ORIGINAL ARTICLE

# An investigation into the clinical efficacy of thiol/disulfide hemostasis and ischemia-modified albumin in cases of gallbladder perforation

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## ABSTRACT

**BACKGROUND:** In the presence of advanced age and comorbidities, patients with gallstones may face gangrenous and perforated cholecystitis during their follow-up. In the literature, dynamic thiol/disulfide homeostasis has been shown to play an important role in detoxification, antioxidant protection, regulation of enzymatic reactions, and apoptosis and cellular signaling mechanisms. In this study, we aimed to evaluate the efficacy of IMA and thiol/disulfide homeostasis in the preoperative diagnosis of patients with cholelithiasis, acute/chronic cholecystitis, and perforated gallbladder.

**METHODS:** Sixty-six patients that presented to the General Surgery Clinic of Ankara City Hospital for a cholecystectomy operation between February 2019 and May 2020 were included in this study. The patients were divided into three groups depending on the condition for which they were scheduled for surgery: cholelithiasis, cholecystitis, and perforated gallbladder. The demographic data, history of cholecystitis, chronic disease, white blood cell (WBC), amylase, lipase and liver function tests (AST and ALT) were recorded before the operation. Gallbladder appearance was evaluated using hepatobiliary ultrasonography. The duration of surgery, pericholecystic adhesions, hospital stay, body mass index (BMI), postoperative complications, and pathology results of specimens were recorded. In addition, thiol/disulfide and IMA values were analyzed in the blood samples taken from the patients preoperatively.

**RESULTS:** The mean native thiol and total thiol values of the patients with an adhesion score of 0 were significantly higher than those with an adhesion score value of 1, 2 or 3. In addition, the disulfide, disulfide/native thiol, native thiol/total thiol and IMA values of the cases with an adhesion score of 2 or 3 were significantly higher than those with an adhesion score of 0. The native thiol and total thiol averages of the patients with normal cholecystectomy were higher than the others. The disulfide, native thiol/total thiol and IMA averages of those who underwent cholecystectomy due to a perforated gallbladder were also higher than the other groups. The mean preoperative WBC of the patients who underwent cholecystectomy due to a perforated gallbladder was also significantly higher than the other groups. Lastly, the native thiol and total thiol values had a statistically significant negative correlation with age, operation time, and hospital stay, and a statistically significant positive relationship with BMI.

**CONCLUSION:** We consider that in the preoperative diagnosis of the perforated gallbladder, the evaluation of thiol/disulfide hemostasis and IMA parameters can be used as an effective and reliable method to predict intraoperative difficulties.

**Keywords:** Cholecystectomy; cholecystectomy difficulty level; ischemia-modified albumin; perforated cholecystitis; thiol/disulfide homeostasis.

## INTRODUCTION

Gallstones can be seen in approximately 15% of the current population, and every year, approximately 3% of these cases

progress from the asymptomatic to symptomatic form.[1] Surgical treatment is indicated when cholelithiasis cases become

symptomatic. As a result of the delay in diagnosis and treatment, undesirable complications, such as acute cholecystitis, choledocholithiasis, cholangitis, acute biliary pancreatitis, bilioenteric fistulas, gallstone ileus, gallbladder carcinomas, and gastric outlet obstruction, can be seen.[2] Laparoscopic cholecystectomy is a common and frequently used laparoscopic procedure in general surgical practice and is the gold standard treatment for symptomatic cholelithiasis; however, although it seems technically simple at a certain experience level, it may also become one of the very difficult operations faced by surgeons in complicated cases.[3,4] Possible peroperative complication risk in patients undergoing laparoscopic cholecystectomy depends on patient characteristics [gender, age, American Society of Anesthesiologists (ASA) score, and body weight], clinical findings (acute and chronic cholecystitis), and the surgeon's clinical experience. Therefore, in cases where difficult cholecystectomy is predicted, an experienced surgeon should be involved in the decision-making process and should be present during the operation. Furthermore, if the operation lasts for more than two hours, the risk of perioperative complications is four times higher than interventions lasting between 30 and 60 minutes, regardless of the surgeon's personal skills.[5] In difficult laparoscopic cholecystectomies, it may be necessary to seek the advice and assistance of an experienced surgeon.[6] There are certain risk factors and scoring systems in the literature to describe challenging elective laparoscopic cholecystectomies; however, there is still no specific marker.[7] If difficult cholecystectomies can be predicted before the operation, the patient can be informed in more detail, so both the patient and the surgeon can be better prepared for the operation. More importantly, these patients can be scheduled to undergo surgery in technically well-equipped centers by referring them to surgeons with more experience in hepatobiliary surgery. As a result, there will be a natural decrease in complications and mortality and morbidity, and complications that may develop can be managed more effectively.

