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A prospective cohort study for prediction of difficult laparoscopic cholecystectomy

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ABSTRACT

Introduction: Difficult laparoscopic cholecystectomy (DLC) is a stressful condition for surgeon which is followed by greater risk for various injuries (biliary, vascular etc.) Preoperative factors that are related to DLC are landmarks for surgeon to assess the possibilities for overcoming difficulties and making early decision about conversion to an open surgery. In prospective cohort study we evaluated and defined the importance and impact of preoperative parameters on difficulties encountered during surgery, defined DLC, predictors of DLC and index of DLC.

Materials and methods: All patients in the study were operated by the same surgeon. We defined the total duration of the operation as the time from insertion of Veress needle to the extraction of gallbladder (GB) and DLC as a laparoscopic cholecystectomy (LC) that lasted longer than the average duration of LC and the value of one standard deviation.

Results: Multivariate logistic regression analysis identified five predictors significantly related to DLC: GB wall thickness $>$ 4 mm, GB fibrosis, leukocytosis $^{>}10 \times 10^{9}$ g/L, $^{>}$ 5 pain attacks that lasted longer than 4 h and diabetes mellitus. The sensitivity of the generated index of DLC in our series is 81.8% and specificity 97.2%.

Conclusion: Preoperative prediction of DLC is important for the surgeon, for his operating strategy, better organization of work in operating room, reduction of treatment expenses, as well as for the patient, for his timely information, giving a consent for an operation and a better psychological preparation for possible open cholecystectomy (OC).

1. Introduction

Laparoscopic cholecystectomy (LC) is one of the most common laparoscopic procedures in daily surgical practice. It is gold standard in the treatment of gallstone disease. Current selection criteria of patients for LC have become more liberal and the absolute contraindications for its performance are patients with bleeding diathesis, gallbladder carcinoma and patients who have high risk for general anesthesia. Approximately, the conversion rate to open surgery in LC has declined to 2–10% [1,2]. Insufficient surgeon experience and a difficult pathological substrate are the most common reasons for conversion. DLC is a current problem for the surgeon because it is accompanied by a higher risk of biliary, vascular and visceral injuries. Although numerous DLC studies were conducted, no precise consensus on its predictors has been made. Many studies are retrospective and therefore the results depend on quality of medical documentation and its objectivity. The definition of DLC itself is questionable because it neglects the surgeon and his skills that aside from the pathological finding of the gallbladder, play important role in the duration of the operation. Only difficulties during operation that are responsible for significant prolongation can be defined as its predictors. The average duration of operation is individual for each surgeon and it is in the range increased or decreased for the value of one standard deviation. Significant prolongation of operation refers to operation that lasts longer than this range and it is a sign of

Abbreviations: DLC, difficult laparoscopic cholecystectomy; LC, -laparoscopic cholecystectomy; GB, - gallbladder; OC, - open cholecystectomy; AH, -acute cholecystitis; BMI, - body mass index; WBC, -white blood cell counts; CRP, -C-reactive protein; US, ultrasound.

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severe pathological substrate and DLC. DLC is a possible introduction to conversion but not an inevitable pathway to conversion. Therefore, predictors of DLC should be conditionally accepted as predictors of conversion to open cholecystectomy.

The aim of this study is to analyze and evaluate the significance of each preoperative parameter on the course and outcome of LC, to identify risk factors of DLC and to define the predictors of DLC. We defined DLC as operation which lasted longer than the average duration of LC and the value of one standard deviation in our series.

