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Analysis of the value of lactate dehydrogenase to albumin ratio as a predictor of early mortality in patients with sigmoid volvulus undergoing emergency surgery

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Abstract

Aim: Sigmoid volvulus represents an important cause of mechanical large-bowel obstruction and may rapidly progress to life-threatening complications, particularly in elderly or frail patients. This study evaluated whether the preoperative lactate dehydrogenase-to-albumin ratio (LAR) predicts early mortality after emergency surgery for sigmoid volvulus.

Methods: The retrospective study included 62 patients who underwent emergency surgery for the treatment of sigmoid volvulus at two tertiary centers between January 2015 and June 2025. A time-dependent receiver operating characteristic (ROC) curve was used to identify the best preoperative LAR threshold; the selected cutoff was 8.84. Factors associated with early postoperative mortality were assessed using logistic regression models.

Results: Among the 62 patients, the mean age was 61.7±15.1 years (range: 19-84), and 52 patients (83.8%) were men. Seven patients (11.29%) died in the early postoperative period. Urea and creatinine elevation, perforation, LAR ≥8.84, and operative time >120 min were significant in univariate analysis. In the multivariable model, LAR remained independently associated with early mortality (odds ratio, 19.024; 95% confidence interval, 1.6895-214.20; P=0.017).

Conclusion: A higher preoperative LAR was independently linked to early postoperative death in patients who required emergency surgery for sigmoid volvulus.

Keywords: Sigmoid volvulus, emergency surgery, lactate dehydrogenase-to-albumin ratio, mortality

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Acil cerrahi uygulanan sigmoid volvulus hastalarında erken mortalitenin öngörücüsü olarak laktat dehidrojenaz/albümin oranının değerinin analizi

Öz

Amaç: Sigmoid volvulus, özellikle yaşlı hastalarda görülen, mekanik intestinal obstrüksiyonun yaygın bir nedenidir ve yüksek mortalite oranına sahip, yaşamı tehdit eden bir acil durumdur. Çalışmamızın amacı, sigmoid volvulus nedeniyle acil cerrahi uygulanan hastalarda erken mortalite açısından laktat dehidrogenaz/albümin oranının (LAR) rolünü araştırmaktır.

Yöntemler: Bu retrospektif çalışmaya, Ocak 2015 ile Haziran 2025 tarihleri arasında iki üçüncü basamak merkezde sigmoid volvulus tedavisi için acil cerrahi uygulanan 62 hasta dahil edildi. Zaman bağımlı alıcı işletim karakteristiği (ROC) analizi sonucuna göre, preoperatif LAR için optimal kesim değeri 8.84 olarak belirlendi. Erken postoperatif mortaliteyi etkileyen prediktörleri değerlendirmek amacıyla lojistik regresyon analizleri kullanıldı.

Bulgular: Sigmoid volvulus nedeniyle 62 hastaya acil cerrahi uygulandı; hastaların ortalama yaşı 61.7±15.1 (aralık: 19–84) olup, 52'si (%83.8) erkekti. Erken postoperatif mortalite 7 (%11.29) hastada gözlendi. Tek değişkenli analizde, yüksek üre-kreatinin düzeyleri, perforasyon varlığı, LAR ≥8.84 olması ve uzamış cerrahi süre (>120 dakika) erken mortalitenin prediktörleri olarak saptandı. Çok değişkenli lojistik regresyon analizinde ise LAR'ın, sigmoid volvulus nedeniyle acil cerrahi uygulanan hastalarda erken mortalitenin bağımsız bir prediktörü olduğu gösterildi (olasılık oranı, 19.024; %95 güven aralığı, 1.6895–214.20; p = 0.017).

Sonuç: Çalışmamız, LAR'ın sigmoid volvulus nedeniyle acil cerrahi uygulanan hastalarda erken mortalite riskindeki artış ile bağımsız olarak ilişkili olduğunu ortaya koymuştur.

Anahtar kelimeler: Sigmoid volvulus, acil cerrahi, laktat dehidrogenaz/albümin oranı, mortalite.

