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Anatomical features of bile ducts in a sample of Colombian corpses

Características anatómicas de las vías biliares en una muestra de cadáveres de población colombiana

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Abstract

Introduction: In comparison with other countries, studies on the anatomical characteristics of bile ducts in Colombian population are scarce.
Objective: To analyze the anatomical features of bile ducts in a sample of 60 gastrointestinal tracts obtained from Colombian cadavers.
Materials and methods: A cross-sectional, analytical and descriptive study was conducted. The bile ducts of 60 human digestive tracts were dissected and analyzed.
Results: According to the Blumgart's classification of the biliary tract anatomical variations, the following variations were found: Type A (78.3%), Type B (5%), Type C2 (3.3%), Type D2 (1.7%), Type E1 (1.7%) Type E2 (8.3%), and Type F (1.7%). Regarding the average dimensions of bile ducts outside the liver, the following average lengths and diameters were found: right hepatic duct, 10.64mm and 3.62mm; left hepatic duct, 10.74 mm and 3.66 mm; common hepatic duct, 25.59 mm and 4.97 mm, and common bile duct, 39.58 mm and 4.90 mm. In general, the anatomical features observed in most of the sample were similar to those reported in the literature.
Conclusions: Usual anatomical features were present in 78.3% of the cases, while anatomical variations were observed in 21.7%. The length and diameter of the bile ducts studied here is within the average range reported in the literature.
Keywords: Anatomy; Liver; Bile; Population (MeSH).

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Resumen

Introducción. En comparación con otros países, los estudios sobre características anatómicas de vías biliares en población colombiana son escasos.
Objetivo. Analizar las características anatómicas de las vías biliares en una muestra de 60 tractos gastrointestinales de población colombiana.
Materiales y métodos. Se realizó un estudio descriptivo analítico transversal donde se emplearon y disecaron las vías biliares de 60 tractos gastrointestinales humanos.
Resultados. Según la clasificación de Blumgart de las variaciones anatómicas del tracto biliar, se encontraron las siguientes variaciones: Tipo A (78.3%), Tipo B (5%), Tipo C2 (3.3%), Tipo D2 (1.7%), Tipo E1 (1.7%), Tipo E2 (8.3%) y Tipo F (1.7%). En cuanto a las dimensiones promedio de las vías biliares extrahepáticas, se encontraron los siguientes diámetros y longitudes: conducto hepático derecho, 3.62mm y 10.64mm; conducto hepático izquierdo, 3.66mm y 10.74mm; conducto hepático común, 4.97mm y 25.59mm, y conducto colédoco, 4.90mm y 39.58mm. En general, las características anatómicas observadas en la mayoría de la muestra fueron similares a las reportadas en la literatura.
Conclusiones. En el 78.3% de los casos se observaron características anatómicas usuales, mientras que las variantes anatómicas estuvieron presentes en el 21.7%. La longitud y el diámetro de las vías biliares están dentro del promedio reportado en la literatura.
Palabras clave: Anatomía; Hígado; Bilis; Población (DeCS).

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Introduction

Bile duct diseases are highly prevalent worldwide and may be asymptomatic or turn into neoplasms with poor prognosis. Some studies report that one of the most common disorders is cholelithiasis, which affects up to 20% of the world population[1] and 15% of the inhabitants of Europe and North America.[2] Symptoms may worsen by the presence of cholangitis or pancreatitis,[3] so a large number of people with these conditions require some surgical procedure, either for diagnostic or therapeutic purposes. The bile ducts can also be affected by injury or iatrogeny,[4] which can be simple or complex with destruction of the bile duct wall.[5]

The increase in the population's health coverage has made it possible to identify a greater amount of people with biliary diseases.[6] To achieve this, it has been necessary to explore the anatomical features of the bile duct by means of endoscopic sphincterotomy, endoscopic retrograde cholangiopancreatography (ERCP), intraoperative cholangiography, laparoscopic or open cholecystectomy, clinical assessment and liver function tests.[7]

Nowadays, bile duct surgeries, with their different modalities, are essential procedures to guarantee the adequate state of health of the people. In addition, echoendoscopy allows obtaining better gallbladder cancer diagnoses.[8,9] Although this type of surgical procedure has been perfected, complications during surgery remain a concern for surgeons. The most frequent causes of these adverse events are the lack of expertise of the surgeon and the failure to perform a careful procedure;[10,11] however, the presence of anatomical variations unbeknownst to professionals also plays an important role for their occurrence.

