“OVIDIUS” University of Constanţa
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MORPHOLOGY OF EXTRAHEPATIC BILE DUCTS

ABSTRACT OF DOCTORAL THESIS

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MORPHOLOGY OF EXTRAHEPATIC BILE DUCTS - ABSTRACT

Cuprins

Key words:

Extrahepatic bile duct, main hepatic duct, choledoch, anatomical variants, cholangiography, gallbladder, dissection, morphometry, ductal caliber

INTRODUCTION

Haberland, quoted by [Testut] said: "Whoever executed on the corpse the needy dissection of the gallbladder and bile ducts, that person will understand the weights, often unusual, in the recognition of topography and abnormalities encountered during the intervention."

[Limanond] states that "biliary ducts lesions remain a significant source of morbidity and even mortality following cholecystectomy. The rate of lesions varies in the medical literature from 0 to 1%, but the need for further intervention and the potential for long-term sequelae for the patient, has led to the development of strategies such as routine use of cholangiography in an attempt to prevent major ducts lesions. The basis of the major lesion of the bile duct is the misidentification of the bile anatomy during its dissection. The reasons cited include inexperience of the operator, acute and chronic inflammation, fibrosis, haemorrhage, liver fat and an aberrant biliary anatomy".

For [Rouvière] "the main bile duct is of major surgical interest; knowledge of its anatomy, of the deep and complex topographic region it traverses, of possible modal variants, is a mandatory condition for the conduct of a surgeon in complete security".

The precise knowledge of normal anatomy, as well as variants and abnormalities of extrahepatic bile ducts, is a primary condition for the success of various surgeries in this sector. [Todo, Kurahashi]: "prior knowledge of any abnormality is essential for reducing the incidence of intraoperative complications and an abnormal anatomy of the extrahepatic bile tree is associated with an increased risk of damage to the bile ducts in laparoscopic cholecystectomy".

For [Rouvière] "a particular aspect of the surgical implication of the amodal cranial bile confluence is the regulated liver resections.

There are liver resections completely free of the risk of damage to the extrahepatic bile ducts, regardless of the typology of the cranial bile confluence (left lobectomy, segmentectomy III and right lateral sectorectomy), due to the fact that the section plans of the parenchyma fall outside the area of variation of the cranial bile confluence.

According to [Champetier] "anatomical variability is the rule rather than the exception in bile duct surgery. However, few studies have focused on anatomical variations of the bile tree in living donor liver transplantation in connection with bile reconstruction. Accurate knowledge of variations in liver confluence is essential for liver transplantation of living donors."

The number of variants and abnormalities of extrahepatic bile ducts has greatly increased in recent decades, [Moore] finding that "anatomical variations at different levels of the bile tree were found in 115 patients at 24.2% of cases".

According to [Vitelles], "variations from the modal anatomical model, commonly described, of the bile tree occur in more than 50% of individuals".

For [Blidaru] disorders in the bile duct remain a significant source of morbidity and mortality after cholecystectomy, the rate of injury in the medical literature ranging from 0 to 1%, but the need for additional intervention and the long potential of adverse sequelae in the patient, has led to the development of strategies, such as routine use of cholangiography, in an attempt to prevent major lesions of the duct".

"Although retrograde endoscopic cholangiopancreatography (ERCP) is well accepted as a "gold" standard for the assessment of bile anatomy, it presents substantial risks (5.5% risk of pancreatitis, 3-5% risk of perforation) in healthy donors. Recently, cholangiopancreatography has emerged as a non-invasive alternative imaging examination for the evaluation of the bile system and is performed with increasing frequency. This study is designed to assess the usefulness of cholangiopancreatography for preoperative mapping of bile duct anatomy in living liver donors using intraoperative cholangiography (IOC) as a “gold” standard [Daoud].

According to [Hyung] "traditional approaches to exploring open common bile ducts (CBD) were replaced with newer, less invasive procedures.

After [Ohkubo], "living donor liver transplantation (LDLT) is an accepted alternative for patients awaiting cadaveric liver transplantation, especially in countries where the availability of brain-dead donors is severely restricted. The evolution of this procedure has extended its applicability to donations of the right liver lobe. Precise understanding of general anatomical principles and common variations is the key to LDLT safety. Despite extensive work on the anatomical and technical aspects of LDLT, few studies have focused on anatomical variations of the bile tree in relation to the division safety and bile ducts reconstruction. Misunderstanding of the bile anatomy can lead to severe postoperative complications".

For [Dayton, Yu Biao Xu], "donor transplanting liver transplantation (LDLT) is a therapeutic alternative for patients with terminal liver disease. Bile complications after LDLT are closely related to the complex anatomy of the donor's bile tree. Therefore, preoperative knowledge of the anatomy of the donor's aberrant bile ducts may minimize postoperative morbidity in the recipient and maximize the safety of the donor".

The main minimally invasive options in the treatment of CBD calculations include retrograde endoscopic cholangiopancreatography (ERCP) with endoscopic extraction and laparoscopic exploration of CBD. ERCP is the treatment of choice for symptomatic CBD calculations for decades. However, the major disadvantages of ERCP are that it requires two-step approach (laparoscopic cholecystectomy and preoperative/postoperative ERCP) and can cause life-threatening complications such as bleeding, perforation and pancreatitis. It has been reported that sphincterotomy can cause appellant ductal calculus, stenosis of the papilla with cholangitis and the late development of bile duct cancer, which is a concern especially in younger patients".

For [Basaran], MRCP has been shown to be 98% accurate in the diagnosis of aberrant hepatic ducts and 95% in the diagnosis of variants of cystic ducts and a potential use of MRCP to demonstrate

the aberrant anatomy before the operation, makes the risk of damage to the bile ducts reduced.

[Popescu ML] concludes that "variations in the anatomy of the bile duct play an important role in donor selection and resection technique selection".

The personal results were exploited by the publication of two articles "in extenso"(entirely), one of which in the journal "Ars Medica Tomitana" (BDI indexed magazine), the second article being published in the "Romanian Journal of Functional and Clinical Anatomy, Macro- and Microscopic and Anthropology" (indexed magazine B+).

I would like to thank the Lecturer Dr. Bulbuc Ionuţ, for his help in the selection of imaging, to the Lecturer Dr. Ionescu Constantin, who helped me in the graphs realization and in the techno-editing of the thesis and also to University Professor Dr. Bordei Petru, the scientific ccordinator of the thesis, who guided me for more than four years, for the completion, realization and finalization of the doctoral thesis.

THESIS PURPOSE

Even if the specialty literature, particularly medical journals, is rich in information on the morphology of extrahepatic biliary ducts, I chose this specific topic because of the numerous biliary ducts anatomical variants, which make the ducts lesions risk not negligible at all, which leads to increased morbidity and sometimes can also be a mortality cause during surgery. The purpose of my study was to assess the variability of the anatomy of the extrahepatic biliary ducts, the position of the gallbladder and associated vascular structures, as observed at dissection and CT cholangiography. Although the variability of the biliary anatomy is well documented, a careful dissection of the cystic duct, the neck of the gallbladder and, where necessary, of the extrahepatic biliary ducts, would significantly limit surgical accidents due to the variability of the anatomy and variants of the extrahepatic biliary ducts.

The study is carried out by several methods of study: dissection on formalized human corpses, ultrasound and especially on cholangiographs in people who do not exhibit a biliary symptomatology. In all cases, the mode and level of the formation of the extrahepatic bile duct (own and common liver ducts, the choledoch duct) as well as their completion and cystic duct, their morphometry (length and diameter) and in particular the anatomical variants they may present will be specified. The gallbladder is tracked in terms of its shape and morphometry (length and width), specifying the morphological characteristics of the cervix and cystic duct.

The findings will be made according to sex, specifying the differences between the two sexes.

The results obtained will be supported by a conclusive number of personal images and exemplified by graphs and tables.

MATERIAL AND WORK METHODS

Results on the extrahepatic bile ducts anatomical characteristics were obtained using as study methods dissection, ultrasound and CT examination (cholangiography).

