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The Role of the De Ritis Ratio in Acute Cholecystitis: A Retrospective Observational Study

De Ritis Oranının Akut Kolesistitteki Rolü: Retrospektif Gözlemsel Çalışma

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Abstract

Aim: Our primary aim was to evaluate the relationship between De-Ritis rate and short-term mortality in patients with cholecystitis. Our secondary aim was to evaluate the relationship between De-Ritis rate and short-term mortality in patients who underwent emergency surgery for acute cholecystitis.

Material and Method: This retrospective observational study was conducted on patients diagnosed with acute cholecystitis by laboratory parameters and ultrasound, and operated on who presented to the emergency medical clinic of University of Health Sciences, Ümraniye Education and Research Hospitalbetween June 1, 2020, and January 1, 2022. The relationship between De-Ritis rate and mortality was evaluated. The Statistical Package for Social Sciences (SPSS) software (v.20; Chicago, IL, USA) was used for all statistical analyses. All results with $p < 0.05$ were considered statistically significant.

Results: In our study, 174 patients were included, and 50.6% of our patients were women. The mean age was 59.0 (43.2 to 71.8). A total of 2.29% of our patients died. No statistically significant relationship was found between AST, ALT, CRP, albumin, and the De-Ritis ratio and mortality (p=0.584, p=0.533, p=0.517, p=0.07, p=0.399, respectively). When mortality rates in patients who underwent emergency surgery for acute cholecystitis were examined, no statistically significant correlation was found between AST, ALT, CRP, albumin, and De-Ritis rates and mortality (p=0.248, p=0.315, p=0.451, p=0.183, p=0.688, respectively)

Conclusion: De-Ritis rate was not found to be associated with mortality in patients with acute cholecystitis. De-Ritis rate was not associated with mortality in emergency operated patients who underwent emergency surgery for acute cholecystitis.

Keywords: Cholecystitis, AST, ALT, De-Ritis ratio

Öz

Amaç: Çalışmamızda primer amacımız kolesistit tanılı hastalarda De-Ritis oranı ile kısa dönem mortalite arasındaki ilişkiyi değerlendirmek idi. Sekonder amacımız ise akut kolesistit nedeni ile acil opere olan hastalarda De-Ritis oranının kısa dönem mortalite ile ilişkisini değerlendirmek idi.

Gereç ve Yöntem: Bu retrospektif gözlemsel çalışma, 1 Haziran 2020 ile 1 Ocak 2022 tarihleri arasında Sağlık Bilimleri Üniversitesi Ümraniye Eğitim ve Araştırma Hastanesi acil servisine başvuran, labaratuvar parametreleri ve ultrason ile akut kolesistit tanısı alan hastalar ve ameliyat edilen hastalar üzerinde yapılmıştır. De-Ritis oranının mortalite ile ilişkisi değerlendirildi. Statistical Package for Social Sciences (SPSS) yazılımı (v.20; Chicago, IL, ABD) tüm istatistiksel analizler için kullanıldı. $p < 0.05$ olan tüm sonuçlar istatistiksel olarak anlamlı kabul edildi.

Bulgular: Çalışmamıza 174 hasta dahil edildi ve hastalarımızın %50,6'sı kadındı. Ortalama yaş 59.0 (43.2 ila 71.8) idi. Hastalarımızın toplam %2,29'u vefat etti. AST, ALT, CRP, albumin ve De-Ritis oranı ile mortalite arasında istatistiksel olarak anlamlı bir ilişki bulunmadı (sırası ile p=0,584, p=0,533, p=0,517, p=0,07, p=0,399). Akut kolesistit nedeni ile acil opere olan hastalarda mortalite oranları incelendiğinde AST, ALT, CRP, albumin ve De-Ritis oranları ile mortalite arasında istatistiksel olarak anlamlı bir ilişki bulunmadı (sırası ile p=0,248, p=0,315, p=0,451, p=0,183, p= 0.688)

Sonuç: De-Ritis oranı akut kolesistit tanılı hastalarda mortalite ile ilişkili bulunmadı. Aku kolesistit nedeni ile acil opere olan hastalarda da De-Ritis oranı mortalite ile ilişkili değildi.