The most common setbacks in bile duct surgery are bleeding, infection and injury to the bile ducts, which occur because anatomical variations are unknown. In Colombia, Ramos-Pachón *et al.*[12] conducted a follow-up study of patients with biliopancreatic diseases, finding that surgical complications occurred in 7.43% of ERCPs, the most frequent being acute cholangitis (3.34%), with mortality of 1.86%. In Latin America, there is little reported research explaining the features and anatomical variations of the bile ducts and, particularly, in Colombia there are no published studies regarding these variations.

Therefore, the aim of this research was to carry out a study on the features and possible anatomical variations of the bile ducts in the Colombian population. This characterization will allow morphologists, surgeons, radiologists and other medical specialists to have a better understanding of the possible biliary variations and their classifications, to analyze their morphometry and to contribute to the decrease of surgical complications derived from the lack of knowledge. This characterization will also allow a better interpretation in cases where such variations are present.

Materials and methods

A descriptive analytical cross-sectional study was conducted on 60 human gastrointestinal tracts comprising the liver, extrahepatic bile ducts, pancreas, and small and large intestines. The tracts were taken from corpses available at the amphitheater of the Medical program offered by the Universidad de Ciencias Aplicadas y Ambientales - U.D.C.A.; specimens that did not have any disease or previous surgeries of the bile ducts were included.

The bile ducts were dissected from the cadavers as follows: the gender of each body was established by identifying the ovaries and uterus in women or the prostate and testicles in men; the bile ducts in the gastrointestinal tract were identified and the peritoneum and omentum were removed; then, the distal intrahepatic bile ducts were dissected, along with a fraction of the liver, as well as the extrahepatic ducts, which were measured to obtain their length and caliber; finally, the anatomical features were described and a photographic record was taken.

The information obtained was analyzed and recorded in the Microsoft Excel 2013 program, and the statistical data was processed in the SPSS program, version 21, using the classification proposed by Blumgart as a parameter[13] (Figure 1).

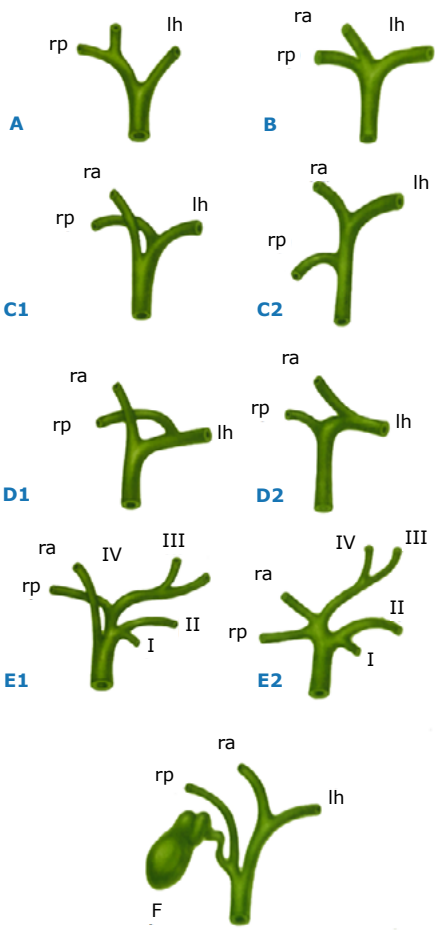

Figure 1. Main variations of the hepatic duct confluence according to Blumgart. A: usual confluence; B: triple confluence; C1: right anterior duct draining into RHD; C2: right posterior duct draining into the RHD; D1: right posterior duct draining into the LHD; D2: right anterior duct draining into the LHD; E1 and E2: absence of hepatic duct confluence; F: drainage of the right posterior duct into the cystic duct and absence of RHD. lh: left hepatic; ra: right anterior; rp: right posterior, RHD: right hepatic duct; LHD: left hepatic duct; CHD: common hepatic duct; I, II, III and IV: segmental ducts.
Source: Own elaboration based on Hahn & Blumgart.[13]