2. Materials and methods

In a prospective study, a total of 369 patients underwent LC over a period of 4 years, from 2005 to 2009, from whom 89 (24.1%) with acute cholecystitis. All patients were operated by the same surgeon. In the study, there were no lethal outcomes. The LC was divided into the following phases: 1. placement of working instruments and pneumoperitoneum creation; 2. Dissection of adhesions around the GB; 3. identification and clipping of the artery and cystic duct; 4. dissection of GB from its bed; 5. GB extraction from the abdominal cavity. DLC was characterized by numerous operative difficulties that significantly prolonged duration of the operation. Diagnosis of acute cholecystitis (AH) was based on a clinical presentantion of acute pain in the right upper quadrant of the abdomen lasting >3 h and requiring an urgent admittance, accompanied with gallstones, tenderness, leukocytosis ˃10×10^9 g/L, body temperature ˃ 37.5 °C and ultrasonography signs–thickened GB wall, edematous GB wall, a positive Murphy's sign or pericholecystic fluid collection.

We defined total duration of the operation as the time from insertion of Veress needle to the removal of gallbladder and DLC as operation which lasted longer than the average duration of LC and the value of one standard deviation in our series.

The average LC time in our study was 43.9 ± 19.4 min. In our study 55(15.3%) patients had DLC with average duration of 80.7 ± 16.1 min.

Routinely available clinical, hematological-biochemical and ultrasonography parameters in predicting a DLC were analyzed and they were correlated with the difficulties while operating, duration of operation and success of LC.

Anamnestic Data: We analyzed data on the gender (m/f), age (>65 years versus < 65 years), course of disease (disease duration > 36 months vs disease duration ˂ 36 months), pain (<five episodes of pain that lasted longer than 4 h vs > five episodes of pain that lasted longer than 4 h, duration of pain prior to admission < 3 days vs duration of pain prior to admission > 3 days), body temperature (>37.5 °C vs < 37.5 °C), diabetes mellitus (yes vs no), previous operations in the upper and lower abdomen (yes vs no), body mass index (BMI < 30 kg/m^2 vs BMI > 30 kg/m^2).

Ultrasound Parameters: In all patients, the same sonographer performed the ultrasound examination at least 24 h before the operation. Data were analyzed on the major axis diameter of GB (≥10 cm vs < 10 cm), the small axis of the GB (>4 cm vs < 4 cm), wall thickness (>4 mm vs < 4 mm), adhesions of the GB (yes vs no), size of stones (>2 cm vs < 2 cm), number of stones (solitary vs multiple) and presence of free fluid in the lodge of the GB (yes vs no).

Biochemical-Hematological Parameters: We analyzed the values of sedimentation (SE) > 20/h versus < 20/h, leukocytes (Le) > 10×10^9/L vs < 10×10^9/L, total bilirubin >20.5 mmol/L vs < 20.5 mmol/L, aspartate aminotransferase (AST) > 40 IU/L vs < 40 IU/L, alanine aminotransferase (ALT) > 50 IU/L vs < 50 IU/L, gamma-glutamyl transferase (GGT) > 49 IU/L vs < 49 IU/L, serum amylase >120 IU/L < 120 IU/L, amylase in urine > 380 IU/L vs < 380 IU/L, C-reactive protein (CRP) > 5 mg/L vs < 5 mg/L.

Pathohistological findings of resected gallbladders: All pathological examinations of resected GB were performed by the same pathologist. Histological findings were classified into acute and chronic cholecystitis and the GB wall fibrosis were analyzed (yes vs no). The outcome variables were: the total duration of operation, duration of certain phases of operation and operative difficulties.

Statistical analysis: Patients were divided into two groups: patients with DLC and patients in whom a LC was performed without any significant difficulties. The two groups were compared using the Student's t-test or the Mann Whitney's U -test for independent (continuous) variables and the $\chi 2$ test for dependent (categorized) variables. The Linear – Pearson's and non-parameter Spearman's correlation quotient were used to test interrelation. We tested the model of interrelation using multivariate linear regression analysis and predictors of difficulties using binary multivariate logistic regression. The difficulty indexes were defined on the bases of the binary multivariate logistic regression quotient whereas DLC index was generated using the standardized β multivariate logistic regression quotients. All analyses were performed using a statistical data processing package SPSS 18.02 (Chicago, IL).

