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Morphometric Study of Extra-Hepatic Biliary Pathways - Study in Human Corpses

Estudio Morfométrico de las Vías Biliares Extrahepáticas – Estudio en Cadáveres Humanos

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SUMMARY: Adverse events (AE) contribute significantly to postoperative morbidities and co-morbidities. Many AEs occur due to a lack of anatomical knowledge and its variants. Latrogenic bile duct injuries, for instance, represent a serious surgical complication of laparoscopic cholecystectomy. Anatomical knowledge for the identification and adequate drainage of all ducts is relevant and fundamental in order to avoid future errors. The objective of the study was to morphometrically analyze the bile ducts in adult human corpses. 13 livers were extracted from adult human corpses to obtain the ducts: choledochal, common hepatic and cystic. After morphological analysis, duct measurements (length and diameter) were continued using a digital caliper. The data obtained were tabulated in SPSS 21 program, performing descriptive analysis with mean and standard deviation. The averages of bile ducts were 61.05 (± 16.43) mm in length and 3.86 (± 0.72) mm in diameter. The cystic duct length and diameter averages were 33.59 (± 12.29) mm and 3.40 (± 0.79) mm, respectively. The common hepatic ducts had an average of 30.02 (± 7.19) mm in length and 3.74 (± 1.18) mm in diameter. The analyzedsamples presented different values ??from those already described in the literature, where the length of the cystic ducts was greater, while the length of the common hepatic ducts was numerically smaller. This work is very significant, as the morphometric variability of the bile ducts allows for varying morphological situations that can compromise the hepatobiliar physiology.

KEY WORDS: Extrahepatic Bile Duct; Hepatic Hilum; Cystic Duct. Biliary Ducts.

INTRODUCTION

Hepatobiliary system disease is an extremely common reason for referral for general surgery. Finding anatomical variation of bile ducts during hepatic hilum dissection is common and can lead to injuries (Ismael *et al*., 2017; Cohen *et al*., 2019; Schreuder *et al*., 2020). Iatrogenic bile duct injuries, for example, represent a serious surgical complication of laparoscopic cholecystectomy (Limaylla-Vega & Vega-Gonzales, 2017). Anatomical knowledge, proper identification and drainage of all ducts are relevant and fundamental in order to avoid future errors (Cohen *et al*.; Boeva *et al*., 2021).

Basically bile, produced by hepatocytes, secrete the initial solution containing a large amount of bile acids, cholesterol and other organic constituents into the bile canaliculi present among liver cells. Bile secretion begins in two large collecting channels and ends in the duodenum. The bile duct is divided into intrahepatic and extrahepatic. The first occurs when there is union of segmental ducts, forming the right paramedian ducts, right lateral duct, left paramedian duct and the left lateral duct. Both ducts on the right side will concubinate to form the right hepatic duct, just as the left and left paramedian ducts will form the left hepatic duct. In addition, they are separated by the main door fissure (Standring, 2010; Abou-Khalil & Bertens, 2019; Vernon *et al*., 2021). The extrahepatic bile duct, on the other hand, consists of an important anatomical site for medical practice, making it indispensable for a surgeon to

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fully understand the anatomy, morphology and anatomical variations of this region to avoid iatrogenies (Standring; Cohen *et al*.; Vernon *et al*.).

This pathway found outside the liver is subdivided into the main and accessory pathways. The latter is formed by the gallbladder, an organ shaped like an elongated pear divided into three parts - bottom, body and neck, and also by the cystic duct. The cystic duct classically fuses with the common hepatic duct, is three to four centimeters in length and extends from the vesicle to the main bile duct. Meanwhile, the main route consists of the junction of the right and left hepatic ducts forming the common hepatic duct, which joins the cystic duct giving rise to the choledochal duct. The common hepatic duct usually has a diameter of four to five millimeters and an approximate length of three centimeters. The length of the choledochal duct, on the other hand, varies from five to fifteen centimeters, depending on its origin (Standring; Moore, 2018). It passes anteriorly to the accessory pancreatic duct, follows the right margin of the main pancreatic duct until both narrow and join in the pancreatic hepatic ampoule, in the descending part of the duodenum. The ampoule is a small dilation in the muscular tunic, lifting the mucosa forming a protrusion called the greater duodenal papilla (Cohen *et al*.).

There are several types of junction of the cystic duct with the common hepatic duct. Depending on the type, there may be a greater or lesser risk of injury to this structure during surgical interventions. The junction can occur in parallel or angular. The distance from the bifurcation of the common hepatic duct to the duodenal ampoule will be designated high, when proximal, medium or low, when distal (Santiago *et al*., 2003; Plaza & Moreno, 2019).

