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Evaluation of the relationship of hemogram parameters with prognosis in older adults with acute abdominal pathologies

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ABSTRACT

Aim: We aimed to investigate the effects of hemogram parameters on the short-term mortality of older adults with acute abdominal pathologies. Secondly, it was aimed to investigate the effect of hemogram parameters on mortality in operated and non-operated patients.

Material and Method: This retrospective observational study was conducted in an emergency medicine clinic between June 1, 2019, and June 1, 2020. Data on patients over 65 years of age who presented to the emergency department with acute abdominal pathologies were analyzed. Hemogram parameters, as in our patient group over 65 years old, who presented with all acute abdomen pathologies; It was examined in terms of its relationship with prognosis in our operated and non-operated patient group. Statistical analysis was performed using SPSS v. 26.0.

Results: The study included a total of 744 patients, of whom 391(52.6%) were women. Mortality was seen in 114(15.32%) patients, and 83(11.2%) patients underwent surgery. AUC and cut off values are for leukocytes count 0.590 and 10.83 for neutrophils count 0.596 and 9.64 for neutrophil-lymphocyte ratio 0.606 and 8.24 to predict mortality (p=0.002, p=0.001, and p>0.001, respectively

Conclusion: In this study, among the hemogram parameters; leukocytes, neutrophils and neutrophil-lymphocyte ratio were determined to have a statistically significant ability to predict mortality in older adults both operaple and non operabl groups groups presenting with acute abdominal pathologies, but their accuracy rates were low.

Keywords: Older adults, leukocytes, neutrophils, lymphocytes, general surgery

INTRODUCTION

The increasing older adults across the world affects hospital systems, discharge rates, and health-related costs. Elective or emergency surgery should be carefully evaluated in older adults. Among patients over 65 years, emergency presentations mostly due to neurological dysfunctions are more common than outpatient clinic presentations. In this patient population, approximately 40% of gastrointestinal operations requiring surgical care occur after emergency presentations (1,2). However, emergency surgical interventions cause a three- to five-fold increase in mortality compared to elective surgery (2,3).

Although comorbidities, medications used, communication difficulties, and insufficient information about a patient's health history are known problems for older adults, the importance of prognostic factors increases with surgical diseases due to the possibility of operation. Hematological parameters have been evaluated in terms of their ability to predict prognoses in many diseases, as well as specifically in the older adults. Red cell distribution width (RDW) (3), hematocrit (HCT) count (4), white blood cell (WBC) count (5), mean corpuscular volume (MCV), hemoglobin (HGB), and neutrophil-lymphocyte ratio (NLR) (6) are among the hemogram parameters that have been individually examined in older adult surgery patients. Acute abdominal pathologies are a frequent reason for admission in older adults. It is important to evaluate the effects of these parameters on the prognosis separately in all older adults, as well as in operated and non-operated older adults, in terms of operation decision.

In this study, we aimed to investigate the effects of hemogram parameters, comorbidities, and findings on the short-term mortality of older adults with acute abdominal pathologies. Secondly, it was aimed to investigate the effect of hemogram parameters on mortality in operated and non-operated patients.

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MATERIAL AND METHOD

The study was carried out with the permission of University of Health Sciences, Ümraniye Education and Research Hospital Ethics Committee (Date: 18/03/2020, Decision No: B.10.1.TKH.4.34.H.GP.0.01/62). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design

This retrospective observational study was conducted in the emergency medicine clinic of Ümraniye Training and Research Hospital between June 1, 2019, and June 1, 2020. Our hospital is a tertiary education and research institute with 836 beds, and it receives 2.8 million presentations per year.

Study Population

Patients over 65 years who presented to our emergency department with acute abdominal pathologies were screened from the hospital computer-based data system (Health Information System [HIS]). According to their survival status, the patients were divided into two groups, either mortality or survivor, and the mortality analysis was performed using the National Death Notification System, which shows all deaths due to all causes in Turkey. Patients under 65 years of age, those with isolated limb or other bone injuries without solid organ injury, and those with missing data or unknown outcomes were excluded from the study.

Data collection

All the patients were examined in terms of demographic data, including age, gender, comorbidities (hypertension (HT), diabetes mellitus (DM), coronary artery disease (CAD), chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), cerebrovascular disease (CVD) and malignancies, previous history of operation, requirement of surgery at current presentation, symptoms and findings at the time of emergency presentation, diagnoses at the time of hospitalization, hemogram parameters (WBC, neutrophil (NEU), lymphocyte (LYM), HGB, HCT, MCV, and RDW), neutrophil-lymphocyte ratio and clinical outcomes (hospitalization, intensive care admission, referral to an external center, death in the emergency department, and discharge). The relationship between hemogram parameters and mortality in all older adults with a prediagnosis of acute abdomen was investigated. Our patient group was divided into two as operated and non-operated patient groups. The correlation of comorbidity, operation history, symptoms, findings and hemogram parameters with mortality in both groups were evaluated separately. The length of hospital stay was also recorded in the operated and non-operated patient groups.

