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Preoperative Grading System for Predicting Operative Conditions in Laparoscopic Cholecystectomy

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Abstract

Purpose. In a previous retrospective study, we predicted the operative conditions for abdominal wall-lifting laparoscopic cholecystectomy (ALLC), using a new preoperative grading system. We conducted the present study to evaluate the validity of our grading system prospectively, and to improve the operative outcome.

Methods. Ninety-seven patients underwent cholecystectomy between January 2000 and March 2002, and were prospectively examined according to our preoperative grading system. Allotting 0–5 points for nine preoperative factors, the total combined score was defined as the predictive score. The postoperative score was defined by allotting 0–8 points to five operative factors. The ratio of the preoperative score / postoperative score was defined as the skill score.

Results. The mean postoperative score was significantly correlated with the predictive score ($P < 0.01$). The mean operation time and the mean postoperative score differed significantly among surgeons with skill scores higher or less than 1.25 ($P < 0.05$). They were significantly improved ($P < 0.05$) by choosing an operator according to the predictive score and skill score.

Conclusion. Our preoperative grading system using the predictive score is a valid method of predicting the actual operative conditions of ALLC. An adequately skilled operator should be chosen according to the difficulty of each case, to ensure the best possible operative outcome.

Key words Laparoscopic cholecystectomy · Abdominal wall lifting method · Grading · Stratification · Skill

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Introduction

It has been more than a decade since laparoscopic cholecystectomy (LC) was introduced clinically, and it is now almost always the operative method of choice for cholecystectomy. Although many improvements in instrumentation and innovative techniques have evolved, some cases are still troublesome and at times result in conversion to open surgery. Despite more sophisticated techniques, thicker and additional trocars, and specialized instruments, prolonged operation time is required for some complicated cases. A more precise preoperative assessment is needed to perform the operation more safely.

Some studies have discussed the role of preoperative investigations to predict the risk factors for conversion, but no established classification exists for predicting actual operative difficulties. We recently reported a preoperative grading system for predicting the operative conditions in abdominal wall-lifting laparoscopic cholecystectomy (ALLC), based on retrospective data. While it showed a significant correlation with the operative outcome,[1] the validity of this grading system has not yet been proven prospectively.

The technique of the operator performing LC has a major influence on the operative outcome. This is because in laparoscopic surgery, the role of the assistant is primarily to expose the operative field, and even in an educational operation, the actual procedure is put in the operator's hands. However, some cases are difficult, even for experienced surgeons, because of severe inflammation or adhesions. Others become troublesome and complicated during the operation because of inexpert technique, associated with a longer operation time, greater blood loss, additional trocars, or even conversion to open surgery. For these reasons, the skill of each surgeon needs to be evaluated objectively, and an adequately skilled operator should be chosen according to the difficulty of each case.

Table 1. Preoperative factors

Previous supraumbilical laparotomy	5 points	White blood cell count during the most recent attack:	
Location of stones:		>15000/mm^3	2 points
Impacted	3 points	10000–15000/mm^3	1 point
Gallbladder and common bile duct	1 point	<10000/mm^3 or unknown	0 points
Gallbladder only	0 points	C-reactive protein during the most recent attack:	
Preoperative drainage:		>15.0 mg/dl	2 points
PTGBD	3 points	5.0–15.0 mg/dl	1 point
ENBD and/or EPBD	1 point	<5.0 mg/dl or unknown	0 points
Latest attack within:		Highest body temperature during the most recent attack:	
2 weeks	3 points	≧38.0°C	1 point
3–4 weeks	2 points	<38.0°C or unknown	0 points
5–24 weeks	1 point	Body mass index:	
25+ weeks or unknown	0 points	>27.0	2 points
		23.0–27.0	1 point
		<23.0	0 points
		History of chronic liver disease, diabetes, or cardiovascular disease	1 point

PTGBD, percutaneous transhepatic gallbladder drainage; ENBD, endoscopic nasobiliary drainage; EPBD, endoscopic papillary balloon dilatation

We performed this study to evaluate the validity of our preoperative grading system prospectively and to improve the operative outcome by evaluating the operative skill of each surgeon objectively.

