Cystic Lymph Node Identification is More Reliable Than Critical View of Safety in Difficult Cholecystectomies

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Abstract

Background: The cystic lymph node (CLN) represents an anatomical safety marker and a surrogate marker of technique during laparoscopic cholecystectomy (LC). We aim to demonstrate the value of CLN in comparison to the critical view of safety (CVS) and study the effects of increasing difficulty on the two approaches.

Methods: A prospective study of consecutive LC was conducted. Patient demographics, type of admission, clinical presentation, operative difficulty grade, visualisation of CLN, identification of CVS, operative time and complications were recorded and analysed.

Results: Of 393 LCs, half of the admissions were emergencies. 34% had obstructive jaundice or acute cholecystitis. The CLN was visually identified in 81.7% with a small difference between operative difficulty grades 1 to 3 versus 4 to 5. Although CVS was unachievable in 62 patients, 43 (69.4%) still had an identifiable CLN. The median operating time was 68 minutes with one mortality but no conversions or intraoperative complications.

Conclusion: Identifying the CLN during LC could compliment the CVS in avoiding major ductal injury. Dissecting lateral to the CLN to commence the process of displaying the cystic pedicle structures may be a strategy in safely achieving the CVS. During the more difficult LC where displaying the CVS is impossible, the CLN may be the key anatomical landmark.

Introduction

The cholecystohepatic triangle, routinely referred to as Calot's triangle, refers to a tiny anatomical region[1] of disproportionately high surgical importance during laparoscopic cholecystectomy (LC). It was first described in 1891 by the French surgeon Jean-François Calot as part of his thesis. He emphasised the identification of the borders of this triangle before any ligation or division of the exposed structures[2, 3]. In 1981, Rocko et al[4] modified the borders of the triangle where the superior border was bounded by the inferior surface of the liver instead of the cystic artery as described by Calot. In current practice, when performing LC, many surgeons rely on target identification through displaying the critical view of safety (CVS)[5]. The CVS was first described by Strasberg in 1995, and re-written in 2010 applying the concept to LC. This simplified concept requires the identification of two and only two structures (cystic artery and duct) entering the gallbladder, opening a window between the gallbladder and lower third of the cystic plate and clearing all connective tissue in this area. However, it has been suggested that one third of the patients will have three structures in Calot's triangle[6].

Major bile duct injury (BDI) occurs in around 0.3 to 0.5% of LC and is a cause of major morbidity and mortality. The recognition and identification of anatomical landmarks (e.g. Rouviere's sulcus, quadrate lobe) during dissection is thought to reduce the risk of BDI. Some surgeons employ operative imaging (e.g. intraoperative cholangiography or laparoscopic ultrasound) to demonstrate biliary anatomy.

The cystic lymph node (CLN), also known as Calot's node, Lund's node or Mascagni's lymph node, has been described as a content of the Calot's triangle[2, 3, 7]. Several studies [8-12] have demonstrated that it is commonly found near the cystic artery. It was, therefore, suggested that using CLN identification and ensuring all dissection is performed lateral to this may reduce the risk of BDI. A lot remains unknown about this innocent lymph node, namely whether it is uniformly present, can be identified during every cholecystectomy [10, 11, 13], and the frequency of multiple nodes.

We aim to evaluate the use of CLN as a safety marker, in addition to or instead of the CVS. We compared the efficacy of identification of CLN and CVS and evaluated the relationship between CLN identification, the operative difficulty of LC and the ability to demonstrate the CVS.

Methods

Design:
A prospective study of consecutive patients undergoing LCs was conducted. We aimed to identify and record the presence of CLN at the start of every procedure and the dissection of the cystic pedicle lateral to the node, thus avoiding its excision. All cholecystectomies were performed by a single surgeon (AHMN) or trainees under his direct on table supervision.

