Original Article

Journal of Kathmandu Medical College, Vol. 11, No. 1, Issue 39, Jan.-Mar., 2022

Operative difficulty grading scale for laparoscopic cholecystectomy at a tertiary care hospital in Eastern Nepal

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Abstract

Background: Predictions of difficult cholecystectomy preoperative make the surgeon prepared, thereby making a more careful dissection, back up from senior surgeons, and a low threshold for early conversion.

Objectives: To utilise an operative grading scale to predict open conversion, duration of surgery, total length of stay, complications and to validate Nassar score.

Method: This was a prospective cross-sectional study done from 2020 July 9 to 2021 January 30 after ethical clearance among all patients of BPKIHS planned for laparoscopic cholecystectomy for symptomatic gallstone disease. Nassar scale was used for risk evaluation of difficult cholecystectomy. The intraoperative outcome parameters were bleeding, bile spillage, stone spillage, presence of bowel or biliary injury, operative time and conversion to open surgery. Postoperative outcomes noted were total length of stay, 30-day complications, reintervention, and mortality. The data were entered in Microsoft Excel sheet 2010 and analysis was done in SPSS v.26.

Results: Seventy-four patients were analysed. Comparison of Nassar scoring system with outcomes revealed a significant association of rising Nassar grade with bile spillage, stone spillage, bleeding, post-surgical drain placement, conversion to open, duration of surgery, and total length of stay. Operative time was significantly more in male, cholecystitis, and interval cholecystectomy. Conversion to open was significantly associated with Nassar grade 4, acute cholecystitis, and interval cholecystectomy. There was no mortality, 30-day reintervention, and complication.

Conclusion: Nassar operating scale is simple scale that can be used by all level of surgeons to predict difficult laparoscopic cholecystectomy. Rising grades have significant correlation with difficulty and complications.

Key words: Cholecystectomy; Cholecystitis; Laparoscopic; Nassar grade; Surgery.

Access this article online

Website: www.jkmc.com.np

DOI: https://doi.org/10.3126/jkmc.v11i1.45496

HOW TO CITE

Sah NP, Gupta RK, Awale L, Deo KB, Sah RP, Kumar A. Operative difficulty grading scale for laparoscopic cholecystectomy at a tertiary care hospital in Eastern Nepal. J Kathmandu Med Coll. 2022;11(1):58-67.

Submitted: Jan 08, 2022
Accepted: Mar 08, 2022
Published: May 24, 2022

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ISSN: 2019-1785 (Print), 2091-1793 (Online)

INTRODUCTION

The probability of encountering difficult cholecystectomy is 16.8%.[1] The common causes are age >65 years (40%), obesity (41%), acute cholecystitis (67%), male (10%), previous abdominal surgery (33%), gall bladder stone (90%) and common bile duct stone (21%) which may require conversion.[2,3] Difficult cholecystectomies are mainly due to adhesions (44.4%), contracted gall bladder (15.07% to 88.1%), stone impacted in Hartmann's pouch (55.6%), time to identify cystic pedicle >90 min (11.1%) and following Endoscopic Retrograde Cholangiopancreatography.[1,4]

Difficult cholecystectomy is associated with biliary injury in 0.2%-1.7% compared to 0.2-0.3% in laparoscopy cholecystectomy.[5] They are associated with a conversion

rate of up to 4.35%.[1] The reason for conversion are the inability to describe the anatomy and difficult dissection, followed by secondary issues such as haemorrhage.[6] The various predictive models are: the Nassar scale, Cuschieri scale, Parkland Scale, and Sugrue scale.[5] However, none of them have established tools to reliably predict the difficulty.

Nassar grading system is simplified tool including gall bladder appearance, cystic pedicle, and adhesion and categories into four grades.[5] This study was conducted with the aim of utilising an operative grading scale to predict open conversion, duration of surgery, total length of stay, and complications as well as to validate the Nassar score.

METHODOLOGY

This was a prospective cross-sectional study done in the department of surgery in B. P. Koirala Institute of Health Science (BPKIHS), Dharan, Sunsari, Nepal from 9th July 2020 to 30th January 2021. All patients planned for laparoscopic cholecystectomy for symptomatic gallstone disease were included after obtaining duly signed informed consent. The patients with malignancy of the extrahepatic biliary tree, cholecystectomy as a part of surgery, and open cholecystectomy were excluded. The patients were evaluated for clinico-demographic parameters like age, sex, comorbidities, preoperative interventions, and preoperative laboratory work-up. Trans-abdominal ultrasonography was the primary radiological modality and details like number and size of the stone, gall bladder wall thickness, common bile duct diameter, presence of mucocoele, etc were noted. Magnetic resonance cholangiopancreatography (MRCP) was done in case of suspicion of bile duct stones. Bile duct suspicion done in case of jaundice and raised alkaline phosphatase. Ethical clearance was taken from the institutional review committee (IRC) of BPKIHS (Ref. 1758/020).