INTRODUCTION

Sigmoid volvulus occurs when the sigmoid segment rotates around its mesenteric axis, producing a closed-loop large-bowel obstruction. It is recognized as one of the major causes of colonic obstruction after colorectal cancer and diverticular disease, and the sigmoid colon is involved in most cases of colonic volvulus[1,2]. Its epidemiology differs by region: in Western Europe and North America it is seen mainly among older patients, whereas in countries within the endemic volvulus belt, including our region, it may occur at younger ages[3,4]. The clinical spectrum ranges from mild or intermittent obstructive symptoms to fecal peritonitis secondary to ischemia and perforation. Accordingly, treatment must be individualized and may include endoscopic detorsion in stable patients or emergency colectomy when ischemia, perforation, or peritonitis is suspected[5].

Clinical outcomes for emergency surgical procedures performed for sigmoid volvulus are worse than for planned surgeries, and mortality rates remain high[6]. High American Society of Anesthesiologists physical status (ASA PS), presence of gangrene, perforation, failure of endoscopic decompression, advanced age, coagulopathy, and renal failure have been associated with early mortality[2,4,7-9]. The LDH/albumin ratio (LAR) is associated with tumor burden, tumor growth, and invasive potential, and has been shown to be a prognostic predictor in colorectal and other malignancies[10-12]. More recently, elevated LAR has also been associated with adverse outcomes in critically ill patients with non-malignant diseases[13-16]. Although data has accumulated in the literature, the effect of LAR on mortality in emergency surgeries performed for sigmoid volvulus has not been investigated.

The present study was designed to assess whether preoperative LAR can predict early postoperative mortality after emergency surgery for sigmoid volvulus and to define a clinically useful cutoff value for postoperative risk stratification.

METHOD

Study design

We performed a retrospective review of consecutive adult patients who underwent emergency surgery for sigmoid volvulus at two tertiary institutions between January 2015 and June 2025 (Dicle University School of Medicine and University of Health Science Gazi Yaşargil Training and Research Hospital). Ethical approval was obtained from the Dicle University Clinical Research Ethics Committee (Approval No: 320/17.09.2025). All procedures conformed to the principles of the Declaration of Helsinki.

Study population

We retrospectively reviewed adult patients who required emergency surgery for sigmoid volvulus. The diagnosis was based on clinical examination and radiological findings, including abdominal X-ray and computed tomography when available (Figure 1), and was further confirmed intraoperatively in patients taken to laparotomy (Figure 2). All relevant data were obtained from the institutional electronic medical records. Endoscopic decompression was performed in patients without perforation, acute abdominal findings, or significant peritonitis findings at initial presentation. Patients whose clinical condition regressed with endoscopic decompression or anal tube placement and who underwent scheduled surgery were excluded from the study. Patients who underwent surgery because their symptoms recurred early enough to prevent hospital discharge, despite successful endoscopic decompression or tube placement, were included in the study. Patients with incomplete laboratory parameters, hemolyzed blood samples, known malignancy, chronic liver disease, and dialysis-requiring kidney disease were excluded from the study.

Figure 1. (**A**) Coronal CT image showing markedly dilated sigmoid colon, compatible with sigmoid volvulus. (**B**) Coronal contrast-enhanced CT image showing the "whirl sign" (arrow), caused by rotation of the sigmoid mesentery and mesenteric vessels, a characteristic finding of sigmoid volvulus associated with impaired mesenteric perfusion.

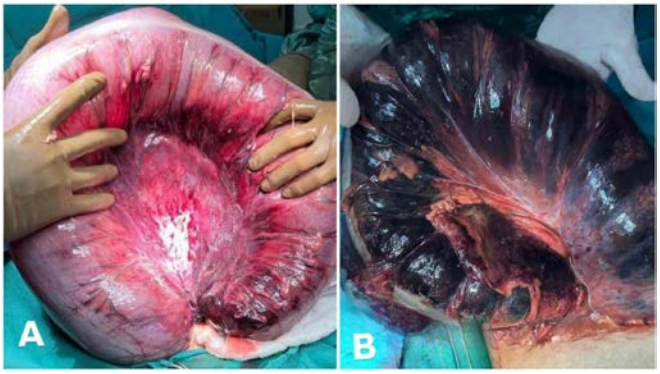

Figure 2. Intraoperative findings of sigmoid volvulus. (**A**) Viable sigmoid colon without necrosis. (**B**) Gangrenous sigmoid colon with transmural ischemia and necrosis.

