

Anatomical Variation of the Cystic Duct: A Case Report

Mohammad Rehan Asad^{1,*}

¹Department of Basic Medical Sciences, College of Medicine, PO Box 66: 11952, Majmaah University, Al Majmaah, Kingdom of Saudi Arabia.

Corresponding author: Mohammad Rehan Asad (e-mail: mr.asad@mu.edu.sa).

©2023 the Author(s). This is an open access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>)

Abstract During a cholecystectomy, cystic duct anatomical variation mostly transpires might experience. Understanding the complex anatomy of the cystic duct and cholecystitis junction is crucial before undergoing biliary surgery to prevent severe ductal damage. This article highlights two unusual cases of irregular cystic duct i.e., cystic duct narrow-wide and low lateral insertion. The first case was of a 66 year old male patient having chronic cholecystitis and cholelithiasis. The aberrant cystic duct entry was thought to be rapid and heading into the correct duct during surgery. Multiple calculi were discovered after more investigation of the common and proper hepatic ducts. Following the completion of the cholecystectomy, the standard and right hepatic ducts were drained using T-tubes. The two T-tubes were found in the cystic and common hepatic ducts, respectively, according to postoperative T-tube cholangiography. The distal choledochus residual stones were removed six weeks later by cholangioscopy through the T-tube's sinus tract. Preoperative endoscopic retrograde cholangiopancreatography (ERCP) in the second case of a 44-year-old woman exposed to a lengthy cystic duct with a small and bent-in lumen. The cholecystectomy was done openly on the patient. Both of the patients recovered. The approach described by the authors for identifying structural changes in the cystic duct is preoperative or MRCP or ERCP, as well as intraoperative cholangiography or cholangioscopy.

Key Words Cholecystectomy, Anatomical variations, Diagnosis, Cystic duct

1. Introduction

It is known that the occurrence of anatomical variations and the cofounding of normal anatomy leads to the incidence of main postoperative difficulties, specifically biliary injuries. These types of injuries sequentially cause substantial morbidity and irregular mortality [1]. Therefore, it is vital to have a detailed knowledge of the surgical implications and the extrahepatic biliary tract's natural anatomy to avoid these issues.

Technological advancements such as magnetic resonance cholangiopancreatography enable non-invasive evaluation for biliary trees [2]. Endoscopic retrograde cholangiopancreatography (ERCP), percutaneous transhepatic cholangiography (PTC), and magnetic resonance cholangiopancreatography (MRCP) are extensively used to recognize anatomical variants of the cystic hepatic junction and cystic duct, and that may surge the injury of bile duct's risk in biliary surgery [3].

In this article, two cases of cystic duct anatomical variations have been studied, in which the irregularity was initiated during surgery and afterward established by ERCP and postoperative cholangiography [4].

Case Report 01

A 66-year-old man was admitted due to fever, vomiting, abdomen tenderness, nausea, and pain in the right upper quadrant, which seems like features of acute cholecystitis [5]. During the examination of the patient's right upper quadrant, tenderness and temperature of 38°C were noticed. The patient also has a history of pain in the abdomen and previously had abdominal CT five years ago, which means slight intra-hepatic dilation duct [6].

Laboratory tests showed that alkaline phosphatase was 302 U/L, aspartate aminotransferase was 37 U/L, and bilirubin and count of white cells were 6 and 24 $\mu\text{mol/L}$, respectively. Gallbladder distension with calculi and a thick wall coupled with pericholecystic fluid was seen on ultrasound [7].

An open, laparoscopic cholecystectomy was scheduled after the diagnosis of cholelithiasis with persistent cholecystitis. The gallbladder had a thick wall and little bond in the triangle of Calot and the adjacent tissues after laparotomy, and the liver was normal. Upon separation, it was mistakenly believed that the cystic was short and was entering the right hepatic duct [8]. They separated and cut the cystic duct.

