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Evaluation of Laboratory Parameters in Stroke Patients Based on Decompressive Craniectomy Timing

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ABSTRACT

Background: *Decompressive craniectomy reduces mortality and morbidity in ischemic stroke patients with malignant cerebral edema. Prognostic markers such as red cell distribution width, neutrophil lymphocyte ratio, and platelet count are needed to predict the timing of decompressive surgery in ischemic stroke patients. Sodium, a parameter that changes before and after decompression surgery, may also be a factor to consider when assessing the patient's prognosis and deciding whether to proceed with surgery. In this study, we aimed to examine the changes in laboratory parameters in stroke patients according to the time of decompression surgery.*

Material and Method: *At our stroke center, 52 patients were diagnosed with stroke and underwent decompressive craniectomy. The patients were divided into four groups based on their decompression time (the first 24 hours, 24-48 hours, 48-72 hours, and after 72 hours). The width of the red cell distribution, platelet count, neutrophil-lymphocyte ratios, and sodium levels were calculated and compared between groups and National Institutes of Health Stroke Scale (NIHSS) and modified Rankin Scale (mRS) scores are all listed.*

Results: *The patients had a mean age of 62 ± 11 years, with 31 males and 21 females. The patients' admission, 24th hour, and post-operative sodium levels were not significantly different. The patients' admission, 24th hour, and post-op RDW did not differ statistically significantly. The 24th hour NLR levels of the groups differed significantly (p=0.049).*

Conclusion: *There is a need for laboratory measurements that can estimate the time required for decompression surgery. Nevertheless, no significant difference between groups was observed in our study, which investigated at RDW, NLR, platelet count, and sodium levels.*

Keywords

Decompressive Craniectomy, Stroke, RDW, Platelet count, Sodium.

Introduction

Ischemic strokes due to large vessel occlusion constitute 24-38% of all strokes [1]. Although large hemispheric infarcts are relatively rare among all strokes, they are responsible for 96% of post-stroke deaths [2]. It has been shown that adding decompressive craniectomy to medical treatment in patients with malignant cerebral edema reduces mortality and morbidity [3]. To predict the time of admission to decompressive surgery in patients with malignant cerebral edema presenting with ischemic stroke and to determine the effect of edema, prognostic markers are required such as red cell, neutrophil lymphocyte ratio [4].

In our study, red cell distribution width (RDW), platelet count (PLT), and neutrophil lymphocyte ratio, which are indirect indicators of systemic inflammation and have been reported to affect prognosis in cerebrovascular diseases, were evaluated. At the same time, we aimed to examine the changes in sodium values at the time of admission, at the 24th hour, and after surgery in patients with increased intracranial pressure.

Material and Method

Between 2014 and 2022, we studied 52 patients who were diagnosed with acute stroke and underwent decompressive craniectomy at our stroke center. The patients were separated into four groups based on the time of their decompressive craniectomy. They were classified as follows: decompression administered in the first 24 hours, 24-48 hours, 48-72 hours, and after 72 hours. Patients' demographics, comorbid diseases, sodium levels at admission and 24 hours after decompression, red cell distribution width, platelet count, neutrophil-lymphocyte ratios, decompression timings, and admission National Institutes of Health Stroke Scale (NIHSS) and modified Rankin Scale (mRS) scores are all listed.

Due to the possible risk of herniation in cases of malignant cerebral edema, mass effect, and midline shift in patients, they underwent neurological examination and imaging methods. Patients were consulted at the neurosurgery clinic. After the consultation, the decompression times of the patients who decided to have a surgical procedure were recorded, and the patients were followed up postoperatively. Preoperative consent forms were obtained from the families.

Results

The mean age of the patients was 62 ± 11 years, with 31 males and 21 females. When comorbid diseases were considered, 34 (81%) of the patients had hypertension, 18 (42.9%) had diabetes, 12 (28.6%) had congestive heart failure, and 12 had a history of ischemic cerebrovascular accident. The patients evaluated at admission had a mean NIHSS of 15.44 ± 4.34. The mean mRS at admission was 0.8 ± 0.9. Thrombolytic therapy was applied to 5 (9%) patients, mechanical thrombectomy to 13 (24%), and both treatments to 26 (50.9%) patients, while 8 (16%) patients did not receive any acute reperfusion treatment. The patients who had decompression surgery had a mean post-procedural mRS of 5.05 ± 0.66. The sodium, RDW, neutrophil lymphocyte ratios, and platelet counts were presented as mean values at admission, the 24th hour, and the post-op period (Table 1). In terms of NIHS scores, gender, or treatments used, there was no statistically significant difference between the treated groups.

There was no statistically significant difference in the patients' admission, 24th hour, and post-operative sodium levels. There were no meaningful results from posthoc subgroup analysis. There was no statistically significant difference in the patients' admission,

Table 1: Age, NIHSS, sodium, RDW, platelet counts, and neutrophil lymphocyte ratios at admission, the 24th hour, the post-op period.