Patients and Methods

Patients and Operative Techniques

In all cases, ALLC was first attempted using our standard gasless method. Briefly, we introduced a 10-mm trocar below the umbilicus, a 5-mm trocar in the epigastric region, and a 2-mm trocar in the right flank. We then inserted an air disk for lifting the abdominal wall and a 10-mm endoscope through the umbilical incision. According to the operative conditions, we also used an additional trocar in the right flank, thicker trocars, and a Kirshner wire in the right subcostal region to obtain more working space.

All patients underwent elective ALLC at the Kikkoman General Hospital in Chiba, Japan, between January 1997 and March 2002. In our previous study, we retrospectively analyzed 145 patients operated on between January 1997 and December 1999 to evaluate the preoperative grading system.[1] In the present study, 97 patients operated on between January 2000 and March 2002 were divided into two groups and prospectively examined. The first group consisted of 34 patients operated on between January 2000 and December 2000 when the operators were randomly chosen. The second group consisted of 63 patients operated on between January 2001 and March 2002, when the mean predictive score / mean postoperative score ratio was used to evaluate the skill of each surgeon, and the operator was chosen for each case according to the predictive score and this ratio.

Predictive Score and Postoperative Score

Our previous study extracted the factors related to the patient's condition for surgery and we defined two clinical parameters, the predictive score and the postoperative sore.[1] Nine preoperative factors were used to obtain the predictive score, as summarized in Table 1. Coexisting cholecystitis was evaluated from the most recent attack, highest body temperature, white blood cell count, and serum C-reactive protein level. The patients' histories included chronic liver disease, diabetes, and cardiovascular disease. Previous upper abdominal laparotomy, the location of stones, preoperative drainage such as percutaneous transhepatic gallbladder drainage (PTGBD), endoscopic papillary balloon dilatation (EPBD) and endoscopic nasobiliary drainage (ENBD), and body mass index (BMI) were also included in the preoperative factors. Allotting 0–5 points for each preoperative factor, the predictive score was defined as the total number of points.

The postoperative score consisted of five intra- or postoperative factors, namely, operating time, blood loss, additional procedures required, postoperative complications, and conversion to open surgery. Postoperative complications included biliary leakage, bleeding, and abdominal abscess. The postoperative score reflected the actual difficulty of the operation. Conversion was allotted 8 points, and postoperative complications were allotted 5 points. The points allotted for the other factors are summarized in Table 2.

Skill Score

We defined the ratio of mean predictive score / mean postoperative score, performed by each surgeon during a certain period, as the "skill score." The skill score was considered to reflect the actual operating skill of each surgeon objectively.

Methods

The predictive score was compared with the postoperative score to evaluate the validity of this grading system. Operative outcomes such as operation time, blood loss, conversion rate, and postoperative score were compared among surgeons with a skill score less than 1.25 and those with a skill score higher than 1.25. Operative outcomes were also compared between the first and second group to evaluate the improvement brought about by choosing the operator according to the predictive score and skill score.

Statistics

Values are expressed as mean ± SD for the characteristics of the patients, and statistical analysis was done using the unpaired Student's *t*-test. For the operative outcomes, values are expressed as the median (range), and statistical analysis was done using the Mann-Whitney *U*-test and the Yates 2 × 2 square test as appropriate. The correlation between the predictive score and the postoperative score was analyzed by Spearman's rank correlation. A *P* value of less than 0.05 was considered significant.

