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Predictors of conversion from laparoscopic to open cholecystectomy

Predictores de conversión de colecistectomía laparoscópica a colecistectomía abierta

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Keywords: cholecystectomy, predictors, critical view, safety, conversion.

Palabras clave: *colecistectomía, predictores, visión crítica, seguridad, conversión.*

ABSTRACT

Introduction: cholecystitis is the acute inflammatory process of the gallbladder wall secondary to lithiasis in 95% of cases. Repeated attacks of acute cholecystitis usually cause chronic cholecystitis. Laparoscopic cholecystectomy may be the most straightforward procedure, or it may become the most difficult laparoscopic procedure; conversion to open surgery has traditionally been a marker of difficult surgery and anticipation to avoid injury and decrease in-hospital stay and complications. **Objectives:** to analyze predictors associated with conversion from laparoscopic to open cholecystectomy. **Material and methods:** an observational, retrospective, single-center, cross-sectional analytical retrospective study was performed from 2016-2018. All cholecystectomies performed were included identifying ultrasonographic and sociodemographic variables, serum laboratories, history of endoscopic retrograde cholangiopancreatography, surgeon experience, and the existence of anatomical variants; it was analyzed by χ^2 in case of non-numerical variables and by Student's t-test for numerical variables. Risk factors were analyzed using a bivariate logistic regression analysis model. A p-value < 0.05 was considered statistically significant. **Results:** 419 patients were studied, of which 57 were excluded, leaving 362 participants divided into two groups: group 1 consisted of those patients in whom laparoscopic surgery was converted to open surgery and group 2 submitted only to laparoscopic cholecystectomy. **Conclusion:** this study showed that the incidence of conversion was 9.6%, and preoperative risk factors predictive of conversion from laparoscopic to open cholecystectomy were found to be age > 65 years, female sex, overweight, C-reactive protein > 10 mg/dl, leukocytes > 10,000 mm^3, and bilirubin > 2 mg/dl. The study showed that intraoperative risk factors were a surgeon in training with only three to four years of experience, and a biliary tract lesion detected, both considered as significant intraoperative risk factors for conversion.

RESUMEN

Introducción: *la colecistitis es el proceso inflamatorio agudo de la pared de la vesícula biliar secundario a litiasis en 95% de los casos. La colecistitis crónica generalmente es causada por ataques repetitivos de colecistitis aguda. La colecistectomía laparoscópica puede ser el procedimiento más sencillo o se puede convertir en el procedimiento laparoscópico más difícil, la conversión a cirugía abierta ha sido tradicionalmente un marcador de cirugía difícil y una anticipación a evitar lesiones y disminuir la estancia intrahospitalaria y complicaciones.* ***Objetivos:*** *analizar factores predictores asociados con la conversión de colecistectomía laparoscópica a colecistectomía abierta.* ***Material y métodos:*** *se realizó un estudio observacional, retrospectivo, analítico transversal unicéntrico, en el periodo de 2016-2018. Se incluyeron todas las colecistectomías realizadas identificando variables ultrasonográficas, sociodemográficas, laboratorios séricos, antecedentes de colangiopancreatografía retrógrada endoscópica, experiencia de cirujano, existencia de variantes anatómicas, se analizó mediante χ^2 en caso de variables no numéricas y mediante prueba t de Student para variables numéricas. Se analizaron los factores de riesgo mediante un modelo bivariado de análisis de regresión logística. Se consideró estadísticamente significativo a un valor de p < 0.05.* ***Resultados:*** *se estudiaron un total de 419 pacientes de los cuales se excluyeron 57, quedando un total de 362 participantes divididos en dos grupos: el grupo 1 lo conformaron aquellos pacientes en quienes la cirugía laparoscópica se convirtió en cirugía abierta y el grupo 2 sólo colecistectomía laparoscópica.* ***Conclusión:*** *este estudio demostró que la incidencia de conversión es de 9.6% y se encontraron factores de riesgo preoperatorios predictores de conversión de colecistectomía laparoscópica a abierta los cuales son: la edad > 65 años, el sexo femenino, el sobrepeso, proteína C reactiva > 10 mg/dl, leucocitos >10,000 mg/dl y bilirrubina > 2 mg/dl. El estudio arrojó, como factores de riesgo intraoperatorios, al cirujano en formación con tres o cuatro años de experiencia, así como a la lesión de vía biliar advertida, la cual fue un factor significante de riesgo intraoperatorio de conversión.*

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Abbreviations:
OS = open surgery.
LC = laparoscopic cholecystectomy.
ERCP = endoscopic retrograde cholangiopancreatography.
USG = ultrasound scan.