Our work has been reported in line with the STROCSS criteria [3].

All patients were informed of the study and all gave written consent. Ethical Approval: COBISS.SR-ID-45086735.

3. Results

DLC was done in 55(15.3%) patients with average duration of 80.7 ± 16.1 min.

Distribution of potential clinical, ultrasonographic and hematological-biochemical predictors of DLC was shown in Table 1.

DLC was more frequent in male patients (p˂0.01), BMI ˃30 (p˂0.01), in patients with diabetes mellitus (p˂0.01), in cases with ultrasonographically verified GB wall thickness ˃4 mm (p˂0.05) and GB wall fibrosis (p˂0.05) - Table 2.

Leukocytosis ˃10×10^9 g/L (p˂0.05), amylases in urine >380 IU/L (p˂0.05), body temperature >37,5 °C (p˂0.01) at admittance and more than 5 pain attacks lasting longer than 4 h (p˂0.01) were more often present in patients with DLC. DLC was more often related with disease duration longer than 36 months (p˂0.01) – Table 3.

Multivariate analysis of separate group of potential predictors of DLC extracted five predictors significantly related to DLC: GB wall thickness >4 mm, GB fibrosis, leukocytosis ˃10×10^9 g/L, ˃5 pain attacks that lasted longer than 4 h and diabetes mellitus.-Table 4.

Fig. 1 shows a prognostic value of effect of DLC predictors after running multiple logistic regression with 95% confidence interval.

3.1. Predictive index

Analysis of predictors of DLC with multiple backward stepwise logistic regression produced the following equation: P = e y/(1 + ey) whereby "P" stands for predictor of difficult operation, "e" is an exponential constant 2.7182 and "y" = −5.129+ (1.66 x GB wall thickness) + (2.558 x GB fibrosis) + (1.66 x leukocytosis ˃10×10^9 g/L) + (1.541x ˃5 pain attacks that lasted longer than 4 h) – (1.288 x diabetes mellitus). P values higher than 0.63 indicate greater probability of DLC, and the P values greater than 0.981 indicate a certain conversion of LC to OC.

3.2. Scoring system for predicting DLC

On the basis of β quotient of multiple logistic model we defined index for predicting DLC (Table 5).

Sensitivity of index of DLC in our study was 0.818 and specificity 0.974 (Table 6).

4. Discussion

Over the previous several years, numerous studies on predictive capabilities of scoring systems for DLC were published, but there is no clear consensus regarding the parameters predicting the DLC [2–11]. The majority of scoring systems are complex because of the numerous determinating factors usage and they are difficult to use in practice

Table 1
Distribution of the analyzed clinical, ultrasonographical and laboratory predictors.

Variables	DLC Yes(n = 55)	No (n = 304)	P
Age˃65 years	11 (20.0%)	57 (18.8%)	0.828
Gender (M/F)	23 (41.8%)	80 (26.3%)	0.019
BMI ˃30kg/m2	28 (50.9%)	93 (30.6%)	<0.01
Diabetes mellitus	18 (32.7%)	43 (14.1%)	<0.01
Large axis of GB ˃10 cm	39 (70.9%)	20(6.6%)	<0.01
Small axis of GB ˃ 4 cm	43 (78.2%)	46 (15.1%)	<0.01
GB wall thickness ˃4mm	48 (87.3%)	17 (5.8%)	<0.01
Fibrosis of the GB	52 (94.5%)	44 (14.5%)	<0.01
Distented GB	39 (70.9%)	20 (6.6%)	<0.01
Impacted stone of cystic duct	40 (72.2%)	37 (12.2%)	<0.01
Pericholecystic fluid collection	15 (27.3%)	0 (0.0%)	<0.01
Size of calculus ˃2cm	43 (78.2%)	97 (31.9%)	<0.01
Adhesions of the GB	35 (36.6%)	46 (15.1%)	<0.01
WBC ˃10 × 109 g/L	40 (72.7%)	22 (7.2%)	<0.01
Blood sedimentation ˃ 20/h	37 (67.3%)	11 (3.6%)	<0.01
Serum amylase>120 IU/L	17 (30.9%)	1 (0.3%)	<0.01
Urine amylase > 380 IU/L	31 (56.4%)	6 (2.0%)	<0.01
CRP >5mg/L	39 (70.0%)	21 (6.0%)	<0.01
Body temperature ˃ 37,50 C	37 (67.3%)	18 (5.9%)	<0.01
Previous history of acute cholecystitis	15 (27.3%)	50 (16.4%)	0.55
Duration of symptoms longer than 36 months	41 (74.5%)	86 (28.3%)	<0.01
Previous abd. oper. (upper abdomen)	5 (9.1%)	9 (3.0%)	0.031
Previous abd. oper. (lower abdomen)	20 (36.4%)	54 (17.8%)	<0.01
Acute cholecystitis on admission	40 (72.7%)	38 (12.5%)	<0.01
˃5 attacks of pain that lasted longer than 4 hours	33 (60.0%)	10 (3.3%)	<0.01
Duration of pain prior to admission ˃3 days	9 (16.4%)	1 (0.3%)	<0.01

