ORIGINAL RESEARCH

A Cadaveric study on Branching Patterns of the Right Intrahepatic Bile Ducts at the Hepatic Hilum

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Abstract

Objective: Comprehensive anatomical knowledge in branching patterns of intrahepatic bile ducts at the hepatic hilum is useful in liver resection and transplantation. This study was aimed on the anatomical relation of the right anterior and posterior segmental branches to the formation of the right hepatic duct and on the variants of their drainage.

Methods: From the year 2022 to 2023, 25 fresh liver specimens were dissected. The extrahepatic bile duct was identified initially. Then the right hepatic duct identified followed by the right anterior and posterior segmental branches were delineated via liver parenchymal dissection.

Results: In our study, 19/25 (76%) of liver specimens had the right posterior duct ran posterior to the right anterior duct and fused it from a left (medial) sided approach to form the right hepatic duct. An ectopic drainage of the right anterior segmental duct into the common hepatic duct was noted in 3/25 (12%). A variant of "triple confluence", was encountered in 1/25 (4%). Drainage of the right posterior hepatic duct into the left hepatic duct before its confluence with the right anterior duct was presented in 1/25 (4%). The direct drainage of the right posterior duct into the common hepatic duct was present in 1/25 (4%). There was no ectopic drainage of the right anterior duct into the left hepatic ductal system, and an ectopic drainage of the right posterior duct into the cystic duct.

Conclusion: Variations of the right hepatic duct confluence were less. However, two most common variations were the ectopic drainage of the right anterior duct into the common hepatic duct and the triple confluence.

Keywords: Cadaveric study, right intrahepatic bile ducts, hepatic hilum, Resection, Transplant

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Introduction

Comprehensive anatomical knowledge in branching patterns of intrahepatic bile ducts at the hepatic hilum is useful in hepatic surgeries such as liver resection and transplantation. A few studies have assessed the anatomic variations of the biliary tree in view of safe bile duct division and reconstruction. The right hepatic duct drains the segments of the right liver lobe (V–VIII) and has two major branches, the right posterior branch draining the posterior segments, VI and VII, and the right anterior duct draining the anterior segments, V and VIII. The right posterior duct has an almost horizontal course, whereas the right anterior duct tends to have a more vertical course. The right posterior duct usually runs posterior to the right anterior duct and fuses it from a left (medial) approach to form the right hepatic duct. Ignorance of the biliary anatomy can result in major postoperative complications. A cadaveric study on the branching patterns of the right intrahepatic bile ducts at the hepatic hilum consists of examining the anatomical variations and configurations of these ducts. Such studies are important for understanding the complexities of liver anatomy, which can significantly impact surgical interventions. The study was focused on the anatomical relation of the right anterior and posterior segmental branches to the formation of the right hepatic duct and on the variants of their drainage (1-5).

Methods

Between 2022 and 2023, 25 fresh liver specimens were dissected at the department of Anatomy, Faculty of Medicine, University of Kelaniya. The extrahepatic bile duct was identified initially. Then the right hepatic duct was identified, followed the right anterior and posterior segmental branches in liver parenchyma.

Results

In our study, 19/25 (76%) of liver specimens had the right posterior duct ran posterior to the right anterior duct and fused it from a left (medial) approach (figure 1) to form the right hepatic duct. An ectopic drainage of the right anterior segmental duct into the common hepatic duct was identified in 3/25 (12%) of our samples. Another variant of the main hepatic biliary branching, also known as triple confluence (figure 2), is an anomaly characterized by simultaneous emptying of the right posterior duct, right anterior duct, and left hepatic duct into the common hepatic duct. In patients with this variant, the right hepatic duct is virtually nonexistent. The specific variation was encountered 1/25 (4%) of our samples. Drainage of the right posterior hepatic duct into the left hepatic duct before its confluence with the right anterior duct (figure 3) is another relatively common anatomic variant of the biliary system and it is presented in 1/25 (4%) of the samples. The direct drainage of the right posterior duct into the common hepatic duct is a variant also known as the aberrant hepatic duct and was present in 1/25 (4%) of our samples. Finally, we did not find any of the following variations, such, ectopic drainage of the right anterior duct into the left hepatic ductal system, and ectopic drainage of the right posterior duct into the cystic duct. Figure 4 shows the schematic diagram of the typical and variant patterns.

