The Usage of Clinical and Ultrasonographic Parameters for Pre-Operative Prediction of Difficult Laparoscopic Surgery

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SUMMARY

Objectives: To evaluate both clinical and ultrasonographic parameters for pre-operative prediction of difficult laparoscopic cholecystectomy.

Methods: In 105 eligible patients who underwent laparoscopic cholecystectomy, during May 2002 to January 2005, at prince Hashim military hospital, patient characteristics, clinical history, laboratory data, ultrasonography results and intra-operative details were prospectively analyzed to determine predictors of difficult laparoscopic cholecystectomy.

Results: Of the 105 patients, 12 (11.4%) required conversion to open cholecystectom. Signification predictors of conversion were body mass index >30 kg/m2, male gender, past history of upper abdominal surgery, and gall bladder wall thickness exceeding 3 mm.

Conclusion: Clinical and ultrasonograpic factors can help predict difficult laparoscopic and likelihood of conversion laparoscopic cholecystectomy of open surgery.

Niger Med J. Vol. 49, No. 1, Jan. – Mar., 2008: 17 – 19.

Keywords: **clinical, ultrasonographic, pre-operative, prediction, laparoscopic surgery.**

INTRODUCTION

Laparoscopic cholecystectomy (LC) may be rendered 'difficult' by various problems encountered during surgery, such as difficulties in accessing the peritoneal cavity, creating a pneumoperitoneum, dissecting the gall bladder (GB), or extracting the excised GB.

We analyzed clinical and ultrasonographic factors that may allow pre-operative prediction of a difficult LC. This could help the patient as well as the surgeon in being better prepared for the intra-operative risk and the risk of conversion to open cholecystectomy (OC).

METHODS AND MATERIALS

In this prospective study, 105 eligible patients who underwent LC between May 2002 and January 2005 were

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included. All the patients had symptomatic cholelithiasis, normal liver function tests, and non-dilated bile ducts. Three patients with concomitant multiple common bile duct stones and one patient with suspected malignancy were excluded, as were those patients in whom LC was done by resident doctors. Patients were admitted to the hospital one day prior to surgery and detailed clinical history was taken. Abdominal ultrasonography was performed within 24 hours before the surgery after a 12-hour fast. Surgeons with experience of doing more than 250 LC over the last 5 years performed the LC.

Body habitus was used as a dichotomous variable (obese [body mass index >30 Kg/m^2] versus non-obese).[1] Previous abdominal surgery was categorized as none (including patients who had previous abdominal wall hernia repair or tubal ligation) versus any intra-abdominal surgery. The subcostal angle was classified as narrow or wide; wide subcostal angle was defined as >90 degrees.

Acute cholecystitis was defined as right upper quadrant pain of acute onset, associated with cholelithiasis and evidence of pericholecystitic fluid collection, and requiring emergency admission.[2] Acute gallstone pancreatitis was defined as cholelithiasis with a raised serum amylase to ten times its normal level at any time prior to surgery. The GB was defined as contracted or distended depending on the shape and transverse diameter. It was defined as distended if the transverse diameter was greater than five centimeters.[3] GB wall thickness was estimated by using the maximal obtainable measurement.[4] The calculus size was evaluated as a dichotomous variable for the purpose of analysis (<1 cm versus> 1 cm). The number of calculi was classified as a dichotomous variable (solitary versus multiple).

The dependent variables (outcomes) included the following operative parameters: duration of surgery (in minutes), bleeding during surgery, access to peritoneal cavity, GB bed dissection, difficult extraction, extension of incision for extraction, and conversion to OC. Bleeding during surgery was graded as minimal, moderate or severe. Moderate bleeding was defined as bleeding leading to tachycardia of greater than 100/min without drop in blood pressure.[3] Severe bleeding was defined as bleeding leading to tachycardia of greater than 100/min with a greater than 10 mmHg drop in blood pressure. Duration of surgery included the time from insertion of the Veress' needle to closure of the trocar insertion site,[4] and was evaluated as a dichotomous variable (<90 min versus >90 min).

The operating surgeon described the access to peritoneal cavity as 'easy' or 'difficult'. Univariate analysis was first performed using the chi-squared test to determine the factors that were associated with difficult LC, and odds ratios and their 95% confidence intervals were calculated.

Next, a correlation matrix was developed to evaluate correlation between individual predictors. A multiple stepwise logistic regression analysis was then performed using all significant predictors from the univariate analysis and relevant interactions. In brief, the following five dummy variables - past history of surgery, past history of acute cholecystitis/acute pancreatitis, patients with BMI >30 Kg/m2, patients with GB wall thickness >3 mm male patients - were assigned value 'I', and '0' otherwise. This provided a formula that allowed calculation of probability of conversion to OC in an individual patient. We used the SAS software (SAS Institute, NC, and USA) for statistical analysis.

RESULTS

The 105 patients (78 women) had a median age of 40 years (range 18 to 75). Difficulty in access to peritoneal cavity was encountered significantly more often in obese patients (p<0.05) and in patients with history of upper abdominal surgery (p<O.O1). (Table 1)

Moderate bleeding during surgery occurred in 23 patients and none had severe bleeding. Bleeding occurred more often in patients with previous upper abdominal surgery (p<0.05), those having GB wall thickness exceeding 3 mm, and those with past history of acute cholecystitis or acute pancreatitis (p<O. 01) (Table 2).