With the anatomy of the bile ducts demonstrated, it is noteworthy that they are frequent sites of pathologies. According to Bonder & Afdhal (2012), the main diseases of biliary system consist of cholestasis, biliary atresia, choledochal cysts, oriental cholangio-hepatitis, primary sclerosing cholangitis, primary biliary cirrhosis, ductopenic syndrome, cholelithiasis, choledocholithiasis, acute and chronic acalculous cholecystitis. Although there are several clinical events affecting the bile ducts without changes, the bile ducts do not always have the same diameter, length and morphology. Thus, even though they do not represent a great risk in daily life, these variations in biliary anatomy occur in more than 45% of the population (Yeh et at., 2004) and can present themselves with important clinical significance during hepatobiliary interventions.

In this sense, the large number of anatomical variations of the biliary tract is a challenge for surgeons in the course of biliary surgery. Furthermore, it is not only necessary for surgeons to know the oscillations of the bile ducts. Ressureição *et al*. (2014), emphasizes that the radiologists' familiarization with the anatomical findings of this region becomes an essential factor in the hepatobiliary assessment, being an important contribution to the reduction of iatrogenesis. Therefore, in order to prevent mistakes in transplants or exams, to evolve surgical techniques and expand the knowledge of liver pathologies, prior knowledge of normal biliary anatomy and its anatomopopographic variations is of paramount importance. Considering this, the present study aimed to analyze the lengths, gauges and paths of the cystic, choledochal and hepatic ducts common in corpses in order to expand knowledge on the subject.

MATERIAL AND METHOD

Ethical aspect of the research. The existing legislation in Brazil on the use of human corpses and/or organs removed from them (visceral blocks) for research and teaching purposes is based on Law 8501, of November 30, 1992 and Resolution 196/96 of the National Health Council Corroborating with the national guidelines. This study is supported ethically by CEP (Research Ethics Committee) of Centro Universitário UniMetrocamp under the favorable opinion number: 3,241,634.

Drawing / Sample. It is a quantitative, longitudinal, prospective, observational and descriptive study in 13 blocks of corpses not identified as to age and ethnicity, under the tutelage of Human Anatomy Laboratory of Centro Universitário UniMetrocamp-Campinas / SP.

Procedures. The blocks were washed, fixed with 10% formaldehyde and thoroughly dissected by direct macroscopic method, thus avoiding damage to the bile ducts (Fig. 1).

After dissection of the bile ducts, ductal length and diameter were measured using a digital caliper (150 mm / Mitutoyo®). To evaluate the ducts, three measurements were taken and arithmetic mean was considered. The photographs were obtained using a Canon camera (model: Rebel-T5).

Data analysis. The data were collected in a file containing the studied variables and these were tabulated in a database in SPSS 21 program (IBM Corp. Property). In the processing of information, the percentage method, summary measures (mean) and dispersion (standard deviation) were used.

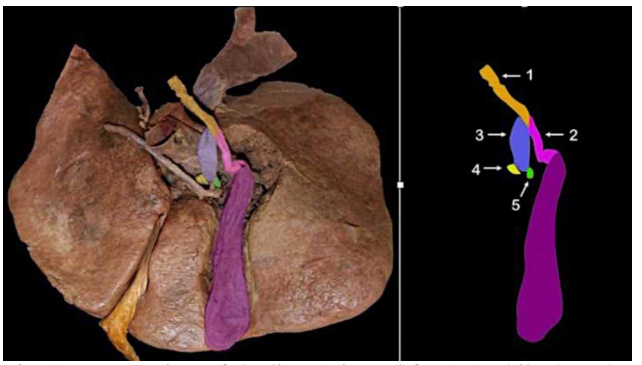

Fig. 1. Bottom view of the liver (visceral face). 1 - bile duct; 2 - cystic duct; 3 - common hepatic duct; 4 - left hepatic duct; 5- right hepatic duct.

RESULTS

In the present study, thirteen corpses were analyzed, twelve adult men (92.30%) and only one female (7.69%). Of these, eleven hepatic ducts, eight cystic ducts and nine choledochal ducts were analyzed as some of them ruptured due to handling, therefore, we excluded from the final results.

In all analyzes, only a single unit was found for each of the three ducts. In four corpses, stones were found in the bile ducts and anatomical variations were not found.

As for the results, the measurements found in the bile duct obtained an average of 61.05 (±16.43) mm in length and 3.86 (±0.72) mm in diameter. For the cystic duct length and diameter averages, they were 33.59 (±12.29) mm and 3.40 (±0.79) mm, respectively. Finally, the common hepatic duct had an average of 30.02 (±7.19) mm in length and 3.74 (±1.18) mm in diameter.

DISCUSSION

Anatomical studies of extrahepatic duct routes are critical for medical procedures, pathologies that affect the region, transplants and even for certain tests. Regarding the measurements found in our study, it is notable that the lengths are within those expected.