Statistical Analysis

Statistical analysis was performed using SPSS v. 26.0. The conformity of the variables to normal distribution was examined using visual (histogram and probability charts) and analytical (Kolmogorov-Smirnov test) methods. The normality analysis of continuous data was undertaken using the Shapiro-Wilk test. In the analysis of categorical data, the chi-square test was used and Fisher's exact test was performed when necessary. Chi-square test was used to evaluate the relationship between the operable and non-operable groups and the prognosis. Quantitative variables were presented as median and interquartile range (IQR, 25th–75th percentile) values, and the Mann-Whitney test was used in the analysis of paired groups. For the hemogram parameters; Mann-whitney u test was used. The Spearman correlation test was conducted to investigate the relationship between hemogram parameters and length of hospital stay (LOHS). The receiver-operating characteristic (ROC) curve analysis was performed to evaluate the diagnostic test performance of the investigated parameters in predicting mortality. During this analysis, the area under the curve (AUC) values were calculated, and the sensitivity, specificity, accuracy, and 95% confidence interval (CI) data were analyzed. The AUC values of the parameters were calculated and tested mutually for significance with the DeLong quality test. Statistical significance was accepted as $p < 0.05$.

RESULTS

A total of 744 patients, 391 (52.6%) female, were included in the study. Of all the patients, 114 (15.32%) died. The median age was 77.5 (66–98) years for the mortality group and 77 (66–105) years for of the surviving patients, with no significant difference between the two groups (p=0.389). The baseline characteristics of the patients in the study population are shown in **Table 1** and **Table 2**.

There was no statistically significant relationship between age (p=0.212; p=0.635, respectively) and gender (p=0.917; p=0.187, respectively) and mortality in both operable and non-operable groups. There was a statistically significant correlation between COPD and mortality in the operable group (p=0.002). There was no statistically significant relationship between other comorbid diseases and mortality in both the operable and non-operable groups. There was a statistically significant difference between the patient group presenting with the symptoms of abdominal pain (p=0.001), fever (p=0.026), vomiting (p=0.004), constipation (p=0.045) and syncope (p<0.001) and mortality in the non-operable group. Again in the non-operable group, a significant correlation was found between the findings of abdominal tenderness (p=0.014) and hematochezia (p<0.001) on physical examination and mortality (**Table 3**)

In the mortality group, six (5.3%) patients died during their follow-up in the emergency department, 56 (49.1%) after hospitalization, 14 (12.3%) after admission to intensive care, 15 (13.2%) while in intensive care at an external center, and 23 (20.2%) within 30 days after discharge. There was a statistically significant difference in clinical outcomes according to the comparison of the mortality and survivor groups (p < 0.001), but there was no significant relationship between mortality and LOHS (p= 0.943). Eighty-three (11.2%) of the patients underwent surgery during their follow-up in our hospital. Thirteen (11.4%) of the operable patients died either after hospitalization (n=8; 61.5%) or after admission to the intensive care unit (n=5; 38.5%). There was a significant difference between the operable and non-operated groups in terms of clinical outcomes (p<0.001). While there was a statistically significant relationship between perforation and mortality in the operated group (p<0.001), with the effect of the lower number of patients with perforation in the non-operable group; no statistical significance was found between perforation and mortality (p=0.671). In the non-operable group, there was a statistically significant relationship between patients diagnosed with gastrointestinal bleeding (p=0.001), mesentery ischemia (p=0.013), pancreatitis (p=0.001), decubitus ulcer (p=0.005), Biliary colic (p=0.012), Malignancy (p<0.001) and mortality. There was a significant relationship between WBC (p<0.001; p=0.001, respectively), NEU (p<0.001; p=0.001, respectively), NLR (p<0.001; p=0.002, respectively) and mortality in both operable and non-operable groups. There was statistical significance between HGB (p=0.008) and HTC (p=0.024) and mortality only in the non-operable group. While there was a statistically significant relationship between LOHS and mortality in the operable group (p<0.001); there was no statistically significant relationship between LOHS and mortality in the non-operable group (p=0.468) (**Table 4**).

Revealed a positive correlation between LOHS and WBC, NEU, and NLR (r=0.177, p <0.001; r =0.196, p<0.001; and r=0.205, p<0.001, respectively) while a negative correlation was observed between LYM and LOHS (r =-0.119, p =0.001). The correlation analysis of NLR with LOHS is shown in **Figure 1**.

