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Original Research Article

A Study on the Cystic Artery in the Calot's Triangle as Well as Common Hepatic Duct

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Abstract

Introduction: The hepatocellular is made up of the gallbladder and liver. They are provided either by the coeliac trunk, which is one of the abdomen aorta's ventrolateral divisions. These hepatocellular frameworks are genuinely provided by sections of the hepatic aorta perfect, a branch of the posterior portion of the widely accepted hepatic artery that delivers components of the stomach, duodenum, as well as bottom portion of the bile duct via its gastro duodenal branch, whereas the proper hepatic artery delivers the right gastric artery but instead splits into right and left sections that deliver the right and left liver lobes. The gallbladder is supplied by a cystic subsidiary of the correct hepatic artery that travels across Calot's triangle. The mischaracterization of anatomical structures, along with the appearance of anatomical changes, have long been identified as contributing factors towards the occurrence of significant postoperative pain, especially biliary contusions, in the frame of reference of a cholecystectomy.

Aims and Objectives: To characterize the course of the cystic artery concerning Calot's Triangle.

Method: This current study considered 35 specimens of gallbladders from the well preserved bodies of Indian individuals. These individuals ranged from 30 years to 90 years during the time of their death. Samples of gallbladders with intact cystic ducts were considered from bodies during their examination in the Department of Anatomy. The samples were obtained with in 36 hours after death to ensure considerable study conditions. The dissection was done carefully and the course of the cystic artery was observed and noted down, especially concerning the position of Calot's Triangle.

Result: The study found that 97.1% of the specimens showed that Calot's Triangle contains the cystic artery. The study also found that there were 32 specimens which showed cystic artery crossing over the Common Hepatic Duct (CHD) and 2 specimens where cystic artery crossed behind the CHD.

Conclusion: The study concluded that more than 85% of its length, the cystic artery can be within Calot's Triangle and on average, 75% of its length crossed behind the CHD.

Keywords: Calot's Triangle, Cystic Artery, Common Hepatic Duct, Gallbladder.

Introduction

The human body's arterial system is frequently exposed to a diverse range of variability. Attempting to discover differences in the connection of the cystic artery to CBD, CHD, as well as Calot's triangle will undoubtedly be a beneficial endeavour for just an Entomologist as well as Autopsy Surgeon; additionally, quite an attempt will aid physicians in making plans and attempting to operate on the hepatocellular framework. The hepatocellular is made up of the gallbladder and liver [1]. They are provided either by the coeliac trunk, which is one of the abdomen aorta's ventrolateral divisions. These hepatocellular frameworks are genuinely provided by sections of the hepatic aorta perfect, a branch of the posterior portion of the widely accepted hepatic artery that delivers components of the stomach, duodenum, as well as bottom portion of the bile duct via its gastro duodenal branch, whereas the proper hepatic artery delivers the right gastric artery but instead splits into right and left sections that deliver the right and left liver lobes. The gallbladder is supplied by a cystic subsidiary of the correct hepatic artery that travels across Calot's triangle [1].

Liver in addition to biliary ailments constitutes the far more prevalent global health issue, including in India. Cholelithiasis is the most common biliary disease. Gallstones affect up to 25% of Indians [2]. Because no medical treatment is available, a conventional surgical intervention again from the infundibulum towards the fundus often is routinely done [3]. Laparoscopic cholecystectomy had also increasingly supplanted outpatient surgery in recent years. Surgeons must immediately recognize the cystic duct as well as the artery before ligation. Blood loss again from the cystic artery as well as its sections is a significant issue that raises the possibility of intraoperative nodules to essential vascular as well as biliary systems. During laparoscopic visualization, anatomic connections have been seen in different manners whereas during the surgical intervention [4-7].

Globally and in India, liver and biliary illnesses are the most prevalent health issue. The biliary illness cholelithiasis is the most prevalent. In India, gallstones can affect up to 25% of the population. Since there is no longer any accessible medical treatment, a conventional cholecystectomy is most frequently performed from the infundibulum to the fundus. Nowadays, laparoscopic cholecystectomy takes the place of open surgery [3,4]. Before ligation during surgery, doctors must correctly identify the cystic duct and artery. It is a major issue because uncontrolled bleeding from the cystic artery and its branches raises the possibility of intraoperative damage to important arterial and biliary systems[5-8].

