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Original Research Article

Predictive factors for subtotal cholecystectomy in delayed elective cholecystectomy after the acute presentation

Hany Nada*, Aaditya Sinha, Annabelle White, Hedda Widlund, Andrew Refalo, Husam Ebied

Department of Surgery, Guys and St Thomas' Hospital, London, United Kingdom

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***Correspondence:**
Dr. Hany Nada,
E-mail: hany.nada@nhs.net

ABSTRACT

Background: Approximately 15% of adults in the United Kingdom (UK) are predicted to have gallstone disease, with about 80% of these having asymptomatic gallstones. Patients with symptomatic gallstone disease are recommended to undergo cholecystectomy. Currently, in the UK approximately 60,000 cholecystectomies are performed. During complex laparoscopic cholecystectomies, surgeons may still need to resort to historic procedures such as an open cholecystectomy (5-10%) or even a cholecystostomy. Alternatively considering a subtotal cholecystectomy has been shown to reduce the need for conversion to an open procedure. The aim of our study is to identify pre-operative factors that would predict the need for a subtotal cholecystectomy.
Methods: A retrospective study, over a period of 01 March 2019 to 29 February 2020 was undertaken at one of London's major tertiary centres. We reviewed all adult patients that had undergone laparoscopic cholecystectomies and subtotal cholecystectomies.
Results: 243 patients were included in the study after being vetted through the inclusion and exclusion criteria, 95 males and 148 females. 243 patients were identified initially for elective cholecystectomy. 230 were managed surgically, 208 with a total laparoscopic cholecystectomy, and 22 with subtotal laparoscopic cholecystectomy. 243 patients were identified initially for elective cholecystectomy. 230 were managed surgically, 208 with a total laparoscopic cholecystectomy, and 22 with subtotal laparoscopic cholecystectomy.
Conclusions: Age, male sex, body mass index (BMI) greater than 30 kg/m^2 patients, previous endoscopic retrograde cholangiopancreatography (ERCP), thickened gallbladder walls, and raised preoperative leucocytosis were associated with a greater risk of patients consented for laparoscopic cholecystectomies to undergo a conversion to a subtotal cholecystectomy.

Keywords: Cholecystectomy, Laparoscopic cholecystectomy, Subtotal cholecystectomy

INTRODUCTION

Approximately 15% of adults in the United Kingdom (UK) are predicted to have gallstone disease, with about 80% of these having asymptomatic gallstones.[1] The remaining 20% of patients are symptomatic, with either pain (biliary colic), or complications such as cholecystitis, cholangitis, or gallstone pancreatitis. These patients with symptomatic gallstone disease are recommended to undergo a cholecystectomy.[1]

The first cholecystectomy was performed by Carl Langenbuch in 1882 in Berlin.[2] Prior to this, surgical therapy for symptomatic gallstones was limited to a cholecystostomy or the extraction of a gallstone. Professor Dr. Med Erich Mühe Böblingen then modified the open cholecystectomy with a laparoscopic approach in

September 1985, which today has become the gold standard for managing gallstone disease.[3,4]

Currently, in the UK, approximately 60,000 cholecystectomies are performed, a fairly common elective and emergency procedure.[5] However, during complex laparoscopic cholecystectomies, surgeons may still need to resort to the more historic procedures, such as open cholecystectomy (5-10% of the time), or even a cholecystostomy (no current data is available on the incidence rate of intra-operative laparoscopic cholecystostomy rates).[5]

During a complex laparoscopic cholecystectomy, where surrounding structures are at risk of injury (especially the common bile duct), an alternate approach needs to be considered. The identification of the cystic duct can be difficult due to adhesion or inflammation. This could lead to an injury to the common bile duct, documented at an incidence rate of 0.25-0.5%.[6] Traditionally, conversion to open surgery has been the next step, although laparoscopic views are normally superior to the views in an open procedure. It also needs to be taken into consideration that conversion to an open procedure is a considerably larger operation, which may require the patient to have a prolonged hospital stay and slower recovery.

Alternatively, considering a subtotal cholecystectomy has been shown to reduce the need for conversion to an open procedure. Doing so could help prevent delays in post-operative recovery, reducing the length of stay and the complications that may be associated with a cholecystostomy. Studies have shown that the procedure decreases the bile duct injury rate and is safe in cirrhotic patients, with an increase in rates over the country.

