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Baseline laboratory parameters as predictors of admission to intensive care unit after laparoscopic cholecystectomy

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ABSTRACT

Introduction: The role of laboratory biomarkers for predicting adverse clinical outcomes after laparoscopic cholecystectomy is unclear. This study aimed to investigate the potential biomarkers for predicting admission to intensive care unit (ICU) in patients who underwent laparoscopic cholecystectomy.

Materials and Methods: All patients over 18 years old that underwent successful laparoscopic cholecystectomy between February 20, 2019, and June 15, 2021, at Ankara City Hospital Department of General Surgery were included in the study. The main outcome of the study was unplanned admission to ICU after laparoscopic cholecystectomy. Stata statistical package program (version 15.1/IC; StataCorp) was used to perform all data analyses.

Results: Of 877 patients that were included in the current study, 76 (8.6%) were admitted to ICU. Multivariable logistic regression analysis revealed that lower levels of potassium (odds ratio [OR]: 0.206; 95% confidence interval [CI]: 0.109–0.388; p<0.001) and higher levels of monocyte (OR: 3.145; 95% CI: 1.472–6.715; p=0.003), total bilirubin (OR: 1.002; 95% CI: 1.001–1.003; p<0.001) and neutrophil (OR: 1.171; 95% CI: 1.102–1.244; p<0.001) were independently associated with an increased risk of admission to ICU. The accuracy of predicting ICU admission was assessed by the area under the receiver operating characteristic curve which was = 0.83. A nomogram was developed with significant predictors (neutrophil, total bilirubin, monocyte, and potassium) for the admission ICU.

Conclusion: This is the first study investigating the role of laboratory parameters for predicting the need for ICU admission after laparoscopic cholecystectomy. If validated, this simple approach can contribute to the development of new personalized treatment strategies.

Keywords: Intensive care; laboratory parameters; laparoscopic cholecystectomy.

Introduction

In recent years, laparoscopic cholecystectomy has become a gold standard technique, being preferred in a significant portion of cholecystectomies due to shorter hospital stays, better aesthetic results, early mobilization, less postoperative pain, and fewer incidents of ileus and hernia.[1-5] Currently, >80% of cholecystectomies are performed laparoscopically.[6,7] Laparoscopic cholecystectomy is a relatively safe procedure with reported mortality <1%.[8] However, the risk of adverse outcomes for individual patients is not well-known.

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Identifying these patients in the preoperative period is an important approach to prevent adverse outcomes in the postoperative period. Complete blood count and biochemistry parameters have been shown to be associated with clinical outcomes in many other surgical procedures.[9-16] However, the role of these biomarkers for predicting adverse clinical outcomes after laparoscopic cholecystectomy remains unclear. Identifying the laboratory parameters associated with intensive care unit (ICU) admission after laparoscopic cholecystectomy may be a non-invasive and uncostly way to improve clinical results. In the light of these, this study aimed to investigate the potential biomarkers for predicting admission to ICU in patients who underwent laparoscopic cholecystectomy.

Materials and Methods

In the current retrospective study, all patients over 18 years old that underwent successful laparoscopic cholecystectomy between February 20, 2019, and June 15, 2021, at Ankara City Hospital Department of General Surgery were included. Patients who had missing laboratory biomarkers were excluded from the study. Patients who were transitioned to open cholecystectomy were also excluded. Patients demographic characteristics including age and sex were recorded. In addition, laboratory markers including complete blood count parameters (hemoglobin, neutrophil, lymphocyte, platelet, mean platelet volume, monocyte, and red cell distribution) and other laboratory markers (estimated glomerular filtration rate [eGFR], total bilirubin, lactate dehydrogenase, gamma-glutamyl transferase, albumin, amylase, alkaline phosphatase, alanine aminotransferase, sodium, potassium, and total protein). Blood samples were collected after fasting for at least 6 h before laparoscopic cholecystectomy. An automated blood cell counter (Beckman Coulter analyzer, California, USA) was used for measuring complete blood count parameters. Blood biochemistry parameter levels that were measured using an automatized analyzer (Beckman Coulter analyzer) using nephelometric measurement before and after the laparoscopic cholecystectomy. The study was approved by the local ethics committee (Approval No: E2-21-684).