In this study, we aimed to investigate the clinical efficacy of thiol/disulfide homeostasis, which has been proven to play a role in the regulation of detoxification, antioxidant pathway, and cellular signaling mechanisms, and IMA parameters, which are associated with tissue ischemia, in the preoperative diagnosis of perforated cholecystectomy cases, which are more important than other types of cholecystitis due to both advanced age and comorbidities.

## MATERIALS AND METHODS

Sixty-six patients aged 20 and 90 years presented to the General Surgery Clinic of Ankara City Hospital between February 2019 and May 2020 and were scheduled to undergo cholecystectomy with the prediagnoses of cholelithiasis, acute/chronic cholecystitis, and perforated gallbladder were included in this study. All patients provided written informed consent. The patients were divided into three groups de-

pending on the condition for which they were to undergo surgery: cholelithiasis (Group 1), cholecystitis (Group 2), and perforated gallbladder (Group 3). Patients with active infections, cancer in any organ, or chronic diseases such as diabetes mellitus, rheumatoid arthritis, and hypertension, and those with a history of radiotherapy in the gastrointestinal region were excluded from this study. The demographic data of the patients, history of cholecystitis, chronic diseases, white blood cell (WBC), amylase, lipase, and liver function test results (aspartate aminotransferase, Alanine transaminase) were recorded before the operation. Gallbladder appearance (I: single stone, II: multiple stones, III: full stone) was evaluated in hepatobiliary ultrasonography. The data on the operation time (time between the placement of trocars and completion of gallbladder dissection) and presence of pericholecystic adhesions (0: no adhesion; I: weak adhesion, easy to dissect; II: dense adhesion, requiring sharp dissection; III: difficult to dissect) were obtained from the surgeon. The duration of hospital stay, body mass index (BMI), postoperative complications, pathology results of specimens (0: cholesterolosis, I: acute cholecystitis, and II: chronic cholecystitis) were also noted.

In addition to the above-mentioned procedures, 2 cc of serum was taken from all the patients before surgery (without additional blood procedure) and placed in an Eppendorf tube and stored at -80 degrees. The thiol/disulfide and IMA values in the sera collected at the end of the study were analyzed free of charge at the Biochemistry Department of Yıldırım Beyazıt University. The data were transferred to IBM SPSS Statistics v. 23. While evaluating the study data, descriptive statistics (mean and standard deviation) were given for numeric variables and numbers and percentages for categorical variables. If there was a difference between more than two groups, one-way analysis of variance (ANOVA) was conducted, followed by first the Levene test for variance homogeneity, and then the multiple comparison test (Bonferroni or Tamhane's T2) was undertaken to identify the group or groups causing the difference. In addition, the Bonferroni test was used to examine the differences between the groups in terms of variables providing variance homogeneity, and Tamhane's T2 test was used to examine the differences between the groups concerning variables that did not provide variance homogeneity. Pearson's correlation analysis was conducted to examine the relationship between numerical variables, and the results were tabulated.

Ethical approval of this study was obtained from the local Ethics Committee of the University of Health Sciences Numune Training and Research Hospital (E-19-2528).

## RESULTS

The mean age of the patients was 51.7, and BMI was 27.59 kg/m2. The average operation time was 40.29 minutes and the duration of hospital stay was 3.36 days (Table 1). The results