Anahtar Kelimeler: Kolesistit, AST, ALT, De-Ritis oranı

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INTRODUCTION

Cholecystitis is an emergency surgical disease that may present with mild clinical symptoms or severe clinical findings, such as cholangitis and pancreatitis, characterized by gallbladder inflammation. An essential part of these is caused by gallstones.[1] The diagnosis is made by specific physical examination findings, laboratory tests, and radiological imaging techniques. The Tokyo criteria (TG18 Diagnostic Criteria and Severity Grading of Acute Cholecystitis) took their last updated form in 2018 and are still used in diagnosing cholecystitis.[2] C-reactive protein[3], neutrophil, lymphocyte[4] are well known systemic inflammatory biomarkers. Occurring after an inflammatory process, the effects of hematological parameters such as WBC (white blood cell), neutrophil, lymphocyte[5], C-reactive protein[6], hematological inflammatory indices[7], and CRP/albumin ratio[8] on the prognosis in patients with cholecystitis have been the subject of studies.

ALT (alanine aminotransferase), one of the clinical laboratory tests, is an aminotransferase from the enzyme group that reversibly catalyzes the conversion of alpha ketoacids to amino acids. It is active in the heart and skeletal muscle along with the liver, but specific ALT activity in the liver is more effective than in the heart and skeletal muscle. It is found in hepatocytes, and its height indicates a defect in the hepatocyte plasma membrane. AST (aspartate aminotransferase) is found mainly in the liver and skeletal muscle, brain, heart, lung, kidney, pancreas, leukocytes, and erythrocytes. It increases in skeletal muscle destruction and cardiac damage, particularly in liver diseases.[9,10]

The De-Ritis ratio (AST/ALT ratio) was first used by Fernando De Ritis in 1957[11], and the De-Ritis ratio began to be used in viral hepatitis, alcoholic hepatitis, and ischemic hepatitis.[12] The effect of the De-Ritis ratio, which is thought to be an indicator of liver damage, on the prognosis has been evaluated in various studies.[13-16] In patients with sepsis[13], patients with intestinal lung disease[14] and patients with COVID-19[15,16], patients diagnosed with cancer[17-25], and patients with clinical conditions and ischemic processes, for example, patients with cardiac arrest[26], patients with acute myocardial infarction[27] and patients with kidney damage during percutaneous coronary angiography[28], the effect of the De-Ritis ratio on prognosis was discussed. To the best of our knowledge, there have been no studies in the literature on the effect of the De-Ritis ratio on prognosis in patients with cholecystitis.

Aim

Our primary aim was to evaluate the relationship between De-Ritis rate and short-term mortality in patients with cholecystitis. Our secondary aim was to evaluate the relationship between De-Ritis rate and short-term mortality in patients who underwent emergency surgery for acute cholecystitis.

MATERIALS AND METHOD

Study Design

This retrospective cross-sectional observational study was conducted on patients diagnosed with AC who presented to the emergency medical clinic of University of Health Sciences, Ümraniye Education and Research Hospital between June 1, 2020, and January 1, 2022. Our hospital is a tertiary education and research institute with approximately 840 beds, receiving 2.9 million presentations per year. However, there are 600,000 applications per year to the emergency department.

Study population

This study included patients aged ≥18 years with clinically, radiologically, and laboratory-confirmed acute cholecystitis diagnoses and hemogram and biochemical parameters measured and registered by the Emergency Department. Patients aged <18 years, those with a history of trauma, incomplete data, patients whose mortality information could not be reached, and patients who died due to a reason other than cholecystitis or cholecystitis complication who refused to participate in the study were excluded.

Data Collection

The data of patients admitted to the emergency department and diagnosed with cholecystitis were collected retrospectively. These data included demographic characteristics, age, sex, comorbid diseases, laboratory findings (neutrophils, lymphocytes, eosinophils, basophils, platelets, WBCs (white blood cells), hemoglobin, hematocrit, mean platelet volume, mean corpuscular volume, C-reactive protein, total, direct, indirect bilirubin, BUN (blood urea nitrogen), creatinine, AST, ALT, De Ritis ratio (AST/ALT), length of hospital stay (LOS) and mortality. The radiological technique we used in the diagnosis was ultrasound. Emergency operated and non-operated patients were also examined. The patients were divided into two groups—nonsurvivors and survivors—based on their status in Turkey's National Death Notification System. The nonsurvivor group consisted of cholecystitis-related deaths, and 30-day mortality was recorded. Intensive care unit admission rates and length of hospital stay were recorded using the hospital's data system.