For the present study, the information was obtained based on the regulations for performing a medico-legal necropsy contained in Decree 786 of 1990 of the Colombian Ministry of Public Health.[14] Likewise, the principles contained in the Declaration of Helsinki[15] for treating the information derived from cadavers were followed, guaranteeing the confidentiality of the data of the deceased patient, his or her dignity and integrity. The regulations of Resolution 8430 of 1993 of the Colombian Ministry of Social Protection and Health were applied.[16] Similarly, this research was submitted for approval by the Ethics Committee of the Faculty of Health Sciences of the U.D.C.A., through unnumbered minutes of November 28, 2017.

Results

60 gastrointestinal tracts were analyzed, of which 4 corresponded to women and 56 to men. They were classified according to Blumgart[13] (Table 1 and Figures 2, 3 y 4).

Table 1. Frequency of bile duct variations according to Blumgart in a sample of cadaveric specimens in Colombia.

Type	A	B	C1	C2	D1	D2	E1	E2	F
Cases	44M+3F=47	3M	0	2M	0	1M	1M	4M+1F=5	1M
%	78.3	5	0	3.3	0	1.7	1.7	8.3	1.7

A: usual confluence; B: triple confluence; C1: right anterior duct draining into RHD; C2: right posterior duct draining into the RHD; D1: right posterior duct draining into the LHD; D2: right anterior duct draining into the LHD; E1 and E2: absence of hepatic duct confluence;F: drainage of the right posterior duct into the cystic duct and absence of RHD; M: Male, F: Female; CHC: common hepatic duct; LHD: left hepatic duct; RHD: right hepatic duct.
Source: Own elaboration.

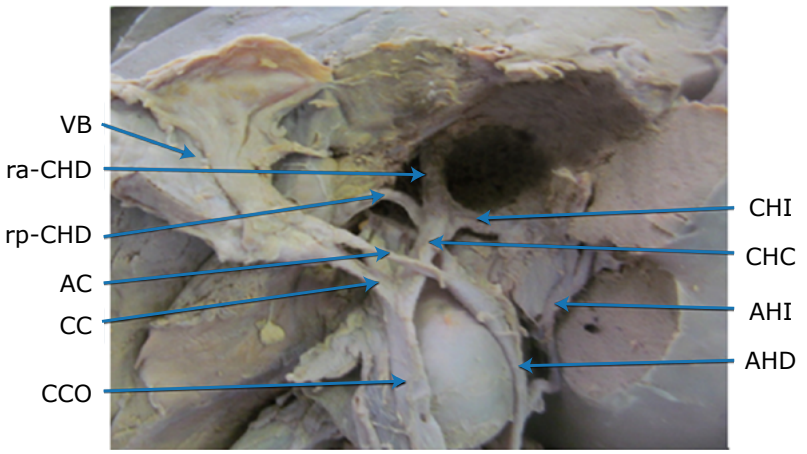

Figure 2. Hepatic duct type C2.
GB: gallbladder; ra-RHD: right anterior branch of the right hepatic duct; rp-RHD: right posterior branch of the right hepatic duct; CA: cystic artery; CD: cystic duct; BD: bile duct; LHD: left hepatic duct; CHC: common hepatic duct; LHA: left hepatic artery; RHA: right hepatic artery
Source: Document obtained during the study.