The dissection was used in a number of 42 cases, only formalin preparations, either human corpses from the dissection room, or organic blocks formed from the liver and the system of extrahepatic biliary ducts, collected in the forensic laboratory, which were initially preserved in a 20% concentration solution of formaldehyde.

TABEL NR. 1. WORKING METHODS USED FOR STUDYING EXTRAHEPATIC BILE DUCTS

NR.	METODA	NR. CAZURI	FOTO
1.	Dissection	42	
2.	Ultrasound	26	
3.	Cholangiography	64	
4	Total	132	

Ultrasounds of the extrahepatic biliary system were performed personally in the gastroenterology clinic of the Emergency Clinical Hospital "St. Andrei" of Constanta, a clinic where I work as a specialist doctor. I worked on a Doppler color echograph GE Logic S8 Premium with a convex transducer C1-6.

The cholangiographies were performed on a General Electric Brightspeed Select 16 slice tomography computer, equipped with the "Medimar" radiology clinic of the "St. Andrei" Emergency Clinical Hospital of Constanta.

For the study of angiographies I had the approval of the general manager of the imaging center to consult the existing archive in the clinic he runs. We did not need the confirmed consent of the applicant, because when carrying out the angiography, the applicant signs an information note on the processing of personal data, agreeing that the investigations carried out should be used for the transmission of the CAS (Insurance Health Department) and for the purpose of scientific research. I studied only cholangiographies that shown pathological signs, my study representing fundamental medical scientific research, which did not require the diagnosis of referral for the owners of angiographies.

Not all the anatomical landmarks studied could be tracked on the same number of cases, each of which was tracked on a specific number of cases, recorded at the beginning of the chapter in which the characteristics of that organ are described.

The morphometric data was processed on the computer, using a KS 400 program, within the anatomy laboratory. Statistical tests (student t-test) are mathematical methods of verifying statistical assumptions. The verification shall be carried out on a sample of data, chosen in such a way as to be representative of the whole lot, so that the hypothesis tested can then be applied to the entire data population. Analytical statistical indicators were also used in statistical processing of data: statistical correlation, covariance and regression. The numeric data were represented using the histogram and line graph methods as methods.

In presenting the images, I considered removing any clues that might have led to the identification of the owner.

MORPHOLOGY OF EXTRAHEPATIC BILE DUCTS - ABSTRACT

In the study carried out, the following were followed:

• origin (mode of formation) and manner of termination of extrahepatic biliary ducts;

• their morphometry: length, width, caliber, angles that form between the branches of origin and termination, angles at the level of the confluence of the bile ducts;

• the trajectory, shape and ratios of the bile ducts and gallbladder;

• mention of possible anatomical variants;

• comparing the results obtained with the data available in the literature consulted;

• the results obtained were supported by conclusive personal images, which leave no room for interpretations, being represented graphically, and comparisons in the discussions were presented in explicit tables;

• analysis of the data obtained (on ultrasounds and cholangiographies) was done depending of sex, being mentioned and the age of the person concerned;

• in both the general and the personal part, the anatomical terminology that emerged in 1998 was respected.

RESULTS

Hepatic ducts (right, left and common) were followed in 92 cases, of which 38 cases were by dissection and 54 cases on cholangiographies, the latter being 17 cases in the female sex and 37 cases in the male sex.

RIGHT HEPATIC DUCTS

On the level of the right liver I found that the segmental hepatic ducts can be in the number of 2-3, the termination of which is different:

• when there are two segmental ducts, anterior and posterior, in 82 cases, most commonly, in 63 cases, they conflate to form the right own hepatic duct;

Fig. 9. The right own hepatic duct, consisting of two branches (anterior and posterior). The medial left liver duct conflates at a sharp angle with the left own hepatic duct, also consisting of two branches, (medial and lateral), to form the common hepatic duct (male sex).

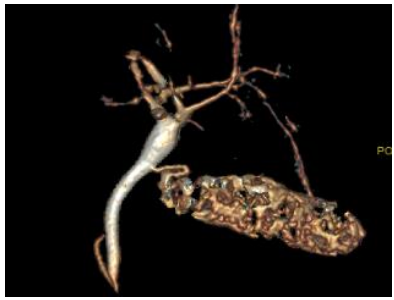


Fig. 10. The posterior right liver duct ends in the left hepatic ducts, above the proper hepatic ducts conflation, right and left. The medial left hepatic duct (segm II) passes anterior the right posterior hepatic duct in order to end in the anterior right hepatic duct. The corrugated cystic duct, in the form of lying omega, with medial concavity, towards choledoch.

• in 11 cases, one of the two ducts ends in the left hepatic duct;
• in 7 cases), both right segmental ducts participated in the formation of the common hepatic duct (female sex);
• in 3 cases, the second right hepatic duct ends in the common hepatic duct.

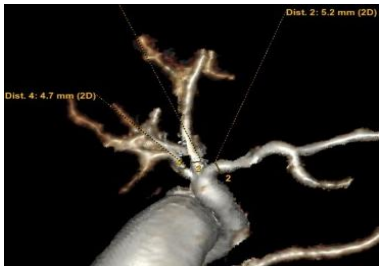


Fig. 11. Common liver duct consisting of three hepatic ducts: two right and one left. The diameter of the right heparin duct 1 (previously) 4.7 mm, the diameter of the right hepatic duct 2 (posterior) 4.3 mm, and the diameter of the left hepatic duct is 5.2 mm. Between the three ducts are formed (female sex).

Fig. 12. The presence of two right, medial hepatic ducts(more voluminous) that join with the left one forming the common and lateral hepatic duct, which ends in the common hepatic duct. The two hepatic ducts, right and left, conflate at the level of the hepatic hilus at an obtuse angle (104º). Both are inferomedial oblique. The cystic canal has a slightly wavy path("S" italic lying down, elongated), ending in the common liver duct at a sharp angle (84º). There's no path in the rifle barrel.

When there are three right segmental hepatic ducts, in 10 cases, they can participate in the formation of the own right hepatic duct, one can end in the left own hepatic duct or participate in the formation of the common hepatic duct, as the third branch of its origin.

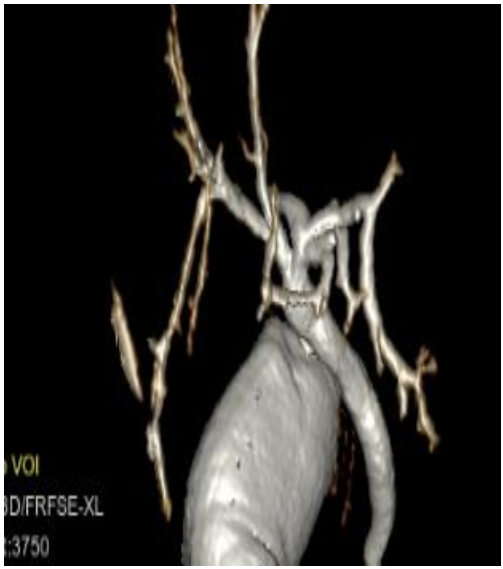
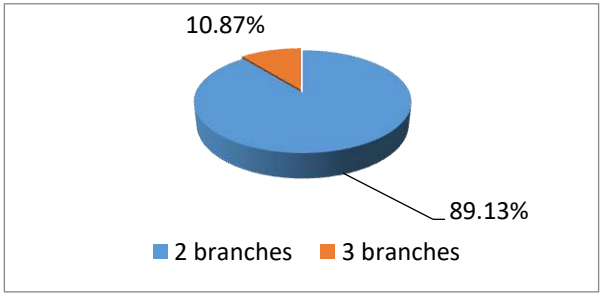


Fig. 13. Hepatic duct as consisting of three branches: anteroinferior branch (segment V), anterosuperior branch (segments VI, VII) and posterior ram (segment VIII and right side of the caudate lobe). The left hepatic duct also consists of three branches: post or medial right (from the right lobe, segment V), middle (posterior) of segments I and VIII) and laterally from segments II and III.



