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Original Article

Per-Operative Predictors of Conversion of Laparoscopic Cholecystectomy into Open Procedure

Ramsha Khan[1*], Umar Javed[1] and Atiq Ur Rehman[1]

[1]Department of Surgery, Bahawal Victoria Hospital, Bahawalpur, Pakistan

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Corresponding Author:
Ramsha Khan
Department of Surgery, Bahawal Victoria Hospital, Bahawalpur, Pakistan
ramshak91@yahoo.com

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ABSTRACT

Laparoscopic cholecystectomy, a minimally invasive procedure for gallbladder removal, is widely preferred due to its advantages like reduced postoperative pain and quicker recovery. However, in certain cases, this procedure may need to be converted to an open cholecystectomy. The ability to predict such conversions preoperatively is crucial for better surgical planning and patient counseling. **Objective:** To identify and analyze the per-operative predictors that may necessitate the conversion of laparoscopic to open cholecystectomy. **Methods:** This study was conducted in Surgical Unit 3 at Bahawal Victoria Hospital, Bahawalpur as a prospective observational study spanning over 6 months from September 2022 to February 2023. All patients who were booked for Laparoscopic cholecystectomy were included. The data of preoperative and perioperative factors were collected on a standard proforma. Operative findings which were analyzed and documented by the surgeon were then, compared to look for the factors that contribute to conversion of Laparoscopic cholecystectomy into open procedure**. Results:** Mean ± SD of age was 42.59 ± 13.14. Regarding frequency of per-operative findings. It reveals that adhesions were found in 20 (22.7%) of the 88 procedures, difficult anatomy at Callot's triangle was present in 12 (13.6%) cases, unmanageable bleeding occurred in 4 (4.5%) cases, and damage to nearby structures was observed in 6 (6.8%) procedures. The remaining procedures did not exhibit these issues. **Conclusions:** Our study has conclusively identified critical per-operative predictors for the conversion of laparoscopic cholecystectomy to an open procedure. These insights are instrumental for preoperative assessment and planning, potentially guiding clinical decisions to optimize patient care and surgical outcomes.

INTRODUCTION

When it comes to minimal invasive surgeries, laparoscopic cholecystectomy brought a revolutionary change. A closer analysis reveals that gall stones are present in about 15 percent of the whole US population and are a major cause of abdominal pain [1]. One of the best management options for such patients is Cholecystectomy [2]. Since, its widespread use in surgery, Laparoscopic surgical management of gall stones has widely replaced the conventional open surgery and is considered a Gold Standard now [3]. For patients undergoing cholecystectomy, some risk factors have been well established with the disease incidence being more in the elderly and in the female gender. Surgical incidence in Pakistan is about 4.2% for males and 14.2% for females [4]. However, despite the increase in surgical expertise and the availability of latest surgical techniques; according to Hu *et al.*, the rate of conversion of Laparoscopic cholecystectomy to open procedure is 1-15% [5]. For a developing country like Pakistan, very little data-based evidence is available that can essentially predict the

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conversion of laparoscopic cholecystectomy to open procedures. It is even more important in our region because of limited resources as conversion increases the perioperative complications, perioperative time and hospital stay and expenses [6]. The most common reasons that are seen as a basis of conversion include difficult anatomy, presence of adhesions, life threatening bleeding and damage to nearby structures including inflammation [7]. In the context of this study, 'Adhesions' refer to the fibrous bands of tissue that abnormally connect the gallbladder or surrounding structures to other internal organs. These are identified intraoperatively through visual inspection and palpation by the surgeon. The presence of adhesions is noted if they impede access to the gallbladder or interfere with the safe dissection of tissues. The term "Difficult Anatomy at Calot's Triangle" refers to any anatomical variations or complications within Calot's Triangle that hinder standard laparoscopic procedures. This includes anomalies like aberrant ducts, unusual vascular structures, or excessive fatty tissue. Identification is based on the surgeon's intraoperative assessment and the need for additional maneuvers to safely expose and dissect within Calot's Triangle. Unmanageable Bleeding is defined as any intraoperative bleeding that cannot be controlled by standard laparoscopic hemostatic techniques and thus poses a risk to patient safety. The threshold for 'unmanageable' is determined by the volume of blood loss that necessitates additional interventions beyond the usual laparoscopic procedures, such as conversion to open surgery or the use of advanced hemostatic tools. Damage to Nearby Structures refers to any inadvertent injury or harm caused to adjacent organs or tissues (e.g., bowel, liver, bile ducts) during the laparoscopic procedure. Such damage is characterized by the type of structure affected, the extent of the injury, and the intervention required to repair it. This is determined through intraoperative findings and postoperative diagnostic assessments when applicable. Furthermore, patients who undergo conversion are seen to have major complications like bile duct injury, biliary leak or unmanageable bleeding all of whom are associated with high morbidity and mortality [8]. It is therefore emphasized that a greater understanding of the per operative factors that lead to conversion of laparoscopic cholecystectomy is very important for ensuring safe surgical practices. Patients are also made more aware of the associated risks before undergoing surgery and are psychologically ready should any such situation arise. Lists can also be more effectively scheduled with the availability of such information.