DLC-difficult laparoscopic cholecystectomy; BMI-body mass index; GB-gallbladder; WBC- white blood cell counts; CRP-C- reactive protein.

[3–15].

This study is a continuation of a research regarding identification of predictors of DLC and it used the analysis of routine preoperative clinical parameters (anamnesis, physical examination, ultrasound (US), biochemical-hematological findings) in patients with DLC.

In our study, the final multivariate model showed that GB wall thickness > 4 mm, GB fibrosis, leukocytosis ˃10 × 10^9 g/L, ˃5 pain attacks that lasted longer than 4 h and diabetes mellitus were significant DLC predictors. Sensitivity of DLC predictive index in our series is 0.818, specificity 0.947, positive predictive value 0.850, negative prediction 0.967.

Analyzing US findings, the thickened GB wall ˃ 4 mm and fibrotic GB were statistically significant indicators of DLC.

In healthy population, 97% of individuals have GB wall thickness < 2 mm [16]. Thickened GB wall on preoperative US is a sign of present inflammation or fibrosis due to cholecystitis [5–7]. Jantsch claims that GB wall thickness ˃ 4 mm is a frequent finding in AC [17]. Progression of inflammation is characterized by multiple adhesions of surrounding anatomic structures with the GB and fibrosis or necrosis of the GB wall, which creates difficulties when dissecting Calot triangle elements and the GB from its bed. Inflammation in the end leads to creation of cicatrix and fibrosis.

In a study published by Jantsch at all [17], in 84% of patients with thickened GB wall ˃ 4 mm there were difficulties during LC. Similar results were published by other authors [18,19].

Thickened GB wall was identified as a risk factor for conversion to OC in almost all studies and critical wall thickness differs depending on a particular study. Fried [20] and Corr [21] conclude that wall thickness of GB 3 mm and more, significantly makes dissection of the GB more difficult. Many authors note that the wall thickness of GB 4 mm, 6 mm and 7 mm or more is a factor that significantly makes the LC [22–24] more difficult. In our study a thickened GB wall ˃4 mm was significantly related to more difficult dissection of the Calot triangle elements and the GB, which correlates to the majority of studies [18,20,22,24].