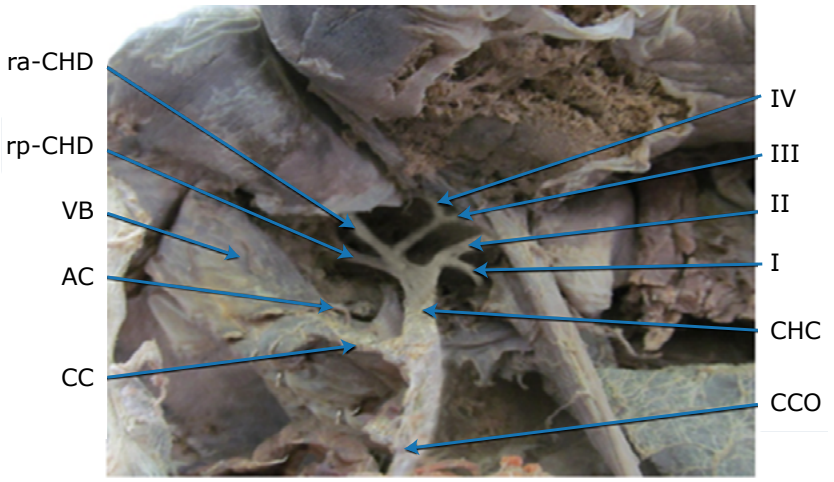

Figure 3. Hepatic duct type E2.
ra-RHD: right anterior branch of the right hepatic duct; rp-RHD: right posterior branch of the right hepatic duct; GB: gallbladder; CA: cystic artery; CD: cystic duct; I, II, III and IV: segmental ducts; CHC: common hepatic duct; BD: bile duct.
Source: Document obtained during the study.

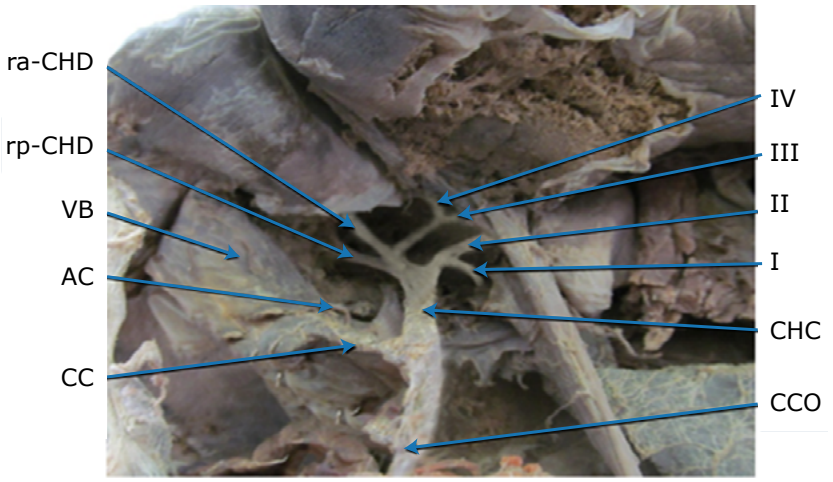

Figure 4. Hepatic duct type F.
GB: gallbladder; ACC: anterior cystic duct; PCC: posterior cystic duct; CC: cystic conduct; rp-RHD: right posterior branch of the right hepatic duct; ra-RHD: right anterior branch of the right hepatic duct; LHD: left hepatic duct; BD: bile duct.
Source: Document obtained during the study.

With regard to the path of the bile ducts, four portions were found in all gastrointestinal tracts:

1. A supraduodenal portion extending from the formation of the common hepatic duct to the crossing behind the first portion of the duodenum.
2. A retroduodenal portion extending behind the first portion of the duodenum and separating from the portal vein, which was pulled to the left of the bile ducts after being divided. This portion had two anatomical relationships: one through its back side with the inferior cava vein, from which it was separated by the retroduodenal fascia, and another through the left side with the retroduodenal artery.
3. A retropancreatic portion crossing the lower border of the duodenum was located behind the head of the pancreas; it then followed a downward path to the right, and ended up on the anterior/internal part of the second portion of the duodenum, in conjunction with the main pancreatic duct.
4. An intramural portion leading to the major duodenal ampulla.