METHODS

This study was conducted in Surgical Unit 3, Bahawal Victoria Hospital, Bahawalpur as a prospective observational study spanning over 6 months from September 2022 to February 2023. This study was approved by the CPSP on August 02, 2022 Ref. # CPSP/REU/SGR-2018-032-10124. Sample size was calculated using Yamene's formula. Total 88 patients who were booked for Laparoscopic cholecystectomy either male or female having age 20-80 years were included using non-probability sampling technique. All patients gave written and informed consents. Immunocompromised patients, patients with malignancy or those having any other infectious etiology were excluded from this study. The data of preoperative and perioperative factors were collected on a standard proforma. These included age, gender, co-morbidity (diabetes, hypertension, hepatitis B and C status as well as history of any previous surgery). History of previous abdominal surgery was also considered. The underlying diagnosis was also divided into patients having Cholelithiasis, Empyema GB or Cholecystitis. Operative findings which were analyzed and documented by the surgeon were then, compared to look for the factors that contribute to conversion of Laparoscopic cholecystectomy into open procedure. Difficult anatomy, Adhesions, Unmanageable bleeding and damage to nearby structures were all classified into presence or absence of these findings. The data were statistically analyzed using Statistical Package for Social Sciences SPSS v.24.0.1. The mean and SD were calculated for age. Frequencies were calculated for per-operative findings (Adhesions, Difficult anatomy at Callot's triangle, Unmanageable bleeding, Damage to nearby structures). Association of per operative conversion with per-operative findings (Adhesions, Difficult anatomy at Callot's triangle, Unmanageable bleeding, Damage to nearby structures) and different variables (gender, co-morbidity, ASA Grade, Experience of surgeon, diagnosis) was detected by using chi-square test/ Fisher's Exact Test. A p-value of <0.05 was considered significant statistically.

RESULTS

The purpose of your our is to identify the frequency of per-operative predictors that result in the conversion of laparoscopic cholecystectomy into an open procedure. Mean ± SD of age was 42.59 ± 13.14. Regarding frequency of per-operative findings. It reveals that adhesions were found in 20 (22.7%) of the 88 procedures, difficult anatomy at Callot's triangle was present in 12 (13.6%) cases, unmanageable bleeding occurred in 4 (4.5%) cases, and damage to nearby structures was observed in 6 (6.8%) procedures. The remaining procedures did not exhibit these issues (Table 1).

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Table 1: Frequency of per-operative findings

Per Operative Findings	Yes (%)	No (%)
Adhesions	20 (22.7%)	68 (77.3%)
Difficult Anatomy at Callot's Triangle	12 (13.6%)	76 (86.4%)
Unmanageable Bleeding	4(4.5%)	84 (95.5%)
Damage to Nearby Structures	6 (6.8%)	82 (93.2%)