A small, shrunken fibrotic GB is a consequence of repeated episodes of AH accompanied by mechanical irritation of the GB wall with calculi, and on US is manifested by thickened GB wall [5,25–27]. Chronic calculous atrophic cholecystitis with presence of hard fibrosis around the cystic duct and the cystic artery as well as the common hepatic duct is usually accompanied by pericholecystic adhesions and adhesions between cystic duct, cystic artery and hepatic common duct. Patients with small, shrunken fibrotic GB or trabecullar GB due to large gallstones, are candidates for DLC and conversion to OC. Fibrotic changes make grasping of the GB fundus by grasper and the positioning of GB, identification and preparation of artery and cystic duct more difficult, as well as GB dissection from the liver tissue, due to the absence of avascular dissection area between the GB and liver tissue. They significantly prolong operation duration time, increase the risk of hemorrhage, injuries of the common bile duct and GB perforation [1,5,7,8,20]. GB fibrosis was statistically significantly related to more difficult dissection of Calot triangle elements and the GB in our series. In numerous studies shrunken fibrotic GB was identified as a potential LC to OC conversion factor [18,20,24].

In our study there was a significant number of difficulties during the GB dissection in patients who had more than 5 episode of pain that lasted longer than 4 h.

Analyzing 628 operated patients, Sanabria [28] concludes that in those who had more than 10 episodes of disease and severe pain, significant number of difficulties during GB dissection occurred. Alponat [5] did not find the relation between difficulties during the operation and the duration of disease symptoms. Kumar [29], analyzing 536 operated patients, notes significant relation between operative difficulties and more than five attacks of disease and severe pain. Repetition of severe pain episodes is most frequently a consequence of repeated episodes of AH, which leads to GB wall fibrosis. In these patients, GB dissection is more difficult because its movement capacity is limited and there is no avascular layer between the liver tissue and its wall. Artery and cystic duct dissection is more difficult.

Gangrenous cholecystitis more often occurs in patients with diabetes mellitus and this possibility should be predicted even when some of the clear signs are absent [30–33]. The cause is interaction between acute inflammatory response of the GB and the existing microvascular atherosclerotic disease. Autonomous and peripheral neuropathy, in some patients with diabetes, may cause occurrence of symptoms in the later phase of the disease and it may be the reason for delaying the timely diagnosis as well as the greater risk for conversion [34,35].

Acute inflammation progression leads to GB wall ischemia, necrosis and perforation. In our series, multivariate linear regression showed that patients with diabetes mellitus had significantly greater number of difficulties during LC, which is confirmed by some other authors [6,30,31,33–35].

Laboratory findings analysis at admission shows that a level of

Table 2
Relationship of the basic characteristics of patients and ultrasonographic parameters with DLC with various parameters on univariate and multivariate analysis.

	Univariate			Multivariate		
Variables	Odds Ratio	95% CI	P	Odds ratio	95% CI	P
Age ›65 years	1.08	0.53–2.23	0.828	0.75	0.34–1.65	0.474
Gender (M/F)	2.01	1.11–2.64	0.021	2.55	1.35–4.81	0.004
BMI› 30 kg/m^2	2.35	1.31–4.21	<0.01	2.37	1.28–4.42	0.006
Diabetes mellitus	2.95	1.54–5.65	<0.01	2.97	1.45–6.08	0.003
Large axis of GB › 10 cm	34.61	16.55–72.38	<0.01	2.07	0.139–30.71	0.598
Small axis of GB › 4 cm	20.10	9.86–40.99	<0.01	2.80	0.43–18.16	0.281
GB wall thickness › 4 mm	115.76	45.60–293.92	<0.01	4.52	1.09–18.77	0.038
Fibrosis of the GB	102.42	30.64–342.39	<0.01	9.91	1.34–73.58	0.025
Impacted stone of cystic duct	19.24	9.69–38.21	<0.01	5.00	0.22–116.80	0.316
Size of calculus ›2 cm	7.65	3.86–15.15	<0.01	2.21	0.64–7.61	0.208
Adhesions of the GB	9.82	5.21–18.28	<0.01	2.27	0.63–8.38	0.220
Accuracy of predictions 92,2%; Hosmer and Lemeshow Test $\chi 2 = 0{,}833$, $p = 0{,}842$						

DLC-difficult laparoscopic cholecystectomy; BMI-body mass index; GB-gallbladder.

Table 3
Relationship of DLC with hematological and biochemical parameters, the previous clinical findings and clinical findings on admission on univariate and multivariate analysis.