Patient demographics, type of admission, reason for admission, American Society of Anaesthesiologists (ASA) physical status classification, operative difficulty grade, presence of CLN, identification of CVS, operative time, conversion to open and pedicle-related and perioperative complications were recorded prospectively. The operative difficulty grade was based on the expanded Nassar Scale[14, 15] using a combination of features of the gallbladder,

adhesions and cystic pedicle to classify LC into five grades: I-V ie. easy, normal, difficult, very hard and complex. The senior author's biliary firm is dedicated to managing biliary emergencies and receives great majority of patients admitted with gallstone complications including those with suspected bile duct stones.

Technique:
A standard 4 port LC (one infraumbilical12mm by open access and three 5mm ports) was performed with the patient in the supine position. Dissection of the cystic pedicle aimed to display the CVS when possible. Dissection was carried out using a "duck-bill" dissector, with swab or hydrosuction being used occasionally when a difficult pedicle is encountered due to inflammation, impacted stones or other factors. Diathermy hooks were not a component of dissection in any case. The CLN(s) was identified visually before or after opening the peritoneum between the gallbladder and liver (Figure 1). CLN appears as a discrete shiny oval swelling immediately under the peritoneum. It is friable and becomes haemorrhagic with minimal handling. There is variability in lymph node size but it is usually solitary (duplicated CLN is shown in Figure 2). The CLN may be tiny or not identifiable within the fibrofatty tissue of the hepatobiliary triangle. The subsequent dissection was carried out lateral to the CLN, identifying and later ligating the cystic artery close to the gallbladder wall and sparing the node whenever possible. It was occasionally necessary to remove an enlarged CLN in order to secure the cystic artery as close to the gallbladder wall as possible. After displaying the CVS (Figure 2), the gallbladder neck was ligated as it joined the cystic duct with 2/0 absorbable suture. Endoclips were not used to secure the structures of the cystic pedicle in this unit. Intraoperative cholangiography was performed routinely through a cystic duct incision using a size 5 French ureteric catheter within a cholangiography cannula/clamp[16] Patients who had common bile duct stones underwent laparoscopic bile duct exploration either transcystically or via choledochotomy.

Informed consent was obtained from all patients with specific emphasis on the specialisation of the unit with regard to the management of suspected bile duct stones. IRB approval was not required as the management protocols were consistent with the recommendations of national and international societies.

Statistics:
Continuous variables were evaluated using means and standard deviations and categorical variables were analysed using frequencies and percentage. Chi Square test was performed on categorical variables and student's t-test on continuous variables. In addition, logistic regression models for the predictors of achieving CVS and CLN identification were then developed. All analyses were performed using stata version 16 software (StataCorp. 2019. *Stata Statistical Software: Release16*. College Station, TX: StataCorp LLC).

Results

393 patients underwent LCs between June 2018 and December 2019. The male to female ratio was 1:2.1 and the median age was 51 years. The split between elective and emergency was essentially half (51% elective and 49 % emergency). The most common cause of emergency admission was acute biliary pain (44.8%) followed by obstructive jaundice (23.9%), acute cholecystitis (9.9%) and acute pancreatitis (7.9%)

The majority of the LCs in this series (n=314; 79.9%) were straightforward, while 20.1% were classified as grades IV and V, reflecting the nature of referrals and workload of the unit.

The CLN was visually identified in 321 LC (81.7%) while in 72 cases (18.3%) the node was not seen. The comparison of characteristics between operation where the CLN was identified and not identified are shown in Table1.

The admission diagnosis did not affect the rate of CLN identification. Body Mass Index above or below 30kg/m^2 did not affect the rate of CLN identification (p=0.206). The CVS was achieved in 84.2% of the LC but did not affect the rate of CLN identification (p =0.826). Operative difficulty grades IV and V vs I to III demonstrated a trend towards a lower rate of CLN identification (OR 0.75; 95% CI 0.50 –1.11). Fundus first dissection was performed in 16 LC (4.1%) and this also showed a trend towards a lower rate of CLN identification (43.8% vs 83.3%; p=0.161).

CLN was identified in 64.6% of the most difficult Grades IV and V LC. However, we were able to visualise the CLN and use it as a guide to starting the cystic pedicle dissection in 69.4% of LC where the CVS was impossible to achieve. On the other hand only 30% of LC with failed CVS also failed positive CLN identification, prompting the utilisation of alternative approaches e.g fundus first dissection.