Table 1. Relationship between the demographic characteristics, comorbidities, symptoms, findings of the older adults surgery patients and their mortality status

	Total	Survivor	Mortality	p
Age (mean,±)	77 (66-105)	77 (66-105)	77.5 (66-98)	0.389
Gender (n,%)				0.228
Female	391 (52.6)	337 (53.5%)	54 (47.4%)	
Male	353 (47.4%)	293 (46.5%)	60 (52.6%)	
Comorbidities (n,%)				
HT	365 (49.1%)	307 (48.7%)	58 (50.9%)	0.673
DM	188 (25.3%)	158 (25.1%)	30 (26.3%)	0.78
CAD	255 (34.3%)	210 (33.3%)	45 (39.5%)	0.204
CKD	68 (9.1%)	54 (8.6%)	14 (12.3%)	0.206
CVD	57 (7.7%)	44 (7%)	13 (11.4%)	0.103
Asthma	3 (0.4%)	3 (0.5%)		0.607
Malignancy	142 (19.1%)	115 (18.3)	27 (23.7%)	0.175
COPD	75 (10.1%)	58 (9.2%)	17 (14.9%)	0.063
History of operation (n,%)	219 (29.4%)	190 (30.2%)	29 (25.4%)	0.309
Symptoms (n,%)				
Abdominal pain	319 (42.9%)	287 (45.6%)	32 (28.1%)	0.001
Fever	53 (7.1%)	50 (7.9%)	3 (2.6%)	0.043
Vomiting	192 (25.8%)	151 (24%)	41 (36%)	0.007
Diarrhea	42 (5.6%)	34 (5.4%)	8 (7%)	0.49
Constipation	107 (14.4%)	95 (15.1%)	12 (10.5%)	0.202
Syncope	12 (1.6%)	4 (0.6%)	8 (7%)	<0.001
Chest pain	19 (2.6%)	17 (2.7%)	2 (1.8%)	0.557
Headache	7 (0.9%)	6 (1%)	1 (0.9%)	0.708
Fatigue	87 (11.7%)	69 (11%)	18 (15.8%)	0.139
Findings (n,%)				
Abdominal tenderness	283 (38%)	249 (39.5%)	34 (29.8%)	0.05
Abdominal guarding	73 (9.8%)	65 (10.3%)	8 (7%)	0.276
Abdominal rebound	17 (2.3%)	14 (2.2%)	3 (2.6%)	0.735
Hematochezia	74 (9.9%)	62 (9.8%)	12 (10.5%)	0.822
Hematemesis	11 (1.5%)	1 (0.2%)	10 (8.8%)	<0.001
Melena	8 (1.1%)	6 (1%)	2 (1.8%)	0.445

Chi-square test was used. HT, hypertension; DM, diabetes mellitus; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; CKD, chronic kidney disease; CVD, cerebrovascular disease.

Table 2. Relationship between clinical outcomes, LOHS, clinical diagnoses ,hematological parameters of the older adults surgery patients and their mortality status

	Total	Survivor	Mortality	p
Clinical outcomes (n,%)				<0.001
Hospitalization	418 (56.2%)	362 (57.5%)	56 (49.1%)	
Intensive care admission	43 (5.8%)	29 (4.6%)	14 (12.3%)	
Referral to external center	27 (3.6%)	12 (1.9%)	15 (13.2%)	
Death in emergency department	6 (0.8%)	0	6 (5.3%)	
Discharge	250 (33.6%)	227 (36%)	23 (20.2%)	
LOHS	47.5 (1-2420)	52 (1-2420)	39 (3-741)	0.943
Clinical diagnoses				
Acute appendicitis	26 (3.5%)	23 (3.7%)	3 (2.6%)	0.417
Ileus	77 (10.3%)	68 (10.8%)	9 (7.9%)	0.35
GIS bleeding	70 (9.4%)	50 (7.9%)	20 (17.5%)	0.001
Mesentery ischemia	8 (1.1%)	4 (0.6%)	4 (3.5%)	0.006
Perforation	14 (1.9%)	7 (1.1%)	7 (6.1%)	<0.001
Pancreatitis	59 (7.9%)	59 (9.4%)	0	0.001
Cholecystitis	67 (9%)	62 (9.8%)	5 (4.4%)	0.061
Abscess	15 (3.5%)	11 (2%)	4 (3.5%)	0.218
Hernia	54 (7.3%)	52 (8.3%)	2 (1.8%)	0.014
Multi-trauma	21 (2.8%)	17 (2.7%)	4 (3.5%)	0.631
Diverticulitis	5 (0.7%)	5 (0.8%)	0	0.434
Decubitus ulcer	5 (0.7%)	2 (0.3%)	3 (2.6%)	0.005
Subcutaneous hematoma	8 (1.1%)	7 (1.1%)	1 (0.9%)	0.824
Biliary colic	45 (6%)	44 (7%)	1 (0.9%)	0.012
Cholangitis	23 (3.1%)	19 (3.0%)	4 (3.5%)	0.78
Cholelithiasis/choledocholithiasis	39 (5.2%)	35 (5.6%)	4 (3.5%)	0.367
Malignancy	53 (7.1%)	36 (5.7%)	17 (14.9%)	<0.001
Other	229 (30.8%)	190 (30.2%)	39 (34.2%)	0.388
Hematological parameters				
WBC	10.9 (0.95-95.08)	10.62 (1.93-95.08)	11.8 (0.95-66.17)	0.002
NEU	8.6 (0.59-92.14)	8.43 (1.21-92.14)	9.95 (0.59-62.46)	0.001
LYM	1.2 (0.15-9.54)	1.34 (0.15-9.54)	1.17 (0.28-8.07)	0.027
HGB	12.1 (2.6-19.0)	12.3 (2.6-18.9)	11.2 (4.9-19.0)	0.004
HCT	37.2 (9.0-61.1)	37.5 (9.0-61.1)	35.1 (15.5-58.1)	0.013
MCV	87.8 (55.3-117.2)	87.8 (55.3-117.2)	88.2 (57.1-111.1)	0.726
RDW	28.7 (13.6-38.4)	28.8 (13.6-38.2)	28.3 (17.6-38.4)	0.074
NLR	6.6 (0.75-99.67)	6.17 (0.75-99.67)	8.8 (1.20-66.45)	<0.001
Total	744	630	114	