For evaluation of the risk of difficult cholecystectomy, the Nassar scale was used.[6] The Nassar Grading Scale includes gall bladder appearance, cystic pedicle, and associated adhesions. Based upon these criteria, difficulty levels were graded in the four grades (Table 1). Grade five was Mirizzi type two or higher, cholecysto-cutaneous, cholecysto-duodenal or cholecysto-colic fistula which was included in type four.

Laparoscopic cholecystectomy was done using the standard four-port technique. Intraoperative findings with special attention to gall bladder appearance, cystic pedicle, and associated adhesions were noted. The decision of conversion to open surgery was made if excessive bleeding occurred, difficult to identify cystic duct and cystic artery due to frozen Calot's triangle, time to identify cystic duct and artery more than 60 minutes, associated bile duct and bowel injury were present. The decision of conversion to open surgery was further confirmed in consultation with a senior surgeon or a second surgeon in case of the senior surgeon being the primary operating surgeon. The intraoperative outcome parameters noted were bleeding, bile spillage, stone spillage, presence of bowel or biliary injury, operative time and conversion to open surgery. Post-operative outcomes noted were total length of stay, 30-day complications, reintervention, and mortality.

Bleeding was defined as vascular injury, slippage of clips/ligatures of the cystic artery, and liver bed bleeding. Operative time was the duration of surgery from opening the first umbilical port to the closure of the port with a skin stapler. Drains were kept if significant biliary and/or vascular injury or bleeding (>100 mL), empyema, mucocoele, and acute cholecystitis. The discharge criteria were able to tolerate an oral diet, mobilise safely, hemodynamically stable without significant pain, nausea, and/or vomiting.

Patients were discharged after 24 hours if vital stable and patient taken orally on the first post-operative day. If the drain was kept, the patient was discharged only after the drain output was less than 50 min and the serosanguinous content. If associated bowel injury or bile duct injury was present, it was managed accordingly with the help of a senior consultant surgeon. All patients were asked to follow up with Surgery Outpatient Department physically after one week and four weeks. Since histopathology report was also given after four weeks, it was easy to do follow-up of the patients as well as reviewing the histopathology report. Any complications, 30-day reintervention, morbidity, and mortality were noted.

In this study, sample size was estimated considering 95% confidence interval and 80% power to estimate sample size. In this regard, the authors used Nassar grading scale to identify the complication by grading wise. According to literature review conducted by Griffths et al., complication conversion to open found 27% in Nassar grade four scale.[5] Therefore, present study considered 1% proportion sample size formula. Proportion of patients with complication (p) = 0.27 (27%); q = 1-p. Taking permissible error, L = 0.054 (20% of p). Using one sample formula, $n_0 = Z^2pq/ L^2$ Z at 95% confidence interval = 1.96; $n_0 = 259.66 \approx 260$. But during the study

period, only 100 cases were operated by investigators. Due to corona virus disease 2019 (COVID-19) pandemic, routine laparoscopic cholecystectomy cases were done less as comparison to normal study period. Therefore, taking N = 100, the correction sample size formula to be used for sample size estimation gave the corrected sample size, $n = n_0/(1+n_0/N)$; $n = 72.22 \approx 74$.

The data were entered into Microsoft Excel 2010 sheet and transferred to IBM SPSS Statistics for Windows, version 26 (IBM Corp., Armonk, N.Y., USA) for analysis. For the quantitative studies, mean and standard deviation was used for parametric variables and the median with interquartile range was used for nonparametric variables. Independent t-test and Mann-Whitney U test was done for quantitative variables to assess the level of significance. P-value of less than 0.05 was considered significant. For the qualitative studies, the comparison of outcome variables between the two groups was done using Chi-square test and Fischer exact test as required. The Welch's one-way ANOVA was used to evaluate the relationship of the Nassar scale with the continuous outcomes of duration of surgery. Receiver operating characteristic (ROC) curve analysis was done using cut off value of duration of surgery >90 minutes and total length of stay more than two days.

RESULTS

A total of 74 patients were analysed. The mean age was 40.12 ± 13.23 (Mean ± SD) with female preponderance (60, 81.1%). The clinico-demographic details, preoperative factors, operative factors, and patient outcomes are shown in Table 2. The diagnoses during the surgery were biliary colic (62, 83.7%), acute calculus cholecystitis (7, 9.45%), and biliary pancreatitis (5, 6.75%). Laparoscopic cholecystectomies were performed as an elective procedure in 64 (86.5%) patients and as interval cholecystectomy in 10 (13.5%) patients.