Graphic no. 1. Right hepatic ducts.

LEFT HEPATIC DUCTS

On the level of the left liver, I found between 1-3 hepatic ducts, which had anatomical characteristics depending on their number:

• when there was a single hepatic duct, in 4 cases, it served the left hepatic lobe, having a large diameter and receiving bile tributaries on its upper and lower faces and even on the anterior face;

• when there were two left liver ducts, in 81 cases, in 64 cases, they conflate to form the left own hepatic duct;

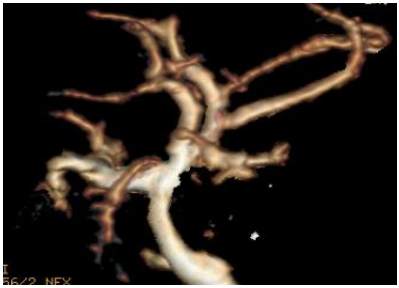


Fig. 14. The left hepatic duct, with a horizontal trajectory, consists of a single medial branch for segment III, receiving tributaries on its upper and lower faces from segments II and III. The right hepatic duct consists of 2 branches: anterior, (of segment III and left side of the caudate lobe) and posterior, more voluminous (serving segments VI, VII, VIII and the right side of the caudate lobe);in it opens on the right flank a duct of segment V. The right hepatic duct is short, having an oblique inferomedial path, almost vertical. The two straight branches are parallel, describing a curve with concavity to the left (female sex).

Fig. 15. Left hepatic duct consisting of two branches: medial and lateral (female sex).

• in 6 cases (6.52% of cases), one of the two ducts ends in the right hepatic duct;

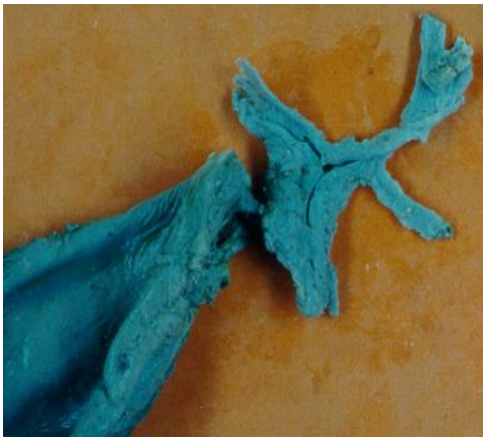


Fig. 16. The right liver duct receives a left biliary branch, which passes before the left hepatic duct, to end in the right one above the confluence of the two hepatic ducts, right and left, which have prior to conflation, an adjacent path; the cystic duct opens in the right hepatic duct, on its posterolateral flank.

• one of the two left hepatic ducts, participates in the formation of the common hepatic duct, in 4 cases.

In 7 cases the left hepatic duct is formed from three branches, which can participate in the formation of the left own hepatic duct, one can end in the right hepatic duct or participate in the formation of the common hepatic duct, as the third origin branch.

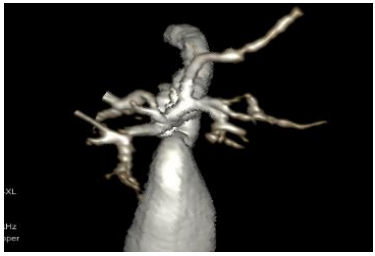


Fig. 17. Left hepatic duct consisting of three branches (medial, lateral and middle posterior) that form the left hepatic duct of the right, with an inferomedial oblique path to the right. The right hepatic duct has a transverse trajectory.The common hepatic duct consists of three ducts: right, left and middle (female sex).

Fig. 18. Left hepatic duct consisting of three branches: upper medial, segment I, its left side; lower medial: segm II; side, segment II and III; in the lateral frame, slightly above its conflation with the medial branches, ends a hepatic duct of the IV segment, its lateral part; the confluence between the right and left hepatic ducts is done in the form of a sharp angle (male sex)

COMMON HEPATIC DUCT

It can be formed by confining two or three hepatic ducts, confining them most frequently at a sharp angle.

The formation of the common hepatic duct from two hepatic ducts, right and left, is ***modal formation***. This is the variant I have encountered in 78 cases.

In 61 cases at the level of the conflating of the two hepatic ducts a sharp angle is formed, most commonly confining taking extrahepatic action.

Fig. 19. The common hepatic duct is formed by extrahepatic confluence, at a sharp angle, of the right and left hepatic ducts.

Fig. 20. The common hepatic duct is formed intrahepatic. At completion, the long cystic duct(32 mm) forms a sharp angle with the common hepatic duct(52º). It has a slightly wavy path and opens directly into the hepatic duct without having an attached path. The cystic artery, the right hepatic artery branch, has the anterior trajectory of the common hepatic duct, goes above the cystic duct and finally passes before the cervix of the gallbladder.

In 14 cases, the common hepatic duct was formed as a result of the confusion of three hepatic ducts (right, left and middle), ***amodal formation***. The middle duct was usually arranged posterior, draining the caudate or anterior lobe, thus draining the segments I or IV, their confluence always finding it extrahepatic.

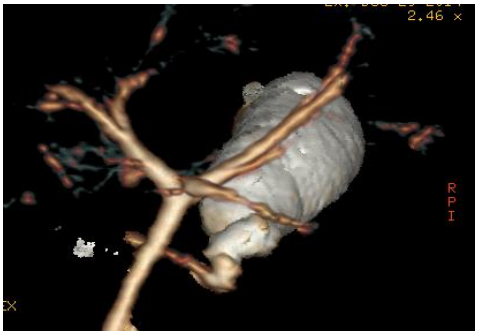


Fig. 21. The common hepatic duct is formed by conflating three own hepatic ducts: left, anterior (from segm IV) and right (made up of two branches (male sex).

MORPHOMETRY OF HEPATIC DUCTS

MORPHOMETRY OF THE RIGHT HEPATIC DUCT

I measured ***the length of the right hepatic duct*** in 36 cases, of which 22 cases in the male sex and 14 cases in the female sex. We found it between 3.0-25.0 mm, in the ***male sex*** finding it between 4.8-25.0 mm, and in the ***female sex*** between 3,0-12, mm.

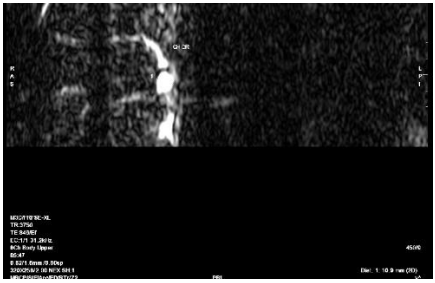


Fig. 22. The length of the right hepatic duct is 10.8 mm (male sex).

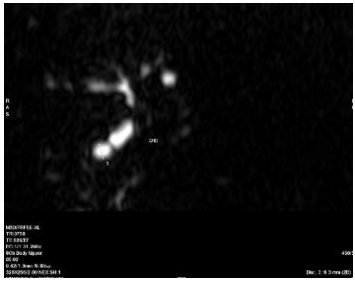


Fig. 25. The diameter of the right hepatic duct is 6.3 mm (female sex).

The diameter of the right hepatic duct, I measured it also on a number of 36 cases, finding it between 3.9-7.2 mm, in the ***male sex*** being between 4.2-6.7 mm, and in the ***female sex*** between 3.9-7.2 mm.

MORPHOMETRY OF THE LEFT HEPATIC DUCT

The length of the left hepatic duct I measured it on a number of 38 cases, finding it between 4.2-24.9 mm, in the **male sex** being contained the length of the left hepatic duct we found it between 4.2-24.9 mm.

I measured **the diameter of the left hepatic duct**, on a number of 38 cases, finding it between 4.7-9.8 mm, in the male sex, being between 3.0-9.6 mm, and in the **female sex** between 4.7-9.8 mm.

