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Anatomical insights into double cystic duct: A rare variation observed in cadaveric dissection

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Abstract. *Introduction.* Rare but significant anatomical differences in the biliary ducts, such as having two ducts, can create challenges in surgeries like laparoscopic cholecystectomy, according to a study that examined a case of double cystic duct found during cadaver dissection and its implications in practice. *Material and method.* In the study, dissections were done on 25 cadavers at the Anatomy Department of the University of Medicine Pharmacy Science and Technology in Târgu Mureș, where a cadaver with a secondary cystic duct anomaly was observed. A series of measurements and histological examinations were conducted to validate the results and juxtapose them with prior literature. *Results.* The secondary cystic duct showed a shape resembling the letter “Y” with separate insertions of the ducts at the common hepatic duct level with the same macroscopic anatomical features. Histological examinations revealed normal biliary epithelium and tubular shaped structure. *Conclusion.* Finding a secondary duct underscores the importance of vigilance during surgery because such variations can raise the chances of bile duct damage during gallbladder cholecystectomy. It is advised to use imaging, before surgery and cholangiography during surgery to manage the risks linked to these abnormalities.

Keywords: double cystic duct, biliary variations, cadaveric dissection, biliary surgery.

INTRODUCTION

Anatomical differences in different organ systems, though common, pose challenges for both medical imaging and surgical procedures. One rare and important anomaly is the presence of a supplementary cystic duct. Potential impact on clinical practice and surgical interventions is present due to specialized literature reports that emphasize the need to take into consideration that such an anatomical variation might occur. During embryological development, variations may occur due to incomplete fusion or abnormal differ-

entiation of the biliary structures, leading to the formation of a double cystic duct. (1,2)

The cystic duct normally links the gallbladder to the bile duct playing a role in transporting bile. Variations in its structure can increase the risk of complications during biliary surgical interventions and cholecystectomy. A double cystic duct, where there are two ducts coming from the gallbladder, adds another level of complexity to biliary anatomy. Although such anomalies are uncommonly documented they require attention and thorough surgical planning to prevent damage to the ducts and related health issues. In the past, there have been classifications for cystic duct abnormalities, with early literature consisting mostly of sporadic case studies. Flannery and Caster, in 1956, classified these irregularities into three types: the “Y” type, where two cystic ducts join to create one channel; the “H” type, where an additional duct drains separately into the hepatic ducts; and the trabecular type, where an extra duct directly connects with the liver tissue. Recent case studies and anatomical research focus mainly on the clinical significance of these variations. Studies on cadavers offer insights into anatomical differences, providing a controlled environment to explore uncommon abnormalities. Cadaver dissection can add to the valuable data of intraoperative and radiological reports in order to define the role of this very rare variation.

In this study, we describe the cystic duct found in our cadaver specimen, connecting our observations with existing literature to offer a comprehensive understanding of this rare anomaly. By incorporating these insights, we aim to equip clinicians to handle variations, ultimately enhancing surgical outcomes and lowering complication risks.

MATERIALS AND METHOD

The research took place in the Department of Anatomy of The University of Medicine, Pharmacy, Science, and Technology, George Emil Palade” Târgu Mureş utilizing the institution’s collection of cadaveric specimens. Dissection was carried out for academic and learning purposes for the first and second-year general medicine students. A total of 25 cadavers underwent dissection over an approximately six-month period as part of the academic year. Cadavers were chosen without regard to gender, age, or suspected cause of death. All specimens had been preserved following formalin fixation procedures to preserve tissue quality and enable anatomical examination. Anatomists and volunteer-trained medical students conducted the dis-

sections under supervision following established protocols. The dissection began by examining the wall and then carefully exploring the organ systems, within the peritoneal cavity in detail. A closer look was given to the hepatobiliary system because a potential anatomical variation had been found. The gallbladder along with structures like the cystic duct and common bile duct, were revealed along with the surrounding blood vessels. The primary aim of the dissection was to pinpoint landmarks such, as the Calots triangle to ensure an understanding and exposure of the biliary system. When a double cystic duct was identified, detailed morphological measurements were taken, including lengths and diameters of the ducts and insertion with anatomical disposition. The researchers took pictures to record their discoveries. Then, they were compared to anatomical references. They verified the nature of the duct through an examination of the ducts at a macroscopic level. The confirmation process involved analyzing the ducts that were pinpointed and removed. Histological checks were necessary, to confirm the findings. Tissue samples were collected, cut into sections and dyed with Hematoxylin and Eosin (H&E) for assessments. The purpose of this study was to confirm the existence of tissue and identify any alterations, such, as inflammation or scarring, that could be linked to observations during surgical procedures and also to assess the impact of anatomical functionality.