chi-square test and mann-whitney u were used. LOHS, length of hospital stay; GIS, gastrointestinal system; WBC, white blood cell; NEU, neutrophil; LYM, lymphocyte; HGB, hemoglobin; HCT,hematocrit; MCV, mean corpuscular volume; RDW, red cell distribution width; NLR,neutrophil/lymphocyte ratio

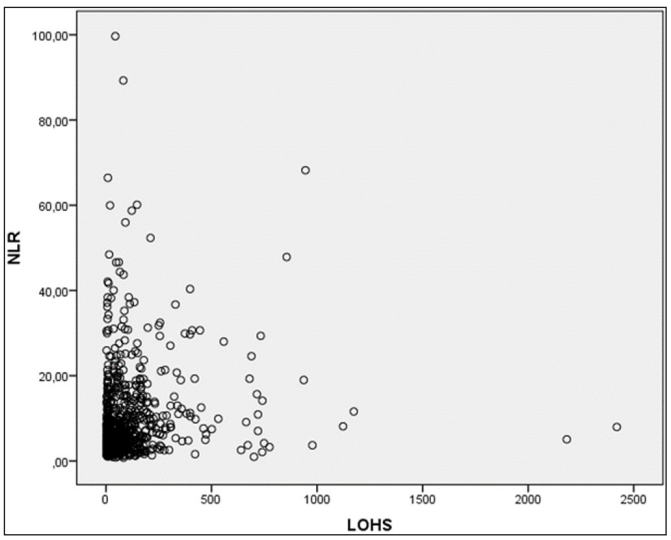

Figure 1. Correlation analysis of NLR with the length of hospital stay

The diagnostic test performance analyses hemogram parameters of WBC, NEU, MCV, RDW, NLR, and LOHS in predicting mortality revealed that WBC, NEU, and NLR were statistically significant in predicting mortality, with the AUC value being calculated as 0.590 (0.553–0.625) for WBC at a cut-off value of 10.83, 0.596 (0.560–0.632) for NEU at a cut-off value of 9.64, and 0.606 (0.569–0.641) for NLR at a cut-off value of 8.24 (p=0.002; p=0.001; and p>0.001, respectively) (**Table 5** and **Figure 2**). When we compared the AUC values of parameters WBC, NEU, and NLR in a pair wise manner using the DeLong quality test, we found no statistically significant difference between these parameters (p=0.386 for WBC vs. NEU; p=0.565 for WBC vs. NLR; and p=0.673 for NLR vs. NEU).