Dissection of GB bed was more often difficult (Table 3) in patients with past history of acute cholecystitis or acute pancreatitis (p<O.OI), and in those with GB wall thickness exceeding 3 mm (p<0.05). Difficulty in extraction was associated with a calculus size greater than 1 cm (OR 5.185; 95% CI 1.81014.849) but not with number of stones (OR 0.873; 95% CI 0.324-2.348). Twelve patients (11.4%) required conversion from

LC to OC, because of the following reasons: inability to delineate anatomy (n=8), bleeding (n=3), and Suspected CBD injury(n=1). On univariate analysis, five factors were significantly associated with conversion to OC; these included obesity, patient gender, past history of acute cholecystitis or acute pancreatitis, past history of upper abdominal surgery, and GB wall thickness >3 nun (Table 4).

A multiple stepwise logistic regression analysis using these five predictors yielded the following equation: P=ey/ (1 + ey), where P indicates the predicted probability of conversion of LC to OC, 'e' is the exponential constant 2.7182 and y =-1.4198 - 1.0218 [GENDER] - 2.7588 [AC/AP] + 1.7550 [OBESITY] + 1.8303 [GB_THICKNESS] - 1.4604 [SURGERY].

A higher value of P indicates a higher likelihood of conversion, with a value of 1.0 indicating certainty of conversion to OC.

Table 3: Relationship of difficulty in gall bladder bed dissection (n=25) with various parameters on univariate analysis

Parameter	Odd ratio	95% confidence interval
Previous acute cholecystits n= 18	0.122	0.040-0.369
Wall thickness>31mn n=32	0.361	0.140-0.919
Surgery in past n= 19	0.671	0.227-1.987
Contracted GB n= 18	0.776	0.247-2.441
Multiple calculi n=67	0.615	0.230-1.642

Table 4: Relationship of conversion to open cholecystectomy (n=12) with various parameter on univariante analysis

Parameter	Odd ratio	95% confidence interval
Previous acute cholecystits n= 18	4.396	1.212-15.947
Wall thickness>3mm n=32	3.808	1.107-13.105
Obese patients n=30	4.261	1.233-14.733
Male gender n=27	3.429	1.001-11.749

DISCUSSION

Conversion to OC is required in 2% to 15% of patients undergoing LC[5,6]. The need for conversion to laparotomy is neither a failure nor a complication, but an attempt to avoid complications. It may be helpful to determine the risk of conversion of an LC to OC beforehand[6]. This may allow the patients to be better prepared for surgery and to plan their absence from work[7]. Also, such prediction may allow a surgeon to be better prepared, to take extra precautions to reduce intra-operative complications, and to convert from LC to OC at an earlier stage.

The risk of conversion to OC is related to surgeon factors, patient factors and, possibly, equipment factors. The most common reason for conversion in our study was inability to delineate the anatomy. Three factors, namely, past history of upper abdominal surgery, past history of acute cholecystitis or acute pancreatitis, and greater thickness of the GB wall, were associated with difficulty in defining the anatomy. Previous abdominal surgery poses problems during creation of pneumoperitoneum and during adhesiolysis to gain adequate

Table 1: Relationship of difficulty in access to peritoneal cavity(n=27) with various parameters on univariate analysis

Parameter	Odd ratio	95% confidence interval
Surgery in past n= 19	0.190	0.067-0.534
Obese patients n=30	0.375	0.149-1.402
Narrow subcostal angle n=44	0.580	0.240-1.402
Xiphi-umbilicual distance n=72	1.407	0.560-3.531

Table 2: Relationship of moderate bleeding (n-23) with various parameters on univariate analysis

Parameter	Odd ratio	95% confidence interval
Surgery in past n= 19	4.149	1.4521-11.869
cholecystitis n= 18	3.840	1.300-11.346
GB wall thickness>3mm n=32	3.382	1.294-8.840
Size of calculus> 1 n=43	2.253	0.081-5.762
Multiple calculi n=67	2.424	0.820-7.173

exposure to the operative field; these problems depend in a large measure on the location of previous surgery. Prior acute cholecystitis or acute pancreatitis results in a scarred and fibrosed GB, and in dense fibrotic adhesions that render laparoscopic dissection difficult. GB wall thickness is related to the inflammation or fibrosis that follows previous attacks of cholecystitis,[3,4] and thus may reflect difficulty in delineation of the anatomy during surgery.

The other two factors that significant predicted the risk of conversion included BMI >30 Kg/m² and male gender. Obesity is known to make access to the peritoneal cavity difficult, thus necessitating conversion to open laparotomy.[8,9] The reason for higher conversion rates in male patients remains unexplained, though male gender has been a significant risk factor in most series.[6,10] It has been observed that male patients have more intense inflammation or fibrosis, resulting in more difficult dissection both in the triangle of Calot and through the plane between the GB and the liver.

In a prospective study of 1,676 patients, Fried *et al*[11] found that age, gender, acute cholecystitis, obesity, and thickened GB wall were significant. Predictors for conversion from LC to OC. Our results are similar to their findings. Prediction of a difficult LC and of conversion to OC may be helpful. Patients with a high-predicted risk of conversion could be operated on either by or under the supervision of a more experienced surgeon[6]. Surgeons in the early phase of their training could operate on patients with low risk of conversion,[11] especially if they are not operating under the supervision of an experienced laparoscopic surgeon. Also, a high predicted risk of conversion may allow the surgeon to take an early decision to convert to OC when difficulty is encountered during dissection; this may shorten the duration of surgery and decrease the associated morbidity.[12]

Our study had certain limitations. First, a selection bias could have crept in, since experienced surgeons tend to operate on cases considered difficult. This may account for the high conversion rate observed in our patients. Second, we did not obtain a prospective validation of the equation that we have derived. In conclusion, clinical and ultrasonograpic findings may help predict a difficult LC. This information may be useful to both the patient and the treating physicians.

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