Patients were categorised as Nassar grade one in 51 (68.9%) patients, grade two in 9 (12.2%) patients, grade three in 9 (12.2%) patients, and grade four in 5 (6.8%) patients (Table 1). There were two (3.2%) cases of Nassar grade four, and 5 (8.1%) cases of Nassar grade three in biliary colic patients but there were three (60%) cases of Nassar grade one in biliary pancreatitis (Table 3). Bile spillage, stone spillage, and bleeding were present in 20 (27%) patients, 11 (14.9%) patients, and 21 (28.4%) patients respectively (Table 2). Post-surgical drain placement and conversion to open were present in 11 (14.9%) patients and one (1.4%) patient respectively. There was no biliary leakage present in the drain in any of the patients. The drain was removed once the drain output was less than 50 ml and serosanguinous in content. The laparoscopic procedure was converted to open in one (1.4%) patient. The reasons for conversion were frozen Calot's triangle in which it was difficult to proceed laparoscopically. All 74 (100%) patients, had good recovery. There was no mortality.

The comparison of various grades of Nassar scoring system with the perioperative outcomes revealed a significant association of rising Nassar grade with bile spillage (p-value = 0.012), stone spillage (p-value = 0.003), bleeding (p-value <0.001), post-surgical drain placement (p-value <0.001), conversion to open (p-value = 0.003) and duration of surgery (p-value = 0.001) (Table 4). There was a significant association of rising Nassar grade with total length of stay (p-value = 0.001) (Table 4). The operative time was significantly more in male patients (p-value = 0.001), cholecystitis patients (p-value <0.001), and interval cholecystectomy admitted after six weeks (p-value = 0.024) (Table 5). Conversion to open was significantly associated with Nassar grade four (p-value = 0.003), acute cholecystitis (p-value = 0.008), and interval cholecystectomy admitted after six weeks (p- value = 0.01) (Table 6).

In ROC curve analysis, the association of Nassar grade with surgical variables and patient outcome were calculated. Operative time of more than 90 minutes and a post-operative hospital stay of more than two days were taken as cut off values. The analysis showed a strong association of rising Nassar grade with operative time (AUROC = 0.877), post-surgical drain placement (AUROC = 0.895), conversion to open (AUROC = 0.973) and postoperative hospital stay more than two days (AUROC = 0.959) (Table 7). ROC curve areas are mentioned in Figure 1-7.

Table 1: **Nassar grading**

Nassar grade	Gall bladder	Cystic pedicle	Adhesion
Grade 1	Floppy, non-adherent	Thin and clear	Simple up to the neck/Hartmann's pouch
Grade 2	Mucocoele, packed with stones	Fat-laden	Simple up to the body
Grade 3	Deep fossa, acute cholecystitis, contracted, fibrosis, Hartman's adherent to common bile duct (CBD), impaction	Abnormal anatomy or cystic duct-short, dilated, or obscured	Dense up to fundus; involving hepatic flexure or duodenum
Grade 4	Completely obscured, empyema, gangrene, mass	Impossible to clarify	Dense, fibrosis, wrapping the gall bladder, duodenum, or hepatic flexure difficult to separate

Table 2: **Demographic, preoperative factors, operative factors, and patient outcomes** **(N = 74)**

Characteristics	Categories	Patient
	Demographics	
Age in years, n (%)	<40	41 (55.4)
	40 – 49	17 (23)
	50 – 64	11 (14.9)
	≥65	5 (6.8)
Mean age in years ± SD (minimum - maximum)		40.12 ± 13.23 (19 - 73)
Gender, n (%)	Female	60 (81.1)
	Male	14 (18.9)
Chief complaint		**n (%)**
Pain in epigastric region		41 (55.4)
Pain in right upper quadrant		33 (44.6)
The median duration of history of a month (IQR) (Minimum - Maximum)		6 (3.75 - 12) (1 - 72)
Diagnosis, n (%)	Colic	62 (83.7)
	Cholecystitis	7 (9.45)
	Pancreatitis	5 (6.75)
Type of admission		**n (%)**
Delay		10 (13.5)
Elective		64 (86.5)
Preoperative investigation		**n (%)**
Ultrasonography finding	Cholelithiasis	66 (89.2)
	Chronic cholecystitis	7 (9.5)
	Thickened gall bladder wall	1 (1.4)
Number of stones	Single	12 (13.2)
	Few	9 (12.2)
	Multiple	53 (71.6)
Perioperative factors		**n (%)**
Nassar grade	One	51 (68.9)
	Two	9 (12.2)
	Three	9 (12.2)
	Four	5 (6.8)
ASA	One	58 (78.4)
	Two	15 (20.3)
	Three	1 (1.4)
Mean duration of surgery in min ± SD (Minimum-Maximum)		52.01 ± 19.12 (30 - 120)
Parameters		**n (%)**
Bile spillage		20 (27)
Stone spillage		11 (14.9)