Regarding the association of per-operating with conversion, the results show that all 20 cases with adhesions were converted into an open procedure, whereas only 4 (5.88%) out of 68 cases without adhesions were converted. This indicates a significant correlation between the presence of adhesions and conversion of the procedure (p=0.000). All 12 cases with difficult anatomy at Callot's triangle resulted in a conversion, compared to 12 (15.79%) of the 76 cases where the anatomy was not problematic. This suggests a significant relationship between the complexity of anatomy at Callot's triangle and the conversion of the surgery (p=0.000). Association of damage to nearby structures with the conversion of the procedure was assessed. All six cases with damage to nearby structures were converted to an open procedure, while only 18 (21.95%) of the 82 cases without damage were converted. This provides a statistically significant correlation between the damage to nearby structures and conversion of the procedure (p=0.000). Association between unmanageable bleeding and conversion to an open procedure evaluate. Of the four cases with unmanageable bleeding, all were converted, while only 20 (23.81%) of the 84 cases without unmanageable bleeding were converted. This signifies a statistically significant association between unmanageable bleeding and the conversion of the procedure (p=0.005) (Table 2).

Table 2: Association of per-operative conversion with per-operative findings

Per-Operative Findings	Per-operative Conversion		Total (%)	p-value
	Not converted (%)	Converted (%)		
Adhesions				
No	64 (94.12%)	4 (5.88%)	68 (77.27%)	0.00
Yes	0	20 (100%)	20 (22.73%)	
Difficult Anatomy at Callot's Triangle				
No	64 (84.21%)	12 (15.79%)	76 (86.36%)	0.00
Yes	0	12 (100%)	12 (13.64%)	
Damage to Nearby Structures				
No	64 (78.05%)	18 (21.95%)	82 (93.2%)	0.00
Yes	0	6 (100%)	6 (6.8%)	
Unmanageable Bleeding				
No	64 (76.19%)	20 (23.81%)	84 (95.45%)	0.005
Yes	0	4 (100%)	4 (4.55%)	

Table 3 shows the association between gender and the conversion of the procedure. For males (16 cases), 10 (62.5%) required conversion to an open procedure. However, among females (72 cases), only 14 (19.4%) required conversion. This significant difference (p=0.000) suggests gender could be a potential predictor. Regarding association of co-morbidity with the conversion of the procedure, of the 72 cases without co-morbidities, 16 (22.2%) required conversion. Meanwhile, 50% of patients with co-morbidities (16 cases) required conversion. This indicates a significant association (p=0.024) between the presence of co-morbidities and procedure conversion. Relationship between the American Society of Anesthesiologists (ASA) Grade and conversion was also assed, for ASA Grade-I (44 cases) and Grade-II (38 cases), the conversions were 22.7% and 26.3% respectively. However, in the case of ASA Grade-III (6 cases), 66.7% required conversion, although this relationship was not statistically significant (p=0.075). in this table evaluates the link between the surgeon's experience and the conversion of the procedure. For surgeons with less than three years of experience, all two surgeries they performed were converted. For those with more than five years of experience, 18 out of 66 surgeries (27.3%) were converted. However, this association was not statistically significant (p=0.055). Regarding association of the initial diagnosis with the conversion of the procedure was evaluated. For patients diagnosed with cholelithiasis (74 cases), 16.21% required conversion. However, for those diagnosed with empyema (10 cases) and cholecystitis (4 cases), the conversion rates were 80% and 100% respectively, indicating a significant association (p=0.000).

Table 3: Association of per-operative conversion with different variables

Different Variables	Per-operative Conversion		Total (%)	p-value
	Not converted (%)	Converted (%)		
Gender				
Male	6 (37.5%)	10 (62.5%)	16 (18.18%)	0.00
Female	58 (80.6%)	14 (19.4%)	72 (81.82%)	
Co-Morbidity				
No	56 (77.8%)	16 (22.2%)	72 (81.82%)	0.024
Yes	8 (50.0%)	8 (50.0%)	16 (18.18%)	
ASA Grade				
Grade-I	34 (77.3%)	10 (22.7%)	44 (50%)	0.075
Grade-II	28 (73.7%)	10 (26.3%)	38 (43.18%)	
Grade-III	2 (33.3%)	4 (66.7%)	6 (6.82%)	
Experience of Surgeon				
<3 years	0	2 (100%)	2 (2.73%)	0.055
3-4 years	6 (100%)	0	6 (6.18%)	
4-5 years	10 (15.6%)	4 (16.7%)	14 (15.91%)	
>5 years	48 (75.0%)	18 (75.0%)	66 (75%)	
Diagnosis				
Cholelithiasis	62 (83.78%)	12 (16.21%)	74 (84.09%)	0.000
Empyema	2 (20%)	8 (80%)	10 (11.36%)	
Cholecystitis	0	4 (100%)	4 (4.55%)	