In terms of ethics, considerations were taken into account in the research and educational use of cadaveric specimens, following standards and guidelines that emphasized the importance of respecting the dignity and integrity of these specimens. The research findings were solely aimed at advancing knowledge without any personal interests. This methodological approach offered an in-depth understanding of the variation under investigation, enabling an exploration of its clinical and surgical implications. The collected data underwent analysis. We compared our findings with anatomical and surgical literature to provide fresh insights into the double cystic duct anomaly.

RESULTS

During the dissection of a body, an unusual anatomical variation was discovered. A double cystic duct. This finding was thoroughly documented using a combination of examining the structure, studying the tissues under a microscope, and capturing images to fully understand this abnormality, in the bile duct system. Initially, the gallbladder appeared normal in its place on



Figure 1. Depicts the initial view of the biliary tree highlighting where the cystic ducts branch off from the gallbladder neck. Using dissection tools showcases how these ducts are positioned („Y” shape pattern).

the liver’s surface. However, further exploration uncovered a split from the neck of the gallbladder, indicating two cystic ducts. The main cystic duct followed its path by extending from the gallbladder’s neck and connecting

with the bile duct at its regular spot in anatomy with no variations present and with the basic anatomical reports present. This primary duct had measurements with a diameter of around 3 mm and a length consistent with what’s generally seen in anatomy. The secondary cystic duct deviated from the main and took a distinct course by joining directly with the common hepatic duct in a „Y” shape pattern. This smaller duct had a diameter of 1 mm and the same superficial structure (Figure 1).

Further exploration reveals how the secondary cystic duct connects and merges with the common hepatic duct. This image clearly displays their relationship and proximity to liver tissues. The secondary cystic duct was sectioned, revealing a macroscopically tubular-shaped structure (Figure 2).

After examining the structure tissue samples, the secondary duct was sectioned for analysis under a microscope. The samples were preserved in formalin, cut into sections, and stained with Hematoxylin and Eosin (H&E) to study the cell composition and confirm the presence of epithelium. The secondary cystic duct showed a lining without signs of inflammation, scarring, or abnormal cell growth. The overall structure of the

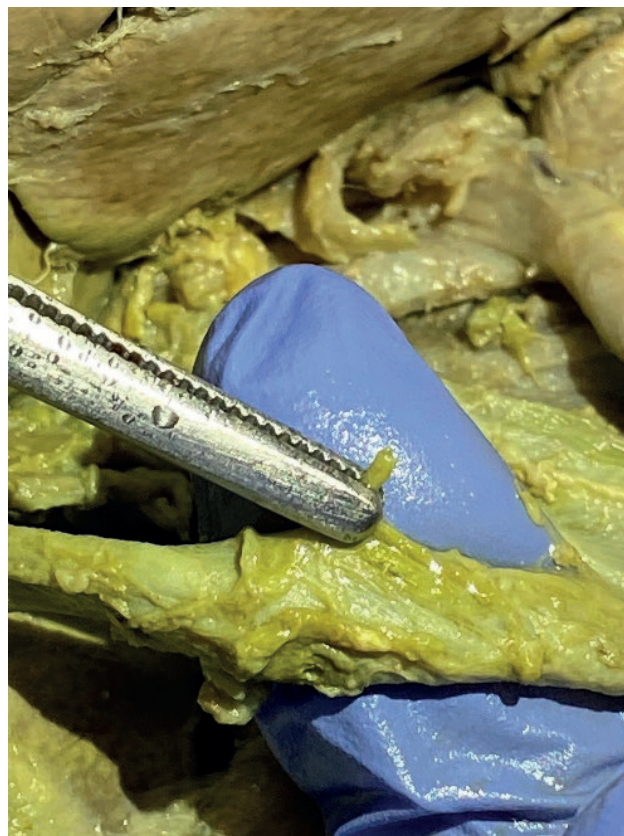


Figure 2. Sectioned secondary cystic duct with tubular-shaped structure.