The left (or lateral) border of the triangle formed either by the duct of bile is the most essential component to protect during cholecystectomy. As a result, a thorough understanding of the anatomical features of the Calot's (hepatocystic) triangle under laparoscopic visual representation in addition to conventional cholecystectomy might be required again for secure implementation of whatever intervention. The mischaracterization of anatomical structures, along with the appearance of anatomical changes, have long been identified as contributing factors towards the occurrence of significant postoperative pain, especially biliary contusions, in the frame of reference of a cholecystectomy [9,10]. In turn, of that kind injuries can cause serious complications as well as, in rare instances, dying. There is also substantial heterogeneity in the beginnings, program, as well as method by which the cystic artery is assigned to the gallbladder, which a physician must deal

with throughout laparoscopic and open cholecystectomy.

With said aforementioned reasoning in thought, the purpose of this research was to recognise the variability in the situation of the cystic artery in the Calot's triangle as well as its connection with both the cystic duct in Indian people, which would aid physicians in the appropriate and secure effectiveness of laparoscopic as well as conventional cholecystectomy, in addition, to start reducing iatrogenic concussion.

Materials and Methods

Study design

This current study considered 35 specimens of gallbladders from post-mortem bodies of Indian individuals. These individuals ranged from 30 years to 60 years during the time of their death. Samples of gallbladders with intact cystic ducts, were considered from post-mortem bodies during their examination in the Department of Anatomy. Samples were obtained to study the hepatic artery, hepatic duct, cystic lymph node, common hepatic duct (CHD), common bile duct (CBD) and especially the cystic artery. The collection of samples and the study were conducted over the period of 24 months. The samples were obtained between 24 and 36 hours after death to ensure considerable study conditions. The dissection was done carefully and the course of the cystic artery was observed and noted down, especially concerning the position of Calot's Triangle.

Inclusion and exclusion criteria

The samples which were taken within 36 hours of the death of the individuals whose cause of death was normal and did not attribute to any form of poisoning were only included. The samples included were taken from bodies. The age of the individuals from which these specimens were taken was between 30 years to 90 years and they were both males and females.

The specimens which could not be retrieved in one piece or in which the artery is not visible clearly or damaged in any form were excluded. Distended or fibrosed gallbladders or putrefied specimens were also excluded.

Ethical approval

The study obtained approval from the hospital's Ethical Committee on using the specimens. The specimens were used according to the guidelines provided by the hospital.

Results

The study found that 97.1% of the specimens showed that Calot's Triangle contains the cystic artery. Figure 1 shows the detailed findings.

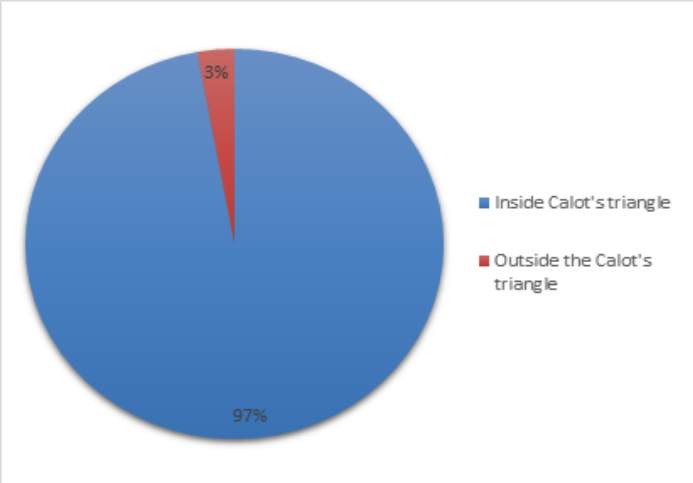

Figure 1: The anatomic variations of the cystic artery found in the sample specimens

The study also found that there were 32 specimens which showed cystic artery crossing over the Common Hepatic Duct (CHD) and 2 specimens where cystic artery crossed behind the CHD (Table 1).