Next, the cystic artery was located, cut, and separated. After more investigation of the common and right hepatic

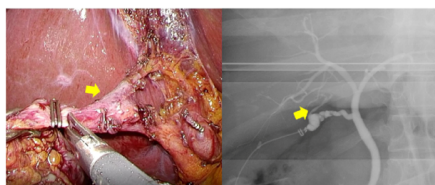


Figure 1: A connection among aberrant right hepatic duct and cystic duct ending in the liver bed

ducts, multiple calculi were discovered. The procedure of Cholecystectomy was done by drainage of the T-tube of the right and common hepatic duct (for postoperative documentation and confirmation) [9].

Abdominal pain developed after the surgery, prompting a request for T-tube cholangiography on postoperative day. The right hepatic and cystic ducts of the cholangiogram using a T-tube were somewhat lengthy (Figure 1). It was possible to identify and fully assess the bile duct. Six weeks later, the cholangiography procedure was used to remove the residual stones via the T-tube's sinus tract. The patient was effectively healed [10].

Case report 02

A 44-year-old female patient was admitted to the hospital with discontinuous pain in the right upper quadrant for the last three years that radiated from her back along with nausea and fever. The fatty foods made the ache worse [11]. She had been taking treatment for parasitic infestations and acid peptic disease throughout her current illness, but neither condition had improved.

The patient had a similar history. Upon physical examination, the patient had a soft, non-distended belly, no right upper quadrant discomfort, and no peritoneal symptoms. Murphy's indication was adverse [12]. Laboratory analysis of vital signs and liver function were normal, and her temperature was 37.5°C. The patient was kept at rest while receiving continuous fluid infusions and gastrointestinal decompression. Within 4 days of treatment, the patient's symptoms improved initially. However, a few days later, she felt pain in her right upper quadrant [13]. A lengthy cystic duct with a narrow, in-curved lumen that was well separated from the gallbladder was discovered when an ERCP was requested. The remainder of the biliary tract was free of calculi and ordinary. The creation of a minor, twisting cystic duct was done after cholecystectomy. After the surgery, recovery went without a hitch until the patient was released [14] (Figure 2).

2. DISCUSSION

There is no clinical significance of cystic duct anatomical variations, mostly occurring in 18-23%. In imaging studies, unidentified aberrant anatomy might cause misunderstanding. Additionally, a range of secondary and primary disease progressions may impact the cystic duct [15]. The injury rate differs in the literature of medicine from 0-1%. Some



Figure 2: Cystic duct

of the disparities in the cystic duct are double cystic duct, parallel common and hepatic cystic duct, cystic duct low convergence, cystic duct Para hepatic duct insertion, short or absent cystic duct, right hepatic duct terminating into the cystic duct, posterior-anterior spiral addition types of the cystic duct on the common hepatic duct of left side, bifurcation of the right and left hepatic ducts and implantation of the cystic duct in the right and left hepatic ducts, the mutual hepatic duct entering the gallbladder is a highly uncommon congenital anomaly. Numerous modalities allow standard anatomy depiction and cystic duct disease procedures i.e., MRCP, CT, ERCP, intraoperative cholangiography, and PTC. Although the dilated cystic duct can be seen using ultrasound and computed tomography, it can be challenging to see the normal-caliber cystic duct using these methods [16].

In our first example, CT failed to identify low insertion of the cystic duct, which was discovered during surgery but did show modest intrahepatic ductal dilatation. In this instance, gallbladder and bile duct calculi were mistakenly diagnosed as the low insertion of the cystic duct. However, ERCP revealed a lengthy cystic duct with an inwards curving, narrow lumen in the second instance. Prior to surgery, a cystic duct anomaly was discovered. At ERCP, anatomical variation is easily detected [17]. In clinical practice, a narrow-winding cystic duct should be taken into consideration if the patient complains of intermittent non-colic right upper abdomen pain, and ultrasound, CT, and endoscopy rule out choledocholithiasis, tumor, and peptic ulcer. In diagnosis, ERCP is particularly useful. Compared to ERCP and PTC, recent investigations have shown that MRCP may offer a non-invasive alternative for diagnosing abnormal cystic ducts [18].

In 171 patients, Rashid and associates assessed the reliability of MRCP in the anatomic variation diagnosis of the biliary tree. In 126 patients (74%), MRCP revealed a cystic duct, with low cystic duct addition seen in 11 patients (9%), and a parallel course of the cystic and hepatic ducts shown in 31 individuals (25%). According to these findings, exact

preoperative valuation is very useful in delivering a treatment strategy for surgery and substantiating diagnosis [19].