Bleeding	21 (28.4)
Post- surgical drain	11 (14.9)
Converted to open	1 (1.4)
Patient outcome	
The median total length of stay in a day (IQR) (Minimum – Maximum)	1 (1 – 2) (1 – 3)

Table 3: Association of Nassar grade with diagnosis of the patients, n (%)

	Nassar grade	1	2	3	4	p-value
Diagnosis	Biliary colic	48 (77.4)	7 (11.3)	5 (8.1)	2 (3.2)	<0.001
	Acute cholecystitis	-	2 (28.6)	2 (28.6)	3 (42.9)	
	Biliary pancreatitis	3 (60)	-	2 (40)	-	

Table 4: Association between Nassar operative difficulty scale with other selected variables and surgery outcome

Characteristics	Categories	Nassar grade				p-value
		1	2	3	4	
Perioperative factors						
Duration of surgery (minutes)	Mean (minimum- maximum)	46.59 (30-90)	53 (35-87)	61.1 (30-90)	89.2 (40-120)	0.001
Bile spillage, n (%)	No	42 (82.4)	6 (66.7)	5 (55.6)	1 (20)	0.012
	Yes	9 (17.6)	3 (33.3)	4 (44.4)	4 (80)	
Stone spillage, n (%)	No	48 (94.1)	6 (66.7)	7 (77.8)	2 (40)	0.003
	Yes	3 (5.9)	3 (33.3)	2 (22.2)	3 (60)	
Bleeding, n (%)	No	44 (86.3)	5 (55.6)	3 (33.3)	1 (20)	<0.001
	Yes	7 (13.7)	4 (44.4)	6 (66.7)	4 (80)	
Post-surgical drain, n (%)	No	50 (98)	7 (77.8)	5 (55.6)	1 (20)	<0.001
	Yes	1 (2)	2 (22.2)	4 (44.4)	4 (80)	
Converted to open, n (%)	No	51 (100)	9 (100)	9 (100)	4 (80)	0.003
	Yes	-	-	-	1 (20)	
Patient outcome						
Total length of stay (days)	Mean (minimum- maximum)	1.12 (1-2)	1.33 (1-2)	2.22 (2-3)	2.40 (1-3)	0.001

Table 5: Association between duration of surgery and other selected variables

Variables	Categories	No of patients	Duration of surgery	p-value
			Mean ± SD	
Nassar grade	One	51	46.59 ± 13.324	<0.001
	Two	9	53.00 ± 15.764	
	Three	9	61.11 ± 19.808	
	Four	5	89.20 ± 29.719	
Gender	Female	60	50.50 ± 16.538	0.001
	Male	14	58.50 ± 27.514	
Diagnosis	Colic	62	48.66 ± 15.785	<0.001
	Cholecystitis	7	77.43 ± 29.799	
	Pancreatitis	5	58.00 ± 13.964	
Admission type	Delay	10	70.00 ± 26.458	0.024
	Elective	64	49.20 ± 16.264	

Table 6: Association between converted to open and other selected variables

Characteristics		Converted to open		p- value
		No	Yes	
Nassar Score	One	51	-	0.003
	Two	9	-	
	Three	9	-	
	Four	4	1	
Diagnosis	Biliary colic	62	-	0.008
	Acute cholecystitis	6	1	
	Biliary pancreatitis	5	-	
Admission type	Delay	9	1	0.01
	Elective	64	-	

Table 7: Area under the curve (AUC) analysis by ROC between Nassar scale and operative factors and patient outcome

Variables	Area under curve (AUC)	Standard error	p-value
Duration of surgery >90 minutes	0.877	0.101	0.002
Bile spillage	0.685	0.076	0.015
Stone spillage	0.759	0.086	0.006
Bleeding	0.766	0.068	<0.001
Post-surgical drain	0.895	0.058	<0.001
Converted to open	0.973	0.025	0.106
Total length of stay more than two days	0.959	0.025	0.001