Table 1: The cystic artery's relationship to the common cystic duct and hepatic duct

Cystic artery	Number of specimens	Percentage (%)
Crossing over the common hepatic duct CHD)	32	91.43%
Crossing behind the CHD	2	5.71%
Crossing below the cystic duct	1	2.86%

Again, the study found the percentage of cystic artery each within Calot's Triangle and outside the Calot's Triangle. Table 2 shows the detailed findings of each specimen.

Table 2: Cystic artery present within the Calot's triangle

Specimen No	Cystic artery within calot's triangle (%)	Cystic artery outside calot's triangle (%)
Specimen 1	76.5	24.5
Specimen 2	94.5	5.5
Specimen 3	88.2	11.8
Specimen 4	86.7	13.3
Specimen 5	78.3	21.7
Specimen 6	82.6	27.4
Specimen 7	87.6	12.4
Specimen 8	86.5	23.5
Specimen 9	76.8	23.2
Specimen 10	78.9	21.1
Specimen 11	75.7	24.3
Specimen 12	76.9	23.1
Specimen 13	83.6	26.4
Specimen 14	89.4	20.6
Specimen 15	92.5	7.5
Specimen 16	94.5	0.5
Specimen 17	93.5	1.5
Specimen 18	88.7	21.3
Specimen 19	85.6	14.4
Specimen 20	76.8	23.2
Specimen 21	77.8	22.2
Specimen 22	79.5	20.5
Specimen 23	83.4	26.6
Specimen 24	87.6	22.4
Specimen 25	88.9	11.1
Specimen 26	91.3	8.7
Specimen 27	75.7	24.3
Specimen 28	77.4	22.6
Specimen 29	79.1	20.9
Specimen 30	87.4	22.6
Specimen 31	93.7	26.3
Specimen 32	95.6	24.4

Specimen 33	92.4	2.6
Specimen 34	90.3	9.7
Specimen 35	91.9	8.1
Average	**85.3085714285714**	**17.72**

The study investigated the whole course of the cystic artery relative to CHD in each specimen and analyzed the percentage of the whole length of the cystic artery's position relative to the CHD. Table 3 shows the detailed findings.

Table 3: Variation in the course of the cystic artery concerning the position of CHD

Specimen No	Crossing behind CHD (%)	Crossing over the CHD (%)	Crossing below the CHD (%)
Specimen 1	61.3	33.6	5.1
Specimen 2	72.5	23.5	4.0
Specimen 3	75.6	22.9	1.5
Specimen 4	73.9	20.5	5.6
Specimen 5	69.3	26.5	4.2
Specimen 6	71.5	24.8	3.7
Specimen 7	70.5	22.8	2.7
Specimen 8	72.5	25.8	1.7
Specimen 9	75.5	19.8	4.7
Specimen 10	71.5	25.8	2.7
Specimen 11	73.2	26.3	0.5
Specimen 12	81.6	15.4	3.0
Specimen 13	83.6	11.0	4.4
Specimen 14	85.5	11.5	4.0
Specimen 15	79.5	18.5	2.0
Specimen 16	78.9	17.6	3.5
Specimen 17	79.8	17.2	2.0
Specimen 18	82.3	15.6	2.1
Specimen 19	85.4	14.4	0.2
Specimen 20	76.2	21.6	2.2
Specimen 21	79.3	19.6	1.1
Specimen 22	76.5	19.5	4.0
Specimen 23	81.6	18.2	0.2
Specimen 24	80.5	18.6	0.9
Specimen 25	72.3	25.6	2.1
Specimen 26	69.6	26.5	3.9
Specimen 27	71.6	23.5	4.9
Specimen 28	76.9	21.6	1.5
Specimen 29	80.6	17.6	1.8
Specimen 30	69.8	29.1	1.1
Specimen 31	70.6	25.3	4.1
Specimen 32	76.5	20.6	2.9
Specimen 33	77.5	19.6	2.9
Specimen 34	79.6	19.6	0.8
Specimen 35	81.6	17.6	0.8
Average	**76.13**	**21.07**	**2.65**