INTRODUCTION

Cholecystitis is the acute inflammatory process of the gallbladder wall secondary to lithiasis in 95% of cases. Chronic cholecystitis is usually caused by repeated acute (sudden) cholecystitis attacks. The clinical picture presents mainly with nausea, vomiting, and pain in the right upper quadrant.[1] The diagnosis is based on the Tokyo 2018 criteria, considering as definitive diagnosis the concomitant presence of local inflammatory signs in the right upper abdominal quadrant, signs of systemic inflammatory response, and typical imaging findings.[1] The diagnostic imaging study of the approach is an ultrasound scan, and it is based on the combination of ultrasound findings since there is no pathognomonic sign. The characteristic findings described in cholecystitis are the presence of an impacted gallstone, gallbladder fluid, and overdistension and thickening of the gallbladder wall. The clinical practice guidelines mention the following risk factors for chronic cholecystitis: age over 40 years, female sex, pregnancy, oral contraceptive pill use, and hormonal therapy, as well as obesity, rapid weight loss, parenteral nutrition, diabetes mellitus, and dyslipidemia.[2] The incidence of gallbladder stones is 10-15% of the population of which will be symptomatic and will present biliary colic, acute cholecystitis, jaundice, and acute pancreatitis; laparoscopic cholecystectomy is the surgical treatment of choice for symptomatic cholelithiasis.[2] Nowadays, 10-15% of the adult population in developed countries present biliary lithiasis; in these individuals, the annual risk of developing complications requiring surgical treatment, such as acute cholecystitis, is estimated at 1-2%. Laparoscopic cholecystectomy is a safe and effective method in about 85% of patients with acute cholecystitis. In the United States, it is estimated that 11.8 million people between 20 and 74 years of age have gallbladder stones; there are approximately 1-2% of patients who present asymptomatic gallbladder stones but will present symptoms eventually requiring treatment.[3] Laparoscopic cholecystectomy can be the simplest procedure or it can become the most difficult laparoscopic procedure; conversion to open surgery has traditionally been a marker of difficult surgery and an anticipation to avoid injury and decrease in-hospital stay and complications.[3] Pre- and perioperative factors such as a history of endoscopic retrograde cholangiopancreatography have not been sufficiently evaluated in patients with chronic cholecystitis in whom elective laparoscopic surgery will be performed.[4] Conversion from laparoscopic cholecystectomy to open surgery has been associated with inflammation and fibrosis of Calot's triangle, which generates unclear anatomy and uncontrollable bleeding that could culminate in bile duct injury. The importance of predisposing factors for conversion from laparoscopic cholecystectomy (LC) to open surgery (OS) has been emphasized in numerous studies, many of which have shown that acute cholecystitis is a major risk factor for conversion surgery.[5] It is important to evaluate the determination of preoperative factors that will affect elective laparoscopic cholecystectomy conversion for cholelithiasis, which could give the surgeon an idea of the complexity and intraoperative findings encountered in such surgery.[6] Acute cholecystitis occurs in 15% of all patients with symptomatic cholecystitis, and laparoscopic cholecystectomy for acute cholecystitis is associated with higher conversion levels than elective laparoscopic cholecystectomy. Therefore, selecting a therapeutic strategy and right patient selection may decrease the conversion rate from laparoscopic to open surgery; the correlation between severity based on the Tokyo guidelines and conversion from laparoscopic to open cholecystectomy has not yet been demonstrated.[6] The high conversion rate from laparoscopic to open surgery has prompted interest in the study to identify various predictors of surgical conversion.[7] Patient selection is crucial for safe training and procedure in laparoscopic cholecystectomy.[8] Universally, the conversion rate of emergency laparoscopic cholecystectomy varies between 5 and 40% and is related to difficulty in identifying the anatomy, severe inflammation, hemorrhage,