**Table 1.**　Descriptive statistics

|  | Mean | SD | N | % |
|---|---|---|---|---|
| Age | 51.70 | 14.729 |  |  |
| Operation time | 40.29 min | 9.813 |  |  |
| Duration of hospital stay | 3.36 days | 2.503 |  |  |
| Body mass index (kg/m$^2$) | 27.59 | 5.165 |  |  |
| Adhesion score |  |  |  |  |
| 0 |  |  | 15 | 22.7 |
| 1 |  |  | 10 | 15.2 |
| 2 |  |  | 23 | 34.8 |
| 3 |  |  | 18 | 27.3 |
| Group |  |  |  |  |
| 1 |  |  | 20 | 30.3 |
| 2 |  |  | 24 | 36.4 |
| 3 |  |  | 22 | 33.3 |
| Preop white blood cell | 9.90 10$^3$/uL | 5.396 |  |  |
| Preop amylase | 59.36 U/L | 34.295 |  |  |
| Preop lipase | 57.98 U/L | 43.220 |  |  |
| Native thiol | 344.25 umol/L | 79.362 |  |  |
| Total thiol | 379.19 umol/L | 87.429 |  |  |
| Disulfide | 12.04 umol/L | 4.801 |  |  |
| Disulfide/Native thiol | 4.09 umol/L | 2.141 |  |  |
| Disulfide/Total thiol | 4.27 umol/L | 1.934 |  |  |
| Native/Total thiol | 82.09 umol/L | 9.167 |  |  |
| Ischemia-modified albumin | 0.60 ABSU | 0.199 |  |  |

ABSU: Absorbance values; SD: Standard deviation.

of the one-way ANOVA test showed that the native thiol and total thiol averages of the patients with an adhesion score of 0 were significantly higher than those of the remaining patients, and the averages of native thiol and total thiol of the cases with an adhesion score of 1 were significantly higher than those with an adhesion score of 2 or 3 (p<0.05). The mean disulfide and disulfide/native thiol values of the patients with an adhesion score of 2 or 3 were significantly higher than those with an adhesion score of 0, and the mean disulfide/total thiol ratios of those with an adhesion score of 1, 2 or 3 were significantly higher than those with an adhesion score of 0. In addition, in patients with high adhesion score, the mean native thiol/total thiol ratio and IMA values of the patients were also high (Table 2). The mean native thiol and total thiol were significantly higher in Group 1 than the other two groups and they were also significantly higher in Group 2 than in Group 3. The mean disulfide, native thiol/total thiol and IMA values of the patients were significantly higher in Group 3 than in the remaining groups. In addition, the mean disulfide/native thiol and disulfide/total thiol ratios of the patients in Groups 2 and 3 were significantly higher than those of Group 1 (Table 3).

While there was no statistically significant difference between the adhesion groups concerning preoperative lipase values (p>0.05), the mean preoperative WBC was higher in the patients with an adhesion score of 2 or 3 than those with an adhesion score of 0 or 1, and the mean preoperative amylase was significantly higher in the patients with an adhesion score of 3 than those with an adhesion score of 0 or 1 (p<0.05) (Table 4). There was no statistically significant difference between the study groups in terms of the preoperative lipase values (p>0.05); however, the mean preoperative WBC of the patients significantly higher in Group 3 than Groups 1 and 2, as well as in Group 2 than Group 1. The mean preoperative amylase value was significantly higher in Group 1 than the remaining two groups, and it was also significantly higher in Group 2 than Group 3 (Table 5).

The disulfide, disulfide/total thiol, disulfide/native thiol, native/total thiol and IMA values had a statistically significant positive correlation with age, operation time, and hospital stay (p<0.05) and had a negative correlation with BMI (p<0.05) (Table 6).

**Table 2.**  Comparison of the parameters by adhesion scores

| | Adhesion scores | N | Mean | SD | F | p |
|---|---|---|---|---|---|---|
| Native thiol (umol/L) | 0 | 15 | 455.87 | 23.973 | 52.350 | 0.000 |
| | 1 | 10 | 366.90 | 39.204 | | |
| | 2 | 23 | 313.88 | 45.918 | | |
| | 3 | 18 | 277.46 | 52.919 | | |
| Total thiol (umol/L) | 0 | 15 | 504.53 | 27.568 | 63.335 | 0.000 |
| | 1 | 10 | 410.40 | 28.261 | | |
| | 2 | 23 | 340.82 | 52.765 | | |
| | 3 | 18 | 306.41 | 50.386 | | |
| Disulfide (umol/L) | 0 | 15 | 8.25 | 1.526 | 6.710 | 0.001 |
| | 1 | 10 | 10.86 | 3.508 | | |
| | 2 | 23 | 13.05 | 4.331 | | |
| | 3 | 18 | 14.56 | 5.816 | | |
| Disulfide/native thiol (umol/L) | 0 | 15 | 2.12 | 0.598 | 10.042 | 0.000 |
| | 1 | 10 | 3.55 | 1.993 | | |
| | 2 | 23 | 4.60 | 1.851 | | |
| | 3 | 18 | 5.39 | 2.229 | | |
| Disulfide/total thiol (umol/L) | 0 | 15 | 2.00 | 0.825 | 14.598 | 0.000 |
| | 1 | 10 | 5.01 | 1.722 | | |
| | 2 | 23 | 4.96 | 1.629 | | |
| | 3 | 18 | 4.88 | 1.679 | | |
| Native/total thiol (umol/L) | 0 | 15 | 72.05 | 4.966 | 24.932 | 0.000 |
| | 1 | 10 | 76.76 | 5.383 | | |
| | 2 | 23 | 85.21 | 7.373 | | |
| | 3 | 18 | 89.42 | 6.294 | | |
| Ischemia-modified albumin (ABSU) | 0 | 15 | 0.36 | 0.123 | 43.144 | 0.000 |
| | 1 | 10 | 0.44 | 0.202 | | |
| | 2 | 23 | 0.71 | 0.080 | | |
| | 3 | 18 | 0.74 | 0.081 | | |