Table 2. Intra- and postoperative factors

Conversion to open surgery	8 points
Postoperative complications	5 points
Blood loss:	
>500 ml	4 points
200–500 ml	3 points
100–200 ml	2 points
1–100 ml	1 point
0	0 points
Operative time:	
>120 min	3 points
90–120 min	2 points
60–90 min	1 point
≦60 min	0 points
Additional trocars and procedures	
Using Endo-GIA	2 points
Adding another 2-mm forceps	1 point
Changing 2 mm to 5 mm	1 point
Changing 5 mm to 10 mm	1 point
Using 1.4-mm diameter steel wire	1 point

Results

There were 145 patients in the retrospective study, being 57 men and 88 women, with a mean age of 57.6 ± 13.4 years and a BMI of 23.8 ± 3.4. In the prospective study, group 1 consisted of 34 patients, being 17 men and 17 women, with a mean age of 57.4 ± 11.4 years and a BMI of 23.6 ± 3.8, and group 2 consisted of 63 patients, being 28 men and 35 women, with a mean age of 55.3 ± 11.4 years and a BMI of 23.8 ± 4.0. There were no significant differences in sex, age, or BMI among the three groups (Table 3).

The predictive score of both the retrospective (January 1997 to December 1999) and prospective (January 2000 to March 2002) studies showed a significant correlation with the postoperative score in each period. The correlation coefficient was 0.416 ($P < 0.01$) for the retrospective study and 0.436 ($P < 0.01$) for the prospective study (Figs. 1 and 2).

The operation time, blood loss, conversion rate, and postoperative score for group 1 were 89.5 (39–287) min, 75.0 (0–1165) ml, 11.8%, and 4.0 (0–15), respectively. Those for the retrospective group were 70.0 (25–270) min, 0 (0–3079) ml, 6.9%, and 1.0 (0–20), respectively. Thus, the operative outcome did not show improvement.

Five operators performed ALLCs at Kikkoman General Hospital between January 1997 and December 2000. The operative outcomes differed among these surgeons. We defined the ratio of mean predictive score / mean postoperative score performed by each surgeon during this period as the "skill score." The patients operated on by the two surgeons whose skill score was higher than 1.25 had better operative outcomes than those operated on by the three surgeons with a skill score of less than 1.25. The operation time, blood loss,

Table 3. Clinical characteristics of the patients

	Retrospective group	Prospective group	*P*	First group	Second group	*P*
n (M:F)	145 (57:88)	97 (45:52)	n.s.	34 (17:17)	63 (28:35)	n.s.
Age (years)	57.6 ± 13.4	56.0 ± 11.4	n.s.	57.4 ± 11.4	55.3 ± 11.4	n.s.
BMI	23.8 ± 3.4	23.7 ± 3.9	n.s.	23.6 ± 3.8	23.8 ± 4.0	n.s.

Values are expressed as mean ± SD. Unpaired Student's *t*-test
BMI, body mass index; n.s., not significant

conversion rate, and postoperative score were 95.0 (35–287) min, 0 (0–3079) ml, 10.8%, and 2.5 (0–20) points for the surgeons with a skill score of less than 1.25; and 62.0 (25–205) min, 0 (0–1735) ml, 5.7%, and 1.0 (0–20) points for those with a skill score higher than 1.25, respectively. A significant difference was seen in the operation time ($P < 0.001$) and postoperative score ($P < 0.01$) (Table 4).

Thus, the skill score reflected the actual operative skill of each surgeon. Operators with a skill score higher than 1.25 were thought to be good, well trained, or experienced, whereas those with a skill score of less than 1.25 were thought to be in their training stage or inexpert.

In group 2, consisting of patients operated on between January 2001 and March 2002, the surgeon for each case was chosen according to the predictive score and the skill score, those with a higher skill score being chosen to operate on patients with a high predictive score. Consequently, the operation time, blood loss, conversion rate, and postoperative score were 66.0 (35–178) min, 0 (0–1390) ml, 7.9%, and 2.0 (0–16), for group 2 (Table 5). The operation time and the postoperative score were significantly better in group 2 than in group 1 ($P < 0.05$). The blood loss and the conversion rate were also better, but the difference was not significant.