Table 3. Relationship between the demographic characteristics, comorbidities, symptoms, findings of the operable and non-operated patients and their mortality status

	Operable				Non-operated			
	Total	Survivor	Mortality	p	Total	Survivor	Mortality	p
Age (mean,±)	76 (67-96)	76 (67-96)	77 (70-95)	0.212	78 (66-105)	78 (66-105)	78 (66-98)	0.635
Gender (n,%)				0.917				0.187
Female	50 (60.2%)	42 (60.0%)	8 (61.5%)		341 (51.6%)	295 (52.7%)	46 (45.5%)	
Male	33 (39.8%)	28 (40.0%)	5 (38.5%)		320 (48.4%)	265 (47.3%)	55 (54.5%)	
Comorbidities (n,%)								
HT	40 (48.2%)	34 (48.6%)	64 (6.2%)	0.873	325 (49.2%)	273 (48.8%)	52 (51.5%)	0.613
DM	23 (27.7%)	19 (27.1%)	4 (30.8%)	0.788	165 (25.0%)	139 (24.8%)	26 (25.7%)	0.844
CAD	23 (27.7%)	17 (24.3%)	6 (46.2%)	0.106	232 (35.1%)	193 (34.5%)	39 (38.6%)	0.421
CKD	6 (7.2%)	4 (5.7%)	2 (15.4%)	0.514	62 (9.4%)	50 (8.9%)	12 (11.9%)	0.349
CVD	1 (1.2%)	1 (1.4%)	-	-	56 (8.5%)	43 (7.7%)	13 (12.9%)	0.085
Asthma	1 (1.2%)	1 (1.4%)	-	-	2 (0.3%)	2 (0.4%)		0.548
Malignancy	9 (10.8%)	8 (11.4%)	1 (7.7%)	0.691	133 (20.1%)	107 (19.1%)	26 (25.7%)	0.126
COPD	14 (16.9%)	8 (11.4%)	6 (46.2%)	0.002	61 (9.2%)	50 (8.9%)	11 (10.9%)	0.531
History of operation (n,%)	22 (30.8%)	18 (25.7%)	4 (26.5%)	0.705	197 (29.8%)	172 (30.7%)	25(24.8%)	0.228
Symptoms (n,%)								
Abdominal pain	54 (65.1%)	48 (68.6%)	6 (46.2%)	0.12	265 (40.1%)	239 (42.7%)	26 (25.7%)	0.001
Fever	5 (6%)	4 (5.7%)	1 (7.7%)		48 (7.3%)	46 (8.2%)	2 (2.0%)	0.026
Vomiting	19 (22.9%)	16 (23.1%)	3 (22.9%)		173 (26.2%)	135 (24.1%)	38 (37.6%)	0.004
Diarrhea	3 (4.3%)		3 (3.6%)		39 (5.9%)	31 (5.5%)	8 (7.9%)	0.349
Constipation	12 (14.5%)	8 (11.4%)	4 (30.8%)	0.069	95 (14.4%)	87 (15.5%)	8 (7.9%)	0.045
Syncope	1 (1.2%)		1 (7.7%)	0.342	11 (1.7%)	4 (0.7%)	7 (6.9%)	<0.001
Chest pain	1 (1.2%)	1 (1.4%)			18 (2.7%)	16 (2.9%)	2 (2.0%)	0.618
Headache					7 (1.1%)	6 (1.1%)	1 (1.0%)	0.941
Fatigue	7 (8.4%)	4 (5.7%)	3 (23.1%)	0.127	80 (12.1%)	65 (11.6%)	15 (14.9%)	0.358
Findings (n,%)								
Abdominal tenderness	48 (57.8%)	39 (55.7%)	9 (69.2%)	0.365	235 (35.6%)	210 (37.5%)	25 (24.8%)	0.014
Abdominal guarding	26 (31.3%)	21 (30.0%)	5 (38.5%)	0.546	47 (7.1%)	44 (7.9%)	3 (3.0%)	0.079
Abdominal rebound	12 (14.5%)	9 (12.9%)	3 (23.1%)	0.336	5 (0.8%)	5 (0.9%)	0 (0.0%)	0.34
Hematochezia	2 (2.4%)	2 (2.9%)			72 (10.9%)	60 (10.7%)	12 (11.9%)	0.729
Hematemesis					11 (1.7%)	1 (0.2%)	10(9.9%)	<0.001
Melena					8 (1.2%)	6 (1.1%)	2 (2.0%)	0.442

Chi-square test was used. HT, hypertension; DM, diabetes mellitus; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; CKD, chronic kidney disease; CVD, cerebrovascular disease.