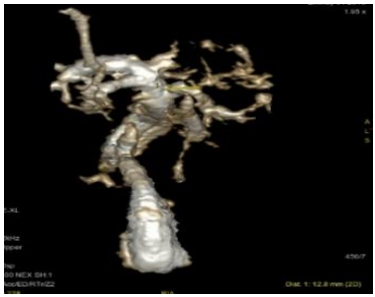


Fig. 26. The length of the left hepatic duct is 12.8 mm (male sex).

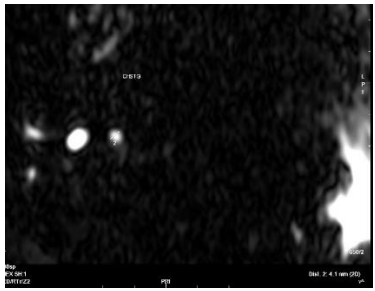


Fig. 29. The diameter of the left hepatic is 4.1 mm (female sex).

MORPHOMETRY OF THE COMMON HEPATIC DUCT

The length of the common hepatic duct I measured in a number of 36 cases, finding it between 17.0-52.9 mm, in the ***male sex*** being between 17.0-52.9 mm, and in the ***female sex*** between 20.2-53.1 mm.

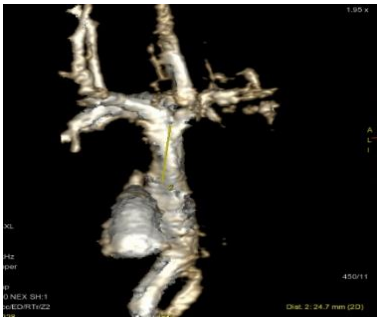


Fig. 30. The length of the common hepatic duct is 24.7 mm (male sex).

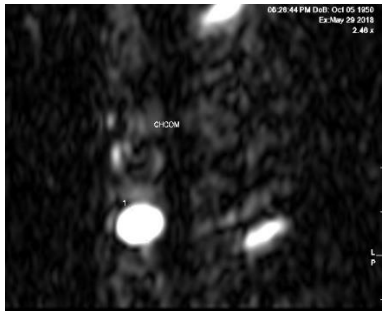


Fig. 33. The diameter of the common hepatic duct is 9.1 mm(female sex).

Regarding ***the diameter of the common hepatic duct***, I measured it on a number of 28 cases, finding it between 3.9-9.7 mm, in the ***male sex*** being between 4.7-9.7 mm, and in the ***female sex*** between 3.9-9.5 mm.

MORPHOMETRY OF THE INTRAHEPATIC ANGLE

The value of the angle formed at the confluence of the two proper hepatic ducts, right and left, was determined in a number of 38 cases, finding it between 35.0-124.2º, the ***male sex*** being contained in 53.5-109.0º, and in the ***female sex*** between 35.0-124.2º.

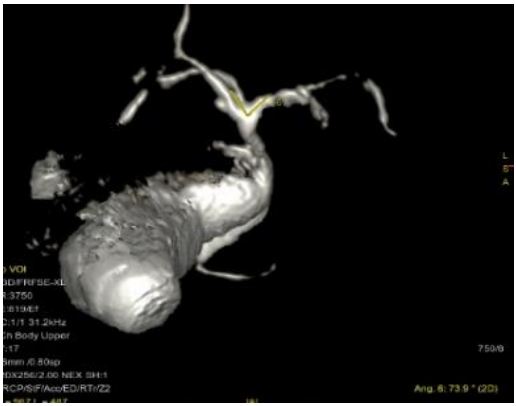


Fig. 34. The intrahepatic angle is 73.9º (male sex).

DISCUTIONS ON HEPATIC DUCTS

For [Testut, Rouvière, Champetier], the right hepatic duct is short, oblique inferomedial, almost vertical, in the extension of the common hepatic duct. For the same authors, the left hepatic duct is long, almost horizontal, being located before and above the branch of the portal vein.

According to [Matusz], the right hepatic duct is between 0.5-2.5 cm long, the left hepatic duct having a length of 1.5-3.5 mm.

[Rouvière] gives an equal caliber to the two hepatic ducts, right and left.

I have found on 38 biliary ducts, 24 male and 14 female, that in all cases the right hepatic duct was oblique, sometimes almost vertical, and the left hepatic duct I found transversal in 29 cases, in 9 cases being obliquely inferomedial to the right. Of the 9 cases, 6 cases were in the female sex and 3 cases in the female sex.

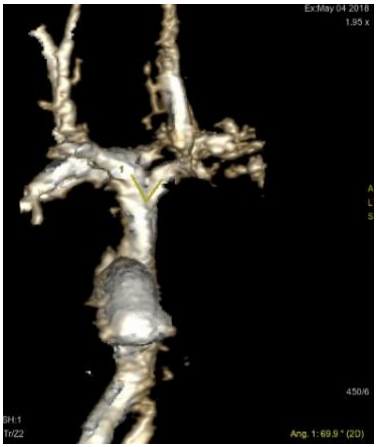


Fig. 36. The left hepatic duct is right inferomedial oblique, forming with the right hepatic duct an intrahepatic angle of 69.9º (male sex).

Fig. 37. The left hepatic duct is the right inferomedial oblique, forming with the right hepatic duct as an intrahepatic angle of 90º (female sex).

COMPARISON BETWEEN THE LENGTH OF THE RIGHT AND LEFT HEPATIC DUCTS

It was made in a number of 36 cases, in 35 cases the left hepatic duct was longer than the right duct with differences between 1.40-20.2 mm, in a single case the hepatic duct being longer than the left hepatic duct. In the ***male sex***, in all 22 cases, the left hepatic duct was longer than the right hepatic duct, with differences between 1.40-16.20 mm, and in the ***female sex***, in 13 cases the left hepatic duct was longer than the right hepatic duct, with differences between 3.4-20.2 mm, and in a single case the left hepatic duct was shorter than the right hepatic duct by 7.8 mm.

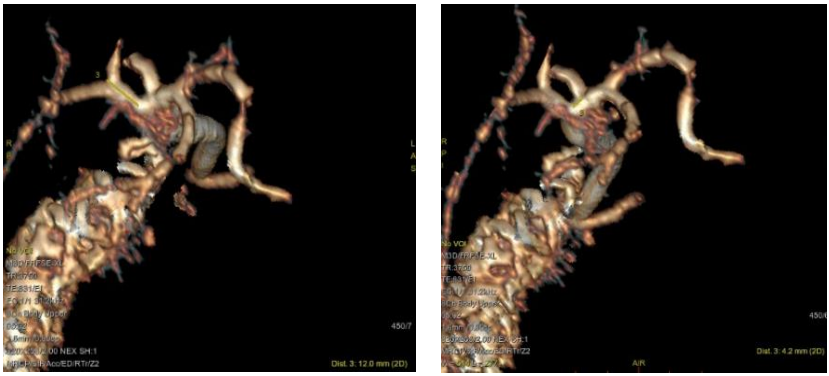


Fig. 38. The length of the right hepatic duct (12.0 mm) is longer than the left hepatic duct (4.2 mm) by 7.8 mm (female sex).

COMPARISON BETWEEN DIAMETERS OF OWN HEPATIC DUCTS RIGHT AND LEFT

It was made in a number of 36 cases, in 27 cases, the right hepatic duct was more voluminous than the left hepatic duct with differences between 0.1-3.1 mm, in 6 cases the left hepatic duct being more voluminous than the right one, with differences of 0.2-4.4 mm. In 3 cases the two hepatic ducts had an equal diameter.

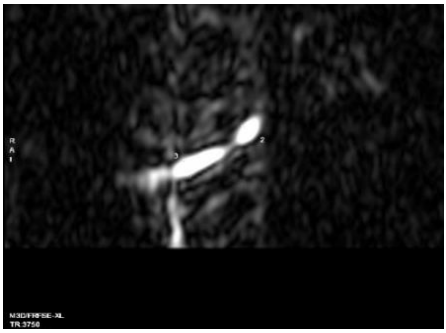


Fig. 39. The right hepatic duct (4.8 mm) is 0.6 mm more voluminous than the male left hepatic duct (4.2 mm)

In the ***male sex***, in 19 cases (86.36% of male cases) the right hepatic duct was more voluminous than the left hepatic duct with differences between 0.1-3.1 mm, in 2 cases the two hepatic ducts having the same diameter. In a single case, the left hepatic duct was more voluminous than the right, with a difference of 4.4 mm.