F: One-way ANOVA test; ABSU: Absorbance values; SD: Standard deviation.

# DISCUSSION

Gallbladder perforation is a rare (5%) but life-threatening complication of acute cholecystitis.[8] It occurs due to ischemia that develops secondary to advanced inflammation and subsequent necrosis. Perforation may develop within a few days or weeks from the onset of acute cholecystitis symptoms. Since the symptoms are similar, it is challenging to clinically distinguish gallbladder perforation from uncomplicated acute cholecystitis, and early diagnosis and treatment is the most important factor in determining the mortality rate.[9] Currently, there is still no clear consensus about the classification of gallbladder perforation. An ultrasonographic examination can reveal thickening of the bladder wall, hydropic gall bladder, and pericholecystic free fluid, which can also be seen in acute cholecystitis. However, the most reliable finding in gallbladder perforation is the presence of a sonographic hole sign observed as a defect in the gallbladder wall in 70% of cases.[10] Nevertheless, the determination of this finding directly depends on the radiologist performing the procedure. Among our cases, this rate was observed to be 66.6% (n=16) in the preoperative ultrasonography of the patients that underwent surgery due to perforated cholecystectomy. Jansen et al.[11] compared 50 patients with gallbladder perforation and 150 patients without perforation and found that being older (>65 years) and having elevated CRP were higher in patients with a perforated gallbladder. The operation time was longer in cases of gallbladder perforation (100.4±47.9 min vs. 131.3±55.2 min), and the rates of conversion to open surgery (22% vs. 4%), morbidity (24% vs. 7%) and mortality (8% vs. 1%) were also significantly higher in this group. The authors also reported that the rate of

**Table 3.** Examination of the differences in the investigated parameters between the study groups

|  |  | N | Mean | SD | F | p |
|---|---|---|---|---|---|---|
| Native thiol (umol/L) | Group 1 | 20 | 441.90 | 32.528 | 95.616 | 0.000 |
|  | Group 2 | 22 | 330.32 | 36.488 |  |  |
|  | Group 3 | 24 | 275.65 | 48.178 |  |  |
| Total thiol (umol/L) | Group 1 | 20 | 486.75 | 39.939 | 110.331 | 0.000 |
|  | Group 2 | 22 | 368.36 | 34.036 |  |  |
|  | Group 3 | 24 | 299.47 | 49.217 |  |  |
| Disulfide umol/L (umol/L) | Group 1 | 20 | 8.45 | 1.854 | 16.019 | 0.000 |
|  | Group 2 | 22 | 11.80 | 3.031 |  |  |
|  | Group 3 | 24 | 15.24 | 5.653 |  |  |
| Disulfide/native thiol (umol/L) | Group 1 | 20 | 2.16 | 0.708 | 18.738 | 0.000 |
|  | Group 2 | 22 | 4.65 | 1.328 |  |  |
|  | Group 3 | 24 | 5.20 | 2.470 |  |  |
| Disulfide/total thiol (umol/L) | Group 1 | 20 | 2.49 | 1.243 | 21.167 | 0.000 |
|  | Group 2 | 22 | 5.44 | 1.309 |  |  |
|  | Group 3 | 24 | 4.69 | 1.866 |  |  |
| Native/total thiol (umol/L) | Group 1 | 20 | 72.50 | 4.748 | 71.337 | 0.000 |
|  | Group 2 | 22 | 81.02 | 6.375 |  |  |
|  | Group 3 | 24 | 91.05 | 4.124 |  |  |
| IMA (ABSU) | Group 1 | 20 | 0.34 | 0.116 | 185.228 | 0.000 |
|  | Group 2 | 22 | 0.64 | 0.049 |  |  |
|  | Group 3 | 24 | 0.78 | 0.054 |  |  |

F: One-way ANOVA test; IMA: Ischemia-modified albumin; ABSU: Absorbance values; SD: Standard deviation.