Postoperative problems could result from incorrectly identifying the cystic duct. The low cystic duct medial insertion justifies special care since, as in our first patient, this anatomical variation may misinterpret imaging and impair therapeutic management [20].

An incomplete bile duct variation literature review showed that the target set by most of the surgeons was to find out whether bile duct stones existed or not. Regarding the unintentional finding of bile duct disparity, the most crucial element in preventing bile duct harm is not the variation's characteristics but rather its existence [21].

Most cystic duct injuries typically happen when they turn equivalent to the mutual bile duct and are covered by a shared sheath, making the difference among the ducts difficult to see during surgery. Installation of a T-tube in the cystic duct remainder is typically unproblematic; however, if reserved shared duct stones are extant and removal of stone through attempted T-tube, there may be a problem [22].

In such conditions, the bile tube is accessed by a region that arrives at the cystic duct; extraction and manipulation must take place across the Heister regulators via the cystic duct. Using this method, stone extraction is more challenging or even unbearable [23]. Suspicion should be aroused if the cystic duct is huge. When in doubt, intraoperative cholangiography should be employed. In exceptional cases, gallbladder cholangiography can be done to help identify the cystic duct along with the main bile tube [24].

3. Conclusion

Conclusively, a variety of anatomical disparities exist in which the cystic duct is involved. Accuracy of diagnosis is based on a clear understanding of anatomical alternates of the cystic duct, the normal anatomy, and mental imagery structures of calculous disease.

Conflict of Interest

The author declares no conflict of interests. Author read and approved final version of the paper.