Discussion

Laparoscopic cholecystectomy is less invasive than open cholecystectomy, and has become widely adapted as the procedure of choice during the past decade. However, some cases are still troublesome, occasionally resulting in conversion to open surgery. Thus, a more

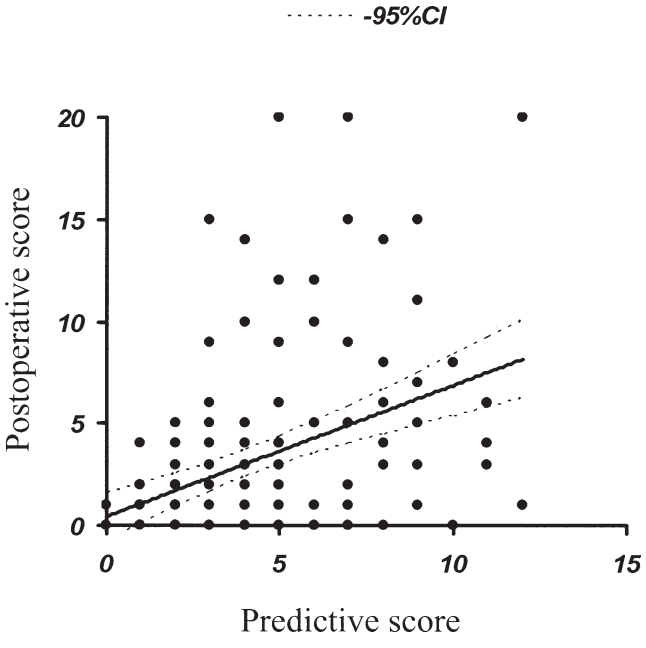

Fig. 1. Correlation between predictive and postoperative scores in the retrospective study. Spearman's rank correlation. A highly significant correlation was seen; correlation coefficient = 0.416 ($P < 0.01$). *CI*, confidence interval

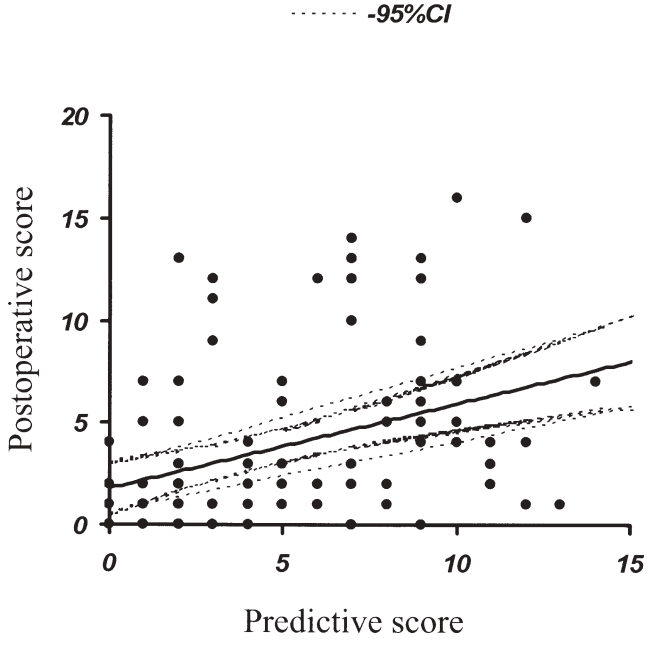

Fig. 2. Correlation between predictive and postoperative scores in the prospective study. Spearman's rank correlation. A highly significant correlation was seen; correlation coefficient = 0.436 ($P < 0.01$)

Table 4. Operative outcomes in each group

	Skill points <1.25	Skill points >1.25	*P*
Operation time (min)	95.0 (35–287)	62.0 (25–205)	<0.001
Blood loss (ml)	0 (0–3079)	0 (0–1735)	n.s.
Conversion rate (%)	10.8	5.7	n.s.
Postoperative score	2.5 (0–20)	1.0 (0–20)	<0.01

Values are expressed as the median (range). Mann-Whitney *U*-test and Yates 2 × 2 square test

Table 5. Operative outcomes for surgeons with a skill score higher or less than 1.25