Aim

The aim of our study is to identify pre-operative factors that would predict the need for a subtotal cholecystectomy, allowing patients to be appropriately consented to and informed prior to surgery of the chances of undergoing a subtotal cholecystectomy. All subtotal cholecystectomy patients were followed up for a minimum of 21 months after their surgical intervention. These predictions aim to also aid in the management of theatre lists and help plan patients' post-operative recovery.

METHODS

A retrospective study, over a period of 01 March 2019 to 29 February 2020 was undertaken at St. Thomas' Hospital, one of London's major tertiary centers for upper gastrointestinal surgery. We reviewed all adult patients that had undergone laparoscopic cholecystectomies and subtotal cholecystectomies (where it was unsafe to undertake a total cholecystectomy, with intra-operative decisions made).

The inclusion criteria included all patients with an initial acute presentation of one of the following pathologies: acute cholecystitis, cholelithiasis, ascending cholangitis, choledocholithiasis, and gallstone pancreatitis. We excluded all patients who underwent surgical intervention within the first 6 weeks of initial presentation and patients who were unfit for surgical intervention.

We reviewed patient demographics (age, sex, and weight), pathology, the inpatient stay depending on pathology at initial acute presentation, as well as the initial biochemical and radiological interventions. The further review looked at whether patients required any intervention such as a percutaneous cholecystostomy or endoscopic retrograde cholangiopancreatography (ERCP).

All patients that did not undergo a standard laparoscopic surgical approach (with 4 laparoscopic ports, a standard 10 mm 30-degree camera, and with antibiotics at induction), were excluded. Of note, all cases were started with the intention to undertake a laparoscopic cholecystectomy.

All patients that underwent a laparoscopic subtotal cholecystectomy were followed up for a minimum of 21 months, to review how many of these patients had complications or required further surgical intervention.

The non-probability sampling technique was used in this retrospective study, where all patients undergoing a delayed laparoscopic cholecystectomy were included. We used purposive sampling using our expertise to select the sample which was most useful to the study. This sample was including all adult patients that had undergone laparoscopic cholecystectomies and subtotal cholecystectomies, over a one-year period.

The study data was collected and analyzed on Microsoft excel, which allowed the data to be accessed easily by all members of the research team and allowed appropriate distribution of data analysis to different members, the analysis was performed by multiple members of the team to confirm it has been correctly done.

RESULTS

243 patients were included in the study after being vetted through the inclusion and exclusion criteria, 95 males and 148 females. Table 1 shows the number of patients per pathology and the length of stay during their initial acute presentation.

13 patients then declined surgical intervention at the time of pre-assessment, although a decision had been made for them to undergo an elective cholecystectomy. Therefore 230 patients were consented and taken to the theatre, for an intended laparoscopic cholecystectomy. 22 (9.56%) of these patients underwent a subtotal cholecystectomy, with an intraoperative decision that a total cholecystectomy would be too dangerous (Figure 1).

Table 1: Presentations of patients included in the study.

Diagnosis	Total patients admitted	Length of stay in days (mean)
Acute cholecystitis	111	5.1
Choledocholithiasis	36	6.1
Gallstone pancreatitis	52	26
Cholelithiasis	34	3.9
Ascending cholangitis	10	22

243 patients were identified initially for elective cholecystectomy. 230 were managed surgically, 208 with a total laparoscopic cholecystectomy, and 22 with subtotal laparoscopic cholecystectomy.

The mean ages of the patients who underwent complete laparoscopic cholecystectomy and a subtotal cholecystectomy were 59.7, and 68.3 years respectively (range 21–85 years). In the complete cholecystectomy group and subtotal cholecystectomy group, the mean white blood cell counts preoperatively were 8,100 and 15,250 respectively ($p<0.05$). The mean thicknesses of the gallbladder wall in mm (calculated with ultrasound) were 4, and 7.4 respectively ($p<0.05$; range, 3.2–9.3 mm). The data is shown in Table 2.

Table 2: Demographic and sonographic parameters of patients in the study.

Parameters	Subtotal cholecystic-tomy	Total cholecystic-tomy
Male: female ratio	2:1	7:20
Mean age (years)	59.7	68.3
Mean BMI (kg/m^2)	34.0	29
Mean pre-operative white cell count (10^9/l)	15250	8100
Mean gallbladder wall thickness (mm)	7.4	4.0

Out of the 22 patients that underwent a subtotal cholecystectomy, 2 patients (9%) had complications or required further surgical intervention. One patient underwent a completion cholecystectomy due to continued biliary colic symptoms. The second patient had choledocholithiasis, requiring an endoscopic ultrasound scan and an ERCP (Table 3).