The median operating time in the whole series was 68 minutes. In patients with no CLN identified, the median operative time was longer (90 min). The perioperative complication rate was 4.4% (n=14) when CLN was identified vs 11.1% (n= 8) with no CLN identification (p= 0.024).

There were no operative complications related to pedicle dissection apart from one post cholecystectomy bile leak (empyema of the gallbladder), contained by the subhepatic drain, which ceased spontaneously within few days. In a few instances, special haemostatic measures to the gallbladder bed were required e.g haemostatic gauze or foam. The source of bleeding was not the cystic artery or its branches in any of these cholecystectomies.

The post operative median hospital stay was 1 day (range 0-20 days). However, as 50% of all cases were emergency admissions and 77.4% were initially admitted to departments or firms before they were referred to the biliary service, the median total length of hospital stay (from day of admission to other team or specialty to discharge date) was 4 days (range 1- 46 days). The perioperative complication rate was 5.6% (n=22), including twelve 30-day readmissions (3.1%) with various symptoms. There were five reinterventions in this series: one percutaneous drainage of an abdominal collection, two Endoscopic Retrograde Cholangiopancreatography (ERCP) for retained stones following transcystic exploration, one relaparoscopy to retrieve a retracted T-tube and one laparotomy for total small bowel infarction (after uneventful LC) resulting in death.

There were no bile duct injuries or conversions to open in this series. Table 2 shows postoperative complications, readmissions and their management.

Discussion

The CLN was identified in 4 out of 5 (81.7%) consecutive LC in this prospective single surgeon series. The CVS was achievable with similar frequency (84.2%). Operative difficulty grades IV and V and the need for fundus first dissection showed a trend towards a lower rate of CLN identification (OR 0.75 and OR 0.53 respectively) suggesting a correlation between increasing difficulty and the inability to identify CLN.

Displaying the CVS is widely recognised as the most important strategy of target identification despite the lack of level 1 evidence. CVS represents the end point of dissection and little emphasis has been placed on the technical details of how the surgeon should get to this end point. Identification of CLN and dissection lateral to it is not a widely recognised aspect of safe cholecystectomy. This could be due to lack of awareness or consistency of the presence of the lymph node as found by some. Torres et al[13] identified 63.6% of CLN in their 88 LC while Qamar et al[11] found 53.3% of CLN in their cohort of 300 LC. In our prospective series, the rate of CLN was much higher at 81.7%, possibly because the surgeon actively looked for the node. Exposing and dividing the lateral lymphatic pedicle is usually sufficient to display the underlying cystic artery because the node drops away. The entire CLN need not be dissected out as this is likely to result in its fracture and haemorrhage.

A few [8-12, 17] have documented the relationship between CLN and the cystic artery. In a study of 40 cadavers, Sonali et al[17] found CLN in Calot's triangle along the cystic artery. Qamar et al[11] found 59.4% of CLN were placed anterior-superior to the cystic artery and 40.6% were posterior-superior to the artery. Suzuki et al[18] have shown a variety of cystic artery patterns which could lead to injury and haemorrhage if the anatomical variant was not recognised. The fixed relationship of CLN to the cystic artery is thus a useful landmark to the artery location which may be especially useful if CVS is difficult to display.

The concept of identifying the CLN has been previously recommended [8-12] as a landmark to help in displaying the CVS. Ferzli et al[8] reviewed their dataset of 907 LC and found no bile duct injury when they used the identification of CLN as an additional method. However the frequency of CLN identification was not reported in that paper. Kunasani et al[9], Channa et al[10] and Singh et al[12] also proposed keeping the dissection lateral to the CLN to avoid bile duct injury.

Nawar[19] has suggested an "artery first technique" as a modified infundibular approach where the cystic artery is identified as it penetrates the gallbladder wall. In his series of 502 LC, this was recommended as being safer than the simple infundibular technique, although that study did not mention the presence of CLN. Being aware of the fixed anatomical relationship of CLN to its artery is a useful means of identifying the artery. The prevention of arterial injury and bleeding is important. The author reported such an event in two cases (0.4%) with one requiring Pringle manoeuvre to control the bleeding. However, care must be taken when pursuing cystic artery dissection without achieving a complete CVS, due to the risk of injury to posterior sectoral bile ducts or subvesical bile ducts, causing major bile leaks, as reported by the author in 2 patients.