and adhesions, among other causes. In Latin America, different studies indicate that the conversion rate ranges between 0.8 and 11%.[9] Laparoscopy for cholecystectomy was introduced in the 1980s, originally for elective surgery, but soon became the gold standard for elective and acute cholecystectomy surgery. Laparoscopic cholecystectomy is associated with decreased costs, shorter in-hospital stay, decreased postoperative pain, and a lower risk of deep infections when compared to open surgery. The conversion rate of laparoscopic versus open surgery ranges from 1.9-11.9%.[10] Laparoscopic cholecystectomy is a common surgery in the Western world, usually electively scheduled with low morbidity and mortality. Conversion from laparoscopic to open surgery has been reported in 1.8-27.7%, and conversion of cases has been associated with an increased number of wound infections and postoperative complications, increased additional procedures, and risk of readmission at 30 days. Identifying variables in patients in the preoperative period could help identify those at risk for conversion from laparoscopic to open surgery.[11] When comparing open cholecystectomy with laparoscopic cholecystectomy, it can be seen that the latter presents a lower morbidity and mortality rates [morbidity: open cholecystectomy (18.7%) versus laparoscopic cholecystectomy (4.8%) $p < 0.0001$; mortality: open cholecystectomy (4%) versus laparoscopic cholecystectomy (2.8%), $p < 0.0001$]. Although the surgeon's clinical judgment indicates when and why to perform a conversion to laparotomy, the conversion rate represents a quality indicator, which should be periodically evaluated in the surgical services.[12]

Laparoscopic cholecystectomy for acute cholecystitis is associated with high rates of conversion to conventional surgery compared to elective surgery.[13] In the early years of laparoscopic cholecystectomy conversion was influenced by multiple factors such as patient characteristics (high body mass index, previous abdominal surgeries), anatomical variations of the extrahepatic bile duct and gallbladder, and pathology (severe inflammation of the gallbladder and common bile duct).[13] In early studies in the 1990s, older age, male gender, obesity, previous abdominal surgeries, previous endoscopic retrograde cholangiopancreatography, and ultrasound findings of inflammation were associated with conversion. Subsequent studies showed that gallbladder thickness on ultrasound is a strong predictor for conversion from laparoscopic to conventional cholecystectomy.[14] C-reactive protein is an acute phase reactant secreted by the liver in response to interleukin-6 and other proinflammatory cytokines in inflammation, infection, trauma, malignancy, and infarcted tissue. The synthesis rate determines the concentration in the circulation as a reflection of the intensity of the pathological process and is a good indicator of severe inflammation.[15] Injury or inflammation of the human body increases the concentrations of some serum proteins; the increase during the postoperative period of these proteins is associated with the regeneration and repair process as an act of restoration of the injured tissue. This injury has a positive correlation between serum protein concentrations, especially C-reactive protein, and inflammation severity. C-reactive protein is consistent in response to injury and is the most proof of certainty of acute phase proteins.[16] C-reactive protein is a normal serum component significantly elevated by trauma or inflammation, with C-reactive protein levels beginning to rise 24-72 hours later and returning to normal within two weeks.[17] When laparoscopic cholecystectomy is performed after endoscopic retrograde cholangiopancreatography, the conditions of adhesion, inflammation, and fibrosis around the gallbladder change the anatomy and increase the difficulty for the surgeon performing the surgery.[18] The association with high levels of C-reactive protein is very notable, so incorporating C-reactive protein levels into patient care could serve to diagnose complications such as gangrenous cholecystitis and diagnose early technical difficulties in converting minimally invasive surgery to open surgery.[19] The critical window of safety is a safe method for identifying anatomical structures in an LC, as described by Strasberg in 1995. The critical window is now accepted as the key point for safe cholecystectomy to prevent bile duct injury during laparoscopic cholecystectomy.[20] Dissection becomes more difficult in acute