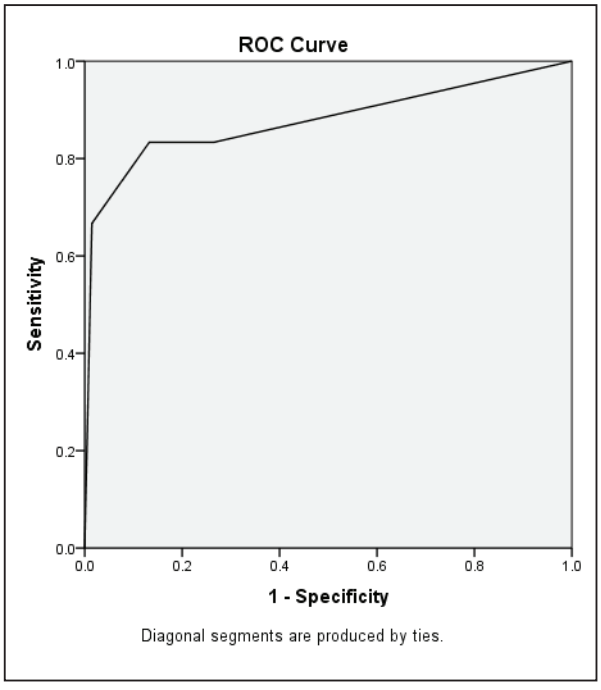

Figure 1: Duration of surgery (cut off >90 min)