Data collection and outcome measurement

Demographic data such as age and gender, ASA PS, and comorbid conditions were analyzed. Clinical symptoms, previous volvulus attacks and endoscopic detorsion, complete blood count, biochemistry, and blood gas laboratory results were included in the analysis. To minimize the effect of hemolysis on LDH measurement, LDH values were interpreted together with AST, ALT, and potassium levels,

and patients with evidence of hemolysis were excluded. The presence of perforation, data related to the surgical procedure, and length of hospital stay were the other parameters examined. Early mortality was defined as mortality occurring in the hospital due to inability to be discharged postoperatively or within the first 30 days after discharge. Patients were categorized as early mortality or survival groups, and variables related to early mortality were evaluated with univariate and multivariate analyses.

Cutoff determination of LAR

A time-dependent ROC analysis was conducted to determine the LAR threshold that best discriminated patients with early mortality. The optimal preoperative LAR cutoff was 8.84, with a sensitivity of 85.71%, specificity of 80.0%, and AUC of 0.803 (p=0.009, Figure 3).

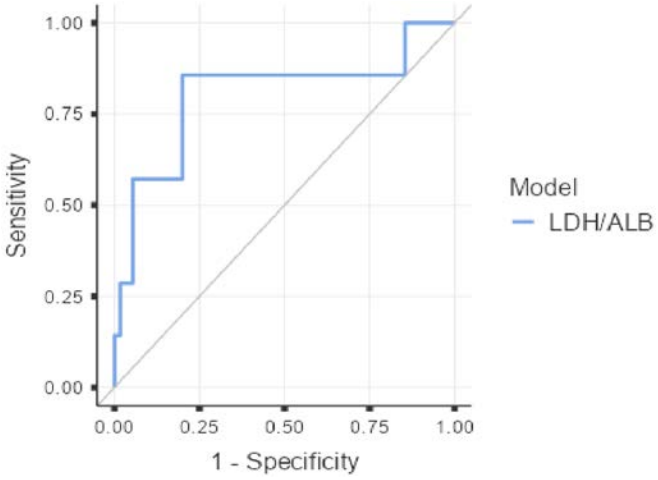

Figure 3. The determination of the best cutoff of preoperative LAR. The cutoff value was 8.84. It resulted in a sensitivity of 85.7% and a specificity of 80.0% (area under the receiver operating characteristics (ROC) curve, 0.803; P = 0.009).

Statistical Analysis

All analyses were conducted with Jamovi software (The jamovi project, 2024; version 2.6; retrieved from https://www.jamovi.org/). Categorical variables are reported as numbers and percentages. Continuous variables are expressed as mean±standard deviation or median (minimum-maximum), as appropriate. ROC analysis was used to determine the LAR cutoff. Categorical variables were compared using the chi-square test. Distribution normality was examined using the Shapiro-Wilk test. Normally distributed continuous variables (LDH and albumin) were analyzed with Student's t-test, whereas non-normally distributed variables were compared using the Mann-Whitney U test. Risk factors for early mortality were first assessed by univariate logistic regression. Variables reaching statistical significance were subsequently entered into the multivariate logistic regression model. Statistical significance was defined as $p<0.05$.

RESULTS

A total of 62 patients underwent emergency surgery for sigmoid volvulus during the 11.5-year study period at the participating tertiary centers. The cohort had a mean age of 61.7±15.1 years (range, 19-84 years), and 52 patients (83.8%) were men. Early mortality occurred in 7 (11.29%) patients. Age, sex, ASA PS class, and comorbidity profile were comparable between survivors and patients with early mortality. Abdominal pain, abdominal distension, and constipation were the most frequently observed symptoms (Table 1A). A history of previous volvulus attacks was identified in 25 (45.5%) of the surviving patients and in 2 (28.6%) of those who developed early mortality. After admission, 36 (65.4 %) patients underwent endoscopic intervention, while 26 patients did not undergo the procedure due to reasons such as hemodynamic instability, perforation, and signs of peritoneal irritation. In endoscopic evaluation, persistent symptoms despite successful decompression (12 patients), mucosal ischemia/gangrene (9 patients), inability to correct torsion or failed tube placement (10 patients) were the reasons for emergency surgery, while the reason could not be explained in 5 patients.