Odds ratios were used to view correlation between several characteristics to assess the likelihood of a patient requiring a subtotal cholecystectomy rather than a total cholecystectomy in the delayed elective cholecystectomy after an acute admission. We considered a statistically significant result with a p value less than 0.05.

The correlations concluded that age (adjusted odds ratio (aOR) 1.20, $p\leq0.02$), male sex (aOR 2.50, $p<0.01$), body mass index (BMI) >30 kg/m^2, previous ERCP, thickened gallbladder wall on ultrasound scan >4 mm, and white blood cell counts >15000, all increased the likelihood of having a subtotal cholecystectomy (Table 4).

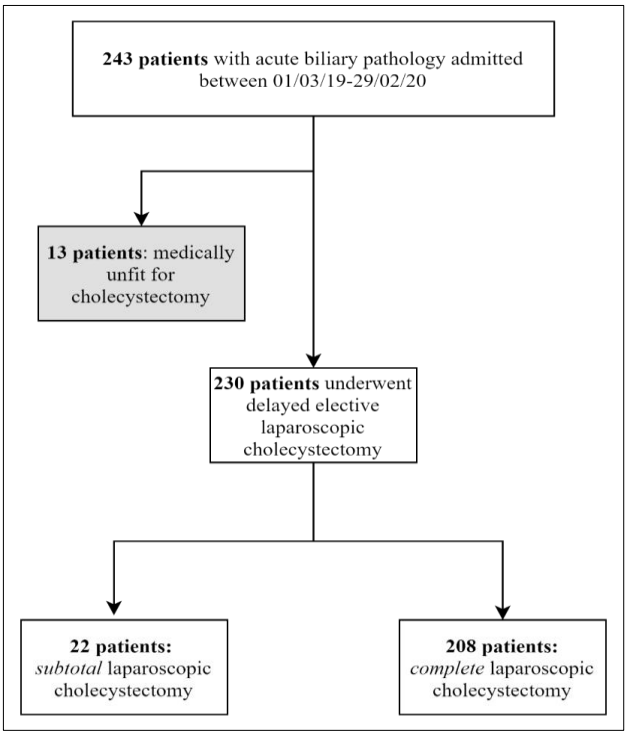

Figure 1: A diagram of the patients was included in the analysis.

Table 3: The pathology at the time of initial acute presentation for the 22 patients who underwent a subtotal cholecystectomy.

Diagnosis	Total patients	Percentage
Acute cholecystitis	12	54.54
Ascending cholangitis	4	18.81
Choledocholithiasis	3	13.6
Cholelithiasis	2	9.09
Gallstone pancreatitis	1	4.5

Table 4: Odds ratios (aOR) and p values predictive factors increasing risk a subtotal cholecystectomy may be the operative outcome.

Patient factors	Adjusted odds ratio (aOR)	P value
Age	1.2	<0.02
Male sex	2.5	<0.01
BMI >30 kg/m^2	1.1	<0.02
Previous ERCP	1.7	<0.01
Gallbladder walls >4 mm on USS	2	<0.01
Pre-operative WCC >15000 (109/l)	2.01	<0.02

DISCUSSION

Looking only at the patients that required subtotal cholecystectomies, 9.6% of the cohort consented to laparoscopic cholecystectomy, we reviewed the factors potentially contributing to a complex procedure, thus requiring a subtotal cholecystectomy to be performed. The figures in our study were comparable to similar studies undertaken previously at other sites, such as Tang et al's study in the United States in 2020, where the review of 916 patients between 2016-2019 showed similar findings, with 9% of patients managed with a cholecystectomy undergoing a subtotal cholecystectomy.[7]

Our research hopes to add to the insights of previous studies, with the identification of factors not previously considered, including BMI, previous ERCP, and the gallbladder wall thickness in radiology. Our initial study observation was that the most common indication for subtotal cholecystectomy was acute cholecystitis, with more than half the patients in our study initially presenting with acute cholecystitis. An explanation for this could be the potential of these patients having multiple prior episodes of acute cholecystitis, leading to chronic inflammatory tissue changes and adhesions. Data collected on other factors, not including pathology, were used to construct odds ratios (aOR) for each contributing factor's correlation. We saw that all the considered factors (age, male sex, BMI >30 kg/m^2, previous ERCP, thickened gallbladder walls >4 mm, and preoperative leucocytosis >15000), contributed to a greater risk of conversion to subtotal cholecystectomy (Table 4).