cholecystitis, where frequent inflammatory reactions occur. It is more time-consuming than the laparoscopic approach, and it is also very complicated to distinguish different tissues. Hence, the range of conversion to open surgery is 15-25%, compared to elective cases, and research on predictors of conversion should be performed to complete an early LC in patients with acute cholecystitis.[21] Sippey comments that literature indicates numerous risk factors that could be predictors for conversion to open surgery, including gender, older age, arterial hypertension, systemic inflammatory response syndrome, preoperative albumin, decreased hematocrit, leukocytosis, hyponatremia, elevated INR, and thickened gallbladder wall by ultrasound.[22] Kevin P. mentions that the duration of symptoms is an important parameter to estimate the changes generated by inflammation in cholecystitis. Some surgeons consider laparoscopic cholecystectomy within 72 hours after the acute event.[17] Narinder reports that the need for conversion from laparoscopic cholecystectomy to open cholecystectomy is 15-25% (five times the conversion rate in cholecystectomy performed for chronic cholecystitis).[23] Due to the biliary tree anatomy, we believe it is necessary to predict factors that could contribute identifying technical difficulties.[24] Currently the criteria of the Tokyo guidelines are recommended for the diagnosis of acute cholecystitis, standardizing the treatment for each type of exacerbation. According to the Tokyo guidelines, diagnostic criteria include physical examination, laboratory findings such as C-reactive protein and elevated white blood cells, and radiological evaluation.[25] The high-risk conversion rates contribute to an interesting study of predictive risk factors, as well as the performance of prompt cholecystectomy in acute cholecystitis; identification of these risk factors leads to careful preoperative screening and prompt cholecystectomy.[26] The National Institute of Health and Nutrition estimates 6.3 million men and 14.2 million women in the United States with gallbladder stone disease with a prevalence over 26%, with women being at higher risk than men.[27] Patient demographics and imaging findings of calculous cholecystitis are predictors of risk in many large series and meta-analysis.[28] Factors associated with complications of laparoscopic cholecystectomy have been associated with advanced age, comorbidities, and risk factors inherent to the underlying disease being treated.[29] Fifteen percent of elective laparoscopic cholecystectomies convert to open surgery; in contrast to acute cholecystitis, the percentage is higher.

The conversion rate depends on the patient's findings, the surgeon's skills, and the available laparoscopic equipment.[30] Preoperative assessment of complexity factors is necessary for various procedures such as LC to identify complications and delays and ensure efficiency during surgery.[31]

MATERIAL AND METHODS

An observational, analytical, retrospective, and cross-sectional study was conducted in the General Hospital "Dr. Miguel Silva" of Morelia, Michoacán, from 2016 to 2018. The sample comprised all cholecystectomies performed in that period; the universe comprised the records of patients diagnosed with chronic calculous cholecystitis who underwent elective laparoscopic cholecystectomy. The variables are the following: conversion from laparoscopic to open cholecystectomy or not, age, sex nutritional status, ultrasonographic variables such as wall thickness > 4 mm, double rail imaging, C-reactive protein > 10 mg/l, leukocytosis > 10,000 mg/l, direct bilirubin >2 mg/dl, history of endoscopic retrograde cholangiography, whether the surgeon was in training, the academic degree of the resident, shift time in which the surgery was performed, whether there was an anatomical variant, bile duct injury detected, and days of in-hospital stay. All elective laparoscopic cholecystectomies performed from January 1, 2016, to December 31, 2018, were reviewed in the operating room registry; once the data were obtained, we went to the hospital archive and reviewed the files to assess those that were complete. Laparoscopic and open cholecystectomies were organized into two groups and the data were emptied into a collection sheet. Numerical variables were expressed as mean and standard deviation, while qualitative variables were expressed as n, proportion, and percentage.

Two groups were formed: 1. Conversion from laparoscopic to open surgery and 2. Differences between groups that were analyzed by χ^2 for non-numerical variables and Student's t-test for numerical variables. Risk factors were analyzed using a bivariate logistic regression analysis model; a p-value < 0.05 was considered statistically significant.