The Tokyo Guidelines 2013 (TG13) and The Tokyo Guidelines 2018 (TG 18) severity grading for acute cholecystitis

"Grade III (severe)" acute cholecystitis is associated with dwysfunction of any one of the following organs/systems:

1. Cardiovascular dysfunction: hypotension requiring treatment with dopamine ≥5 µg/kg per min, or any dose of norepinephrine.
2. Respiratory dysfunction: PaO_2/FiO_2 ratio <300.
3. Neurological dysfunction: decreased level of consciousness.
4. Renal dysfunction: oliguria, creatinine >2.0 mg/dl.
5. Hematological dysfunction: platelet count <100,000/mm³.

6. Hepatic dysfunction: PT-INR >1.5.

"Grade II (moderate)" acute cholecystitis is associated with any one of the following conditions:

1. Palpable tender mass in the right upper abdominal quadrant.
2. Elevated WBC count (>18,000/mm³).
3. Duration of complaints >72 hours.
4. Marked local inflammation (gangrenous cholecystitis, pericholecystic abscess, hepatic abscess, biliary peritonitis, emphysematous cholecystitis).

"Grade I (mild)" acute cholecystitis does not meet the criteria of "Grade III" or "Grade II" acute cholecystitis. It can also be defined as acute cholecystitis in a healthy patient with no organ dysfunction and mild inflammatory changes in the gallbladder, making cholecystectomy a safe and low-risk operative procedure.

Statistical Analysis

The Statistical Package for Social Sciences (SPSS) software (v.20; Chicago, IL, USA) was used for all statistical analyses. All results with $p < 0.05$ were considered statistically significant. The normality of continuous data was assessed using the Shapiro–Wilk test. Categorical variables are presented as numbers (percentages), continuous variables are presented as medians (ranges), and quantitative variables are presented as medians (interquartile ranges; 25th-75th percentiles). Categorical data were compared using Chi-square tests and Fisher's exact tests. Continuous data were compared pairwise using Mann–Whitney tests.

Ethics

The study was conducted with the permission of the University of Health Sciences, Ümraniye Education and Research Hospital Ethics Committee (Date: 20/10/2022, Decision No: B.10.1.TKH.4.34.H.GP.0.01/322). The ethical rules and the principles of the Declaration of Helsinki performed out all procedures.

RESULTS

In our study, 174 patients were included, and 50.6% of our patients were women. The mean age was 59.0 (43.2 to 71.8). A total of 2.29% of our patients died. Coronary artery disease and chronic renal failure, which are comorbid diseases, had a statistically significant relationship with mortality (p=0.006, p=0.007, respectively). It was determined that there was a statistically significant relationship between low hemoglobin and hematocrit and mortality. (p=0.006, p=0.003, respectively). No statistically significant relationship was found between AST, ALT, CRP, albumin, and the De-Ritis ratio and mortality (p=0.584, p=0.533, p=0.517, p=0.07, p=0.399, respectively). The demographic characteristics and laboratory findings of the patients are given in **Table 1**.

A total of 39.66% of our patients underwent surgery. Only one patient died from the operation (1.4%). No statistically significant correlation was found between comorbid diseases and the patients being operated on (**Table 2**). There was no statistically significant relationship between AST, ALT, CRP, albumin, and the De-Ritis ratio and mortality between operated and non-operated patients (p=0.069, p=0.095, p=0.353, p=0.535, p=0.89, respectively). (**Table 2**)

When mortality rates in operated patients were examined, no statistically significant correlation was found between AST, ALT, CRP, albumin, and De-Ritis rates and mortality (p=0.248, p=0.315, p=0.451, p=0.183, p=0.688, respectively) (**Table 3**). No statistically significant correlation was found between AST, ALT, CRP, albumin and De-Ritis rates and mortality in patients who underwent surgery and had a hospital stay longer than seven days (p=0.668, p=0.610, p=0.835, p=0.303, p=0.871, respectively).

DISCUSSION

Our study found that the De-Ritis ratio in patients diagnosed with cholecystitis was statistically insignificant in predicting mortality. AST, ALT, albumin, and CRP levels were also ineffective in predicting mortality in all patients. Additionally, the De-Ritis ratio was not associated with surgical operations in patients with cholecystitis. There was no difference in the De Ritis ratio in patients who underwent surgery compared to patients who did not undergo surgery. Our study showed that the De-Ritis ratio has no prognostic significance in cholecystitis patients. According to the Tokyo guidelines classification, in our study, it was observed that grade III did not have superiority over other grades in terms of mortality. To the best of our knowledge, no study has examined the relationship between cholecystitis and the De-Ritis ratio.

