A gallbladder with the “hidden cystic duct”: A brief overview of various surgical techniques of the Calot’s triangle dissection

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Abstract: We present a case of a middle-aged female who attended for a routine laparoscopic cholecystectomy as a day case surgery. At operation, she was found to have a distended gallbladder with an unusually prominent distal portion. This has made the dissection of the Calot’s triangle challenging. As a result, the “critical view of safety” technique was applied. This allowed for the clear Calot’s triangle visualization and identification of the cystic duct and artery. This case highlights that the knowledge of various ways of the cystic duct dissection is essential to every surgeon. Furthermore, this helps to adjust the dissection approach on an individual case basis ensuring avoidance of the common bile duct injuries.

Keywords: laparoscopic cholecystectomy, common bile duct injury, Calot’s triangle, critical view of safety, intraoperative cholangiography, “hidden cystic duct”

Introduction

Bile duct injuries during laparoscopic cholecystectomy remain an important cause of morbidity, mortality, increased hospital stay, and litigation [1, 2]. Their reported rate varies from 0.3% to 0.5% and has not changed considerably since the introduction of laparoscopic surgery in early 1990 [3]. The common bile duct (CBD) injuries comprise a complete transection, thermal injuries, or combination of CBD and hepatic vascular injuries [1]. This case highlights that a routine laparoscopic cholecystectomy can be challenging when cystic duct is obscured. Therefore, we feel that it is important to report our experience in order to improve recognition and understanding of biliary tree injuries among surgeons. Furthermore, we provide a summary of various surgical techniques used when dissecting the Calot’s triangle. This is vital in providing a safe surgical practice.

Case Report

A 44-year-old healthy female presented with 48 hours history of the right upper quadrant (RUQ) pain. The pain was radiating to the back and was associated with nausea, vomiting, and anorexia. The patient denied dark urine, pale stools, or weight loss. There was no history of previous abdominal pain or surgical interventions. The patient was a nonsmoker with no alcohol consumption. There was no significant past medical history. On admission, the patient was afebrile with normal haemodynamic observations. Examination of the cardiovascular and respiratory systems was unremarkable. On palpation, abdomen was soft with RUQ tenderness. The Murphy’s sign was negative. Laboratory tests (including liver function tests, amylase, full blood count, and renal function) and an erect chest radiograph revealed no abnormalities. An abdominal ultrasound scan showed multiple gallstones. In a view
of the above history, the diagnosis of biliary colic was made, and the patient was treated conservatively with analgesia and intravenous fluids. She was discharged the following day and 6 weeks later attended for an elective laparoscopic cholecystectomy as a day case surgery.

A standard four-port technique was used under general anaesthetic. Pneumoperitoneum was established via an open Hassan method. At operation, the gallbladder (GB) was distended with an unusually prominent distal portion, which has made a safe identification of the cystic duct (CD) challenging (Fig. 1). In a view of the above finding, primary differential diagnoses in this case included diverticulum of the gallbladder, hidden cystic duct, parallel union (CD with common hepatic duct (CHD) confluence), and prominent Hartmann’s pouch. Therefore, instead of an infundibular approach, the decision was made to utilize the “critical view of safety” (CVS) method in order to minimize the risk of the common bile duct (CBD) injury. The Calot’s triangle was dissected bluntly of fat, fibrous, and alveolar tissues (Fig. 2). The lower portion of the gallbladder was also dissected off the liver bed demonstrating the “critical view” window (Fig. 2). This technique allowed not only to visualize the only two structures (cystic duct and cystic artery) entering the gallbladder from the hepatoduodenal ligament but also confirmed the absence of any abnormal anatomy suspected earlier on (Fig. 1). Subsequently, two endoclips were applied on the proximal ends of the cystic duct and cystic artery, and the gallbladder was safely removed with no need for the CBD or CHD exposure. Overall, the patient has made an uneventful recovery and was discharged home on the same day. The histopathology report confirmed the features consistent with chronic cholecystitis.

Discussion

Biliary tree injury represents the most serious complication that can occur during laparoscopic cholecystectomy [4]. Three main risk factors have been identified, which increase the risk of the biliary tree trauma, and these include surgeon’s experience, an inflammatory process, and biliary anatomical variations [1, 4]. However, the vast majority of reported biliary injuries results from misidentification of the CBD as the CD [2, 3]. Therefore, over the past few decades, surgeons have spent considerable amount of time developing a safe way of Calot’s triangle dissection and cystic duct identification. As a result, several different methods have been described regarding the CD dissection [3]. These techniques include the infundibular approach, “fundus-down” method, hepatic hilum exposure, intraoperative cholangiography, and “critical view of safety” technique.

The infundibular approach (IA)

The IA is often called a method of a “ductal identification” because is based on the identification of the CD and GB junction [1, 5]. During the dissection on the anterior and posterior aspects of the Calot’s triangle once the CD is found, it is then traced on to the union with the GB. A characteristic “flare” or a funnel like shape should emerge when the CD joins the GB [1]. Unfortunately, this approach has several limitations. Firstly, when faced with an acute inflammatory process, which obscures the CD, it can lead to errors in the CD identification. In such circumstances, the false infundibular views cause the CBD to adhere to the GB [1, 2]. Subsequent dissection of the CBD instead of CD occurs because the CD is hidden within the inflammatory...
mass [5]. Additionally, chronic inflammatory process by retracting the GB against the CHD contributes to CHD injury during the GB dissection of the liver bed [5]. The above examples make the IA an unreliable technique. On the other hand, when delivered by an experienced surgeon, it has been found to be as safe as the “critical view of safety” technique [6].