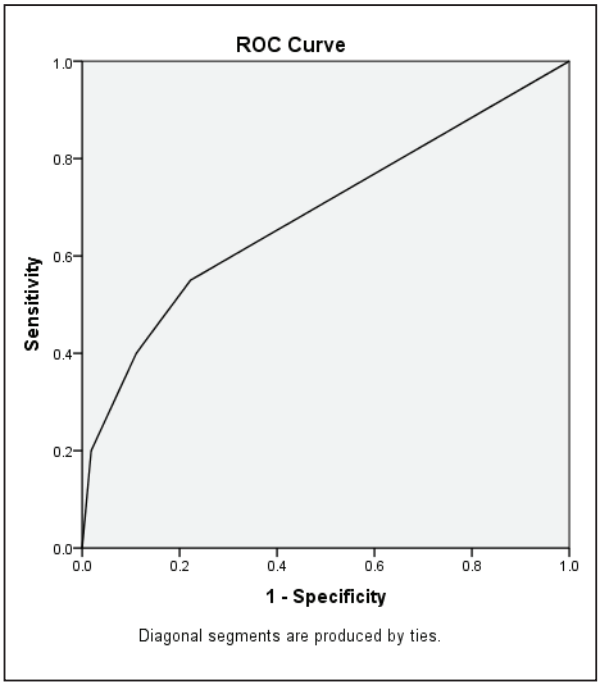

Figure 2: Bile spillage with Nassar

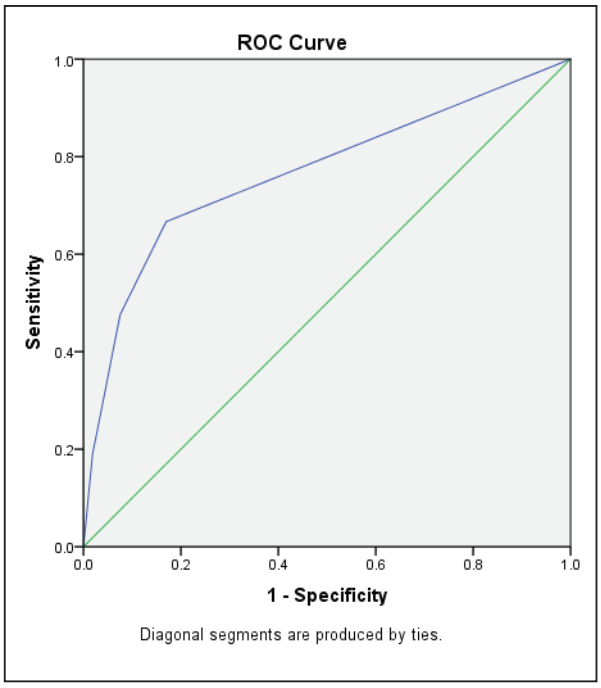

Figure 3: Stone spillage

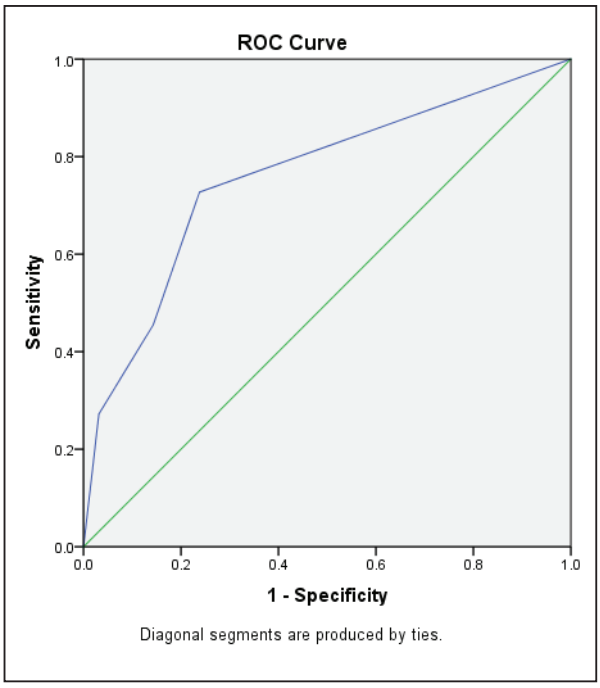

Figure 4: Bleeding

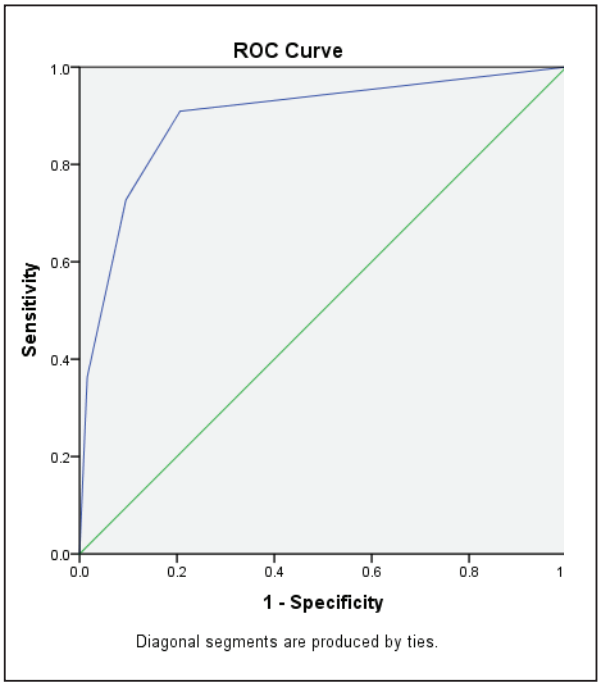

Figure 5: Post-surgical drain

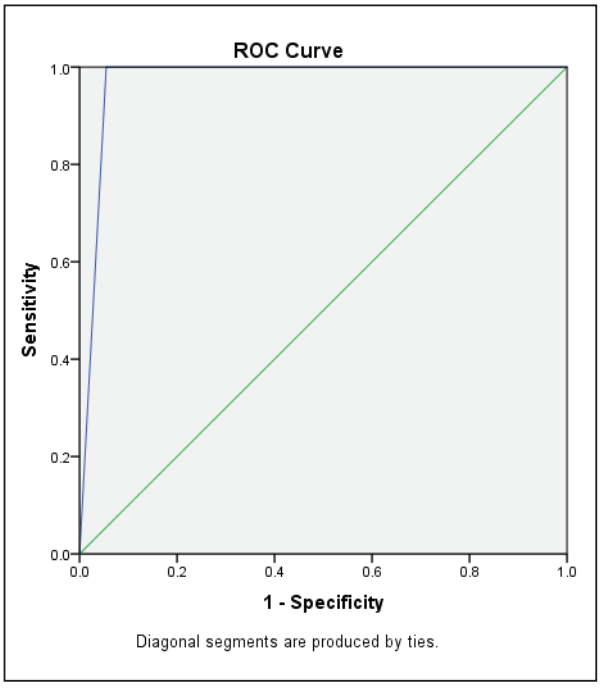

Figure 6: Converted to open

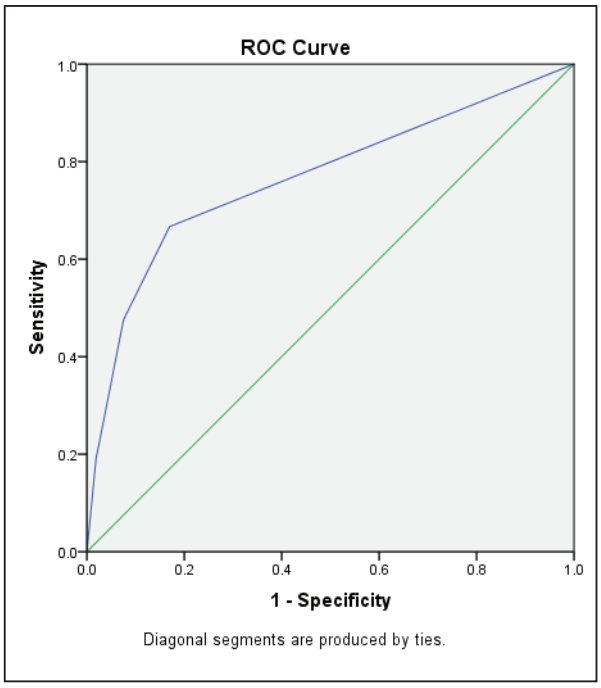

Figure 7: Total length of Stay (cut off >2 day)

DISCUSSION

This study is a prospective validation of Nassar grade. The primary outcome of this study was "conversion to open" which correlates with the rise in Nassar grades. There was one case in which conversion to open was done. None of the cases were undergone reintervention.