In addition, the relationship between the De-Ritis ratio and patient prognosis in sepsis[13], lung diseases[14,16], and cancers[17] was examined. The effect of the De-Ritis ratio on the prognosis in patients with sepsis progressing with an inflammatory process was investigated, and Schupp et al. found that the De-Ritis ratio and bilirubin values on the 1st, the third, fifth, and seventh days were associated with mortality in patients with septic shock. On the 30th day, although it could determine mortality, the De-Ritis ratio was observed to be superior in determining mortality compared to bilirubin values.[13] In a retrospective study, the De-Ritis ratio was found to be a predictive factor for mortality in patients with intestinal lung disease-related polymyositis-dermatomyositis.[14] In a study conducted on patients diagnosed with COVID-19, the De-Ritis ratio was found to be statistically significantly higher in patients diagnosed with COVID-19 than in healthy people.[15] In a study conducted on patients diagnosed with COVID-19 with respiratory disease, similar to our study, no statistically significant relationship was found between having a history of liver disease or elevated AST and ALT and mortality. However, it was found that there was a statistically significant relationship between a high De-

Table.1 Relationship of demograhic parameters, laboratory parameters, De-Ritis ratio with mortality

	Survivor n=170 (97.71 %)	Nonsurvivor n=4 (2.29%)	Total (n=174)	p value
Age median (IQR)	58.5 (43.0 to 71.0)	81.0 (75.5 to 83.0)	59.0 (43.2 to 71.8)	0.030
Gender n(%)				0.323
Female	85.0 (50.0%)	3.0 (75.0%)	88.0 (50.6%)	
Male	85.0 (50.0%)	1.0 (25.0%)	86.0 (49.4%)	
Comorbidities n(%)				
Hipertension	76.0 (44.7%)	3.0 (75.0%)	79.0 (45.4%)	0.229
Diabetes Mellitus	35.0 (20.6%)	1.0 (25.0%)	36.0 (20.7%)	0.830
Malignancy	3.0 (1.8%)	0.0 (0.0%)	3.0 (1.7%)	0.789
Alzheimer	3.0 (1.8%)	0.0 (0.0%)	3.0 (1.7%)	0.789
Chronic Obstructive Pulmonary Disease	10.0 (5.9%)	1.0 (25.0%)	11.0 (6.3%)	0.120
Coronary artery disease	32.0 (18.8%)	3.0 (75.0%)	35.0 (20.1%)	0.006
Asthma	15.0 (8.8%)	0.0 (0.0%)	15.0 (8.6%)	0.534