RESULTS

A total of 419 files presenting a diagnosis of chronic calculous cholecystitis were reviewed, of which 57 files were excluded, leaving a total of 362 participants with a mean age of 39.34 years, with the highest percentage (32.04%) of patients in the 21 to 30 years age group. We found that the highest percentage corresponded to the female sex with 78.17% (283), while the male sex obtained 21.82% (79%); according to nutritional status, normal weight predominated with 42.54% (154), followed by overweight with 41.71% (151), then grade I obesity with 9.67% (35), grade II obesity with 4.97% (18), underweight with 0.83% (3) and finally grade III obesity with 0.28%. Two groups of patient files were divided: group 1 consisted of those patients in whom laparoscopic surgery was converted to open surgery (9.67%) and group 2 consisted only of laparoscopic cholecystectomy (90.33%); 35 patients were included in the first group, and 327 patients in the second.

Following conversion predictors were analyzed: age, sex, nutritional status, wall thickness, double rail imaging, CRP greater than 10, leukocytes > 10,000/mm^3, direct bilirubin greater than 2 mg/dl, and history of endoscopic cholangiopancreatography (ERCP) *(Table 1)*. Group 1: a total of 35 patients were included with a mean age of 47.4 years; the age groups are shown in *Table 2*. Eighty percent (28) were female, 20% (7) were male, and only 6 (17.14%) were older than 65 years; in terms of nutritional status, we found a higher risk of conversion in patients who were overweight (40%). Group 2: 327 patients participated with a mean age of 38.47 years; the age groups are shown in *Table 2*; 77.98% (255) belonged to the female sex and 22.02% (72) to the male sex; only 17 (5.20%) were older than 65 years, and regarding nutritional status we found a higher percentage in patients with normal weight (43.12%) *(Figure 1)*. When performing a bivariate analysis for sex and age over 65 years, we obtained statistical significance in both variables. When analyzing the rest of the predictors of conversion of patients in group 1, we observed that most did not have a wall thickness > 4 mm [24 (68.6%)]; double rail imaging was only present in 25.7% (9), CRP > 10 mg/l in 65.7% (23), leukocytes > 10,000/mm^3 in 71.4% (25), direct bilirubin > 2 mg/dl in 11.4% (4), and history of ERCP in 14.29% (5). In group 2, on the other hand, most of them did not have wall thickness > 4 mm with 74.9% (246), double rail imaging was only present in 17.7% (58), CRP > 10 mg/l in 11.9% (39), leukocytes > 10,000/mm^3 13.1% (43), direct bilirubin > 2 mg/dl in 2.5% (10), and history of ERCP in 7.03% (23). When analyzing the predictors of conversion with χ^2, we found that for CRP, we obtained a value of 64.44, with a statistically significant p-value, leukocytes with 70.38/mm^3 with a p-value with statistical significance. Subsequently, the intraoperative conversion risk factors were studied: surgery performed by a physician in training, surgeon's degree of training, shift time, anatomical variant, bleeding greater than 200 ml, and bile duct injury. Most of the patients were operated on by surgeons in training; this represents 65.7% (23), while 34.3% (12) were operated on by the attending physician (group 1). In group 2, most of the patients were operated on by surgeons in training, representing 74.92% (245), while the attending physician operated on 25.07% (82). The training grade that presented the most conversions in group 1 was the fourth grade, with 40% (14); for group 2, we noticed that the third-grade resident was the one who performed the highest number of interventions, with 44.64% (146), followed by the attending physician with 85 (25.99%). When analyzing with χ^2 the degree of training of the physicians we obtained significance only in the surgeries performed by R3 and R4. The shift time in which most surgeries were converted, in group 1 was the morning shift with 74.3% (23). In group 2, the main shift was the morning shift, with 191 (58.4%), followed by the evening shift, with 118 (36.08%), the night shift with 11 (3.3%), and the weekends with only 7 (2.1%).

Table 1: Frequency of predictors of conversion and analysis with χ^2.