**Table 4.** Examination of the differences in investigated blood parameters by adhesion scores

|  | Adhesion scores | N | Mean | SD | F | p |
|---|---|---|---|---|---|---|
| Preop white blood cell ($10^3$/uL) | 0 | 15 | 5.87 | 0.984 | 10.343 | 0.000 |
|  | 1 | 10 | 6.95 | 2.313 |  |  |
|  | 2 | 23 | 10.67 | 5.057 |  |  |
|  | 3 | 18 | 13.89 | 6.121 |  |  |
| Preop amylase (U/L) | 0 | 15 | 41.93 | 10.512 | 7.990 | 0.000 |
|  | 1 | 10 | 48.10 | 10.472 |  |  |
|  | 2 | 23 | 53.30 | 27.542 |  |  |
|  | 3 | 18 | 87.89 | 45.961 |  |  |
| Preop lipase (U/L) | 0 | 15 | 52.73 | 9.004 | 0.280 | 0.839 |
|  | 1 | 10 | 51.20 | 11.811 |  |  |
|  | 2 | 23 | 59.48 | 40.798 |  |  |
|  | 3 | 18 | 64.22 | 68.934 |  |  |

F: One-way ANOVA test; SD: Standard deviation.

need for intensive care after surgery (56% vs. 15%) and the length of hospital stay (11.2±12.0 days vs. 5.8±6.5 days) were higher in patients with a perforated gallbladder than in the other group.

Soiva et al.[12] suggested that stretching of the gallbladder and edema of its walls may be the earliest signs of impending perforation, and evaluated the presence of findings, such as pericholecystic fluid collection, free peritoneal fluid, and loss of

**Table 5.** Comparison of the study groups concerning investigated blood parameters

|  |  | N | Mean | SD | F | p |
|---|---|---|---|---|---|---|
| Preop white blood cell ($10^3$/uL) | Group 1 | 20 | 6.22 | 1.480 | 22.234 | 0.000 |
|  | Group 2 | 22 | 8.44 | 3.013 |  |  |
|  | Group 3 | 24 | 14.30 | 6.175 |  |  |
| Preop amylase (U/L) | Group 1 | 20 | 41.40 | 9.472 | 10.785 | 0.000 |
|  | Group 2 | 22 | 51.59 | 13.497 |  |  |
|  | Group 3 | 24 | 81.46 | 47.284 |  |  |
| Preop lipase (U/L) | Group 1 | 20 | 52.80 | 10.924 | 1.052 | 0.355 |
|  | Group 2 | 22 | 51.59 | 10.340 |  |  |
|  | Group 3 | 24 | 68.17 | 70.087 |  |  |

F: One-way ANOVA test; SD: Standard deviation.

**Table 6.** Relationship between the investigated parameters and patient characteristics

|  |  | Age | Operation time | Hospital stay | BMI |
|---|---|---|---|---|---|
| Native thiol (umol/L) | r | -0.649 | -0.607 | -0.682 | 0.251 |
|  | p | 0.008 | 0.000 | 0.000 | 0.042 |
| Total thiol (umol/L) | r | -0.649 | -0.622 | -0.675 | 0.253 |
|  | p | 0.000 | 0.000 | 0.000 | 0.040 |
| Disulfide (umol/L) | r | 0.569 | 0.484 | 0.443 | -0.213 |
|  | p | 0.000 | 0.000 | 0.000 | 0.085 |
| Disulfide/native thiol (umol/L) | r | 0.560 | 0.408 | 0.390 | -0.258 |
|  | p | 0.000 | 0.001 | 0.001 | 0.036 |
| Disulfide/total thiol (umol/L) | r | 0.509 | 0.336 | 0.277 | -0.005 |
|  | p | 0.000 | 0.006 | 0.024 | 0.970 |
| Native/total thiol (umol/L) | r | 0.435 | 0.569 | 0.614 | -0.164 |
|  | p | 0.000 | 0.000 | 0.000 | 0.188 |
| IMA (ABSU) | r | 0.559 | 0.556 | 0.634 | -0.317 |
|  | p | 0.000 | 0.000 | 0.000 | 0.009 |

r: Pearson's correlation coefficient. BMI: Body mass index; IMA: Ischemia-modified albumin; ABSU: Absorbance values.