Heart Failure	9.0 (5.3%)	0.0 (0.0%)	9.0 (5.2%)	0.637
Chronic Renal Failure	4.0 (2.4%)	1.0 (25.0%)	5.0 (2.9%)	0.007
Cerebrovascular Disease	10.0 (5.9%)	0.0 (0.0%)	10.0 (5.7%)	0.617
Laboratuary parameters Median (IQR)				
WBC (103µ/L)	12.9(10.5- 16.2)	9.7 (8.6 -11.9)	12.9 (10.3-16.2)	0.182
Neutrophil (103µ/L)	10.5 (8.2-13.6)	7.9 (6.6-10.0)	10.5 (8.0-13.6)	0.265
Monocyte (103µ/L)	0.7 (0.5-0.9)	0.7 (0.6-0.8)	0.7 (0.5-0.9)	0.928
Lymphocyte (103µ/L)	1.6 (1.0-2.2)	1.1 (0.9-1.5)	1.6 (1.0-2.2)	0.396
Eosinophil	0.1 (0.0-0.1)	0.0 (0.0-0.1)	0.1 (0.0-0.1)	0.758
Basophil	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.951
RBC	4.6 (4.3-5.0)	3.2 (3.0-3.5)	4.6 (4.3-5.0)	0.003
Hemoglobin (g/dl)	13.2 (12.3-14.4)	9.7 (9.0-10.9)	13.2 (12.3-14.4)	0.006
Hematokrit (%)	40.3 (37.7-43.6)	30.8 (29.3-33)	40.0 (37.5-43.3)	0.003
MCV (fl)	86.7 (83.9-90.1)	96.8 (86.8-105)	86.7 (83.9-90.3)	0.169
RDW (fl)	13.6 (13.0-14.4)	14.4 (13.8-15.1)	13.6 (13.1-14.4)	0.175
Platelet (103µ/L)	247.5 (207.5- 313)	210.5(181.8-277.5)	247.0(207-313.0)	0.460
MPV (fl)	9.4 (8.6-10.3)	9.6 (9.2-10.1)	9.5 (8.6-10.3)	0.767
PDW (%)ALT (IU/L)	16.2 (15.9-16.5)31.0 (17.0- 112.8)	16.3 (16.1-16.6)66.0 (27.0-115.8)	16.2 (15.9-16.5)31.5 (17-112.8)	0.6330.833
Albumin (g/dl)	38.5 (35.0- 42.0)	34.5 (28.6-37.2)	38.1 (35.0-42.0)	0.070
AST (IU/L)	34.0 (22.0-104.2)	97.5 (72.0-123.8)	34.0 (22-105.8)	0.584
CRP (mg/ml)	63.5 (11.0-150.2)	129 (94.2-138.2)	64.0 (11.0-148)	0.517
BUN (mg/dL)	32.1 (23.5-40.7)	46.0 (42.3- 48.2)	32.1 (23.5-40.7)	0.085
Creatinine (mg/dL)	0.8 (0.7-1.0)	1.1 (0.8-1.4)	0.8 (0.7-1.1)	0.313
Total Bilirubin (mg/dL)	1.2 (0.7-2.0)	0.9 (0.8-1.4)	1.2 (0.7-2.0)	0.633
Direkt Bilirubin (mg/dL)	0.4 (0.3-0.9)	0.4 (0.3-0.9)	0.4 (0.3-0.9)	0.833
Indirekt Bilirubin(mg/dL)	0.7 (0.4-1.1)	0.5 (0.4-0.6)	0.7 (0.4-1.1)	0.289
De-Ritis Ratio	1.2 (0.8-1.6)	1.3 (1.1-1.8)	1.2 (0.8-1.6)	0.399
LHOS Median (IQR)	4.0 (3.0-6.0)	2.0 (2.0-3.2)	4.0 (3.0-6.0)	0.118
surgery	68.0 (40.0%)	1.0 (25.0%)	69.0 (39.7%)	0.544
Tokyo 2018 severity grade				0.987
Grade 1	84.0 (49.4%)	2.0 (50.0%)	86.0 (49.4%)	
GradeII	38.0 (22.4%)	1.0 (25.0%)	39.0 (22.4%)	
Grade III	48.0 (28.2%)	1.0 (25.0%)	49.0 (28.2%)	