Fig. 40. Short common hepatic duct (high confluence), formed by conflating the two liver ducts, right and left at an angle of 90º. The right hepatic duct longer and less voluminous than the left, has an oblique path, and the cystic duct conflates with the common hepatic duct at an angle of 80º, about 1 cm under the formation of the common hepatic duct (high confluence), male sex.

In the ***female sex***, in 8 cases the right hepatic duct was more voluminous than the left hepatic duct with differences between 1.1-3.1 mm, in 5, the left hepatic duct was more voluminous than the right duct, with differences of 0.2-0.7 mm, and in one case, the two hepatic ducts had the same diameter (6.3 mm).

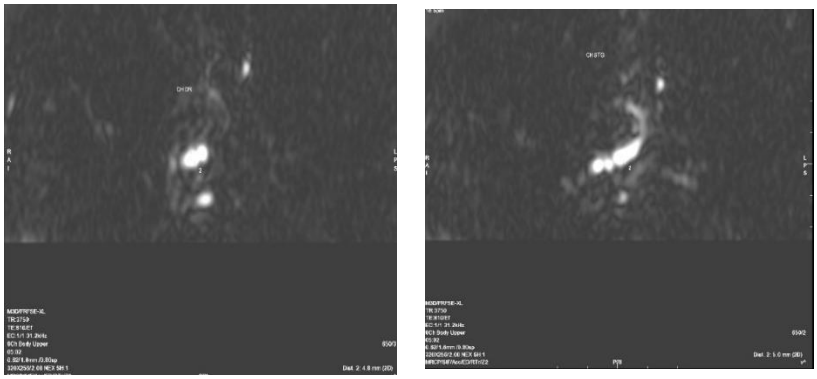


Fig. 42. The diameter of the right hepatic is less than the diameter of the left hepatic by 0.2 mm (female sex).

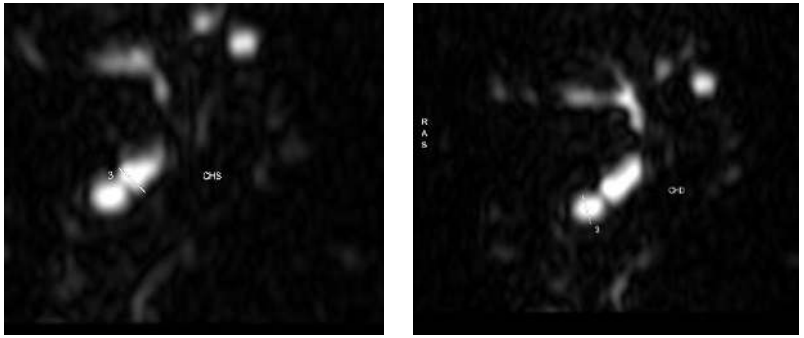


Fig. 43. The size of the left hepatic is equal to that of the right hepatic: 6.3 mm (female sex).

On dissection preparations, I found that the two hepatic ducts, right and left, met in order to form the common liver duct, most commonly, in 28 cases at different levels, under the visceral face of the liver and only in 3 cases we found their intrahepatic confluence.

According to [Făgărăşanu], the two liver ducts conflate immediately below the central part of the visceral face of the liver, and for [Tomulescu] the conflation of the hepatic ducts is done at a distance of 0.25-2.5 cm from the visceral face of the liver.

For [Champetier, Champeau], "the conflation of the hepatic ducts is done very superficially, in the hilar plate, under the hepatic segment IV".

[Severn, Streeter] states that the hepatic ducts, right or left, instead of confluence into a single trunk, can end separately in the cystic duct.

TABLE NO. 2. MODE OF HEPATIC DUCTS CONFLATION

AUTHOR	MODAL %	AMODAL %
Arianoff	59	41
Champetier	< 50	> 50
Couinaud		
Puente	< 50	> 50
Hjortsjo	56	44
Limamond	73,08	26,92
Personal results	***84,78***	***15,22***

TABLE NO.3.MORPHOMETRY OF THE COMMON HEPATIC DUCT

AUTHOR	LENGTH (CM)	DIAMETER (MM)
Testut	3-4,2	4-5
Rouvière	3-4	5
Gray	6-8	6
Kamina	3-4	3
Arianoff	-	5,1
Papilian	4,5-5,0	5
Iancu	3	5
Duca	3	-
Ţurai	3	-
Făgărăşanu	4	-
Chiriac	3	5
Popescu	3	-
Personal results	***1,70-5,29; M: 1,70-5,29; F: 2,02-5,31***	***3,9-9,7; M: 4,7-9,7; F: 3,9-9,5***

GALLBLADDER MORPHOLOGY

I followed the gallbladder shape on a number of 29 cases, in 2 cases the gallbladder being ***oval***, 1 case in the male sex and the other case in the female sex.

Fig. 49. The gallbladder has an oval shape. Short common hepatic duct (high confluence), formed by conflate the two hepatic ducts, right and left at an angle of 84º. The right hepatic duct is less voluminous than the left, it has an oblique path, and the cystic duct conflates with the common hepatic duct at an angle of 90º, about 1 cm under the formation of the common hepatic duct (high confluence).

In 11 cases, the gallbladder was ***elongated***, having a width roughly equal to the bladder's bottom with its terminal width.

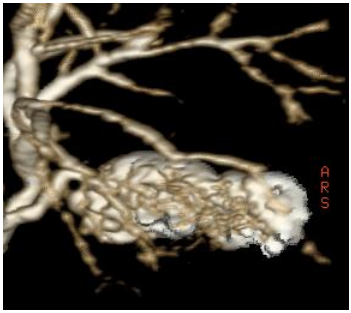


Fig. 50. Elongated bile bladder (male).

Fig. 51. Elongated gallbladder.

In 7 cases, the gallbladder was ***"in drop" (pear),*** having a greater width at the bladder bottom and thinner at the level of its terminal portion, giving the image of hanging through the cystic duct, to the hepatic duct.

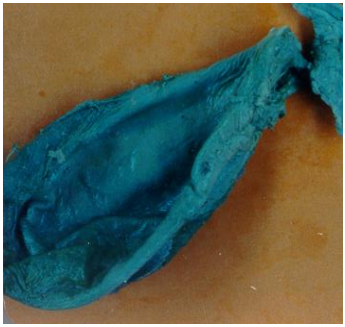


Fig. 52. Gallbladder "in drop" (pear).

Fig. 54. Globular-shaped gallbladder (female sex).

In 5 cases (17.24% of cases), the gallbladder had a ***globular*** shape.

In 4 cases (13.79% of cases), the oval-shaped gallbladder had a curve with concavity to the left, taking the appearance ***"in boomerang".***

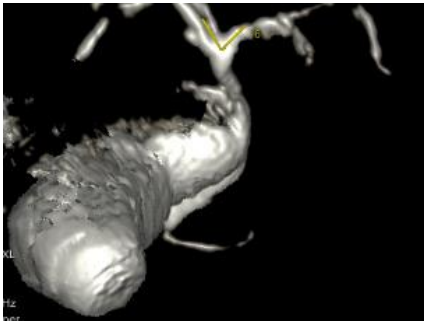


Fig. 55. Gallbladder with "in boomerang" shape (male sex).

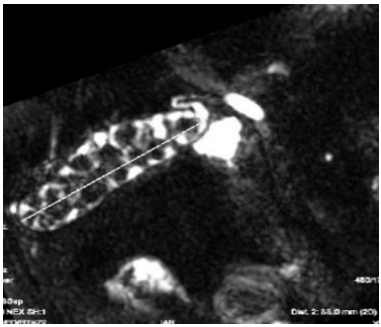


Fig. 57. The length of the gallbladder is 8.80 cm (female sex).