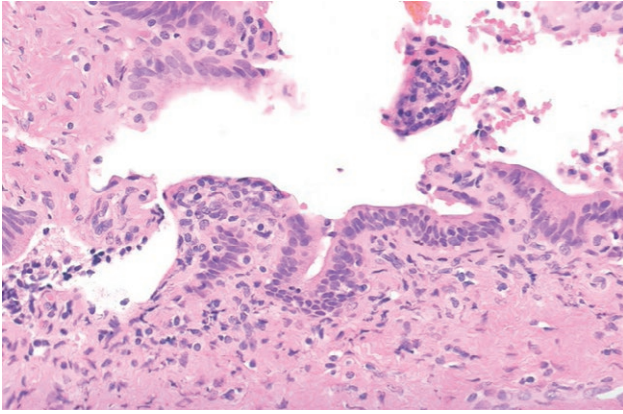


Figure 3. Secondary biliary duct with tubular structure and cell lining.

duct matched that of a duct, confirming its drain role in the anatomical biliary system (Figure 3).

DISCUSSIONS

The discovery of a secondary duct during the dissection of a cadaver offers valuable information about the intricate nature of biliary anatomy. While differences in the tree are frequently encountered, having two cystic ducts is considered an exceptionally uncommon abnormality, with only a limited number of documented instances in the medical literature. Recognizing these variations is crucial for studies and medical procedures in laparoscopic surgery, where unidentified anomalies can result in serious complications (1-4).

In this instance, we noticed a formation that resembles the “Y” shape pattern, with one duct connecting to the common bile duct in its typical position and another duct linking separately above close to the hepatic duct junctions. This arrangement corresponds to the system outlined by Flannery and Caster for classifying duct cases according to their drainage routes. Our case falls under the “Y” type, which is defined by two duct paths merging at points. In line, with findings in existing studies and reports in the literature, it is common for instances of duplicated duct to either converge both into the common bile duct or, independently empty, into the hepatic duct/common hepatic duct (2,5,8). From a clinical viewpoint, the existence of a cystic duct notably heightens the likelihood of bile duct injury, during surgeries like laparoscopic cholecystectomy. Recognizing and addressing aspects of the bile system is crucial to prevent issues like bile leakage or even total severing of bile ducts. These dangers are further complicated by the

chance that pre-surgery scans, like Magnetic Resonance Cholangiopancreatography (MRCP), may not consistently spot these deviations. While MRCP has been commonly used to chart the system before surgery, its ability to identify duct structures, like double cystic ducts, is somewhat restricted (2,6,7,11). The double cystic duct was found during a cadaver dissection, in our study, where we could thoroughly investigate the anomaly in a controlled setting. However, in real-life surgeries, this variation may not become evident until the surgeon is operating. In cases of suspected variations during surgery it is strongly advised to use intraoperative cholangiography for live imaging of the biliary tree. Numerous research studies have highlighted the importance of using cholangiography to lower the risk of bile duct injuries in patients with complex or unusual biliary structures (8,5).

The anatomical discovery in this research aligns with what has been observed in cystic duct cases documented in other studies. In a research conducted by Huston and Dakin (2008), they discussed a scenario where a double cystic duct was found during a scheduled cholecystectomy surgery. The abnormality went unnoticed, before the operation; however, during the surgery, cholangiography revealed two duct structures – one connecting to the bile duct and the other leading to the right hepatic duct. (2,4). Anisi et al. (2020), in another study, discovered a cystic duct that proved to be quite troublesome, in the context of laparoscopic surgery, requiring the implementation of sophisticated imaging methods to prevent any potential complications that may arise (5,9-11).

The unique aspect of our study, compared to others, in existing literature, lies in the thorough examination carried out during dissection sessions. While previous studies have mentioned variations like the “H” type – where the additional duct connects to the liver duct separately – our discoveries provide measurements of structures and a detailed analysis of tissue samples that enhance our understanding of this uncommon condition. Encountering a secondary cystic duct presents considerable challenges for surgeons during minimally invasive surgeries due to limited visibility. Even though preoperative imaging tools are useful in cases to identify these anomalies sometimes they might miss detecting rarer variations, which highlights the importance of a thorough assessment during the surgery. It’s also crucial to consider the possibility of duct presence, along with other biliary or vascular irregularities, during the procedure (13). At times, such irregularities might be linked to a range of anomalies, within the bile duct system, which could complicate the planning of surgical procedures. For instance, variations in the artery supplying

the gallbladder or the existence of multiple bile ducts have been observed alongside cases of double gallbladder. Surgeons need to stay alert for these variations while conducting surgeries as they can impact the technique significantly and heighten the chance of complications, during surgery (14,15).

CONCLUSIONS

During a dissection session, when a double cystic duct is found, it offers information about the intricate nature of biliary anatomy. It highlights the significance of identifying such variations in real-world medical settings. Although uncommon occurrences like these can present difficulties during procedures like laparoscopy, special attention must be given to the use of intraoperative cholangiography and precise dissection to prevent any complications in situations where there is suspicion of a double cystic duct.

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