It is worth noting that the three first portions had an anatomical relationship, through their back side, with the inferior cava vein.

The features of each duct analyzed are described below (Table 2).

The *right hepatic duct* was measured in only 47 gastrointestinal tracts since it did not form in the remaining tracts due to their anatomy. The length varied between 3.1mm and 18.5mm, with an average of 10.64mm; it was ≤9.05mm in 25% of the samples. The diameter varied between 2.1mm and 5.9mm with an average of 3.62mm, and ≤3.2mm in 25% of the samples.

The *left hepatic duct* was measured in 54 gastrointestinal tracts, since it did not form in the remaining tracts due to their anatomy. The length varied between 3.2mm and 35.1mm, with an average of 10.74mm, being ≤8.85mm in 25% of the samples. As for the diameter, it varied between 2.4mm and 5.5mm, with an average of 3.66mm, being ≤3.2 in 25% of the samples.

The length of the *common hepatic duct* varied between 5mm and 58.5mm, with an average of 25.59mm, being ≤16mm in 25% of the samples. Its diameter varied between 3.7mm and 7.9mm, with an average of 4.9mm, being ≤4.3mm in 25% of the samples.

The length of the *bile duct* varied between 11.9mm and 81mm, with an average of 38.58mm, being ≤32.25mm in 25% of the samples. Regarding the diameter, it varied between 3.5mm and 6.0mm, with an average of 4.79, being 4.3mm in 25% of the sample.

Table 2. Length and diameter of bile ducts in millimeters.

Conduct	Measurement	n	Minimum	Maximum	Average	Median	Percentile 25%
Right hepatic duct	Length	47	3.1	18.5	10.64	10.85mm	9.05mm
	Diameter	47	2.5	5.9	3.62	3.4mm	3.2mm
Left hepatic duct	Length	54	3.2	35.1	10.74	11.15mm	8.85mm
	Diameter	54	2.4	5.5	3.636	3.66mm	3.2mm
Common hepatic duct	Length	60	5.0	58.5	25.595	24.5mm	16mm
	Diameter	60	3.7	7.9	4.975	4.8mm	4.3mm
Bile duct	Length	60	11.9	81.0	39.585	39.6mm	32.25mm
	Diameter	60	3.5	6.0	4.790	4.9mm	4.3mm

Source: Own elaboration.

Discussion

According to Blumgart's classification, type A duct was the most common (78.3%) in the present study, which coincides with the findings by Hribernik *et al.*[17] (82%) and Cova & Louis[18] (78.7%); in contrast, type A was less frequent in the study by Tolino *et al.*[19] (41%). The second most common variation in this study was duct type E2, which differs from what was reported by Cova & Louis,[18] where type B was the second most common. Furthermore, the prevalence of type A found here is higher than that described by Al-Jiffry[20] (57%) and Brunicardi *et al.*[21] (59%), with type C1 duct being the second most frequent in these two studies.

On the other hand, Chaib *et al.*,[22] who used a different classification (type A1, A2, A3 and A4 for right hepatic ducts and B1, B2, B3, B4 and B5 for left hepatic ducts) reported a frequency of 61.3% and 76.2% for types A1 and B1, respectively (which would correspond to Blumgart's type A), and 14.5% and 15% for A2 and B2, respectively (which would correspond to Blumgart's type B). This means that the prevalence of type A is >60% and coincides with the results of the present study and most of the literature on the subject (Table 3).

The F-type variation, one of the less frequent in this study and in the existing literature, has a higher risk of being injured during cholecystectomy due to the proximity to the cystic duct outlet.

No studies on the length and diameters of the bile ducts are reported in Colombia, but similar averages are reported worldwide and are consistent with the bile duct paths of most of the data recorded in anatomy and surgical texts. However, some books do not measure or describe the dimensions of all ducts[23-34] (Table 4).

Table 3. Reported bile duct variations.