The definition of difficult laparoscopic cholecystectomy is not well established because the difficulty depends not only on patient factors but also on surgeon's expertise.[1] Significant prolongation of surgery acts as a predictor for difficult laparoscopic cholecystectomy.[6,7] There are various studies that define preoperative factors as a predictor for difficult laparoscopic cholecystectomy.[8-10] Ghadhban labelled laparoscopic cholecystectomy difficult or easy based on history, age, prior admission for cholecystitis, body mass index, abdominal scar, palpable gall bladder, radiologically gall bladder wall thickness, pericholecystic collection, and impacted stone.[11] Sugrue et al. developed a new scoring system for difficult laparoscopic cholecystectomy based on intraoperative findings such as gall bladder appearance, distension/contraction, access, severe sepsis/complication, and time to identify cystic duct and artery more than 90 minutes.[8] Similarly, Sudhir and Raj labelled difficult laparoscopic cholecystectomy based on preoperative and intraoperative factors.[6]

Nassar grading is a well-designed scale based upon a large-scale multi-centric study for the evaluation of difficult laparoscopic cholecystectomy. It has four points based upon gall bladder appearance, cystic pedicle, and associated adhesions. The disadvantage of the study was that it only included intraoperative parameters to define difficult laparoscopic cholecystectomy does not include preoperative parameters. Present study had a conversion rate of 1.4%. The cause of conversion was the inability to identify the cystic duct and arteries due to frozen Calot's triangle. Although the study population was low, other studies also have conversion rates of 2.6%[9] to 12%.[10] The causes of conversion in the other studies were the inability to identify the anatomy of Calot's triangle as a result of inflammation in the gall bladder, dense adhesion of the gall bladder to the duodenum or CBD, and contracted gall bladder with shortening of cystic duct.[9,10] The latest Tokyo consensus underlines that conversion to open is neither failure nor complication and is actually for patient safety and same should be explained before surgery to patients.

Although in current case, majority of the bulk of patients were of biliary colic but among them 11.3% had a difficult laparoscopic cholecystectomy (Nassar grade three and four). In these conditions, the grading system may prove to be useful especially for junior surgeons. Other studies also have shown that 3.2% to 16% of patients with no preoperative predictors of difficult cholecystectomy had difficult laparoscopic cholecystectomy.[7,11]

In this study, the operative time of >90 minutes were significantly associated with higher Nassar grade. Lal et al. stated that any laparoscopic cholecystectomy requiring more than 90 minutes was regarded as difficult.[12] Ghadhban labelled laparoscopic cholecystectomy difficult if the duration of surgery more than 60 minutes.[11]

It was difficult to perform laparoscopic cholecystectomy in patients admitted on delayed admission because those patients admitted on a delay basis was previously admitted for acute cholecystitis and acute biliary pancreatitis. Due to acute cholecystitis, Calot's triangle anatomy is not clear and dense fibrosis prolongs the surgery duration. In this study, the duration of surgery was 70 ± 26.45 min with delayed admission in comparison to elective admission (50.29 ± 18.37).

It took longer time to do laparoscopic cholecystectomy in a male patient in comparison to a female patient (p-value = 0.001). It might be due to stronger inflammation or fibrosis, which causes thick adhesion and so makes

dissection more difficult. This is comparable to 39 minutes in male comparison to 36 minutes in female in Ambe and Köhler study,[13] 67.9 ± 27.8 minutes in males in comparison to females (56.5 ± 23.98 minutes) in Bazoua and Tilston,[14] and 72.48 ± 28.5 in males in comparison to females (65.46 ± 24.83) in Coelho et al. study.[15]

The Nassar scale's ROC curve analysis when converted to open was similar to Griffith et al.'s study (0.903).[5] ROC curve of bile spillage and stone spillage were comparable to Griffith study, i.e., bile spillage (0.673) and stone spillage (0.764).The ROC curve of bleeding and post-surgical drain were more in this study in comparison to Griffith study i.e. bleeding (0.693) and post-surgical drain (0.789).

In this study, duration of surgery >90 minutes, total length of stay more than two days, bile spillage, stone spillage, and bleeding were significantly associated with Nassar scale except conversion to open (Table 4). Nassar scale can detect all predictors except conversion to open. So Nassar can validate to find out the intraoperative and post-operative outcomes.