	First group (Jan. 2000–Dec. 2000)	Second group (Jan. 2001–Mar. 2002)	*P*
Operation time (min)	89.5 (39–287)	66.0 (35–178)	<0.05
Blood loss (ml)	75.0 (0–1165)	0 (0–1390)	n.s.
Conversion rate (%)	11.8	7.9	n.s.
Postoperative score	4.0 (0–15)	2.0 (0–16)	<0.05

Values are expressed as the median (range). Mann-Whitney *U*-test and Yates 2 × 2 square test

precise preoperative assessment is needed for each individual case to ensure that the operation is performed safely and to avoid unexpected conversion to an open procedure.[2]

Several studies[3,4] have predicted the operative conditions and conversion rate of LC from the clinical manifestations, laboratory findings, ultrasound findings, and the surgeon's skill. However, the actual operative conditions are too complicated to be evaluated by a single factor[2] and should be evaluated based on all associated factors together.[5]

We previously introduced a new scoring system for predicting the operative conditions of ALLC by combining nine preoperative factors that are objective and easy to obtain prior to surgery. First, we evaluated the actual operative conditions from the postoperative score, including operation time, blood loss, additional procedures, conversion, and postoperative complications. Preoperative factors were verified according to the correlation with the postoperative score. Coexisting cholecystitis, history, previous upper abdominal laparotomy, preoperative drainage (such as PTGBD, EPBD, and ENBD), location of stones, and BMI were correlated with the postoperative score, and were allotted appropriate points according to the correlation. The predictive score was defined as the total number of points, and 145 patients operated on between January 1997 and December 1999 were retrospectively analyzed according to this grading system. The predictive score of the retrospective group was significantly correlated with the postoperative score; correlation coefficient = 0.416 ($P < 0.01$) (Fig. 1). Patients with a higher predictive score had a longer operation time, greater blood loss, and a higher conversion rate.[1]

In the present study, the predictive score was strongly correlated with the postoperative score, prospectively. Patients with a higher predictive score had a longer operation time, greater blood loss, and a higher postoperative score than those with a lower predictive score. The predictive score reflected the actual conditions of the operation. These results clearly show the validity of the nine preoperative factors chosen to predict the operative conditions of ALLC. Thus, we believe that our preoperative grading system using the predictive score is a reliable and feasible method for predicting the actual operative conditions. However, the operative outcome did not improve in the first group when the operators were chosen randomly. Therefore, predicting the difficulty of the operation before surgery was not enough to improve the operative outcome, and some other measure was needed. Greenwald et al.[6] reported how they improved operative outcome by controlling who performs the operation. We defined the ratio of mean predictive score / mean postoperative score, of each surgeon during a certain period, as the "skill score." The skill score evaluated the technique of each surgeon objectively; with a higher skill score being considered to reflect a "well-trained" or "experienced" surgeon. Van den Broek et al.[7] reported a conversion rate of 13% in LC performed by general surgeons and 2% in LC performed by specialized surgeons, suggesting that the actual skill of the operator has a large influence on the conversion rate. Several other studies[8–10] indicate that surgical experience is an important factor in operative outcome and our study supports these opinions. In group 2, surgeons with a high skill score were chosen to perform operations with a higher predictive score, and the operative outcome improved. The improvement was more remarkable in patients with higher predictive scores, and there are two possible reasons for this. First, the surgeons were able to make better decisions about the need for additional trocars or conversion more quickly according to the predictive score, especially in difficult cases. Second, by evaluating the technique of each surgeon objectively, an adequate operator for each case was chosen according to the surgeon's skill. Development of the surgical skills necessary to perform LC is required to improve the operative outcome even further.

We conclude that our novel preoperative grading system using the predictive score is a reliable and feasible method for predicting the actual operative conditions of ALLC. Thus, while it is important to predict the operative conditions prior to surgery and make better operative plans to improve the operative outcome, it is also essential to evaluate the skill of each surgeon objectively and choose an adequately skilled operator according to the difficulty of each case.

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