I followed ***the length of the gallbladder*** on a number of 36 cases, finding it between 5.40-10.60 cm, in the male sex being between 5.40-10.60 cm, in the female sex between 6.16-8.80 cm.

I also followed ***the width of the gallbladder*** on a number of 36 cases, finding it between 1.50-4.14 cm, in the ***male sex*** being between 1.50-3.79 cm, and in the ***female sex*** between 2.76-4.14 cm.

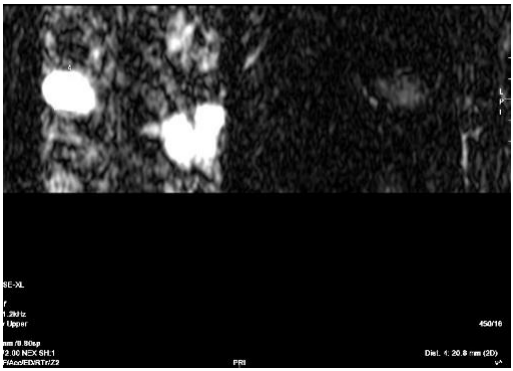


Fig. 58. The width of the gallbladder is 2.08 mm (male sex).

DISCUSSIONS

TABLE NO. 4. MORPHOMETRY OF THE GALL BLADDER

AUTHOR	LENGTH (CM)	WIDTH (CM)	CAPACITY (ML)
Testut	9-11	3,5-4,0	50-60
Rouvière	8-10	-	-
Moore	7-10	3-4	50
Kamina	7-10	3	50
Țurai	9-11	3-4	40-60
Papilian	10	4	50-60
Iancu	10	4	40-50
Chiriac	10	4	40-50
Personal results	***5,4-10,6 M: 5,4; F: 6,16***	***10,6 M:10,6; F: 8,8***	***-***

Opening the gallbladder finds the presence of transverse, in the upper half of the bladder, parallels between them and oblique, simple or branched, in the lower half of the gallbladder, is present in the interior. In the vesicular bottom there may also be vertical mucous membranes. On the level of the bladder bottom I found the presence of valves in variable numbers (1-3 valves), which continue with the valves of the cystic duct.

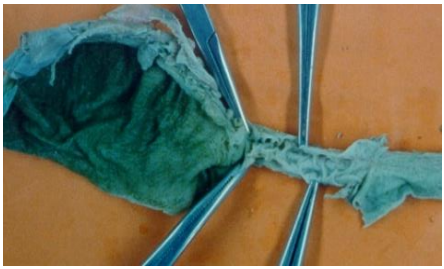


Fig. 60. The presence of mucous folds in the gallbladder and a valve in the vesicular cervix, which continues with the valves of the cystic duct.

I did not find the presence of variants or abnormalities in the gallbladder, except for external morphological variations, related to the angulation of the cervical and corporeal portions, or the existence of other sachets, which perform the different types of gallbladder shape (boomerang, semi-lunar). The lack of these sachets (drops) achieves the forms of gallbladder described: oval, elongated (cylindrical), "in drop", or globular, which other authors have pointed out [Kamaina, Senecail, Gross].

CYSTIC DUCT MORPHOLOGY

The overall shape of the cystic duct is very variable, I find the following forms:

• can be ***rectilinear*** along its entire length, taking the appearance of "lying omega" or "***Italic S***" or vertically lying down;

• may be ***rectilinear*** on one portion of its path and ***curled*** at the level of the other portions;

Fig. 61. Corrugated cystic duct (spiraled), in the form of lying omega,

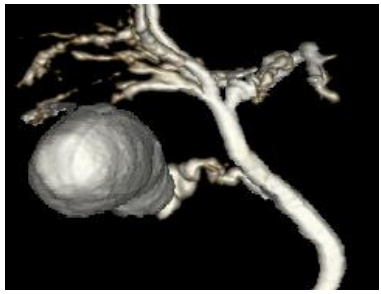


Fig. 62. The cystic has a horizontal wavy portion in the form of an "S" lying

with medial concavity, towards the choledoch Ends laterally right in the common hepatic duct.

back, continued with a rectilinear descending portion, on the right posterolateral edge of the common hepatic, in the "gun pipe".

• the cystic duct may present two angulations, ***making the appearance of the letter "Z" inverted***, inverted or normal, presenting two angulations;

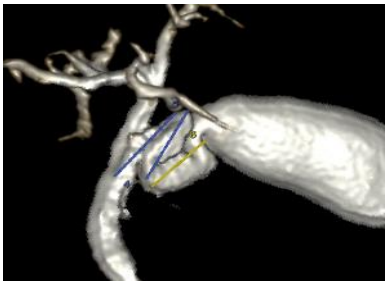


Fig. 63. Cystic with 2 angulations and 3 segments, creating an aspect of an inverted Z.

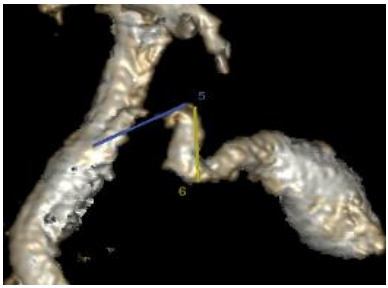


Fig. 64. The path of the cystic duct creates the letter Z.

• other times the path of the cystic duct realizes **the appearance of the letter "L turned"** or ***"U turned"***, with uneven arms;

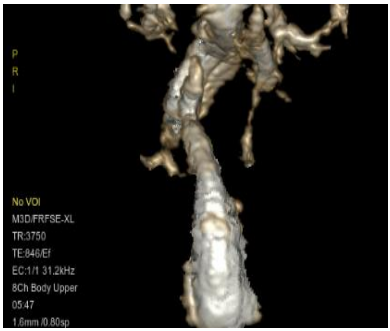


Fig. 65. The cystic duct in L turning ends on the posterior face of the hepatic duct.

Fig. 66. Cystic duct (in "U" turned, with uneven arms), terminal descending on the posterior face of the common hepatic duct (female sex).

The completion of the cystic duct in the common liver duct is most commonly done on the right side of the duct, either directly or after a parallel and attached downward path with it, the so-called "in rifle pipe" path, ending at different levels in the common hepatic duct.

According to [Larobina], the modal completion of the cystic duct (on the right side of the common liver) is done in a variable percentage, between 17-35% of cases.

[Descomps] finds that in 80% of cases, the cystic duct ends on the right flank of the common hepatic, in 8% on the left flank of it, in 10% of cases on its anterior face and only in 2% of cases on the posterior face of the hepatic.

Fig. 67. Direct completion of the cystic duct in the hepatic duct, without route in the rifle pipe.

Fig. 68. Cystic duct corrugated in the ascending portion, with terminal trajectory in the rifle pipe on the posterior face of the common hepatic duct.

The parallel trajectory of the two is carried out with the location of the cystic duct on the right side of the joint hepatic duct or on its posterolateral, posterior or even on the left side of the common hepatic, after the cystic duct crosses the anterior or posterior.

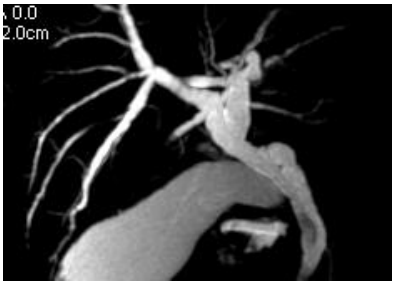


Fig. 70. The cystic duct passes the posterior of the common hepatic duct, to descend posterior, on the left lateral flank of the duct. The common hepatic passes before the cervix of the gallbladder (female sex).

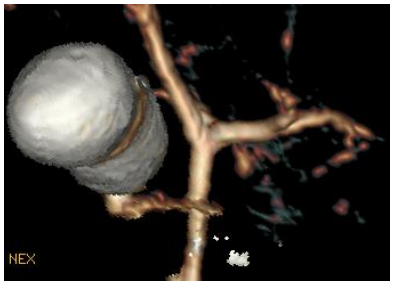


Fig. 71. The cystic duct passes the common hepatic duct to the left side, ending on its left posterolateral face. (female sex)

During their adjacent trajectory, the two bile ducts, cystic and hepatic joint can be surrounded by a common connective sheath.