References

- [1] Sarawagi, R., Sundar, S., Gupta, S. K., & Raghuvanshi, S. (2016). Anatomical variations of cystic ducts in magnetic resonance cholangiopancreatography and clinical implications. *Radiology Research and Practice*, 2016.
- [2] Tastemur, Y. (2020). Anatomical variations of the cystic duct in Turkish population and their association with biliary track stone. *J Coll Physicians Surg Pak*, 30(10), 1005-1008.
- [3] Samnani, S. S., & Ali, A. (2015). "Y" variant of double cystic duct: incidental finding during laparoscopic cholecystectomy. *Indian Journal of Surgery*, 77, 1491-1491.
- [4] Fujimoto, N., Tomimaru, Y., Yamamoto, T., Hayashi, Y., Noguchi, K., Noura, S., ... & Dono, K. (2020). Clinical investigation of the cystic duct variation based on the anatomy of the hepatic vasculature. *Surgery Today*, 50, 396-401.
- [5] Gündüz, N., Dogan, M. B., Alacagöz, M., Yagbasan, M., Orhan Söylemez, U. P., & Atalay, B. (2021). Anatomical variations of cystic duct insertion and their relationship with choledocholithiasis: an MRCP study. *Egyptian Journal of Radiology and Nuclear Medicine*, 52(1), 1-7.
- [6] Salih, A. M., Kakamad, F. H., Mohammed, S. H., Salih, R. Q., Habibullah, I. J., Muhiyaldeen, A. S., & Fatih, H. (2017). Double cystic duct, a review of literature with report of a new case. *International Journal of Surgery Case Reports*, 38, 146-148.
- [7] Andall, R. G., Matusz, P., du Plessis, M., Ward, R., Tubbs, R. S., & Loukas, M. (2016). The clinical anatomy of cystic artery variations: a review of over 9800 cases. *Surgical and Radiologic Anatomy*, 38, 529-539.
- [8] Güngör, F., Sür, Y., Gür, E. Ö., & Dilek, O. N. (2019). A rare anatomical variation of the bile ducts: Cystic duct draining to the right hepatic duct. *The Turkish Journal of Gastroenterology*, 30(4), 375-376.
- [9] Plaza, O., Moreno, F., Plaza, O., & Moreno, F. (2019). Biliary tract in trident, an anatomical variation between the cystic duct and its union to the common hepatic duct. a rare case report. *Int. J. Morphol*, 37(1), 308-310.
- [10] D'Angelo, T., Racchiusa, S., Mazziotti, S., & Cicero, G. (2017). Magnetic resonance (MR) cholangiopancreatography demonstration of the cystic duct entering the right hepatic duct. *The American Journal of Case Reports*, 18, 242-245.
- [11] Munie, S., Nasser, H., Go, P. H., Rosso, K., & Woodward, A. (2019). Case report of a duplicated cystic duct: a unique challenge for the laparoscopic surgeon. *International Journal of Surgery Case Reports*, 56, 78-81.
- [12] Choi, S. J., Yoon, J. H., Koh, D. H., Lee, H. L., Jun, D. W., & Choi, H. S. (2022). Low insertion of cystic duct increases risk for common bile duct stone recurrence. *Surgical Endoscopy*, 36(5), 2786-2792.
- [13] Qamar, N., Ishaque, I., Ilyas, A., Parveen, K., Zubair, M., & Ahmad, S. (2016). Identification of cystic duct variations in laparoscopic visual field. *Pakistan Journal Of Surgery*, 32(2), 96-99.
- [14] Sherifi, F., Bajraktari, I., Bexheti, S., Lahu, A., Gashi, Z., & Shatri, J. (2018). Anatomic variations of the cystic duct assessed by magnetic resonance cholangiopancreatography. *Italian Journal of Anatomy and Embryology*, 123(2), 158-164.
- [15] Yu, J. J., Morell, M., Lee, J. G., & Imagawa, D. K. (2017). A case report on a rare anatomic variant of cystic duct insertion. *Journal of Surgical Case Reports*, 2017(7), rjx131-rjx131.
- [16] Rashid, A., Mushtaque, M., Bali, R. S., Nazir, S., Khuroo, S., & Ishaq, S. (2015). Artery to cystic duct: a consistent branch of cystic artery seen in laparoscopic cholecystectomy. *Anatomy Research International*, 2015, 150-152.
- [17] AbeshaAmbaye, M., Anderson, B. A., & Tsegay, A. T. (2015). Variation of cystic duct insertion in relation to the extrahepatic ducts and observed frequency of double lumen apparent common bile duct. *International Journal of Pharma Sciences and Research (IJPSR)*, 6(2), 254-258.
- [18] Renzulli, M., Brocchi, S., Marasco, G., Spinelli, D., Balacchi, C., Barakat, M., ... & Golfieri, R. (2021). A new quantitative classification of the extrahepatic biliary tract related to cystic duct implantation. *Journal of Gastrointestinal Surgery*, 25, 2268-2279.
- [19] Fujiwara, K., Hiraka, K., Shindo, K., Abe, A., Masatsugu, T., Hirano, T., & Sada, M. (2024). Variations in the Cystic Duct: Frequency and the Relationship Among Insertion Sides and Heights on the Bile Duct. *Surg Radiol Anat*. doi: 10.1007/s00276-023-03275-9. Epub ahead of print. PMID: 38197959
- [20] Aljiffry, M., Abbas, M., Wazzan, M. A., Abduljabbar, A. H., Aloufi, S., & Aljahdli, E. (2020). Biliary anatomy and pancreatic duct variations: a cross-sectional study. *Saudi Journal of Gastroenterology: Official Journal of the Saudi Gastroenterology Association*, 26(4), 188-193.
- [21] Watson, C. J. E., & Harper, S. J. F. (2015). Anatomical variation and its management in transplantation. *American Journal of Transplantation*, 15(6), 1459-1471.
- [22] Otaibi, W., Quach, G., & Burke, B. (2015). Double cystic duct in a septated gallbladder. *Journal of Investigative Medicine High Impact Case Reports*, 3(2), 2324709615579105.
- [23] Shaikh, B., Baloach, I. B., & Shaikh, S. A. (2016). Anatomical variations: Dangerous culprits behind difficult cholecystectomies. *Rawal Medical Journal*, 41(3), 316-319.
- [24] Alsabek, M. B., Arafat, S., & Aldirani, A. (2016). A case report of laparoscopic cholecystectomy in situs inversus totalis: Technique and anatomical variation. *International journal of Surgery Case Reports*, 28, 124-126.