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DISCUSSION

In this study, we aimed to identify the per-operative predictors of conversion from laparoscopic cholecystectomy to an open procedure. We analyzed a total of 88 patients who underwent laparoscopic cholecystectomy over a period of 6 months in our unit, and found that 27.3% (n=24) of them required conversion to an open procedure. Identifying risk factors associated with conversion can significantly improve patient outcomes and post-operative recovery. Comparing our findings with previous studies, we observed that the conversion rates varied. Gabriel *et al.*, reported a conversion rate of 26.1%, while Amin *et al.*, reported a rate of 7.78% [11, 15]. In our study, we found that male patients had a higher likelihood of conversion compared to female patients, with a conversion rate of 62.5% in men and 19.4% in women. This finding is consistent with studies by Kama *et al.*, and Gharaibeh *et al.*, which also indicated a higher predisposition towards conversion in males [16, 17]. Regarding comorbidities such as diabetes, hypertension, and hepatitis B and C, as well as the American Society of Anesthesiologists (ASA) status and the expertise of the operating surgeon, we found no significant associations with the conversion rate. This suggests that these factors may not play a significant role in predicting the need for conversion. When analyzing the per-operative diagnoses associated with conversion, we found that all three diagnoses - Empyema GB, Cholelithiasis, and Cholecystitis - showed significance. The conversion rate for patients with cholelithiasis was 16.2%, while it was 80% for patients with empyema and 100% for patients with acute cholecystitis. However, statistically, all three diagnoses had a significant p-value, indicating that any of them could lead to conversion. It is important to note that the presence of empyema GB and acute cholecystitis presents technical difficulties due to inflammation, as supported by a study by Chahin *et al* [18]. Regarding the intraoperative findings, we categorized them into four groups: presence or absence of adhesions, unmanageable bleeding, difficult anatomy at Callot's triangle, and damage to nearby structures. Adhesions were found in 20 out of 88 patients, and all 20 underwent conversion. This finding is consistent with a study by *Amin et al.*, which showed similar results [7]. Adhesions make dissection and identification of structures difficult due to tissue friability. Difficult anatomy at Callot's triangle also showed a significant p-value of 0.000, indicating that when the anatomy in this region is challenging, surgeons may find it difficult to identify the correct ducts and arteries, leading to conversion. Shamim *et al.*, also reported similar results, with 54.32% of patients with difficult anatomy undergoing conversion [19]. In cases where damage to nearby structures occurred during the laparoscopic cholecystectomy, only 6 out of 88 patients had such damage, further supporting the safety of laparoscopic surgery. However, all 6 patients required conversion. Damage to nearby structures, particularly the bowel or common bile duct, can make it challenging to proceed with the laparoscopic approach, leading surgeons to prefer conversion for better visualization and repair. Unmanageable bleeding, although rare (6 out of 88 patients), also resulted in conversion due to the obscured vision it causes. This finding is consistent with a study by Shea *et al.*, which emphasized the significance of both damage to nearby structures and bleeding in predicting conversion [20].

CONCLUSIONS

In conclusion, our study identified several pre-operative predictors of conversion from laparoscopic cholecystectomy to an open procedure. Male gender, specific diagnoses such as empyema GB and acute cholecystitis, the presence of adhesions, difficult anatomy at Callot's triangle, and damage to nearby structures or unmanageable bleeding were significant factors associated with conversion. These findings contribute to a better understanding of the decision-making process in converting laparoscopic procedures to open procedures and can help guide surgical planning and patient counseling. Further research is warranted to validate and expand upon these findings in larger cohorts and diverse populations.

Authors Contribution

Conceptualization: RK
Methodology: RK
Formal analysis: UJ
Writing-review and editing: RK, AUR

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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