All 22 patients that required a subtotal cholecystectomy were followed up for a minimum of 21 months. By reviewing their re-presentations to A&E and the surgical unit, we identified the patients that required further intervention. One patient underwent a completion cholecystectomy due to continued biliary colic symptoms. A second patient had a choledocholithiasis, requiring an endoscopic ultrasound scan and an ERCP.

The 208 patients that underwent a total cholecystectomy were not followed up to review the complication rates. However, considering the retrospective analysis by Duca et al which looked at 9542 patients undergoing laparoscopic cholecystectomies, these patients had considerably lower post-operative complications than those undergoing subtotal cholecystectomies in our study.[8] Of note, however, is that this was only a 12-month, rather than 21-month, follow up.

Some other studies identify only elective patients, limiting the study's ability to identify factors that may have an impact on emergency patients. Most studies had a higher conversion to open cholecystectomies, such as LeCompte et al and Duca et al. Compared to our study, the conversion rate was 0%, even though we did have similar rates of subtotal cholecystectomies.[8,9]

The majority of patients in the UK undergoing laparoscopic cholecystectomy do so electively, with our findings having the potential relevance for both elective and emergency patients.[5] The predictive factors proposed could potentially be useful when planning management options of a complex procedure requiring a subtotal cholecystectomy in either case.

Tang et al's 2020 study, presented that the rate of subtotal cholecystectomy increased each year over a three-year period, a finding echoed by Sabour et al in their 2020 review.[7,10] However, both of these studies were conducted on data from the United States. Our study was limited in that the data was taken from one centre with presentations over one year, therefore a shortfall in our study was to provide statistical evidence of whether the rate of subtotal cholecystectomy is also increasing in other centers around the United Kingdom.

Nassar et al have used similar findings to create a pre-operative risk score to predict 'difficult' laparoscopic cholecystectomies, and consequently facilitate more specific risk counseling of patients when gaining consent, and better surgical planning, such as identifying a surgeon with training in, and experience of difficult cases.[11] Our findings could be used in a similar way, and as such facilitate both preoperative planning, and intra-operative decision making, specifically by providing pre-operative evidence to support the surgeon in making this often difficult, crucially timed decision to convert to a subtotal procedure, and reduce the risks associated with completing a difficult cholecystectomy, such as common bile duct injury.[12]

Our analysis was conducted on patients admitted before the first COVID wave hit the United Kingdom, however, studies estimate that during the pandemic, elective surgical activity reduced in England and Wales by 38.6%.[13,14] Consequently, thereis a large backlog of patients awaiting elective surgery a proportion of whom are likely to have presented later and/or avoided medical intervention for longer.[13,15] These patients may present with a more 'difficult' gallbladder pathology and consequently greater peri-operative challenges.[6] Utilizing frequently measured pre-operative factors to predict which cases are more likely to require subtotal rather than complete cholecystectomy can potentially enable surgical teams to undertake more precise pre-operative risk assessment and planning, optimize intraoperative conditions, and inform the patient about the possible outcomes in a more accurate form.

To improve on this study, we could additionally review the outcomes and follow up the 208 patients who underwent a total cholecystectomy. The number of patients that we included was smaller than many other multi-center studies and the time period could be longer. This could allow us to assess whether we are seeing an increase in the number of patients undergoing cholecystectomy, as seen in the United States.

CONCLUSION

Through our study, age, male sex, BMI >30 kg/m^2 patients, undergoing a previous ERCP, having a thickened gallbladder wall on radiology, and raised preoperative leukocytosis, were all factors found to be associated with a greater risk of patients consented for laparoscopic cholecystectomies to undergo a conversion to a subtotal cholecystectomy. These findings support and expand upon the existing evidence base of previously identified pre-operative factors predictive of subtotal conversion. These factors could be used in consideration prior to consenting and informing patients due to undergoing laparoscopic cholecystectomy, on the possibilities of an intraoperative decision to undertake a subtotal cholecystectomy being made. With delayed procedures due to COVID-19, a subtotal cholecystectomy can be considered for patients with complex anatomy who are at high risk of complications.

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