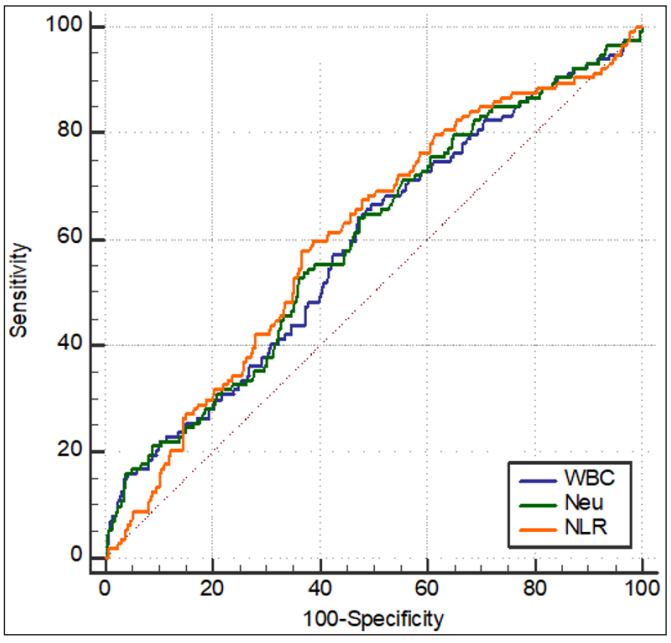

Figure 2. Pairwise comparison of the ROC analysis between WBC, NEU and NLR (DeLong analysis)

DISCUSSION

In this study, WBC, NEU, and NLR were found to be statistically significant in predicting mortality in patients with geriatric surgery indications. When we compared the AUC values of these three parameters, we found no statistically significant difference between them. LYM had a statistically significant relationship with mortality only in the operated group. To the best of our knowledge, there is no other study investigating the relationship between hemogram parameters and mortality in patients presenting to the emergency department with acute abdominal pathologies.

In the literature, older adults have mostly been evaluated in studies undertaken in the fields of gastric or oncological surgery, and the effects of hemogram parameters on postoperative mortality and prognosis have been examined (1). In a study examining factors affecting mortality in older adults undergoing elective surgery, Kim et al. (2) found a statistically significant

Table 4. Relationship between clinical outcomes, clinical diagnoses, hematological parameters, LOHS of the operable and non-operated patients and their mortality status

	Operable				Non-operated			
	Total	Survivor	Mortality	p	Total	Survivor	Mortality	p
Clinical outcomes (n,%)				<0.001				<0.001
Hospitalization	74 (89.2%)	66 (94.3)	8(61.5%)		344 (52.0%)	296 (52.9%)	48 (47.5%)	
Intensive care admission	7 (8.4%)	2 (2.9%)	5 (38.5%)		36 (5.4%)	27 (4.8%)	9 (8.9%)	
Referral to external center					27 (4.1%)	12 (2.1%)	15 (14.9%)	
Death in emergency department					6 (0.9%)		6 (5.9%)	
Discharge	2 (2.4%)	2 (2.9%)			248 (37.5%)	225 (40.2%)	23 (22.8%)	
Clinical diagnoses								
Acute appendicitis	17 (20.5%)	16 (22.9%)	1 (7.7%)	0.213	9 (1.4%)	7 (1.3%)	2 (2.0%)	0.56
Ileus	12 (14.5%)	10 (14.3%)	2 (15.4%)		65 (9.8%)	58 (10.4%)	7(6.9%)	0.287
GIS bleeding	2 (2.4%)	2 (2.9%)		0.537	68 (10.3%)	48 (8.6%)	20 (19.8%)	0.001
Mesentery ischemia	5 (6.0%)	3 (4.3%)	2 (15.4%)	0.122	3 (0.5%)	1 (0.2%)	2 (2.0%)	0.013
Perforation	13 (15.7%)	6 (8.6%)	7 (53.8%)	<0.001	1 (0.2%)	1 (0.2%)	0 (0.0%)	0.671
Pancreatitis	7 (8.4%)	7 (10.0%)		0.517	52 (7.9%)	52 (9.3%)	0(0.0%)	0.001
Cholecystitis	12 (14.5%)	11 (15.7%)	1 (7.7%)	0.45	55 (8.3%)	51 (9.1%)	4 (4.0%)	0.085
Abscess	4 (4.8%)	3 (4.3%)	1 (7.7%)		11 (1.7%)	8 (1.4%)	3 (3.0%)	0.265
Hernia	14 (16.9%)	14 (20.0%)		0.172	40 (6.1%)	38 (6.8%)	2 (2.0%)	0.062
Multi-trauma					21 (3.2%)	17 (3.0%)	4 (4.0%)	0.626
Diverticulitis					5 (0.8%)	5 (0.9%)		0.34
Decubitus ulcer					5 (0.8%)	2 (0.4%)	3 (3.0%)	0.005
Subcutaneous hematoma	1 (1.2%)	1 (1.4%)			7 (1.1%)	6 (1.1%)	1 (1.0%)	0.941
Biliary colic					45 (6.8%)	44 (7.9%)	1 (1.0%)	0.012
Cholangitis					23 (3.5%)	19 (3.4%)	4 (4.0%)	0.775
Cholelithiasis/choledocholithiasis					39 (5.9%)	35 (6.3%)	4 (4.0%)	0.369
Malignancy	4 (4.8%)	4 (5.7%)		0.858	49 (7.4%)	32 (5.7%)	17 (16.8%)	<0.001
Other					229 (34.6%)	190 (33.9%)	39 (38.6%)	0.362
Hematological parameters								
WBC	14.7666 (3.28-95.08)	10.4 (1.93-32.46)	11.7 (0.95-66.17)	<0.001	10.65 (0.95-66.17)	10.4 (1.93-32.46)	11.7 (0.95-66.17)	0.001
NEU	12.5447 (2.45-92.14)	8.26 ((1.21-28.67)	9.93 (0.59-62.46)	<0.001	8.49 (0.59-62.46)	8.26 (1.21-28.67)	9.93 (0.59-62.46)	0.001
LYM	0.77367 (0.20-4.66)	1.5411±0.79401	0.9808±0.42211	0.016	1.28 (0.15-9.54)	1.31 (0.15-9.54)	1.21 (0.28-8.07)	0.157
HGB	12.535 (7.3-18.9)	12.674 ±1.9416	11.785±2.3519	0.146	12.10 (2.6-19)	12.2 (2.6-18.3)	11.1 (4.9-19)	0.008
HCT	38.660 (24.0-53.9)	38.944± 5.5550	37.131±6.8439	0.301	37 (9-61.1)	37.3 (9-61.1)	35.1 (15.5-58.1)	0.024
MCV	87.263 (68.4-99.4)	87.149±6.0365	87.877±3.8739	0.677	87.8 (55.3-117.2)	87.8 (55.3-117.2)	88.2 (57.1-111.1)	0.762
RDW	28.275 (20.3-33.4)	28.353±2.3187	27.854±1.8192	0.465	28.7 (13.6-38.4)	28.8 (13.6-38.2)	28.4 (17.6-38.4)	0.120
NLR	11.1681 (1.30-47.86)	6.045 (0.75-99.67)	8.81 (1.20-66.45)	<0.001	6.35 (0.75-99.67)	6.04 (0.75-99.67)	8.81 (1.2-66.4)	0.002
LOHS	106 (6-1174)	41.50 (1-2420)	35 (3-741)	<0.001	41 (1-2420)	41.5 (1-2420)	35 (3-741)	0.468