gallbladder wall echoes in the preoperative period were signs in favor of gallbladder perforation. In a study by Gore et al.,[13] complex pericholecystic fluid collection, focal deterioration in the wall, and visualization of the gallbladder in or around a pericholecystic abscess were evaluated as significant variables in predicting gallbladder perforation. In our study, pericholecystic fluid was observed in the ultrasonography of 79.2% (n=19) of patients with a perforated gallbladder, and a pericholecystic abscess was present in 25% (n=6). Kim et al.,[14] comparing the pre-operative ultrasonography and computed tomography (CT) images of 13 patients who were confirmed to have postoperative gallbladder perforation, showed that both modalities were equally effective in demonstrating pericholecystic fluid collection, thickening of the gallbladder wall and presence of cholelithiasis. Ultrasonography was success-

ful in determining the perforation site in five patients (38.5%), while CT was successful in nine patients (69.2%), and the latter was superior to the former in revealing omentum adhesions (84.6%).

Thiols are organic compounds containing a sulfhydryl group consisting of a hydrogen atom and a sulfur atom attached to a carbon atom, and they react with oxidants through disulfide bonds and form disulfide bonds.[15] When these disulfide bonds are formed, under suitable conditions, they become sulfhydryl by reducing again to thiol groups, thus providing dynamic thiol/disulfide homeostasis.[16] Erel and Neşelioğlu were the first to report that under oxidative stress conditions, the reduced thiol concentration was increased, the native (non-reduced) thiol concentration was decreased, and the disulfide

values were increased in a correlated manner.[17] Although the literature contains many studies on serum thiol-disulfide homeostasis, which is one of the oxidative stress parameters, and IMA, which is an indicator of ischemia in the body, to our knowledge, there is no research investigating the role of these parameters in gallbladder perforation. In a study conducted with patients with acute myocardial infarction, Kundi et al.[18] reported that the thiol-disulfide, thiol-disulfide/total thiol and disulfide/native thiol values were significantly higher and accordingly concluded that the thiol/disulfide homeostasis could be an important biochemical marker in patients with this condition. Ates et al.[19] evaluated 48 patients with autoimmune subclinical hypothyroidism and suggested that abnormal thiol/disulfide homeostasis might be related to the pathogenesis of patients with autoimmune subclinical hypothyroidism. In another study conducted with 65 patients to investigate the efficacy of thiol/disulfide homeostasis and IMA values in predicting the degree of difficulty of laparoscopic cholecystectomy, Akkurt et al.[20] observed higher mean values for native thiol and total thiol in the patients without a history of cholecystitis than those with a history of this condition, and higher mean values for disulfide, disulfide/native thiol, disulfide/total thiol ratio, native thiol/total thiol and IMA among the cases with a history of cholecystitis than those without this history. In the same study, the IMA, disulfide, disulfide/total thiol, native/total thiol and disulfide/native thiol values were higher in patients with a longer operation time and hospital stay. As the degree of intraoperative pericholecystic adhesion increased, the preoperative values of these parameters were shown to increase in a parallel manner. Based on these findings, the authors suggested that the evaluation of thiol/disulfide hemostasis and IMA parameters before cholecystectomy could be used as an effective method to predict intraoperative difficulties. In recent studies have been shown to be impaired thiol-disulfide homeostasis in chronic kidney disease, diabetes, cardiovascular diseases, liver diseases, cancer, chronic inflammatory joint diseases and various neurodegenerative diseases. Patients with chronic diseases, cancer and active infections were excluded from the study to avoid confusion.[21]

In the current study, in accordance with the literature, as the intraoperative gallbladder adhesion degree, age, operation time and hospital stay increased, the native and total thiol values decreased and the IMA, disulfide, disulfide/total thiol, native/total thiol and disulfide/native thiol values increased.