Discussion

Bergamaschi and Ignjatovic (2000) conducted a postmortem examination of further than dual components in Calot's triangle and published their findings. Over 6 months, the liver, as well as the hepatoduodenal ligament of 90 sequential human bodies, were corrosive environment cast, post -mortem arteriography, as well as post-mortem cholangiography. In 36.2% of the test samples, arteries (0.6-5.7 mm wide) were found (an initial subsidiary of the right hepatic artery, 8.6%; caterpillar hump right hepatic artery, 12.9%; liver branch of the cystic artery, 10%; dual cystic arteries, 5.7%), and bile ducts (0.3-1.6 mm diameter) were found in 5.7% (small-calibresectoral ducts, 1.4%; right). Knowledge of the aforementioned anatomy is essential for surgeons who are confronted with a little more and over two components inside of Calot's triangle all through laparoscopic cholecystectomy [11].

Rahman and Anwar (2012) investigated and documented 60 post-mortem gallbladders composed with post-mortem dead patients under the supervision of Rangpur Medical College's Forensic Medicine department. The Calot triangle's boundary was identified after the specimen was collected, and the development of the cystic artery was monitored to determine whether or not it managed to pass through to the triangle. The connection of the cystic artery towards the hepatic duct common was also observed. Another study shows that the cystic artery occurs in 96.65% of specimens and 90% of specimens had cystic artery behind the common bile duct. Observations are showing cystic arteries crossing through the common bile duct, and only 3.33%, of them, crossed behind the cystic duct. Calot's node was observed inside the Calot's triangle. A finding of the current study was compared to those of other researchers. Even though many researchers found comparable findings when it came to the path of the cystic artery through the Calot' triangle, some discovered a larger number of cystic arteries having to pass well outside the triangle. Many other studies have found a higher proportion of cystic arteries having to pass over through the common liver duct than that of the latest research. Unexpected cystic artery differences may pose a surgical threat. Understanding anatomical variability of the cystic artery will be beneficial in preventing unmanageable cystic artery internal bleeding as well as attempting to avoid extrahepatic bile duct concussion, particularly in the case of fairly young physicians who are unfamiliar with the management of an anatomically unusual cystic blood flow [12].

Chakraborty et al., (2021) conducted and in the context of hepato-biliary surgical procedure, autopsy-based research on the connection of the cystic artery towards the mutual bile duct, communal liver duct, in addition to calot's triangle was reported. Few studies were conducted to determine the association of Cystic artery through CBD as well as CHD, as well as whether Cystic artery was present within Calot's triangle. In another study, it included mature human corpses over the age of 18, but excluded pediatric patient corpses under the age of 18, dead bodies over through the age of 18 in which debridement is difficult to achieve due to pathology in and surrounding the portahepatis, decayed dead people, as well as mass graves, decided to bring for an autopsy to gross abdominal strain encompassing the hepatobiliary system. The study was longitudinal, cross-sectional, observational, as well as autopsy-based. The cystic artery was found posterior towards the CHD as well as CBD in 90% of instances, while it was found late rally in 10%. The cystic artery was found anterior towards the CHD in 6% of instances and anterior towards the CBD in 4% of situations. In 4% of these situations, the CA was also placed laterally in

connection towards the cystic duct. The cystic artery has been discovered within Calot's triangle 96% of the time and outside the triangle 4% of the time.

Because liver, as well as cystic artery differences, are popular, specialists will be capable of performing secure laparoscopic or open Cholecystectomy, hepatic resections, as well as a vascular rearrangement in organ transplants, attempting to avoid mistakes and patient comorbidities. Calot's triangle is required for both traditional and laparoscopic Cholecystectomy [1,13-15]. Precision as well as a complete and accurate understanding of the various trends of the liver cell as well as cystic arteries is required for sheltered operative processes on the gallbladder and liver. Because hepatic, as well as cystic artery differences, are frequent, physicians will be able to perform safe laparoscopic or open Cholecystectomy, liver resections, as well as vascular reassortment in organ transplants, attempting to avoid mistakes and patient comorbidities. [16]Calot's triangle is required for both traditional as well as laparoscopic Cholecystectomy.