As statistical analysis, mann-whitney u was used in parametric data, and chi-square esti was used in non-parametric data. GIS, gastrointestinal WBC, white blood cell; NEU, neutrophil; LYM, lymphocyte; HGB, hemoglobin; HCT, hematocrit; MCV, mean corpuscular volume; RDW, red cell distribution width; NLR, neutrophil/lymphocyte ratio; LOHS, length of hospital stay

Table 5. ROC analysis of hematological parameters and LOHS for 30-day mortality

	AUC	P value	Cut-offvalue	Sensitivity	Specificity	PPV	NPV	Accuracy	95% CI
WBC	0.590	0.002	10.83	65.8	51.4	19.7	89.3	17.22	0.53-0.64
NEU	0.596	0.001	9.64	54.4	62.4	20.7	88.3	16.77	0.53-0.65
MCV	0.510	0.736	88.9	48.2	58.3	17.3	86.2	6.5	0.45-0.57
RDW	0.553	0.074	29	65.79	45.87	18	88.1	11.6	0.39-0.50
NLR	0.606	<0.001	8.24	57.9	63.3	22.2	89.3	21.23	0.55-0.66
LOHS	0.502	0.940	53	38.6	50.3	12.3	81.9	11.09	0.44-0.55

ROC, receiver operating characteristic; LOHS, length of hospital stay; AUC, area under the curve;PPV, positive predictive value; NPV, negative predictive value; CI, confidence interval; WBC, white blood cell; NEU, neutrophil; MCV, mean corpuscular volume; RDW, red cell distribution width; NLR, neutrophil/lymphocyte rat

relationship between high WBC and low HGB and mortality. In a study investigating acute kidney injury after Cardiac surgery in older adults, it was determined that HGB values were statistically significantly correlated with the development of acute kidney injury (7). In another study that examined older adults undergoing non-cardiac surgery, a statistically significant difference was detected between decreased preoperative HCT levels and borderline polycythemia and 30-day mortality (8). In our study population, there was a statistically significant relationship between WBC elevation, low HGB and HTC levels, and mortality. While no statistically significant difference was observed in the HGB and HCT values of the operable and non-operated groups, WBC was significantly higher in the former.