## Conclusion

We consider that in addition to the routinely used biochemical and radiological examinations, the evaluation of thiol/disulfide hemostasis and IMA parameters before cholecystectomy is an effective and easy-to-apply method in predicting difficulties that may be encountered intraoperatively in perforated gallbladder cases. In addition, we believe that the use of thiol/disulfide hemostasis and IMA parameters can positively contribute to the surgical team in vital issues, such as the

operation being performed by a more experienced surgical team, preparations being undertaken by the operating room staff in advance, making postoperative intensive care preparation, and informing patients about complications.

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## ORİJİNAL ÇALIŞMA - ÖZET

# Thiol/disülfid hemostazı ve iskemi modifiye albümin'in safra kesesi perforasyonu olgularında klinik etkinliğinin araştırılması

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AMAÇ: Safra kesesi taşı olan ileri yaş ve ek hastalığa sahip hastalar, takiplerinde gangrenöz ve perfore kolesistit tablosu ile karşı karşıya kalabilmektedir. Literatürde dinamik thiol/disülfid homeostazisinin; detoksifikasyonda, antioksidan korumada, enzimatik reaksiyonların düzenlemesinde, apoptoziste ve hücresel sinyal mekanizmalarında önemli rol oynadığı gösterilmiştir. Çalışmamızda, kolelityazis, akut/kronik kolesistit ve perfore kolesistit olgularında İMA ve thiol disülfit homeostazının operasyon öncesi tanı koymadaki etkinliğini değerlendirmeyi amaçladık.

GEREÇ VE YÖNTEM: Çalışmaya Şubat 2019–Mayıs 2020 tarihleri arasında kolesistektomi operasyonu amaçlı Ankara Şehir Hastanesi Genel Cerrahi Kliniği'ne başvuran 66 hasta dahil edildi. Hastalar, kolelityazis nedeniyle ameliyata alınan (Grup 1), kolesistit nedeniyle ameliyata alınan (Grup 2) ve perfore safra kesesi nedeniyle ameliyata alınan (Grup 3) olmak üzere üç gruba ayrıldı. Hastaların demografik veriler, kolesistit öyküsü, kronik hastalık öyküsü, ameliyat öncesi ve sonrası çalışılan WBC, amilaz, lipaz ve karaciğer fonksiyon testleri (AST, ALT) kayıt edildi. Hepatobilier ultrasonografide safra kesesi görünümü değerlendirildi. Ameliyat süresi, perikolesistik yapışıklıklar, hastanede kalış süresi, vücut kitle indeksi (VKİ), ameliyat sonrası komplikasyonlar, spesimen patoloji sonuçları kayıt altına alındı. Ek olarak hastalardan ameliyat öncesi alınan kanda thiol/disülfid ve İMA değerleri çalışıldı.

BULGULAR: Adezyon değeri 0 olanların native thiol ve total thiol ortalamaları adezyon değeri 1, 2 ya da 3 olanlara göre anlamlı derecede yüksek izlendi. Ayrıca adezyon değeri 2 ya da 3 olanların disülfid, disülfid/native thiol, native thiol/total thiol oranları ve İMA değerleri adezyon değeri 0 olanlara göre anlamlı derecede yüksekti. Normal kolesistektomi olanların native thiol ve total thiol ortalamaları diğerlerine göre daha yüksek iken, perfore safra kesesi nedeniyle kolesistektomi olanların disülfid, native thiol/total thiol oranı ve İMA ortalamaları da diğer gruplardan daha yüksek olarak izlendi. Perfore safra kesesi nedeniyle kolesistektomi olanların ameliyat öncesi WBC ortalaması da diğer gruplara göre anlamlı olarak daha yüksekti. Son olarak native thiol ve total thiol değerleri ile yaş, ameliyat süresi ve hastanede kalış süresi arasında negatif yönde, VKİ ile pozitif yönde istatistiksel olarak anlamlı derecede bir ilişki bulunmakta idi.

TARTIŞMA: Ameliyat öncesi olarak perfore safra kesesi tanısı koymada thiol/disülfid hemostazı ve İMA parametrelerinin değerlendirilmesinin intraoperatif olarak karşılaşılabilecek zorlukları önceden tahmin etmede etkin ve güvenilir bir yöntem olarak kullanılabileceği düşüncesindeyiz.

Anahtar sözcükler: İskemi modifiye albümin; kolesistektomi; kolesistektomi zorluk derecesi; perfore kolesistit; thiol/disülfid homeostazı.