(WBC, white blood cell; RBC, red blood cells; MCV, mean corpusculer volüme; RDW, red cell distribution width; MPV: mean platelet volüme; PDW, Platelet Distribution Width; ALT, alanine aminotransferase; AST, aspartate aminotransferase; CRP, C-reactive protein; BUN, blood urea nitrogen; LHOS, length of hospital stay/day)

Table.2 Relationship of demograhic parameters, laboratory parameters, De-Ritis ratio with operation status

	Non-operated n=105(60.34%)	Operated (n=69)(39.66%)	Total(n=174)	p value
Age median(IQR)	59.0 (43.0to74.0)	59.0 (44.0to71.0)	59.0 (43.2to71.8)	0.884
Gender n(%)				0.068
Female	59.0 (56.2%)	29.0 (42.0%)	88.0 (50.6%)	
Male	46.0 (43.8%)	40.0 (58.0%)	86.0 (49.4%)	
Comorbidities n(%)				
Hipertension	49.0 (46.7%)	30.0 (43.5%)	79.0 (45.4%)	0.679
Diabetes Mellitus	17.0 (16.2%)	19.0 (27.5%)	36.0 (20.7%)	0.071
Malignancy	2.0 (1.9%)	1.0 (1.4%)	3.0 (1.7%)	0.821
Alzheimer	2.0 (1.9%)	1.0 (1.4%)	3.0 (1.7%)	0.821
Chronic Obstructive Pulmonary Disease	5.0 (4.8%)	6.0 (8.7%)	11.0 (6.3%)	0.297
Coronary artery disease	23.0 (21.9%)	12.0 (17.4%)	35.0 (20.1%)	0.468
Asthma	6.0 (5.7%)	9.0 (13.0%)	15.0 (8.6%)	0.09
Heart Failure	7.0 (6.7%)	2.0 (2.9%)	9.0 (5.2%)	0.272
Chronic Renal Failure	2.0 (1.9%)	3.0 (4.3%)	5.0 (2.9%)	0.345
Cerebrovascular Disease	6.0 (5.7%)	4.0 (5.8%)	10.0 (5.7%)	0.982
Laboratuary parameters Median (IQR)				
WBC (103µ/L)	12.6 (10.3-16.1)	13.0 (10.6-16.2)	12.9 (10.3-16.2)	0.763
Neutrophil (103µ/L)	10.4 (8.2-13.8)	10.5 (7.9-13.4)	10.5 (8.0-13.6)	0.797
Monocyte (103µ/L)	0.7 (0.5-0.9)	0.7 (0.4-0.9)	0.7 (0.5-0.9)	0.510
Lymphocyte (103µ/L)	1.5 (1.0-2.2)	1.7 (1.0-2.2)	1.6 (1.0-2.2)	0.404
Eosinophil	0.1 (0.0-0.1)	0.0 (0.0-0.1)	0.1 (0.0-0.1)	0.456
Basophil	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.072
RBC	4.6 (4.2-5.1)	4.6 (4.3-4.9)	4.6 (4.3-5.0)	0.296
Hemoglobin (g/dl)	13.4 (12.4-14.5)	13.0 (12.0-14.1)	13.2 (12.3-14.4)	0.184
Hematokrit (%)	40.3 (37.8-43.8)	39.1 (36.9-42.8)	40.0 (37.5-43.3)	0.288
MCV (fl)	86.6 (84.0-90.0)	86.7 (83.6-90.9)	86.7 (83.9-90.3)	0.862
RDW (fl)	13.8 (13.2-14.5)	13.5 (12.9-14.2)	13.6 (13.1-14.4)	0.122
Platelet (103µ/L)	241.0 (196.0-302)	257.0 (225.0-339)	247.0 (207.0-313)	0.042
MPV (fl)	9.5 (8.8-10.3)	9.3 (8.5-10.4)	9.5 (8.6-10.3)	0.969
PDW (%)	16.3 (16.0-16.6)	16.1 (15.8-16.4)	16.2 (15.9-16.5)	0.018
ALT (IU/L)	36.0 (18.0-127.0)	27.0 (16.0-62.0)	31.5 (17.0-112.8)	0.095
Albumin (g/dl)	38.0 (34.0-42.0)	38.6 (35.0-43.0)	38.1 (35.0-42.0)	0.535
AST (IU/L)	42.0 (23.0-162.0)	31.0 (22.0-49.0)	34.0 (22.0-105.8)	0.069
CRP (mg/ml)	61.0 (10.0-143.0)	74.0 (16.0-157.0)	64.0 (11.0-148.0)	0.353
BUN (mg/dL)	34.2 (23.5-42.8)	32.1 (23.5-38.5)	32.1 (23.5-40.7)	0.808
Creatinine (mg/dL)	0.9 (0.7-1.1)	0.8 (0.7-1.0)	0.8 (0.7-1.1)	0.126
Total Bilirubin (mg/dL)	1.3 (0.8-2.2)	1.0 (0.6-1.7)	1.2 (0.7-2.0)	0.051
Direkt Bilirubin (mg/dL)	0.5 (0.3-1.2)	0.4 (0.2-0.7)	0.4 (0.3-0.9)	0.049
Indirekt Bilirubin (mg/dl)	0.7 (0.5to1.1)	0.6 (0.4to0.9)	0.7 (0.4-1.1)	0.143
De-Ritis Ratio	1.2 (0.8to1.6)	1.2 (0.8to1.8)	1.2 (0.8-1.6)	0.890
LHOS Median (IQR)	4.0 (3.0to7.0)	4.0 (3.0to6.0)	4.0 (3.0-6.0)	0.369
Mortality	3.0 (2.9%)	1.0 (1.4%)	4.0 (2.3%)	0.544

(WBC, white blood cell; RBC, red blood cells; MCV, mean corpusculer volüme; RDW, red cell distribution width; MPV: mean platelet volüme; PDW, Platelet Distribution Width; ALT, alanine aminotransferase; AST, aspartate aminotransferase, CRP, C-reactive protein; BUN, blood urea nitrogen; LHOS, length of hospital stay/day)