The effect of RDW levels on prognosis has been investigated regarding many diseases as well as specifically in the older adults. Liu et al. (3) who examined 1,891 older adults after percutaneous coronary intervention, observed that mortality was higher in those with high RDW levels. In a study by Abdullah et al. (4), older adults who underwent non-cardiac surgery were included in the sample, and a statistically significant relationship was found between serious RDW elevation and anemia and mortality. In another study, Ichinose et al. (5) evaluated patients who underwent resection for small cell lung cancer, the effect of RDW on mortality for older adults did not change according to age, which is similar to our study; however, a high RDW level without anemia was determined to be more prognostic than a high RDW level accompanied by anemia. It is difficult to decide whether to perform surgery in older adults. However, as far as we know, there is no study examining older adults who presented with acute abdominal pathologies and who were not operated for reasons such as comorbidity and age. In a study investigating the relationship between mortality after hip fracture surgery and pre-treatment RDW levels, 203 older adults were examined and RDW levels were found to be statistically significantly higher in the mortal group (9). On the other hand, in a study examining the results of conservative approach to osteoporotic vertebral fractures, mortality was found to be significantly higher in older adults with high RDW levels compared to older adults with normal RDW levels (10). In the current study, no statistically significant relationship was observed between RDW levels and mortality in any of the patient groups, regardless of operation status.

In addition to HGB, HTC and RDW levels, NLR has also taken its place in older adults surgery patients in the literature, but as with other hemogram parameters, the prognosis was evaluated only in operated patients. Ichinose et al. (5) reported a relationship between NLR elevation and morbidity. In a study investigating mortality after emergency abdominal surgery, NLR was the best predictor in determining mortality (6). Similarly, Cigsar et al. (11) examined 755 patients who underwent laparotomy for acute appendicitis and found that NLR could predict appendectomy in the adults patient group but not in the older adults patient group. Complications have also been investigated in terms of; In a study examining the development of anastomotic leakage after colorectal surgery, no statistical significance was found between the NLR level and the development of anastomotic leakage (12). The results of our study revealed a positive correlation between NLR and LOHS in all patient groups, regardless of operation status, and there was a significant correlation between the level of this parameter and mortality.

The literature confirms that comorbidities and medications such as those related to hemogram parameters negatively affect the treatment process of elderly patients followed up for surgical diseases. In a study examining the prognosis after acute cholecystitis treatment in older adults, 1075 patients were examined and the patients were divided into 2 groups receiving medical and surgical treatment. While there was no difference between the groups in terms of mortality and major complications; Patients with congestive heart failure were significantly higher in the group receiving medical treatment (13). Kim et al. (2) investigated postoperative mortality in older adults and found a statistically significant difference in mortality according to the presence of cancer and stroke but detected no statistically significant relationship between DM, HT, and ischemic heart disease and mortality. In the studies of Wei-Hsiang et al. (9) on hip fracture operations, the relationship between diabetes and hypertension and mortality was statistically insignificant. We determined that mortality was statistically significantly related only to COPD ($p=0.002$) in the operable group, and there was no clinically significant relationship between any of the comorbidities and mortality when the entire patient group was taken into consideration.

Besides comorbidities, we know that age can affect surgical decision making in older adults. In a study of head and neck cancers, Stepherd et al. (14) found that age alone had no effect on postoperative mortality, complications, and length of hospital stay. Cost is also considered in deciding on surgery. Rao et al. (15), in a study in which they analyzed the cost and mortality in rectal cancers, emphasized that it is necessary to be more careful when deciding on surgery in older adults. In addition to the evaluation of hemogram parameters, this study examined the older adults according to whether they were approved for surgery or considered inoperable. In the literature, mortality analyses were

mostly performed in studies on gastric or tumor surgery, and surgical decision differs according to the stages of the disease or diagnosis (14,15). However, acute abdominal pathologies may not always require surgery. In our study, there was no statistically significant relationship between operation status and mortality, suggesting that the surgical decision was made in cases where risk factors decreased.

Limitations

The single-center design of our study is a serious limitation. Differences in the diagnoses of the patients also limited the comparisons performed according to operation status. Lastly, we compared short-term mortality according to only emergency surgery operations, and we did not have data on elective surgeries scheduled to be performed 30 days after presentation. Another limitation of this study was we couldn't compare the medications of patients between groups that may affect the results of study.

CONCLUSION

In this study, WBC, NEU, and NLR were determined to have a statistically significant ability to predict mortality in older adults presenting with acute abdominal pathologies, but their accuracy rates were low. When the AUC values were compared, there was no statistically significant difference between these three parameters, but NLR was superior to WBC and NEU in predicting mortality. Besides, since there was no difference in the results in the operated and non-operated groups, we can say that an operation decision cannot be made with only NLR values.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of University of Health Sciences, Ümraniye Education and Research Hospital Ethics Committee (Date: 18/03/2020, Decision No: B.10.1.TKH.4.34.H.GP.0.01/62).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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