Although these events did not lead to any post-operative complications or reinterventions in follow-ups, the results of this study may help junior surgeons to anticipate the difficulty in the early period, make a proper operative plan, and take early help.

The limitation of the study was its small sample size, single centre study, and only including perioperative factors to define difficult laparoscopic cholecystectomy. However, this study was a prospective study. The applicability of this study helps junior residents to define difficult laparoscopic cholecystectomy on the basis of Nassar scale and plan accordingly.

CONCLUSION

The Nassar operating scale is a simple scale and can be used by all level of surgeons to predict difficult laparoscopic cholecystectomy. The rising grade has significant correlation with conversion to open and increased duration of surgery. Although this is a study with limited samples, the applicability, consistency, and repeatability of the grading method were established. This shows its usefulness in as a method for reporting illness and intraoperative severity that may be used to change outcomes. A larger study may help for further validation of the Nassar grading scale.

ACKNOWLEDGEMENT

The authors are thankful to those patients who had given consent to participate in this study.

Conflict of interest: None
Source(s) of support: None

REFERENCES

1. Jameel SM, Bahaddin MM, Mohammed AA. Grading operative findings at laparoscopic cholecystectomy following the new scoring system in duhok governorate: Cross-sectional study. Ann Med Surg. 2020;60(October):266-70. [PubMed | Full Text | DOI]
2. Chandio A, Timmons S, Majeed A, Twomey A, Aftab F. Factors influencing the successful completion of laparoscopic cholecystectomy. J Soc Laparoendosc Surg. 2009;13(4):581-6. [PubMed | Full Text | DOI]
3. Jethwani U, Singh G, Mohil RS, Kandwal V, Razdan S, Chouhan J, et al. Prediction of difficulty and conversion in laparoscopic cholecystectomy. OA Minim Invasive Surg. 2013 Aug 1;1(1):2. [Full Text]
4. Mann K, Belgaumkar AP, Singh S. Post-endoscopic retrograde cholangiography laparoscopic cholecystectomy: Challenging but safe. J Soc Laparoendosc Surg. 2013;17(3):371-5. [PubMed | Full Text | DOI]
5. Griffiths EA, Hodson J, Vohra RS, Marriott P, Katbeh T, Zino S, et al. Utilisation of an operative difficulty grading scale for laparoscopic cholecystectomy. Surg Endosc. 2019 Jan;33(1):110-21. [PubMed | Full Text| DOI]
6. Sudhir MS, Raj P. Preoperative grading system versus intraoperative grading system as predictors for difficult laparoscopic cholecystectomy: A comparative validation study. J Clin Basic Res. 2018;2(1):39-47. [Full Text | DOI]
7. Stanisic V, Milicevic M, Kocev N, Stanisic B. A prospective cohort study for prediction of difficult laparoscopic cholecystectomy. Ann Med Surg. 2020 Dec 1;60:728-33. [PubMed | Full Text | DOI]
8. Sugrue M, Sahebally SM, Ansaloni L, Zielinski MD. Grading operative findings at laparoscopic cholecystectomy- a new scoring system. World J Emerg Surg.2015;10(1):14. [PubMed | Full Text | DOI]
9. Atmaram DC, Lakshman K. Predictive factors for conversion of laparoscopic cholecystectomy. Indian J Surg. 2011 Dec;73(6):423-6. [PubMed | Full Text | DOI]
10. Hassan A, Zargar S, Malik A, Shah P. Surgical significance of variations in anatomy in the biliary region. Int J Res Med Sci. 2013;1(3):183. [Full Text]

11. Ghadhban BR. Assessment of the difficulties in laparoscopic cholecystectomy among patients at baghdad province. Ann Med Surg. 2019 Mar 27;41:16-9. [PubMed | Full Text | DOI]
12. Lal P, Agarwal PN, Malik VK, Chakravarti AL. A difficult laparoscopic cholecystectomy that requires conversion to open procedure can be predicted by preoperative ultrasonography. J Soc Laparoendosc Surg. 2002;6(1):59-63. [PubMed | Full Text]
13. Ambe PC, Köhler L. Is the male gender an independent risk factor for complication in patients undergoing laparoscopic cholecystectomy for acute cholecystitis? Int Surg. 2015;100(5):854-9. [PubMed | Full Text | DOI]
14. Bazoua G, Tilston MP. Male gender impact on the outcome of laparoscopic cholecystectomy. J Soc Laparoendosc Surg. 2014;18(1):504. [PubMed | Full Text | DOI]
15. Coelho JCU, Dalledone GO, Schiel W, Berbardin J de P, Claus CMP, Matias JEF, et al. Does male gender increase the risk of laparoscopic cholecystectomy? Arq Bras Cir Dig. 2019;32(2):2-5. [PubMed | Full Text | DOI]