Table IA: Demographic and clinical characteristics of patients with and without early mortality

Characteristic	Survival group (n =55)	Death group (n=7)	*P* value
Age (years)	60.6±16.6 65 (19-84)	67.4±14.4 72 (38-81)	0.301
Age ≥65	30 (54.5)	5 (71.4)	0.455
Sex Male Famele	 44 (80.0) 11 (20.0)	 6 (85.7) 1 (14.3)	 1.000
ASA PS classification≥III	38 (69.1)	7 (100.0)	0.175
Diabetes	12 (21.8)	2 (28.6)	0.651
Cardiovascular disease	19 (34.5)	3 (42.9)	0.691
Pulmonary disease	1 (1.8)	1 (14.3)	0.215
Neuropsychiatric disease	13 (23.6)	1 (14.3)	1.000
Abdominal pain	45 (81.8)	5 (71.4)	0.612
Abdominal distension	44 (80.0)	5 (71.4)	0.630
Constipation	40 (72.7)	3 (42.9)	0.187
Previous volvulus attack	25 (45.5)	2 (28.6)	0.455
Preoperative endoscopic intervention	36 (65.4)	3 (42.9)	0.380

Patients who died early had significantly higher urea, creatinine, and LDH values. Mean LAR was 7.55±3.01 among survivors and 12.12±4.55 among patients with early mortality (p<0.001). Perforation was confirmed in 4 patients in each group during surgical exploration, and resection+stoma (Hartmann type procedures) was the most frequently performed procedure. The detorsion with sigmoidopexy procedure was performed in 2 survivors and in 1 patient with early mortality. The surgical duration was 125 (range: 65-215) minutes in the group with mortality and 75 (range: 40-150) minutes in the group without mortality, and a significant between-group difference was observed (p<0.001, Table 1B).

Table IB: Laboratory, operative, and postoperative characteristics of patients with and without early mortality

Characteristic	Survival group (n =55)	Death group (n=7)	*P* value
Lactade (mmol/L)	1.92±1.63 1.60 (0.60-11.52)	3.32±2.60 2.30 (1.20-8.50)	0.055
Lactade (mmol/L) ≥2	13 (26.0)	4 (57.1)	0.180
Acidosis (pH<7.35)	18 (36.0)	2 (28.6)	1.000
Urea (mg/dL)	46.41±30.18	96.29±51.78	**<0.001**
Urea (mg/dL) >50	15 (27.3)	6 (85.7)	**0.005**
Creatinine (mg/dL)	1.01±0.60 0.86 (0.50-3.76)	1.56±0.71 1.71 (0.70-2.75)	**0.029**
Creatinine (mg/dL)>1.3	6 (10.9)	4 (57.1)	**0.01**
Albumin (g/L)	35 (14-49.60)	26 (18-46.90)	0.112
Lactate dehydrogenase (U/L)	242.53±54.31 246 (151-375)	319.43±74.98 330 (230-439)	**0.001**
LAR	7.55±3.01 6.73 (3.58-17.57)	12.12±4.55 12.99 (4.90-18.33)	**<0.001**
LAR ≥8.84	11 (20.0)	6 (85.7)	**0.001**
White blood cell (10^9/L)	11.20±5.07	13.13±10.22	0.414
Hemoglobin g/L	13.6 ± 2.02	14.5 ± 1.3	0.411
Platelet ×10^9/L	235(125-500)	193(143-298)	0.386
Perforation	4 (7.3)	4 (57.1)	**0.004**
Surgical procedure Resection+stoma Resection+anastomosis Detorsion+pexy	 35 (63.6) 18 (32.7) 2 (3.6)	 6 (85.7) 0 (0.0) 1 (14.3)	0.122
Surgical approach Open Laparoscopic	 51 (92.7) 4 (7.3)	 7 (100.0) 0 (0.0)	1.000
Duration of surgery (min)	75 (40-150)	125 (65-215)	**<0.001**
Duration of surgery ≥120 min	11 (20.0)	4 (57.1)	0.052
Postoperative stay (day)	7 (3-30)	5 (1-12)	0.080

Values are presented as number (%) or mean ± standard deviation (range).