Outcomes and Follow-up

The main outcome of the study was unplanned admission to ICU after a successful laparoscopic cholecystectomy. Patients were separated into two groups according to admission to ICU. Follow-up values for each laboratory parameter were recorded for up to 1 week. All patients were alive at discharge.

Statistical Analysis

Stata statistical package program (version 15.1/IC; StataCorp) was used to perform all data analyses. Kolmogorov-Smirnov test was used to analyze the distribution pattern. Normally distributed numerical variables were presented as mean ± standard deviation. Categorical variables were presented as number and percent (%).

To show significant predictors of admission to ICU, univariable logistic regression models were used for each variable, and then those which had <0.1 P-values were tested in the multivariable logistic regression model. Odds ratios (ORs) and their 95% confidence intervals (CIs) for admission to ICU were presented. Receiver operating characteristic (ROC) analysis was used to show the discrimination of the final model. A nomogram including significant predictors of admission to ICU was graphed. In addition, dynamic changes of significant predictors were graphed on a daily basis for a period of 1 week after laparoscopic cholecystectomy according to ICU admission. All $P < 0.05$ was considered significant in all statistical analyzes.

Results

A total of 877 patients were included in the current study. Baseline demographic, hematological, and biochemical measurements of the study population according to ICU admission are presented in Table 1. In total, 76 (8.6%) patients were admitted to ICU. There were no differences between the two groups for age, platelet, mean platelet volume, red cell distribution, eGFR, lactate dehydrogenase, gamma-glutamyl transferase, albumin, amylase, alkaline phosphatase, alanine aminotransferase, sodium, and total protein.

As shown in Table 1, while the rate of male patients, and mean levels of hemoglobin, neutrophil, monocyte, and total bilirubin were significantly higher in the ICU admission group, the mean lymphocyte and potassium levels were significantly lower. Multivariable logistic regression analysis revealed that lower levels of potassium (OR: 0.206; 95% CI: 0.109–0.388; p<0.001) and higher levels of monocyte (OR: 3.145; 95% CI: 1.472–6.715; p=0.003), total bilirubin (OR: 1.002; 95% CI: 1.001–1.003; p<0.001), and neutrophil (OR: 1.171; 95% CI: 1.102–1.244; p<0.001) were independently associated with an increased risk of admission to ICU (Table 2).

Table 1. Baseline demographic and laboratory parameters of patients according to intensive care unit admission

	Total N=877	Non-ICU Unit N=801	ICU Unit N=76	p
Demographics				
Age	49.6 (14.8)	49.6 (14.9)	49.4 (13.6)	0.91
Sex				
Male	350 (39.9%)	311 (38.8%)	39 (51.3%)	0.034
Female	527 (60.1%)	490 (61.2%)	37 (48.7%)	
Hemogram Parameters				
Hemoglobin	12.8 (1.6)	12.7 (1.6)	13.3 (1.7)	0.005
Neutrophil	8.0 (3.9)	7.8 (3.8)	10.8 (4.6)	<0.001
Lymphocyte	1.6 (0.7)	1.6 (0.7)	1.4 (0.7)	0.019
Platelet	251.6 (86.7)	252.5 (85.1)	242.2 (102.4)	0.32
Mean platelet volume	8.3 (1.0)	8.4 (1.0)	8.2 (0.8)	0.24
Monocyte	0.5 (0.3)	0.5 (0.2)	0.7 (0.3)	<0.001
Red cell distribution width	14.1 (1.5)	14.1 (1.6)	13.8 (1.0)	0.094
Other Laboratory Parameters				
eGFR	99.7 (22.2)	99.8 (22.2)	99.5 (21.9)	0.92
Total bilirubin	118.0 (298.9)	94.8 (266.0)	362.6 (471.9)	<0.001
Lactate dehydrogenase	250.0 (89.5)	248.6 (90.6)	264.2 (77.2)	0.15
Gamma glutamyl transferase	74.3 (105.1)	73.9 (105.3)	78.2 (104.0)	0.73
Albumin	39.7 (3.8)	39.7 (3.8)	39.2 (4.0)	0.22
Amylase	82.0 (131.6)	80.5 (125.4)	98.0 (185.0)	0.27
Alkaline Phosphatase	90.3 (52.4)	90.1 (51.9)	92.5 (57.2)	0.71
Alanine aminotransferase	68.8 (85.7)	69.0 (86.4)	65.9 (78.9)	0.76
Sodium	139.6 (3.0)	139.6 (3.0)	139.1 (2.7)	0.11
Potassium	4.1 (0.4)	4.1 (0.4)	3.8 (0.4)	<0.001
Total Protein	61.6 (6.0)	61.8 (6.1)	60.4 (5.7)	0.053