Figure 1: LHD – Left Hepatic Duct, CBD – Common Bile Duct, PV – Portal vein, HD – Hepatic Duct, A- Anterior division of RHD, P – Posterior division of RHD

Figure 2: LHD – Left Hepatic Duct, CBD – Common Bile Duct, PV – Portal vein, HD – Hepatic Duct, A- Anterior division of RHD, P – Posterior division of RHD

Figure 3: LHD – Left Hepatic Duct, CBD – Common Bile Duct, PV – Portal vein, HD – Hepatic Duct, A- Anterior division of RHD, P – Posterior division of RHD

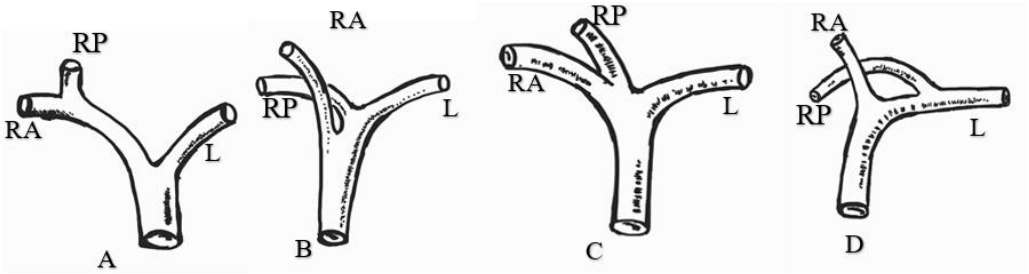

Figure 4: A-Typical pattern (medial approach), B- Right anterior duct draining into common hepatic duct, C- Triple confluence, D- Right posterior duct draining into left hepatic duct

Discussion

Thorough knowledge of anatomical variations is important during surgical procedures, especially when it comes to anatomic regions with numerous variations, such as the hepatobiliary system. Knowledge of variations of the biliary system is paramount in liver transplantations (7,8). Right lobe transplantations carry more donor complications compared to left lobe transplantations. Preoperative or intraoperative identification of the atypical or anomalous will help preventing major postoperative complications including leaks and other biliary complications (9–11). Anatomic variations of the biliary tract are often accompanied by variations in the portal venous system and the hepatic arterial system, (12–16). More specifically, portal venous anomalies have been demonstrated to significantly correlate with anomalous biliary drainage (13,15,16), especially in the right lobe (16).

Our findings are, in general, consistent with those reported in similar studies, although with a few exceptions. The normal biliary anatomy has been reported to be present in 52.9%–58% of the population (20,21), slightly less frequently than in our sample series. Our rates of ectopic drainage of the right anterior segmental duct in the common hepatic duct are like the already reported rates (21). Although abnormal drainage of the right posterior segmental duct into the left hepatic duct, which was described as the most common atypical anatomy, with rates from 13% to 19% (20,21), seemed to be less frequent in our cadavers' sample. On the other hand, the triple confluence presence rate in our study was less to the 11% to 12% reported in other studies (20,21). Direct drainage of the right posterior duct into the common hepatic duct, reportedly present in 4% to 5% of the population (21), which was similar in our study. Finally, rates of rare variants of biliary branching such as ectopic drainage of the right anterior duct into the left hepatic duct or ectopic drainage of the right posterior duct into the cystic duct (20, 21) were not identified in our study. Sample size of 25 is a limitation noted in this study, therefore expanding the study on several centers is recommended.

Conclusion

Abnormal variations of the right hepatic duct confluence were less. Even though atypical branching pattens of the right hepatic duct were found less, the two most common variations were the ectopic drainage of the right anterior duct into the common hepatic duct and trifurcation of the right anterior segmental duct, right posterior segmental duct, and left hepatic duct.

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