	Univariate			Multivariate		
Variables	Odds Ratio	95% CI	P	Odds ratio	95% CI	P
WBC ›10 × 10^9 g/L	34.18	16.39–71.29	<0.01	4.63	1.20–17.87	0.026
Blood sedimentation › 20/h	54.75	24.01–124.86	<0.01	2.186	0.30–15.75	0.438
Serum amylase>120 IU/L	135.55	117.5–1047.5	<0.01	3.47	033–36.23	0.299
Urin amylase >380 IU/L	64.15	24.37–168.90	<0.01	4.85	1.15–20.54	0.032
CRP >5 g/L	32.85	15.80–68.265	<0.01	2.024	036–11.361	0.423
Previous history of AC	1.91	0.98–3.71	0.058	0.53	0.25–1.14	0.530
Duration of symptoms longer of 36 months	7.42	3.85–14.306	<0.01	8.32	3.98–17.41	<0.01
Previous abd.oper.(upper abd.)	3.29	1.06–10.18	0.040	1.48	0.44–4.97	0.526
Previous abd.oper.(lower abd.)	2.65	1.42–4.93	<0.01	1.77	0.895–3.49	0.101
Body temperature > 37,5 °C	32.66	15.62–68.29	<0.01	11,02	2,36–54.29	<0.01
AC to admission	18.67	9.42–36.99	<0.01	1.34	0.29–6.23	0.708
›5attacks of pain that lasted longer of 4 h	44.10	19.24–101.10	<0.01	16.66	5.90–47.08	<0.01
Duration of pain prior to admission ›3days	59.28	7.34–478.88	<0.01	0.849	0.082–8.77	0.849
Accuracy of predictions 92,2%; Hosmer and Lemeshow Test $\chi 2 = 0{,}833$, $p = 0{,}842$						

DLC-difficult laparoscopic cholecystectomy; WBC-white blood cell counts; CRP-C-reactive protein; AC-acute cholecystitis.

Table 4
Relationship of DLC with group predictors on multivariate analysis.

Predictors	B	P	Exp(B)	95% C·I.for EXP (B)	
				Lower	Upper
GB wall thickness ›4 mm	1.666	.025	5.290	1.228	22.780
Fibrosis of the GB	2.558	.002	12.907	2.497	66.729
WBC ›10 × 10^9 g/L	1.677	.006	5.352	1.621	17.671
› 5 attacks of pain that lasted longer of 4 h	1.541	.018	4.671	1.304	16.729
Diabetes mellitus	1.288	.036	3.625	1.090	12.063
Constant	−5.129	.000			
Accuracy of predictions 94,2%; Hosmer and Lemeshow Test $\chi 2 = 10{,}37$, $p = 0{,}155$; s-statistics = 0,981					

DLC-difficult laparoscopic cholecystectomy; GB-gallbladder; WBC-white blood cell counts.

leukocytosis helps in prediction of DLC. Leukocytosis was the predictive conversion factor in many studies [2,20,36,37]. In our study, in 55 patients who had DLC, in 40 (72.7%) indication for LC was the acute cholecystitis with leukocytosis higher than 10 × 10^9 g/L. Histopathological analysis showed that 5 patients had moderate inflammation and 35 had severe inflammation.

Leukocytosis is a sign of an intensive inflammatory response and an advanced phase of a disease, although immunocompromised patients with complicated AH may have normal or low leukocyte values [38]. Acute gangrenous cholecystitis should be considered in leukocytosis higher than 15 × 10^9 g/L [39], GB gangrene is suspected in leukocytosis higher than 17 × 10^9 g/L [40] and it is indicative when higher than 20 × 10^9 g/L [41,42].