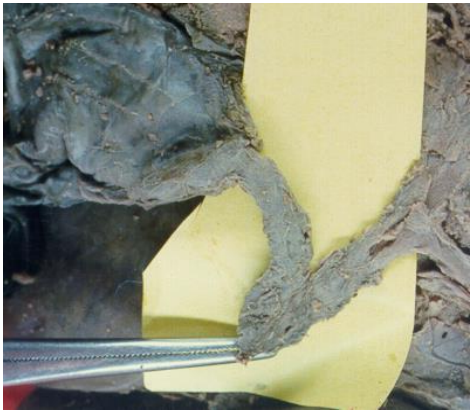


Fig. 72. The cystic duct is curved with right inferolateral concavity. Its short terminal route, attached to the hepatic duct ("in the rifle pipe"), is noted in a common connective sheath.

The cystic duct can end in one of the two liver ducts, more frequently in the right one, above their conflation to form the common liver duct. In the right liver duct, the completion of the cystic duct is done on the right face of it, above the conflation with the left one. When it ends in the left hepatic duct, the cystic duct passes anterior or posterior to the right hepatic duct.

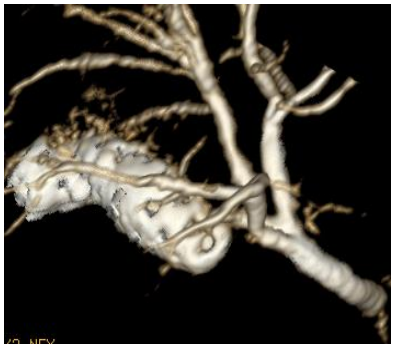


Fig. 73. The cystic duct ends in the left hepatic duct above the intrahepatic confluence, passing the posterior right hepatic duct.

Fig. 74. The cystic duct ends in the left hepatic duct, which it reaches by anterior passing the right hepatic duct. The confluence of the two hepatic ducts, right and left, is done at a sharp angle, 1.81.8 cm below the end of the cystic duct in the left hepatic duct.

Fig. 75. The cystic duct opens in the right hepatic duct, the left (thinner) hepatic duct opening lower than the conflation of the right cystic and hepatic ducts (at 1.2 cm).

Fig. 76. The cystic duct ends in the right hepatic duct above the first portion of the duodenum (male sex).

Most commonly, the cystic duct has a variable number of valves inside, but we also encountered cases where the valves were missing, the cystic duct being smooth on the inside.

Fig. 78. Avalvular cystic duct.

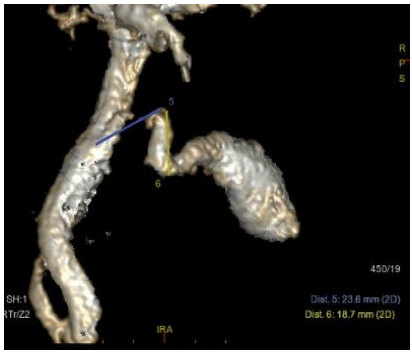


Fig. 79. The length of the cystic duct (in the inverted italic "S") is 4.23 cm (male sex).

The length of the cystic duct I measured in a number of 36 cases, finding it between 2.34-6.64 cm, in the male sex being between 2.41-4.23 cm, and in the female sex between 2.34-6.64 cm.

The diameter of the cystic duct was also measured in a number of 36 cases, finding it between 2.40-5.0 mm, in the ***male sex*** being between 2.40-5.50 mm, and in the ***female sex*** between 2.40-4.30 mm.

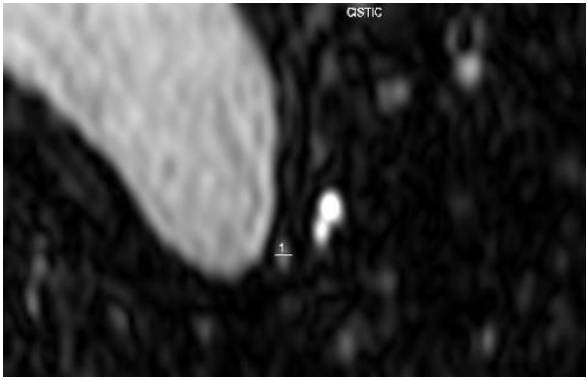


Fig. 82. The diameter of the cystic duct is of 2 - 2.4 mm (female sex).

TABLE NO. 5. CYSTIC DUCT MORPHOMETRY

AUTHOR	LENGTH (CM)	CALIBRE (MM)
Testut	3,3-4,5	3,4
Rouvière	3	2,5-3-4
Moore	3,5-4,5	2-4
Hyondo	3-4	3-4
Dayton	3-4	-
Duca	4	-
Țurai	4	3-4
Blidaru	4	4
Tomulescu	2-4	-
Personal results	***2,46-6,64; M: 3,41-4,62; F: 2,46-6,64***	***2,4-5,5; M: 2,4-5,5; F: 2,5-4,0***

CHOLEDOCH DUCT MORPHOLOGY

I measured ***the length of the choledoch duct*** in a number of 36 cases, finding it between 1.98 -5.73 cm, in the ***male sex*** being between 1.98-5.73 cm, and in the ***female sex*** between 2.77-5.64 cm.

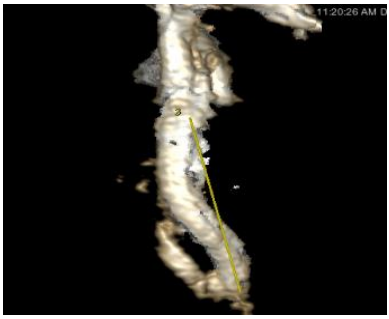


Fig. 83. The length of the choledoch duct is 5.73 cm (male sex).

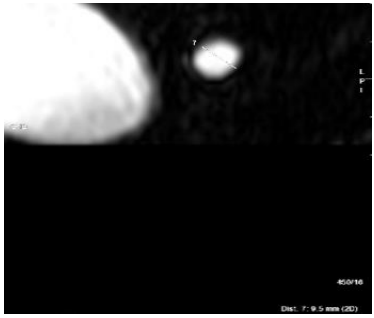


Fig. 86. The diameter of the choledoch duct is 9.5 mm (female sex).

The diameter of the choledoch duct I measured in 37 cases, finding it between 3.10-9.5 mm, in the ***male sex*** being between 3.1-7.1 mm, and in the ***female sex*** between 3.80-9.50 mm.

TABLE NO. 6. MORPHOMETRYOF THE CHOLEDOCH DUCT

AUTHOR	LENGTH (CM)	CALIBRE (MM)
Testut	6-8	4-5
Rouvière	5	5-6
Gray	6-8	6
Kamina	5	3-6
Beauthier	7,5	6
Barraya	-	6
Hand	-	6,5
Arianoff	-	5,8
Papilian	3-3,5	5
Iancu	6-7	5
Chiriac	5-7	6-10
Duca	6	-
Țurai	6	5
Blidaru	7	6-7
Panaitescu	7	-
Tomulescu	8-10	4-10
Personal results	***1,98-5,73; M: 1,98-5,73; F: 2,77-5,60***	***3,1-9,5; M: 3,1-5,7; F: 3,8-9,5***

As a rule, the choledoch duct has a rectilinear trajectory, sometimes describing a curve with concavity to the right (more frequently) or to the left (when the cystic duct ends on the posterior face or left lateral flank of the common liver duct).

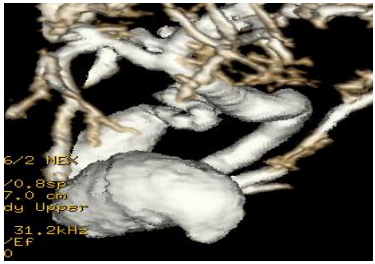


Fig. 87. After formation the choledoch duct has a lower oblique path to the left, describes a loop with the infero-lateral concavity to the right, after which it has a lower oblique path to the right, posterior to the first portion of the duodenum, its path being parallel to the path of the main pancreatic duct.