Table. 3 Relationship between laboratory parameters and De-Ritis rate and mortality in operated patients

	Survivor n=68	Non-survivor n=1	Total (n=69)	p value
Age	59.0 (43.8-71.0)	59.0 (59.0-59.0)	59.0 (44.0-71.0)	0.980
Laboratuary parameters Median (IQR)				
WBC (103µ/L)	12.9 (10.6-15.7)	16.8 (16.8-16.8)	13.0 (10.6-16.2)	0.340
Neutrophil (103µ/L)	10.5 (7.9-13.3)	14.8 (14.8-14.8)	10.5 (7.9-13.4)	0.292
Monocyte (103µ/L)	0.7 (0.4-0.9)	0.8 (0.8-0.8)	0.7 (0.4-0.9)	0.725
Lymphocyte (103µ/L)	1.7 (1.0-2.2)	1.2 (1.2-1.2)	1.7 (1.0-2.2)	0.514
Eosinophil	0.0 (0.0-0.1)	0.0 (0.0-0.0)	0.0 (0.0-0.1)	0.762
Basophil	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	0.778
RBC	4.6 (4.3-4.9)	3.1 (3.1-3.1)	4.6 (4.3-4.9)	0.088
Hemoglobin (g/dl)	13.0 (12.0-14.1)	8.9 (8.9-8.9)	13.0 (12.0-14.1)	0.097
Hematokrit (%)	39.4 (36.9-42.8)	28.1 (28.1-28.1)	39.1 (36.9-42.8)	0.097
MCV (fl)	86.7 (83.6-90.9)	90.7 (90.7-90.7)	86.7 (83.6-90.9)	0.422
RDW (fl)	13.5 (12.9-14.2)	13.6 (13.6-13.6)	13.5 (12.9-14.2)	0.841
Platelet (103µ/L)	256 (223.8-336.0)	438 (438-438)	257.0 (225-339)	0.132
MPV (fl)	9.4 (8.5-10.4)	8.1 (8.1-8.1)	9.3 (8.5-10.4)	0.191
Pct	0.2 (0.2-0.3)	0.3 (0.3-0.3)	0.2 (0.2-0.3)	0.238
PDW (%)	16.1 (15.8-16.4)	15.9 (15.9-15.9)	16.1 (15.8-16.4)	0.513
ALT(IU/L)	26.5 (16.0-56.8)	98.0 (98.0-98.0)	27.0 (16.0-62.0)	0.315
Albumin (g/dl)	39.0 (35.6-43.0)	32.0 (32.0-32.0)	38.6 (35.0-43.0)	0.183
AST(IU/L)	30.5 (21.5-48.2)	102.0 (102.0-102.0)	31.0 (22.0-49.0)	0.248
CRP (mg/ml)	71.5 (15.0-158.2)	135.0 (135.0-135.0)	74.0 (16.0-157.0)	0.451
BUN (mg/dL)	31.0 (23.5-39.1)	34.2 (34.2-34.2)	32.1 (23.5-38.5)	0.782
Creatinine (mg/dL)	0.8 (0.7-1.0)	0.7 (0.7-0.7)	0.8 (0.7-1.0)	0.422
Total Bilirubin (mg/dL)	1.0 (0.6-1.7)	1.0 (1.0-1.0)	1.0 (0.6-1.7)	0.880
Direkt Bilirubin (mg/dL)	0.4 (0.2-0.7)	0.5 (0.5-0.5)	0.4 (0.2-0.7)	0.514
Indirekt Bilirubin	0.6 (0.4-0.9)	0.4 (0.4-0.4)	0.6 (0.4-0.9)	0.547
De-Ritis Ratio	1.2 (0.8-1.8)	1.0 (1.0-1.0)	1.2 (0.8-1.8)	0.688
LHOS Median (IQR)	4.0 (3.0-6.0)	2.0 (2.0-2.0)	4.0 (3.0-6.0)	0.139

(WBC, white blood cell; RBC, red blood cells; MCV, mean corpusculer volüme; RDW, red cell distribution width; MPV: mean platelet volüme; PDW, Platelet Distribution Width; ALT, alanine aminotransferase; AST, aspartate aminotransferase, CRP, C-reactive protein; BUN, blood urea nitrogen; LHOS, length of hospital stay/day)

Ritis ratio and mortality.[16]