5. Conclusion

Preoperative identification of DLC is particularly important in non-referential LC centers and in hospitals in which OC became a rarity as a primary prevention in intraoperative injuries of the bile ducts and vascular structures. Routinely taken findings in preoperative preparation of patients for LC may help in identifying patients in whom LC is going to be difficult and can hasten decision on conversion to OC as important measure in secondary prevention of intraoperative injuries. If DLC is anticipated, precedence should be given to it when making operative programme. Laparoscopic approach to difficult cholecystectomy is technically more challenging than OC and it requires experienced laparoscopic surgeon. Patients with thickened GB wall higher than 4 mm, GB fibrosis, those who had more than 5 attacks of disease and pain lasting longer than 4 h, leukocytosis higher than 10 × 10^9 g/L and patients with diabetes mellitus are at high risk of DLC.

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Declaration of competing interest

No conflict of interest exists.

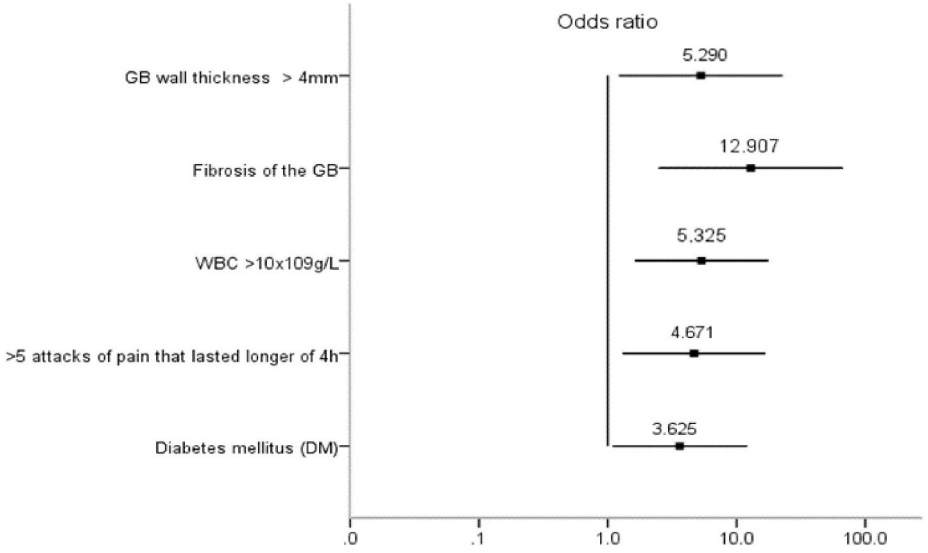

Fig. 1. DLC-difficult laparoscopic cholecystectomy; GB-gallbladder; WBC- white blood cell counts.

Table 5
Index generation DLC.

Variables	B	B/B(DM)	%
GB wall thickness ˃4 mm	1.666	1.293	19.08
Fibrosis of the GB	2.558	1.986	29.31
WBC ˃10 × 10^9 g/L	1.677	1.302	19.21
˃5 attacks of pain that lasted longer of 4 h	1.541	1.196	17.65
Diabetes mellitus	1.288	1.000	14.75
Total		6.778	100.00

DLC-difficult laparoscopic cholecystectomy; GB-gallbladder; WBC- white blood cell counts.

Table 6
Preoperative evaluation score index in 359 patients with LC.

Preoperative Evaluation	Operation		
	Difficult	Not Difficult	Total
Difficult	45	8	53
Not difficult	10	296	306
Total	55	304	359
Statistical measures of the performance of Our Score			
Sensitivity	0.818		
Specificity	0.974		
Accuracy	0.950		
Positive predictive value	0.850		
Negative predictive value	0.967		

LC-laparosopic cholecystectomy.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2020.11.082.

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Author contribution

VS contributed to study design, data analysis and interpretation, manuscript revisions, and drafting the manuscript.

MM contributed to study design, data analysis and interpretation, and manuscript revisions.

NK contributed to data analysis and interpretation analysis.

BS contributed to data acquisition and manuscript revisions.

All authors read and approved the final manuscript.

Guarantor

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