Guidelines suggest various approaches to performing a safe cholecystectomy in order to minimize the rate of BDI. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) proposed 6 strategies in their SAGES Safe Cholecystectomy Program[20], 'strategies for minimizing bile duct injuries: Adopting a universal culture of safety in cholecystectomy' (https://www.sages.org/safe-cholecystectomy-program). Connor et al[21] proposed a standardized 5-step method for safe laparoscopic cholecystectomy that includes

dissection close to the gallbladder and lateral to the CLN in order to display the CVS. However, CLN identification was not specifically included in their 5-step final intraoperative checklist. On the other hand, a few studies addressed the need for either excision or sparing of CLN in benign cholecystectomies. Habib et al[22] published their technique for widely opening Calot's triangle and described the excision of CLN as one of their steps in the dissection of cystic duct and artery. There were no bile duct injuries in their 220 cholecystectomies.

Nonetheless, the need for CLN excision in benign cases is not well established. Wysocki et al[23] reviewed 1332 LC performed by a single surgeon and reported that only 10.4% of LC pathology specimens included the CLN irrespective of disease severity or surgical difficulty. In another study published a year later by Wysocki et al[24], 2332 LCs performed by 27 surgeons in a single hospital were reviewed. A mean of 18.7% CLN were found in LC pathology specimens with wide inter-surgeon variability around the mean of 18.7%: 0% (six surgeons who together performed 59/2332 LCs) to 50.0% (one surgeon who performed 7/2332 LCs). The rate of spared CLN is thus very similar to the present series, although we did not rely on histological confirmation of excision. The excision of CLN was therefore proposed as a surrogate marker of technique independent of disease severity and of operative difficulty on the Nassar Scale[14, 15]. Table 1 shows a trend towards a lower rate of CLN identification with increasing operative difficulty (64.6% in grades IV & V vs 86.0% in grades I-III; p=0.147) perhaps indicating that sometimes the node is shrunken/ fibrotic and thus difficult to identify.

There seems to be a complimentary relationship between CLN and CVS. In this study, positive identification of the CLN was possible in 43 (69.3%) of 62 LC where displaying the CVS was unsuccessful. As CLN identification guides the commencement and progress of the dissection and displays the structures of the cystic pedicle, its adoption as a safety strategy during complex cholecystectomies is more reliable than the CVS. As the CVS is essentially the conclusion of a process of dissection it is more likely to be subject to the risk of complications before that conclusion is reached. In our study no incidents were recorded and the procedures were safely completed when the CVS was impossible to display, confirming the usefulness of CLN identification.

The multi-society consensus conference on preventing bile duct injury identified no direct comparative evidence to support the CVS over other methods for anatomic identification [25]. The description of CVS does not address how and where to start and advance the dissection in order to achieve this end point. It would be inconceivable for injuries of the main bile ducts to occur after displaying the CVS[26].

There are limitations in our study. The data is based on a large series performed by a single surgeon with more than 30 years experience and a large biliary emergency workload. However, the dataset also includes cases done by trainees performing the procedures under direct supervision. Histological confirmation of CLN non-excision was not pursued. A prospective multicentre study with a more traditional mix of diagnoses and with the procedures performed by surgeons with a wider range of experience in biliary surgery is needed and can be easily conducted. The results may encourage more surgeons to apply the concept of CLN identification to their practice, increasing the safety of LC.

Conclusion

The identification of CLN during LC can help minimize the rate of major bile duct injury. This prospective study demonstrated the value of CLN in facilitating safe dissection and completion of LC in a significant percentage of cases (69.4%) where the CVS was impossible to achieve. Using the CLN as a guide to commencing and progressing cystic pedicle dissection during complex cholecystectomies may be a more helpful strategy than the end point of attaining CVS.