The fundus-down technique (FDT)

The FDT has been found to be associated with the most serious injuries, which predominantly are vascular in nature [7]. However, subsequent biliary tree infarction has been reported as well [5]. As the name of the technique implies, the direction of the GB dissection is from the top down. Unsurprisingly, this does not include the preliminary Calot’s triangle dissection, which is performed once the GB is free of the liver bed [7]. From one point of view, this approach offers a speedy cholecystectomy when tissues are free of inflammation [5]. However, when inflammation of the GB obliterates the Calot’s triangle, this brings the lower portion of GB against CHD and over the right hepatic artery with veins. Consequently, this can lead to a major vascular and biliary trauma [5].

The intraoperative cholangiography (IOC)

The role of the IOC remains controversial. Although few would argue that IOC significantly reduces the CBD injuries, others suggest that it is an unnecessary biliary instrumentation [4, 5]. Furthermore, some advocate that CVS technique can be viewed as an alternative to IOC [4]. However, one must remember that this should be interpreted with caution as there are no large randomized control trials to confirm this. Therefore, the most reasonable approach is to use the IOC selectively when obstructive pictures of liver functions tests or dilated CBD are present implying CBD calculi. The principle is to cannulate the CD and demonstrate the biliary tree anatomy. Unfortunately, there are few pitfalls. Firstly, if contrast flow is seen in the CBD and duodenum only, this is not reassuring. Although, a rapid emptying may cause this, it is more likely that the failure to visualize the upper biliary tree is due to misidentification of the CBD [5]. In fact, in such circumstances, it is very likely that the CBD has been cannulated instead of the CD [8]. This can be complicated even further when an aberrant duct or ducts are present. Despite these challenges, the IOC should be considered in cases when dissection is difficult because it can delineate variants of anatomy providing an anatomical road map for the surgeon [8]. However, it should not be viewed as a “substitute” tool instead of a meticulous technique of the Calot’s triangle dissection or careful use of electrocautery [8].

The hepatic hilum exposure (HHE)

The HHE is achieved by a retraction of the quadrare lobe and lateral segment of the liver. This method was introduced by Sekimoto et al. in 1996 in order to provide a better exposure of the Calot’s triangle [9]. The technique utilizes a Roticator forceps and subsequent surgeon's lateral and the caudal retraction of the infundibulum of the GB. As a result, the Calot’s triangle is not narrowed, and the CBD is not angulated, which occurs with the traditional Reddick’s approach when GB is retracted upwards and laterally [9]. The other exposure method, which was described by Perissat [10], also retracts the inferior portion of the liver but not to the extent that the HHE does. Overall, the HHE offers less anatomical distortion with an axial CBD stretch leading to further reduction in the CBD injuries [9]. However, no randomized control trials have been performed in order to prove the superiority of this technique.

The critical view of safety technique (CVS)

The CVS technique was for the first time described in 1995 by Strasberg [11]. This approach requires complete dissection of the Calot’s triangle as well as GB dissection of the liver bed [2]. This allows for an obvious recognition of the CD and cystic artery. Many authors found the CVS technique to be reliable, easy to perform, and applicable in the vast majority of patients [1, 2, 4, 6]. Furthermore, it has been found to reduce the CBD injuries even when performed by the junior surgeons with varying level of surgical skills [3, 6]. This reinforces an earlier on statement that the majority of the biliary tree injuries are a consequence of the misunderstanding of an anatomy within the Calot’s triangle. This is particularly true in the less experienced hands. Hence, this CVS approach makes laparoscopic cholecystectomy a safer procedure with reduced number of the CBD injuries [2, 11].

Summary

Gallstone disease is common and affects 10–15% of adults in Western populations [12]. The vast majority of patients remain asymptomatic. Others may present with symptoms of an acute cholecystitis, pancreatitis, or cholangitis which lead to more than 25,000 acute admissions in England alone each year [13]. Consequently, laparoscopic cholecystectomy remains one of the most commonly performed operations with 57,000 procedures recorded in England in 2012 [14].

When surgeon faces an unusual or distorted anatomy, limited knowledge of the Calot’s triangle dissection techniques is not only insufficient but also unsafe from
a surgical perspective. This potentially could lead to the considerable difficulties at operation and an increased risk of biliary tree injury [15]. Although preoperative planning is important, its role is limited because biliary anatomy is best assessed in vivo during the operation. Therefore, surgeon has to have a full competence and range of skills that allow him or her to choose the most appropriate Calot’s triangle dissection approach on an individual case basis. This not only constitutes a good surgical practice but, above all, ensures the best possible outcome for a patient. For that reason, we feel that all aforementioned methods of the cystic duct identification are essential for a practicing surgeon.

Although CVS has been adopted worldwide, there are no randomized control trails to prove that this technique actually reduces the rate of the CBD injury [15]. On the other hand, two largest case series by Yegiyants and Collins [3] and Avgerinos et al. [1] revealed that, with the use of the CVS, there were no biliary injuries owing to the misidentification of the CD. Hence, giving the fact that misjudged anatomy is the most common cause of the CBD injury, Strasberg and Brunt proposed to support the CVS technique as the one which has protective role against the biliary tree injuries [15].

Additionally, convincing evidence showed that reduced rates of CBD injuries are encountered in higher volume units [13]. This comes with no surprise as a high volume caseload is essential to maintain the operative skills. However, one must remember that volume is not an exclusive indicator of both the quality and successful outcome. There are many other factors such as selection of patients, preoperative preparation, surgical judgement, knowledge, and skills. Nevertheless, few would argue with this concept.

We have demonstrated that, despite limited evidence from the literature, the CVS technique has been widely utilized. It is a safe approach allowing for the clear Calot’s triangle dissection even by the trainees in their early stages of a surgical career. Finally, the knowledge of various ways of the cystic duct dissection is essential to every surgeon.

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