It's shown that the rate of De-Ritis was more frequently investigated in patients with cancer in the literature. The rate of De-Ritis, which can be obtained quickly and easily, has also been investigated in patients with many different malignancies.[17-19] In a study examining the relationship between colorectal and lung cancers and mortality, the De-Ritis ratio was found to have a significant relationship with both cancer incidence and mortality in cancer patients.[17] In a meta-analysis, the De-Ritis ratio was found to be effective in determining the prognosis of liver cancers, renal cell cancers, and gallbladder cancers.[18] In a retrospective study conducted on patients with hepatocellular cancer and including 1147 patients, it was observed that the preoperative De-Ritis ratio could predict the postoperative prognosis in patients with hepatitis B and hepatitis C-related cancer.[19] In a study conducted by Ghahari et al. on 89 patients with urethral bladder cancer who underwent radical cystectomy, they found that the average De-Ritis ratio was effective in the survey, and a high De-Ritis ratio was associated with mortality.[20] In another study, a similarly low De-Ritis ratio was found to be significant in disease-specific survival and overall survival.[21] The effect of the De-Ritis ratio on the prognosis before the operation was evaluated in patients who underwent surgery for prostate cancer, and it was determined that, contrary to our study, the De-Ritis ratio could be used as a risk factor.[22] Jadhav et al., on the other hand, found that the De-Ritis ratio could predict prognosis in patients diagnosed with prostate cancer.[23] In patients with testicular tumors who underwent orchiectomy, it was found that the rate of De-Ritis was not statistically significantly higher than in patients who underwent varicocelectomy.[24] Our study found that the De-Ritis ratio in operated patients was statistically insignificant in determining the prognosis.

In addition to studies on malignancy, clinical conditions with ischemic origin were also included in the studies. In a study conducted on patients brought to the hospital with cardiac arrest, 57% of the patients died during hospital follow-up. The high De-Ritis ratio was statistically significantly correlated with hospital mortality and intensive care mortality.[26] A study including 3000 patients diagnosed with acute myocardial infarction found a statistically significant correlation between a high De-Ritis ratio in cardiac mortality and three-year mortality. However, in the same study, it was also found that the De-Ritis ratio was moderately sensitive in terms of determining mortality in the postangio period and was not

superior to other risk prediction models in terms of mortality.[27] In a study conducted on patients who developed acute kidney injury associated with elective percutaneous coronary intervention, AST and ALT values were found to be higher than those in patients who did not develop acute kidney injury after angiography. The de-Ritis ratio was statistically significantly higher in patients with acute kidney injury.[28]

The De-Ritis ratio, which is discussed as to whether it is an indicator of liver injury or not, was also investigated in patients with thoracoabdominal trauma, regardless of liver injury. In a study conducted by Su et al. with 2248 thoracoabdominal trauma patients, mortality was found to be statistically significantly higher in the group with a De-Ritis ratio higher than >1.64; there was no statistically significant difference in mortality between those with a De-Ritis ratio <1.20 and those with a De-Ritis ratio between 1.20-1.64.[29] In a study investigating the rate of De-Ritis in 351 patients with extensive burns, a statistically significant relationship was found between AST, ALT, De-Ritis ratios, and mortality, and it was found that the De-Ritis ratio was superior to albumin in determining prognosis.[30] In a study conducted on patients with upper gastrointestinal bleeding treated in the intensive care unit, there was a statistically significant relationship between low albumin and mortality, and similar to our study, the De-Ritis ratio was not found to be statistically significant with mortality.[31]

Limitations

There are many limitations in our study. Data from our patients were collected retrospectively. Cholecystitis with and without gallstones was not differentiated, and all acute cholecystitis cases were included in the study. Therefore, classification according to etiology was not made. The study did not include those who applied to the emergency department with a clinical condition other than cholecystitis. Therefore, the number of patients was limited. Since death due to cholecystitis is rare, our mortality rate was also low. The first admission laboratory examinations of the patients were included in the study. Follow-up laboratory values during hospitalization were not taken.

CONCLUSION

De-Ritis rate was not found to be associated with mortality in patients with acute cholecystitis. De-Ritis rate was not associated with mortality in emergency operated patients who underwent emergency surgery for acute cholecystitis.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was conducted with the permission of the University of Health Sciences, Ümraniye Education and Research Hospital Ethics Committee (Date: 20/10/2022, Decision No: B.10.1.TKH.4.34.H.GP.0.01/322).

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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