ASA PS, American Society of Anesthesiologists physical status; LAR, LDH-to-albumin ratio.

In the univariate logistic regression model, urea elevation (p=0.013), creatinine elevation (p=0.014), perforation (p=0.002), LAR ≥8.84 (p=0.005), and operative time ≥120 minutes (p=0.045) were associated with early mortality. In multivariate analysis, only LAR ≥8.84 was an independent predictor of early mortality (odds ratio [OR], 19.024; 95% confidence interval [CI], 1.6895-214.20; P = 0.017, Table 2).

Tablo II: Logistic regression analysis of early mortality predictors.

	Univariate analysis		Multivariate analysis	
Variable	OR (95% CI)	P-value	OR (95% CI)	p-value
Age (years ≥ 65)	2.08 (0.372-11.7)	0.404		
Gender (male)	1.500 (0.163-13.779)	0.720		
ASA PS≥3	5.79 (0.00-)	0.995		
Cardiovascular disease	1.42 (0.288-7.02)	0.666		
Diabetes	1.43 (0.247-8.33)	0.689		
Pulmonary disease	9.0 (0.496-163)	0.137		
Acidosis (pH<7.35)	0.711 (0.125-4.05)	0.701		
Lactae (mmol/L) ≥2	3.79 (0.0.747-19.27)	0.108		
Urea (mg/dL) >50	16.0 (1.775-144.1)	**0.013**	0.979 (0.949-1.010)	0.163
Creatinine (mg/dL)>1.3	10.89 (1.949-60.83)	**0.014**	0.399 (0.028-5.746)	0.500
LDH≥250 (U/L)	3.00 (0.535-16.814)	0.212		
Albumin<30 (g/L)	0.308 (0.0617-1.53)	0.150		
LAR ≥8.84	24.0 (2.613-2020.4)	**0.005**	19.024 (1.6895-214.20)	**0.017**
White blood cell (10^9 /L)	0.500 (0.102-2.455)	0.393		
Perforation	17.0 (2.782-103.89)	**0.002**	7.169 (0.7695-66.80)	0.084
Duration of surgery ≥120 min	5.33 (1.038-27.39)	**0.045**	4.503 (0.5026-40.43)	0.179

DISCUSSION

The present study evaluated the association between LAR and early mortality after emergency surgery for sigmoid volvulus. The rationale for this analysis was that LAR integrates two clinically relevant components: LDH, which reflects tissue injury and cellular damage, and albumin, which is closely related to nutritional reserve, systemic inflammation, and disease severity in critically ill patients. In this retrospective study examining the results of two tertiary care centers, early mortality in emergency surgery for sigmoid volvulus was found to be 11.29%. In univariate analysis, elevated urea and creatinine levels, colonic perforation, prolonged operative time, and LAR ≥8.84 were significant; however, after adjustment for other significant variables, LAR remained the only parameter significantly linked to early mortality. To our knowledge, this is the first study addressing preoperative LAR specifically in the emergency surgical management of sigmoid volvulus. Earlier studies have mainly emphasized clinical and operative predictors such as age, comorbidity, ASA PS class, bowel gangrene, and perforation, whereas the combined prognostic effect of LDH and albumin has not been evaluated in this setting.