	Min.	Max.	Mean/ Std. Deviation
Age	34	91	61,23 ± 14,597
Admission Sodium (mEq/L)	129	145	138,44 ± 3,183
24nd hour Sodium (mEq/L)	129	174	141,75 ± 8,607
Post-op Sodium (mEq/L)	120	183	149,44 ± 13,760
Admission RDW	10,4	22,1	14,1 ± 2,1
24nd hour RDW	10,40	22,3	14,3 ± 2,1
Post-op RDW	11,8	27,9	14,9 ± 2,5
Admission Platelet (10^3/µL)	118	482	282,31 ± 95,78
24nd hour Platelet (10^3/µL)	43	486	261,13 ± 105,01
Post-op Platelet (10^3/µL)	65	581	253,12 ± 115,212
Admission NLO	1,08	65,50	8,7033 ± 10,498
24nd hour NLO	2,06	41,09	14,6488 ± 9,940
Post-op NLO	3,51	43,58	12,3568 ± 9,471
NIHSS	4	26	15,62 ± 4,662

Table 2: Comparison of sodium, RDW, NLO ratio and platelet values of 4 groups separated according to decompression time at admission, the 24th hour and postop period.

Parameters		Sodium		RDW		NLO		Platelet	
Timing		Sum of Squares	p	Sum of Squares	p	Sum of Squares	p	Sum of Squares	p
Admission	Between Groups	47,5	0,197	4,7	0,794	434,6	0,272	33497,3	0,308
	Within Groups	469,3		219,2		5186,8		434393,7	
	Total	516,8		223,9		5621,4		467891,0	
24th Hour	Between Groups	570,6	0,047	2,9	0,892	756,0	**0,049**	18361,2	0,657
	Within Groups	3207,0		225,9		4283,1		544058,7	
	Total	3777,7		228,8		5039,1		562420,0	
Post-op	Between Groups	1505,2	0,042	2,7	0,938	497,1	0,134	37655,3	0,428
	Within Groups	8151,5		326,7		4077,4		639311,9	
	Total	9656,8		329,5		4574,6		676967,3	

24th hour, and post-op RDW values. The neutrophil-lymphocyte ratios (NLR) of the patients were measured at admission, the 24th hour, and after surgery. There was a significant difference between the groups' 24th hour NLR values (p=0.049). The first and second groups differed significantly in posthoc subgroup analyses (Table2).

The NIHSS was used to assess the association between admission, 24th hour, and post-op sodium values, and no significant difference was detected (Table 3).

Table 3: The NIHSS and admission, 24th hour, and post-op sodium values.

Sodium (mEq/L)	p	95,0% CI	
		Lower Bound	Upper Bound
		-61,851	54,97
Admission Sodium (mEq/L)	0,62	-0,336	0,559
24th hour Sodium (mEq/L)	0,357	-0,099	0,271
Post-op Sodium (mEq/L)	0,328	-0,172	0,059
Dependent Variable: NIHSS			

Discussion

Cerebrovascular diseases are among the most frequent central nervous system diseases, with a high mortality and morbidity rate [5]. Because of the increased mortality caused by vasogenic edema, approximately 10% of ischemic strokes are considered malignant [6]. Malignant middle cerebral artery syndrome has an 80% mortality rate, and these individuals are at risk of herniation. Decompressive surgery reduces mortality in these patients.

A meta-analysis of studies such as DESTINY, DECIMAL, HAMLET, and HeADDFIRST in patients with malignant cerebral edema found that decompressive craniectomy is advantageous, particularly in the first 48 hours and in patients under 60 years old [7].

RDW is a hemogram measure that represents the size distribution of erythrocytes. RDW could be a biomarker that reflects the status of the body. A study of adults found that having a greater RDW was connected with a higher risk of mortality from any cause [8]. Furthermore, several research have suggested that RDW may provide predictive information for stroke patients' function [9]. Based on these, the relationship between the value of RDW at admission, 24 hours, post-op, and the time of decompression surgery was investigated in our study. However, no significant positive or negative relationship was observed.

Several studies have demonstrated that the neuroinflammatory response is involved in the pathophysiology of ischemic stroke [10,11]. The neutrophil-to-lymphocyte ratio (NLR) was recently identified as a possible biomarker of the early inflammatory phase [12,13]. NLR may be able to predict functional prognosis in ischemic stroke patients [14,15]. The relationship between the patients' NLR values at admission, the 24th hour, the post-op period, and surgery timings was then analyzed. This parameter, which was considered a positive predictor of systemic inflammation, showed no significant difference between groups.

Hyponatremia and hypernatremia are the most prevalent fluid-electrolyte abnormalities with increasing intracranial pressure. Whereas hyponatremia can be caused by insufficient ADH syndrome and cerebral salt wasting syndrome, hypernatremia can be caused by diabetes insipidus [16]. In our study, when serum sodium levels at admission, the 24th hour, and the post-op period were compared in terms of surgical time, only a significant difference in sodium values was discovered between the first and second groups.

The lack of a control group, the small number of patients and the lack of homogenization between the groups can be cited as shortcomings of the study.

Conclusion

There is a need for radiological and laboratory parameters that can predict the need for decompression surgery in patients with severe cerebral edema. For these reasons, no significant difference between the groups was revealed in our study, in which RDW, NLR, and sodium values were investigated as supporting laboratory parameters.

In light of the current findings, there is a need to develop broader and more comprehensive laboratory parameters to predict patients' need for decompression surgery as well as the development of mortality and morbidity.

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