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Anatomical observation of gall bladder niche in cholecystectomy patients: A surgical approach

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Abstract

Background: Gallstone disease is common worldwide, affecting 10-20% of the population and causing serious complications such as biliary colic and obstructive jaundice. Understanding anatomical variances in the biliary system, particularly structures such as Calot's triangle, is critical for performing safe surgical treatments.

Aim: The purpose of this observational study was to look into anatomical changes in the extrahepatic biliary system using embalmed human cadavers, specifically the union of the cystic duct with the common hepatic duct, duct lengths, and variations in Calot's triangle.

Methodology: Fifty embalmed adult human cadavers were dissected over a two-year period using Cunningham's guidebook. Parameters such as common hepatic duct formation patterns, cystic duct union types, cystic duct lengths, gallbladder characteristics, and Calot's triangle changes were thoroughly documented and studied.

Results: The study found that the angular type of union between the cystic duct and common hepatic duct was most common (96%), with a small minority of cystic duct terminations at high levels (4%). The cystic duct had an average length of 2.89 cm, with variations between 2 cm and 4 cm. Gallbladders were primarily pear-shaped (84%) with normal contents, while few specimens included gallstones (10%). Calot's triangle limits were clearly defined in all specimens, with minimal deviations observed.

Conclusion: This study delves deeply into the anatomical variability of the extrahepatic biliary system, highlighting the significance of exact anatomical knowledge for surgical planning and execution, particularly in procedures such as cholecystectomy. Understanding these variances allows surgeons to avoid complications and enhance patient outcomes.

Keywords: Gallstone disease, cystic duct, common hepatic duct, cholecystectomy, surgical anatomy

Introduction

Gall stones usually form in the gall bladder and these stones once they enter cystic duct cause biliary colic, a severe painful condition. The prevalence of gall stones in India is approximately 4% with a range of 10-20% worldwide. [1] Obstructive jaundice can occur when a stone becomes stuck at the junction of the common bile duct and the pancreatic duct, proximal to the vater's ampulla. The conventional treatment for cholelithiasis is cholecystectomy. Hemorrhage occurs during the laparoscopic cholecystectomy procedure. The reason for this was the wide range of variations in the course of the cystic artery, as well as its relationship to the ductal system. The cystic artery should be cut or ligated during the surgery. Congenital anomalies such as accessory bile duct and accessory cystic duct though rare, they cause remarkable surprise during procedures for surgeons. So, the position and outline of major bile ducts should be ascertained earlier for taking away the gall bladder in order to continue the bile drainage into second part of duodenum. Identification of these anomalies and variants may help the surgeons stay away from diagnostic error and thus prevent inadvertent ductal injuries, fistulas, ductal strictures and shock. [2] Analyzing various literature shows various anatomic variations in the biliary apparatus. During operative and invasive procedures complications such as ductal injures, clamping anomalous vessels, and ligating duct along with artery can occur. Biliary peritonitis if unrecognized during surgery leads to more serious trouble. Dissection of cystic artery should commence adjoining to or near the position of origin of cystic duct or near the entry of branch vessels of the artery into gall bladder wall. The most important step in preventing artery or bileduct injury during open and laparoscopic cholecystectomy. [3] As a result, dissection should be meticulous around Calot's triangle, which is required for both open and laparoscopic cholecystectomy. [4] In this study, to investigate the anatomical nature of the extrahepatic biliary apparatus, particularly the precise arrangement of the cystic duct, Calot's triangle limits, and contents.

Materials & Methods

This is an observational study conducted with fifty embalmed adult human cadavers for a period of two years. The guidelines of Cunningham’s manual of practical anatomy were followed. The specimens were obtained from the cadavers allotted for dissection to the first year MBBS students and Post Graduate students of KAPV Government Medical College, Tiruchirappalli, Tamilnadu, India. The specimens were numbered serially and photographed. The readings obtained using Vernier calipers were recorded and tabulated.

The cadavers' abdomen was opened by a long midline incision made from xiphisternum towards umbilicus to suprapubic region and moving this incision to the right anterior superior iliac spine. 90 Incision from xiphisternum extended laterally along costal margin. Then on both sides the ribs were cut and reflected upwards along with sternum. A cut was made in the rectus muscle and the peritoneum was opened and slowly entered in to abdominal cavity. First the stomach along with its curvatures was identified and defined. Then the small intestine and stomach were retracted downward and then laterally towards left.