The three most common mechanical causes of colonic obstruction in adults include cancer, diverticular strictures or colonic volvulus. Volvulus develops when a redundant colonic segment rotates around its mesenteric pedicle, which can obstruct both the involved segment and the upstream colon. If the torsion compromises vascular inflow or venous outflow, ischemia may progress to gangrene and perforation[4,17]. Colonic volvulus accounts for approximately 10-15% of all large-bowel obstructions in Western countries, but its prevalence varies worldwide and is slightly higher in the Middle East, where our country is located[5,18]. Narrow and long meso-sigmoid is

the main cause, but diabetes, neuropsychiatric disorders, institutional care, prolonged bed rest, and megacolon (in the younger age group) increase the risk[5,19].

For clinically stable patients without peritonitis, perforation, or evidence of gangrene, endoscopic detorsion is generally preferred as the initial treatment. Although decompression succeeds in many cases (60-95%), recurrent volvulus is frequent; therefore, definitive colectomy is recommended soon after successful detorsion, often during the same admission[20,21]. Mucosal ischemia may promote bacterial translocation and gas production, thereby worsening distension and systemic toxicity[22]. Early detorsion is crucial in preventing colon necrosis and ischemia-reperfusion injury. Unstable patients, failure of endoscopic detorsion, perforation, ischemia, or signs of peritonitis require urgent sigmoid resection[5,17]. Emergency surgery for sigmoid volvulus is an important predictor of early mortality. Advanced age, male gender, severe comorbidity, presence of necrosis or perforation, systemic inflammatory response syndrome septic shock, and ASA class ≥ III are other common unmodifiable risk factors for mortality[2,6-9,23].

LDH is released during cellular injury and tissue breakdown; therefore, serum concentrations may rise in a broad range of conditions, including hematologic disease, malignancy, tissue infarction, hepatic and pulmonary disorders, heart failure, and multiorgan dysfunction[24-26]. Increased LDH is seen in gangrenous sigmoid volvulus and gangrene of other intestinal organs, and this condition is associated with high mortality[27,28]. Albumin plays an important role in balancing physiological processes for the continuation of life[29]. Hypoalbuminemia is an expected condition in chronic diseases and cancer, but it is also common in critical illnesses such as sepsis, trauma, pancreatitis, and aortic aneurysm, and is considered a risk factor for unfavorable outcomes[13-16,30]. LAR is a low-cost marker that can be easily calculated from routine laboratory parameters. High LAR has been associated with poor prognosis in several malignancies[12]. Similarly, high LAR values have been observed to be associated with poor outcomes in certain critical illnesses caused by benign conditions. A study by Xiao and colleagues 13 analyzing 5.784 septic patients found that LAR is an independent risk factor negatively affecting early mortality. Similarly, in a large cohort of patients with severe acute pancreatitis, elevated LAR values were reported to correlate with in-hospital death[14]. For patients requiring intensive care, LAR may provide a more comprehensive assessment than LDH or albumin alone for predicting organ failure and early death[31]. Our findings are consistent with this concept: LDH and albumin alone were not significant predictors, whereas their ratio was.

Limitations

Several limitations should be acknowledged. First, the retrospective design and limited sample size increase the possibility of selection bias and residual confounding. The low number of mortality events also restricted the stability of the multivariable model, and the results should therefore be interpreted cautiously. Second, external validation was not performed; confirmation in larger independent cohorts is required. Third, the LAR threshold identified in this study may not be directly generalizable because no universally accepted cutoff is available. Finally, the small number of deaths and the wide confidence interval around the effect estimate limit the precision of the model. Despite these limitations, our findings suggest that preoperative LAR may serve as an independent prognostic indicator for early mortality after emergency surgery for sigmoid volvulus.

CONCLUSION

Elevated LAR levels have been found to be significantly associated with an increased risk of early mortality in patients with sigmoid volvulus undergoing emergency surgery. Its low cost and ease of measurement make it a promising candidate as a biomarker for identifying patients at risk for high short-term postoperative mortality. However, more prospective, multicenter studies are needed before LAR can be introduced into routine clinical practice.

Ethics Committee Approval: Ethical approval was obtained from the Dicle University Clinical Research Ethics Committee (Approval No: 320/17.09.2025). All procedures conformed to the principles of the Declaration of Helsinki.

Conflict of Interest: The author(s) declare that there is no financial conflict of interest related to this article.

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