Study	Cases	Type A	Type B	Type C1	Type C2	Type D1	Type D2	Type E1	Type E2	Type F	Country
Cova & Louis18 2015	232 ERCP	78.9 %	10.77%	7.75%	0.862%	0.862%	0	0	0.43%	0	Venezuela
Tolino *et al.*19 2010	690 ERCP	41.16%	25.8%	15.94%	5.51%	1.16%	3.33%	2.6%	3.9%	0.58%	Argentina
Al-Jiffry20 2015	117 ERCP	59%	10.70%	11.3%	6.7%	4%	2.2%	2.7%	0	1.1%	Saudi Arabia
Brucardi *et al.*21 2015	No reported number	57%	12%	16%	4%	5%	1%	2%	1%	2%	United States
Quijano (present study) 2019	60 gastrointestinal tracts	78.3%	5%	0	3.3%	0	1.7%	1.7%	8.3%	1.7%	Colombia

ERCP: endoscopic retrograde cholangiopancreatography.
Source: Own elaboration.

Table 4. Length and diameter of extrahepatic bile ducts.

Study	Measurement	RHD	LHD	CHD	BD	Country (Editorial, if published in a book)
Brucardi *et al.*[21] 2015	Length	-	-	10-40mm	70-110mm	United States (McGraw Hill)
	Diameter	-	-	4mm	5-10mm	
Cachoeira *et al.*[23] 2012	Length	-	-	4.1-50mm	-	Brazil (Journal article)
	Diameter	-	-	-	-	
Moore *et al.*[24] 2013	Length	-	-	-	50-150mm	Spain (Wolters Kluver)
	Diameter	-	-	-	-	
Rouvier & Delmas[25] 2005	Length	-	-	30-40mm	50 mm	Spain (Mason)
	Diameter	-	-	5mm	6mm	
Latarjet & Ruiz[26] 2005	Length	-	-	40mm	80mm	Argentina (Panamericana)
	Diameter	-	-	6mm	6mm	
Snell[27] 2001	Length	-	-	40mm	80mm	Mexico (McGraw Hill)
Testud & Latarjet[28] 1993	Length	-	-	30mm	60-80mm	Spain (Salvat)
	Diameter	-	-	4-5mm	13mm	

Table 4. Length and diameter of extrahepatic bile ducts. (Continued)

Study	Measurement	RHD	LHD	CHD	BD	Country (Editorial, if published in a book)
Bouchet & Cuilleret[29] 19997	Length	-	-	-	80mm	Argentina (Panamericana)
Williams[30] 1998	Length	-	-	-	75mm	Spain (Hancourt)
	Diameter	-	-	-	6mm	
Lippert[31] 2013	Length	-	-	40-60mm	40-80mm	Spain (Marbán)
	Diameter	-	-	-	5mm	
Gardner[32] 2002	Length	-	-	-	40-80mm	Mexico (McGraw Hill)
Linder[33] 1990	Length	5-15mm	5-15mm	20-65mm	75-110mm	Mexico (Manual Moderno)
Cadena[34] 1992	Length	-	-	30mm	60-80mm	Colombia (Celsus)
	Diameter	-	-	4mm	-	
	Diameter	-	-	-	-	
Quijano (present study) 2019	Length	3.1-18mm	3.2-35.1mm	5-50mm	11.9-81mm	Colombia (Journal article)
	Diameter	2.5-5.9mm	2.4-5.5mm	3.7-7.9	3.5-6mm	

RHD: right hepatic duct; LHD: left hepatic duct; CHD: common hepatic duct; BD: bile duct.
Source: Own elaboration.

Conclusions

The usual anatomy of the bile ducts was observed in 78.3% of the cases; anatomical variations were frequent (21.7%). This prevalence should encourage morphologists, forensic scientists and surgeons to consider the variants during the study and management of biliary diseases in order to prevent complications and injuries.

The length, diameter, features and path of the extrahepatic bile ducts analyzed were within the average reported in the existing literature.

Conflicts of interest

None stated by the author.

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