Predictors of conversion	Group 1: patients who converted from laparoscopic to open cholecystectomy				Group 2: patients without LC conversion					
	Yes		No		Yes		No			
	n	%	n	%	n	%	n	%	χ^2	p
Wall thickness > 4 mm	11	31.40	24	68.60	81	24.80	246	74.90	0.70	0.3898
Double rail image	9	25.70	26	74.30	58	17.70	269	82.30	1.33	0.2433
PCR > 10 mg/l	23	65.70	12	34.30	39	11.90	288	88.10	64.44	0.0001
Leukocytes > 10,000/mm^3	25	71.40	10	28.60	43	13.10	284	86.90	70.38	0.0001
Direct bilirubin > 2 mg/dl	4	11.40	31	88.60	10	2.50	317	99.70	5.45	0.0146
History of ERCP	5	14.29	30	85.71	23	7.03	304	92.97	2.39	0.1269

No statistical significance was obtained for this variable. The surgeries that were converted presented hemorrhage > 200 mL in 45.7% and biliary tract lesion in 5.7%; in those that were not converted, hemorrhage > 200 ml manifested in 7.6%, with a variant of 0.3%. Finally, complications were studied: surgical wound infection, jaundice, and days of in-hospital stay. The surgeries that were converted presented minimal complications, which were surgical wound infection in 8.6% and jaundice in 5.7%; in group 2, surgical wound infection in 2.4% and jaundice in 1.5%; when analyzing with χ^2 statistical significance was not obtained. The mean length of stay was 3.97 days since most patients had an in-hospital stay of three days (14.40%) even when the surgery was open. In group 2, the mean was 3.12 days, finding that 168 patients stayed only for two days in the hospital, 106 stayed three days, and 24 more than five days.

DISCUSSION

Laparoscopic cholecystectomy is the most performed surgical procedure worldwide, so it is important to impact factors that could predict the risk before complications occur. The conversion rate in this study was 9.6%; this is comparable with the conversion rate ranging from 5 to 40% found in the study of Ergun et al.[11] as well as in the study of Samer al Masri, where the conversion rate was 1.6%.[31] Age > 65 years was the factor studied that represented statistical significance, as mentioned by Yoshikazu Morimoto in his paper, where he found a relationship between complications of surgery in patients above 65 years.[32] In this study, female sex showed statistical significance in contrast to the international literature that mentions that a predictor of conversion is male sex, as reported by Antonio Gengeni in his paper *Risk Factors for Open Conversion in minimally invasive Cholecystectomy*[33] where he also mentions that male sex is an independent risk factor for complications and a risk of conversion from laparoscopic to open cholecystectomy, this predictor factor presents a bias because the majority of the population studied in this hospital was of female gender.[33] Leukocytes > 10,000/mm^3 also proved a predictor since elevated levels at this cutoff point have been associated with conversion from laparoscopic to open cholecystectomy.[33]

Table 2: General graph of factors.

Factors	Group 1. Conversion from laparoscopic to open cholecystectomy (N = 35) n (%)	Group 2. Laparoscopic cholecystectomy (N = 327) n (%)	p
Age (mean) [years]	47.40	38.40	0.324
Age > 65 years	8 (22.80)	72 (22.02)	**0.003**
Female	28 (80)	255 (77.98)	**0.008**
Male	7 (20)	72 (22.02)	0.168
Nutritional status			
Malnutrition	0	0	0
Normal	13 (37.14)	141 (43.12)	0.06
Overweight	14 (40)	137(41.90)	**0.005**
Obesity grade I	4 (11.40)	31 (9.40)	0.135
Obesity grade II	3(8.50)	15 (4.50)	0.139
Obesity grade III	0	1 (0.41)	0.864
Wall thickness > 4 mm per USG	11 (31.40)	81 (24.80)	0.389
The image on the double rail by USG	9 (25.70)	58 (17.70)	0.2433
CRP > 10 mg/dl	23 (65.70)	39 (11.90)	**0.0001**
Leukocytes > 10,000/mm^3	25 (71.40)	43 (13.10)	**0.0001**
Bilirubin > 2 mg/dl	4 (11.40)	10 (2.50)	**0.0146**
History of ERCP	5 (14.29)	23 (7.03)	0.1269
Transoperative risk factors			
Surgeon in training	23 (65.70)	245 (74.90)	0.001
Degree of training			
Attending physician	12 (34.29)	85 (25.99)	0.292
R2	2 (5.71)	36 (11.01)	0.331
R3	7 (20)	146 (44.65)	**0.005**
R4	14 (40)	60 (18.35)	**0.002**
Shift time			
Morning	26 (74.29)	191 (58.41)	0.068
Evening	8 (22.86)	118 (36.09)	0.118
Night	1 (2.86)	11 (3.36)	0.863
Weekend	0	7 (2.14)	0
Anatomical variant	16 (45.71)	127 (38.83)	0.154
Hemorrhage > 200 ml	16 (45.70)	25 (7.60)	0.4788
Bile duct injury	2 (5.70)	1(0.30)	**0.0008**
Post-surgical complications			
Wound infection	3 (8.70)	8 (2.40)	0.0448
Jaundice	2 (5.70)	6 (1.50)	0.1379
Days of hospital stay in-hospital, mean	3.9	3.12	0.222