After identifying hepato duodenal ligament, the greater omentum was cut transversely below the stomach and then the stomach pushed upwards towards right. After pushing the stomach, the small intestine was retracted towards left and second part of duodenum was identified. The pyloric end of stomach was tied tightly at one end and one more ligature was tied just below the second part of duodenum. At the epiploic foramen, the pedicle was grasped between thumb and forefinger and the common bile duct, hepatic artery and portal vein were seen. Out of these three, common bile duct was anterior and to its right lay the hepatic artery and the portal vein was behind the duct. Gall bladder was identified and details were noted. Inferior vena cava was then identified and cut. The liver with gall bladder and duodenum were removed in to and then washed in running tap water. After this, the specimens were kept in separate containers containing preservative solution consisting of 10 litres of normal saline, 50 ml glycerine, 1 litre of 40% formalin and 100gm of detergent powder. The parameters furnished in the Table 1were noted and studied in detail.

Table 1: Parameters studied in the cadevars

• Pattern of formation of common hepatic duct • Type of union of cystic duct with common hepatic duct • Level of termination of cystic duct • Number of cystic duct • Length of cystic duct • Length of common bile duct • Length of gall bladder	• Number of gall bladder • Shape of gall bladder • Interior of gall bladder • Calot's triangle boundaries • Calot's triangle contents • Sources of Origin of cystic artery • Relations of cystic artery to Calot's triangle • Relation of cystic artery to common hepatic duct

Results and Discussion

Cystic duct united with common hepatic duct in three forms. In the angular type, the cystic duct unites with common hepatic duct at an acute angle. This type of union was observed in 96% specimens. In another type of union, the cystic duct is parallel to the common hepatic duct for a short distance. This type of union was seen in 4% Specimens. None of the specimens showed third type i.e spiral type of union of cystic duct with common hepatic duct. Similar report was published in 100 cadavers wherein angular type in 97 % cases; parallel type in three cases and spiral type was not seen in any case.[5]The most common type was angular union that was evidenced bymany studies. [6-8] The level at which the cystic duct meets the common hepatic duct is the level of termination. It can be either at a normal level, high level or at low level. The common hepatic duct's length (3 cm; according to Gray's anatomy [9]) in high level of union is very small than its average. This study finding reported 4% specimens with high level of union whereas 96% were with normal union. None of the specimens showed low level of union. The average length of cystic duct was 2.89 cm that ranged between 2 cm and 4 cm. The proportion of different length of cystic duct measured was tabulated (Table 2).

Table 2: Length of cystic duct observed in study population

Length (in cm)	**Frequency (%)**
> 3.5cm	4 (8%)
3.1 -3 .5cm	9 (18%)
2.6 -3 .0cm	22 (44%)
2. 1 -2 .5cm	14 (28%)
< 2 cm	1 (2%)
Total	50 (100%)

The retrieved gall bladders were in different shapes in the order of pear (84%), cylindrical (10%), hourglass, flask and tubular exhibited in one specimen each. The most common shape was pear shape which coincides with the findings of Desai et al., (2015) and Nadeem et al., (2016).[10,11] The interior of gall bladder was normal in 45 specimens however, five specimens showed gallstones. None of the specimens were with diverticulum and septum. In all 50 specimens, the Calot's triangle boundaries were well defined. Few studies such as Sridhar et al., (2018) reported 5% abnormality in Calot's triangle while majority of them had 2% variations. [12]

In 45 specimens the content was cystic artery and in 4 specimens the content was cystic artery that was found outside the triangle. The cystic artery was seen outside the triangle in only one specimen but arose from left hepatic artery. The cystic artery was found within the Calot's triangle in 90% of specimens and in 10% of specimen it was seen outside the triangle. Dandekar and Dandekar et al.,(2016) reported >35% of observations were with outside of Calot's triangle.[13] Sidana et al., (2016) in his study observed 16.66% of cystic arteries arose from segmental branch of right hepatic artery while in the present study it was seen only in 2% of specimens.[14] In 2% of specimens the cystic artery arose from Left hepatic artery. Majority (90%) of specimens had the cystic artery passed posterior to common hepatic duct and in 10%cases it passed anterior to common hepatic duct. The study's limitations include its reliance on cadaveric material, which may not accurately replicate the real surgical scenario due to post-mortem alterations and variances in tissue elasticity. Furthermore, while the sample size is appropriate for anatomical descriptions, bigger research may be required to fully capture unusual anatomical variants.

Conclusion

This study used cadaveric dissection to investigate the anatomical variability in the extrahepatic biliary system. The angular junction of the cystic duct with the common hepatic duct, together with the well-defined borders of Calot's triangle in all specimens, emphasizes the structures' variety and complexity. For surgeons undergoing cholecystectomy, it is essential to comprehend these anatomical subtleties in order to reduce complications, such as ductal damage, and guarantee the best possible outcome for their patients. Further research and anatomical investigations will help us better our understanding of gallstone disease and improve surgical techniques.

Conflict of interest

The authors declare no conflict of interest.

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