Conclusion

The study concluded that more than 85% of its length, the cystic artery can be within Calot's Triangle and on average, 75% of its length crossed behind the CHD. The study investigated the frequency of anatomical alterations involving the cystic artery inside the Calot's triangle to minimize the risk during surgery. Frequent surgeries involving cystic artery or surrounding areas are done and without the proper experience, it can lead to fatal incidents.

This study is limited by the number of specimens and there is a need to conduct more similar studies to bring out the bigger picture of cystic artery location and positions which would be helpful for aspiring surgeons to avoid surgical bleeding and perform surgery effectively. This study has brought forward some important findings regarding the position of the course of the cystic artery which would in minimizing the fatalities during surgery.

References

1. Chakraborty P, Dutta SS, Mukhopadhyay S. An Autopsy based Study on the Relationship of Cystic Artery concerning Common Bile Duct, Common Hepatic Duct and Calot's Triangle in Light of Hepato-Biliary Surgery. Indian Journal of Forensic Medicine & Toxicology. 2021 Jul 1; 15(3):391-402.
2. Wikipedia contributors. Gallbladder [Internet]. Wikipedia, The Free Encyclopedia; 2008 Nov 11, 02:49 UTC [cited 2022 Nov 28].
3. Neri V, Ambrosi A, Fersini A, Tartaglia N and Valentino TP. “Antegrade dissection in laparoscopic cholecystectomy”. JSLS: Journal of the Society of Laparoendoscopic Surgeons /Society of Laparoendoscopic Surgeons. 2007; 11(2): 225–8.
4. Haubrich, W S 2002, Calot of the triangle of Calot, Gastroenterology, 2000; 123(5): 144.
5. Specht, MJ, Calot‘s triangle, JAMA, 1967; 200(13): 1186.
6. Balija, M, Huis, M, Nikolic, V, and Stulhofer, M, Laparoscopic visualization of the cystic artery anatomy, World J Surg, 1999;23(7):703-07.
7. Suzuki M, Akaishi S, Rikiyama T, Naitoh T, Rahman M, Matsuno S. Laparoscopic cholecystectomy, Calot’s triangle, and variations in cystic arterial supply. Journal Surgical Endoscopy. New York. Springer. 2000 February; 14(2): 141-44.
8. Datta A.K. Essentials of Human Anatomy, Part-I. Mumbai. India. 6th ed Current Books International. 2002; 266-67.
9. Sanjay N. Anatomy relevant to cholecystectomy. Journal of Minimal Access Surgery. 2005; 1(2): 53-58.

10. Ibingira, C.B.R. Groos Anatomical variations and congenital anomalies of surgical importance in hepatobiliary surgery in Uganda. East and Central African Journal of Surgery, 2006;12(1):93-98.
11. Bergamaschi R, Ignjatovic D. More than two structures in Calot's triangle. Surgical endoscopy. 2000 Apr; 14(4): 354-7.
12. Rahman MK, Anwar S. Presence of Cystic Artery in the Calot s Triangle and Its Relation with Common Hepatic Duct a Postmortem Study. India Journal of Anatomy. 2012;10(2):50-6.
13. Patil S, Rana K, Kakar S et al. Clinicoanatomical Study of Blood Supply Of Extrahepatic Biliary Ductal System. British Biomedical Bulletin. 2014: 2(2): 447-459.
14. Tejaswi HL, Dakshayani KR, Ajay N. Prevalence of anatomical variations of cystic artery in South Indian cadavers. International Journal of Res Med Science. 2013; 1:424-8.
15. Md. Khalilur Rahman, Anwar S. Presence of Cystic Artery in the Calot's Triangle and its Relation with Common Hepatic Duct – a Postmortem Study Bangladesh. Journal of Anatomy. 2012: 10(2) :50-56
16. Rawee D. R. Y. A., Abdulghani M. M. F., Alsabea D. W. M. B. Y., Daoud D. M. A., Tawfeeq D. B. A.G., & Saeed D. F. K. Attitudes and Intention towards COVID-19 Vaccines among the Public Population in Mosul city. Journal of Medical Research and Health Sciences. 2021; 4(9): 1438–1445.