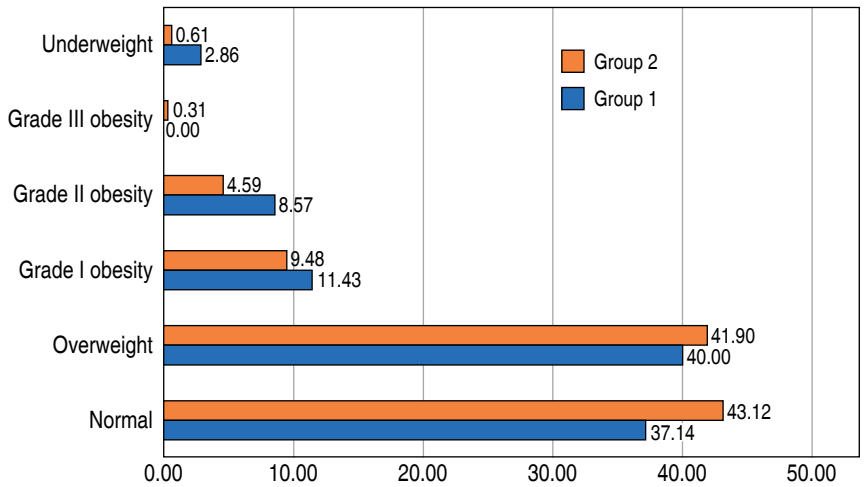

Figure 1:

Percentages of patients' nutritional status.

Ultrasonographic data, such as wall > 4 mm and double-rail imaging of the gallbladder wall, in this study, did not present statistical significance in contrast to several articles, as mentioned by Samer al Masri and colleagues in their article where they report ultrasonographic data as statistically significant.[31] This is probably because ultrasound is operator dependent and several ultrasounds are not performed in this institution, so we believe that this may be the reason. Bilirubin greater than 2 mg/dl is a predictor of conversion in this institution, which had not been studied in published articles; most studies mention total bilirubin levels below 1 mg/dl.[31] The history of ERCP was not a risk factor in the present study, contrasting with what is mentioned in the literature. In our study, factors that could be risk factors were incorporated, such as the fact that the physicians in training performing the surgery was statistically significant. Likewise, the years that turned out to be risk factors were the third and fourth year of residency; the shift time did not prove to be a risk factor. As mentioned in several studies, the hemorrhage greater than 200 ml was not statistically significant and the anatomical variant was not a risk factor. Bile duct injury as a conversion factor turned out to be a risk factor; these variables had not been reported in the literature as risk factors for conversion of laparoscopic cholecystectomy, except for > 200 ml. Licciardello, in his work, mentions that bleeding > 200 ml, as well as leukocytes greater than 10,000/mm^3, are risk factors for conversion from laparoscopic to open surgery. Male gender, age > 65 years, elevated leukocyte count, and ultrasonographic data were predictors; all these agreed with the findings of our study, and only the ultrasonographic factors were not statistically significant. In contrast, postoperative complications such as surgical wound infection, jaundice, and post cholecystectomy, were not risk factors in this study.

CONCLUSIONS

It is important to determine the risk factors that make us refer to a technically difficult surgery prior to surgery. Knowing these factors can prevent serious consequences. According to the surgeon's experience, conversion to open surgery is common when faced with technical difficulty; nowadays, most of the complications can be resolved laparoscopically.

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