.71; 95% CI: 1.13- 2.52; *P* = 0.034) were identified as independent predictors for unfavorable outcomes in multivariable logistic regression analysis.

Conclusions

The result of the present study suggest that delta NLR could be a predictor of poor clinical outcome of pediatrics with moderate to severe TBI. This cost-effective and easily available biomarker could be used to predict clinical outcomes in these patients.

Introduction

Traumatic brain injury (TBI) is the most common cause of death and morbidity among young people in the USA [1]. Taylor et.al reported there were about 640 000 TBI-related emergency department visits, 18 000 TBI-related hospitalizations, and 1500 TBI-related deaths among pediatrics aged 14 years and younger [2]. TBI can be divided into primary and secondary brain injury events [3]. Primary TBI is a nonreversible event that is defined as a direct physical injury to the brain such as compression, displacement, deformation, stretching, shearing, tearing, or crushing of brain parenchyma and blood vessels [1,3]. Secondary brain damage is an indirect result of the injury. It results from a series of neuro-electro-chemical cascade events that ultimately lead to neuronal cell death [1,4].

Post-traumatic alterations of the immune system have been shown to play important roles in the initiation and development of secondary brain damage [4,5]. Neutrophils, the most abundant leukocyte in humans, play a major role in mediating inflammation-induced injury [6]. Depending on the stage of

injury, neutrophils can either contribute to repair mechanisms or exacerbate the pathophysiology of trauma [6].

The neutrophil-to-lymphocyte ratio (NLR) is one of the nonspecific markers of systemic inflammation [7]. Elevated NLR has been reported to be associated with poor prognosis in patients with TBI [4,5,8]. However, previous studies mainly focused on admission NLR. The changes in NLR over time (Delta NLR) were not fully investigated. The present study aimed to evaluate the association between the dynamics of neutrophil-to-lymphocyte ratio and clinical outcomes of children with moderate to severe TBI.

Section snippets

Design and study approval

We retrospectively evaluated all pediatrics patients (age 18 years and younger) with moderate to severe TBI (according to the Head Injury Severity Scale classification) who were referred to our center between May 2016 and May 2020 [8]. The inclusion criteria were as follows: (1) isolated head trauma; (2) an admission GCS score ≤13; (3) age younger than 18.

Patients with clinical signs of concomitant infection and those who received steroids were excluded. We also excluded patients who received

Results

We evaluated a total of 374 pediatric patients with moderate to severe TBI.

There were 197 (52.7) male and 177 (47.3) female. The mean age (years) at trauma was 7.37 ± 3.11.

The baseline characteristics of the patients are shown in Tables 1 and 2.

Based on the ROC curves, a value of 5 was determined as the NLR cut-off value.

The low NLR and the high NLR were detected in 251 patients (67.1%) and 123 patients (32.9%), respectively.

Patients in the high NLR group had lower GCS scores and higher

Discussion

Our results show that the value of baseline NLR was higher among TBI pediatric patients with unfavorable outcomes compared to those with favorable outcomes. Moreover, the multivariate logistic analysis demonstrates that the delta NLR is as an independent predictor of the clinical outcome of these patients.

Elevated NLR has been reported to be associated with poor prognosis in patients with TBI [4,5,8]. However, the relationship between changes in NLR (Delta NLR) and the clinical outcome of these

Limitations

There are several limitations to the present study. This study was a retrospective analysis of a single-center experience and all data were extracted from the electronic medical records of all patients. The retrospective nature of the study may have led to bias in terms of data selection and analysis. The sample size was relatively small and this resulted in limitations of the prognostic value of changes in NLR. Clinical outcome was limited to assessment at discharge or last follow up and was

Conclusions

The result of the present study suggest that delta NLR can be a predictor of poor clinical outcome of pediatric patients with moderate to severe TBI. This cost-effective and easily available biomarker could be used as a predictor of clinical outcomes in this patient population.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due them containing information that could compromise research participant privacy/consent but are available from the corresponding author on reasonable request.

The patient's data included in this manuscript has not been previously reported

Authors' contributions

EA, FM, AZ, and SRB had the idea for this study. EA, KE, MN, and SA participated in outlining the concept and design. SH and AA did the data acquisition. EA, AZ, and FM did the statistical analysis and wrote the first draft of the manuscript. EA, SRB, AA, SE, and MN revised the final manuscript. All authors have read and approved the manuscript.

Compliance with ethical standards

Ethics approval and consent to participate

The study received ethics approval by the Kermanshah University of Medical Science Ethics Committee. Written informed consent to participate was obtained from all patients.

All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

Not applicable.

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Declaration of Competing Interest

All authors declare that they have no conflict of interest.

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