In our study, the average cystic duct was 33.59 (±12.29) mm, a higher average than that found by Cachoeira *et al*. (2012), where the authors obtained an average of 19.11 (± 6.77) mm. In contrast, the review carried out by Turner & Fulcher (2001), corroborate our results, where the authors report that the average varies from 20 to 40 mm in length and 10 to 50 mm in diameter. There is evidence associating the size of the cystic duct over 30 mm in length with a greater incidence of gallstones (Caroli-Bosc *et al*. 1997). In our study, we did not evaluate this relationship which could give greater support to this hypothesis.

The length of the common hepatic duct has been reported in studies with cadaveric material, cholangiopancreaticography and MRI-magnetic resonance imaging (Cachoeira *et al*.; Khayat *et al*., 2014; Alves & Fonseca, 2015) in several population groups. The dimensions obtained are in a range of 19.1-36 mm, dimensions that corroborate with our measurements (30.2 mm). Some authors report that the presence of a long hepatic duct common to the union with the cystic duct is lower, which is beneficial in performing surgical interventions that can compromise the hepato-biliary tract (Tellez *et al*., 2018).

Finally, comparing our findings in the choledochal duct in relation to data in the literature (Cachoeira *et al*.; Tellez *et al*)., we observed a greater average in length (61.05 mm versus 60.6 mm), but with a smaller diameter (3.86 mm versus 5.29 mm). These differences can be attributed to the size of the samples evaluated in the various studies and the measurement methodology.

Furthermore, although aberrations of the common, cystic and choledochal ducts are not so rare in contemporary bibliographies, in this project we did not observe them, probably due to the reduced number of extrahepatic bile ducts studied. The possible anatomical variations, in the cystic and hepatic ducts, are of great challenge for surgeons, since the absence of immediate knowledge of the opening or morphology of the ducts generates confusing ideas and increases the possibility of obstructing any of the ducts, causing iatrogenic (Cachoeira *et al*.; Cohen *et al*.; Schreuder *et al*.). In line with the anatomical findings mentioned above, a literature review carried out by Andrade *et al*. (2017), observed that there are countless cases of anatomical variations in the bile ducts, requiring consistent observation and anatomical knowledge by the surgeon, in order to avoid iatrogenesis in these regions of extreme hepatic importance.

CONCLUSION

This work reveals to be of great anatomical/clinical significance, since the variability of bile ducts exposes variant morphological situations that can compromise the hepatobiliary physiology. Thus, the knowledge of this theme is very important for surgeons, radiologists and doctors in general, thus contributing to prevent/decrease hepatobiliary iatrogenesis.

Despite being portrayed in the literature, variations in the topography of the bile ducts were not found in this study, probably due to the restricted sample. Therefore, further studies are needed to investigate variations in the bile ducts and, thus, there is also an increase in the number of reported anomalies.

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RESUMEN: Los eventos adversos (EA) contribuyen significativamente a las morbilidades y comorbilidades postoperatorias. Muchos EA se deben a la falta de conocimiento de la anatomía y sus variaciones. Por ejemplo, las lesiones iatrogénicas de las vías biliares representan una complicación quirúrgica grave de la colecistectomía laparoscópica. El conocimiento anatómico para la identificación y drenaje adecuado de todos los conductos es relevante y fundamental para evitar futuros errores. El objetivo del estudio fue analizar morfométricamente las vías biliares en cadáveres humanos adultos. Se extrajeron 13 hígados de cadáveres humanos adultos y se retiraron los conductos: colédoco, hepático común y cístico. Después del análisis morfológico, se continuó con las mediciones de los conductos (longitud y diámetro) utilizando un calibrador digital. Los datos fueron tabulados en el programa SPSS 21, mediante análisis descriptivos con media y desviación estándar. Los promedios de las vías biliares fueron de 61,05 (± 16,43) mm de longitud y 3,86 (± 0,72) mm de diámetro. Los promedios de longitud y diámetro del conducto cístico fueron 33,59 (± 12,29) mm y 3,40 (± 0,79) mm, respectivamente. Los conductos hepáticos comunes tenían un promedio de 30,02 (± 7,19) mm de longitud y 3,74 (± 1,18) mm de diámetro. Las muestras analizadas presentaron valores diferentes a los ya descritos en la literatura, donde la longitud de los conductos císticos era mayor, mientras que la longitud de los conductos hepáticos comunes fue numéricamente menor. Este trabajo es significativo, debido a que la variabilidad morfométrica de las vías biliares y permite identificar situaciones morfológicas que pueden comprometer la fisiología hapatobiliar.

PALABRAS CLAVE: Vía biliar extrahepática; Hilio hepático; Conducto cístico; Conductos biliares.

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