GFR: glomerular filtration range.

Table 2. Independent predictors of intensive care unit admission after multivariable logistic regression analysis

	Odds ratio (95% confidence interval)	p
Potassium	0.206 (0.109-0.388)	<0.001
Monocyte	3.145 (1.472-6.715)	0.003
Total bilirubin	1.002 (1.001-1.003)	<0.001
Neutrophil	1.171 (1.102-1.244)	<0.001

The accuracy of predicting ICU admission was assessed by the area under the ROC curve which was = 0.83 as shown in Figure 1. A nomogram was developed with significant predictors (Neutrophil, Total Bilirubin, Monocyte, Potassium) for the admission ICU and shown in Figure 2.

Figure 3 shows the dynamic changes in significant predictors of ICU admission (on a daily basis) for up to 1 week. As shown in this figure, the difference in the baseline levels of significant predictors was persisted during the follow-up period in both groups.

Discussion

In this study, we found some parameters that predict whether the patients will need intensive care with the routine examinations taken before laparoscopic cholecystectomy. Since the parameters to be taken before the operation will not impose an additional financial and interventional burden on the patient, it may be recommended to pay attention to these examinations. As seen in our results, when the potassium, bilirubin, monocyte, and white blood cell values are evaluated, we can highly

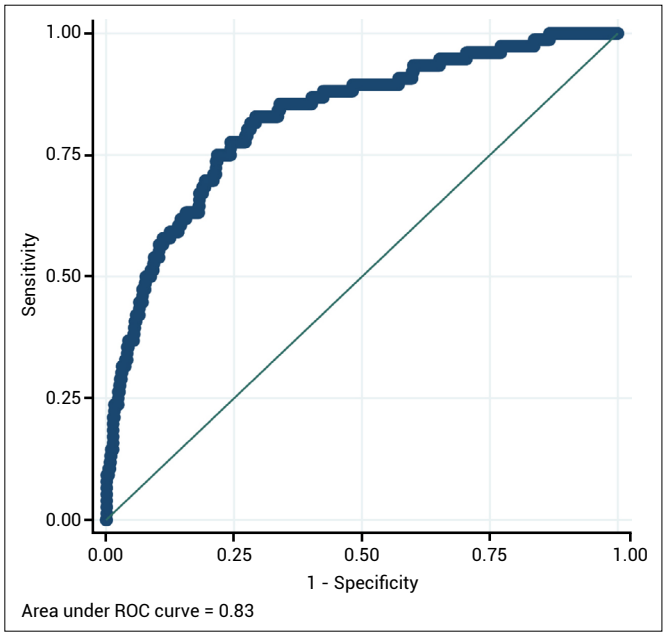

Figure 1. The area of under the curve for significant predictors of intensive care unit admission.