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Characteristic	Number (%)	CLN identified (n=321)	CLN not identified (n=72)	p value	Odds Ratio (95% CI)
Admission diagnoses*					
Chronic biliary colic	192 (48.9%)	161 (50.2%)	31 (43.1%)	-	1
Acute biliary pain	176 (44.8%)	139 (43.3%)	37 (51.4%)	0.701	0.94 (0.69 – 1.28)
Obstructive jaundice	94 (23.9%)	74 (23.1%)	20 (27.8%)	0.738	0.94 (0.65 – 1.36)
Acute pancreatitis	31 (7.9%)	26 (8.1%)	5 (6.9%)	0.999	1.00 (0.57 – 1.75)
Acute cholecystitis	39 (9.9%)	33 (10.3%)	6 (8.3%)	0.972	1.00 (0.61–1.68)
Acute cholangitis	9 (2.3%)	7 (2.18%)	2 (2.78%)	0.884	0.93 (0.34–2.55)
Type of presentation					
Emergency	193 (49%)	155 (48.3%)	38 (52.3%)	0.827	0.97 (0.72 – 1.30)
Elective	200 (51%)	166 (51.7%)	34 (47.2%)	-	1
Body Mass Index					
≤ 30	284 (72.3%)	218 (76.8%)	66 (23.2%)	-	1
> 30	109 (27.7%)	103 (94.5%)	6 (5.5%)	0.206	1.23 (0.89 – 1.70)
Operative difficulty grade (I/II/III v IV/V)					
I/II/III	314 (79.9%)	270 (86.0%)	44 (14%)	-	1
IV/V	79 (20.1%)	51 (64.6%)	28 (35.4%)	0.147	0.75 (0.50 – 1.11)
Critical view of safety identified					
Yes	331 (84.2%)	278 (84.0%)	53 (16.0%)	-	1
No	62 (15.8%)	43 (69.4%)	19 (30.6%)	0.826	0.83 (0.54 – 1.26)
Fundus first dissection					
Yes	16 (4.1%)	7 (43.8%)	9 (56.3%)	0.161	0.53 (0.21 – 1.30)
No	377 (95.9%)	314 (83.3%)	63 (16.7%)	-	1
Operative time median (SD) min	68 (43)	64 (37)	90 (57)	<0.001	0.99 (0.98- 0.99)

Table 1: Preoperative data and operative parameters.

*Acute pain was recorded alone or in addition to another primary diagnosis

Causes	Number n= 22 (5.6%)	Management	Clavien Dindo Classification
Post operative complications			
Urinary retention	1	Urinary catheterisation	G1
Chest infection	2	IV antibiotic	G2
Post operative jaundice	1	Conservative management, MRCP showecd no retained stone, settled spontaneously	G1
Retained stone	1	Retained stone requiring ERCP for bile duct clearance	G3a
Bile leak	1	Transient, settled spontaneously	G1
Post operative anaemia	1	Blood transfusion	G2
Retracted T- tube	1	Relaparoscopy to remove T- tube	G3b
Bowel ischemia	1	Laparotomy. Total mesenteric infarction	G5
Pyrexial	1	Radiology investigations normal, self resolved.	G1
30 day readmission			
Nausea and vomiting	1	Conservative management, self resolved	G1
Chest infection	1	IV antibiotic	G2
Umbilical port haematoma	1	Conservative management, self resolved	G1
Non specific abdominal pain	2	Conservative management, self resolved	G1
Diarrhoea causing acute kidney injury	1	Conservative management, self resolved	G1
Retained stone	1	Retained stone requiring ERCP for bile duct clearance	G3a
Abdominal collection	2	1 Conservative management, self resolved 1 Radiologically guided percutaneous drainage	G1, G3a
Post operative persistent pancreatitis	3	Conservative management, self resolved	G1

Table 2: Post operative complications and 30 day readmission and management. (MRCP: Magnetic Resonance Cholangiopancreatography, ERCP: Endoscopic Retrograde Cholangiopancreatography)

Figure 1: Early identification of cystic lymph node.

Figure 2: Demonstration of critical view of safety and shows cystic artery ligation between 2 lymph nodes.