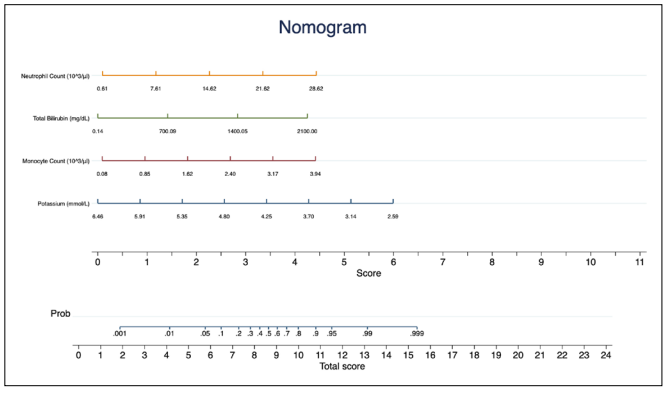

Figure 2. The nomogram of intensive care unit admission.

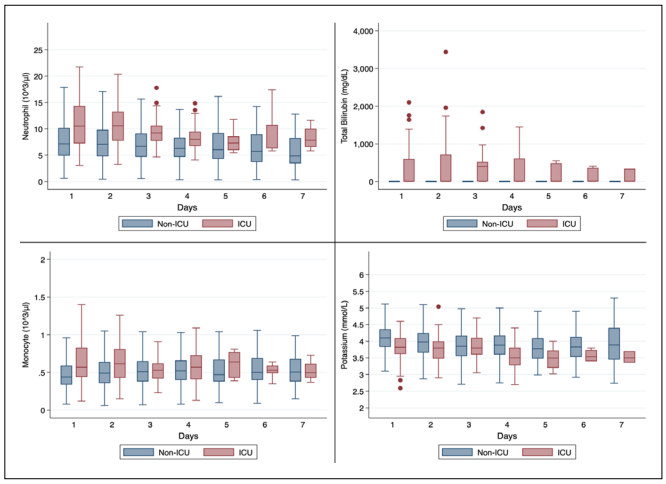

Figure 3. Dynamic changes of significant predictors after the first week of laparoscopic cholecystectomy according to intensive care unit admission.

decide whether the patient will need intensive care and prepare accordingly. Thus, while preparing for this type of surgery, attention should be paid to the details that are overlooked in the results of the examination, and the post-operative condition of the patient can be predicted by carefully looking at these routine biochemical and hematological results.

Laparoscopic cholecystectomy is a very common procedure in general surgery practice. The aim is to quickly return the patient to normal life and to allow rapid recovery without spending additional time.[1,2] However, the need for postoperative intensive care in such a patient group is not an expected problem. Therefore, it may be necessary to use some time to predict whether these patients will need intensive care, to inform the patients, or to bring the parameters to the normal range. For example, it would be a better choice to wait for a patient with a very high white blood cell count to be ready for surgery with a normal range of white blood cells. Otherwise, the patient will experience intensive care, which will lead to a long hospital stay after a simple operation and deterioration of patient comfort. The surgical timing of the patient is at least as valuable as the success of the surgical procedure, even acute abdomen patients who have not been adequately examined may sometimes experience problems. There are many studies in the literature that draw attention to the importance of surgical timing.[17] Some authors point out that additional problems may be experienced more when the surgery is rushed.

This study may have some limitations, for example, being retrospective is a limitation, but a large number of patients can fill this gap and allow for an accurate interpretation. Another limitation may be the subjectivity in the need for intensive care, but no clinician will approve of their patient being followed in the ICU even though they do not need it, so we can easily say that only patients who really need intensive care are followed up in the ICU.

Despite the pandemic, the fact that so many patients were operated in such a short time is a very strong aspect of our study. Our hospital is the largest hospital in a crowded city with a very high bed capacity and application numbers. We are trying to provide a very high-quality service with our experienced staff and talented surgical team.

Conclusions

Our study is the first study on the need for intensive care in cholecystectomy patients with these simple laboratory findings. It is highly valuable that the findings are original, simple, and instructive. If validated, this simple approach can contribute to the development of new personalized treatment strategies. We believe that these findings will be supported by other studies and similar results will be found.

Disclosures

Ethichs Committee Approval: The study was approved by the Local Ethics Committee.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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