Fig. 89. Separate termination at the duodenum level of the two ducts, choledoch and main pancreatic duct.

Less often, the choledoch duct can have a parallel path with the main pancreatic duct, not confining it with it, each duct opening separately into the duodenum, there is no hepato-pancreatic ampula, the main pancreatic duct may present a dilation at its end.

According to [Dayton], the choledoch duct meets the main pancreatic duct 1 cm from the duodenum.

CONCLUSIONS

The present thesis, relating to the extrahepatic biliary ducts, is a morphological macro and mesoscopic study, considerated interesting not only for the anatomist, it also serves the radiologist, gastroenterologist and especially surgeon, to whom it gives him some data necessary to successfully attack the needy surgery of the bile ducts and to remember or develop some knowledge that needs to be refreshed relentlessly.

The paper does not claim to present an exposition of original data or just strictly personal opinions, only partially, making a close correlation of classical data in literature with those found personally.

The vast majority of those described are only updates of those that are valuable representatives of anatomy, gastroenterology and surgery of the biliary ducts, have seen or described for a long time, I added details that were less described or even unreported until now, referring in particular to the presentation of anatomical landmarks in relation to sex and compared to each other, in the situation where the organs are doubl , right and left.

In order not to suffer any alteration during interventions on the extrahepatic bile ducts, especially during cholecystotomy, their preoperative radiological exploration must be carried out, which allows the discovery of individual anatomical variants of the extrahepatic bile duct, which are frequent and unpredictable [Champetier, Pollack].

Recognition of floored bile convergences can prevent unpleasant accidents, while focusing on the most appropriate interventional conduct [Duca].

The obliqueness of the hepatic ducts, especially the left one, influences the value of the interhepatic angles and the angle between the left and right hepatic ducts with the common hepatic angle.

Numerical variants in the liver ducts of the own liver we encountered only in the right liver duct, it can be double or triple. The cystic duct did not present numerical variants, but presented variants of trajectory, length and completion.

The way of ending the cystic duct depends on the lengths of the common liver ducts and choledoc.

The differences of morphological characteristics in relation to the sex of the individual are real, being met especially with regard to morphometry and angles of confluence of the various bile ducts, this depends also on the constitutional type of the individual. In the male sex: the maximum value of the length of the common liver duct and the cystic duct, the minimum value of the length of the choledoc duct and the values (minimum and maximum) of the caliber of the choledoc duct are higher than in the female sex. In terms of the angles that form at the confluences of the bile ducts, in the female sex were higher: the maximum value at the level of conflation of the right and left liver ducts and the minimum values of the cystico-hepatic and cystico-choledocian angle.

There are differences between the morphometric results found by me and the same results cited in the literature that I consulted. These differences are due to the number of cases on which the study was carried out, the working methods used, in the case of imaging methods depending also on the experience and attention of the radiologist.

Numerical variants on the level of the hepatic canals I found only on the level of the right hepatic canal, it ca be double or triple.

The extreme, minimum and maximum values of the anatomical landmarks described, I met, most frequently, in one case, the percentage differences with the data in the literature.

The common and cystic hepatic ducts showed no numerical variants, but they presented variations of trajectory, length and completion (termination).

Experience has shown that every time any replay brings some new clarifications. So it is that even today, after more than two thousand years of dissections and after a multitude of new techniques of study, new descriptions and findings can be made in anatomy through work and observation.

Montesquieu used to say that "when you treat a subject it is impossible to exhaust it, it is enough to draw a little attention to it".

ORIGINALITY OF THE DOCTORAL THESIS

• an appropriate number of cases in order to enable justified and reasoned conclusions to be by personal cases, on the subject matter being treated and in particular a reasonable number of cases of dissection, given the large crisis of teaching material;
• crossing of the right/left biliary ducts and with the common cystic or hepatic duct, as well as the cross-path for the anterior and posterior hepatic ducts of the right hepatic duct;
• multiple variants of the cystic duct, especially morphological forms and ways of ending the cystic duct;
• the special relations of the extrahepatic biliary ducts, both between them and with the blood vessels in the vicinity;
• obliqueness of the left hepatic duct, which is not a general rule;
• gallbladder shapes;
• anastomosis between the two hepatic ducts, right and left;
• right double hepatic duct;
• the completion of the hepatic ducts in the right or left cystic duct;
• the ways of ending the cystic duct in the common hepatic duct.

GENERAL BIBLIOGRAPHY

1. Arianoff AA Analysis of 607 cases of Choledochal Sphincterectomy. World J Surg, 1980, 4: 483-486
2. Barbin JY, Hardy N, Pineau H Topographie de la jonction cystico-hépatique. Étude cholangiographique. Bull Assoc Anat, 1962, 111: 92-108
3. Barraya L, Gard Cl, ColombieR - Les “oddipathies”. Nouv Presse méd, 1978, 7: 2639-2648
4. Barraya L, Pujol-Soler R, Yvergneaux JP La région odiènne. Anatomie millimétrique. Presse Méd, 1971, 79: 2527-2534
5. Blidaru Paul Căile biliare intra- şi extrahepatice. In: Traumatismele hepatice. Ed. Academiei, 1977, 32-35
6. Champeau M, Pineau P, Leger P Atlas de technique opératoire. Chirurgie du foie et des voies biliaires. Ed. Flammarion, Paris, 1966.
7. Champetier J, Davin JL, Letoublon C, Laborde Y, Yver R, Cousset F Aberrant biliary ducts (vasa aberantia): surgical implication. Anat Clin, 1982, 4: 137-145
8. Champetier J, Letoublon C, Alnaasan I, Charvin B Cystohepatic ducts: surgical implications. Surg Radiol Anat, 1991, 3: 203-212
9. Champetier J. Les voies biliaires, In: Chevrel JP Anatomie clinique. Le Tronc. Ed. Springer-Verlag, Paris, 1994, 407-420
10. Chevalier JM, Hannoun L Anatomic bases for liver transplantation. Surg Radiol Anat, 1991, 13: 7-16
11. Chevrel JP, Duchène P, Salama J, Flament JB Bases anatomiques des anastomoses bilio-digestive intra-hépatiques. Anat Clin, 1979, II: 159-168
12. Chiriac M, Zamfir M, Antohe D St Căile biliare. In: Anatomia trunchiului. Vol. II, UMF Iaşi, 1991, 195-202
13. Ciobanu St, Nubert Gr, Ciobanu L, Jicman L, Georgescu C Despre confluenţe etajate ale căilor biliare şi importanţa lor pentru chirurgie. Chirurgia, 1970, 19 (2): 147-156
14. Couinaud C - The parabiliary venous system. Surg Radiol Anat, 1988, 10: 311-316.
15. Dayton TM, Doty EJ, Sachdeva KA, Peoples BJ The Biliary Tract. In: Lawrence P. Essentials of General Surgery, Ed.

Williams&Wilkins, Baltimore-Hong Kong-London-Sydney, 1988, 231-244

16. De Filippo M, Calabrese M, Quinto S, Rastelli A, Bertellini A, Martora R, Sverzellati N, Corradi D, Vitale M, Crialesi G, Sarli L, Roncoroni L, Garlaschi G, Zompatori M Congenital anomalies and variations of the bile and pancreatic ducts: magnetic resonance cholangiopancreatography findings, epidemiology and clinical significance. Varianti ed anomalie congenite delle vie biliari e pancreatiche: aspetti colangiopancreato-RM, epidemiologia e significato clinico, La radiologia medica, 2008, 113, 6: 841-859
17. Duca S Anatomia chirurgicală a căilor biliare principale. In: Coledocul. Patologie, explorare, terapeutică chirurgicală. Ed. Dacia, Cluj-Napoca, 1986, 9-34
18. Düşünceli E, Erden A, Erden I Anatomic variations of the bile ducts: MRCP findings, 2004 10(4): 296-303
19. Fayard LM, Kamel IR, Mitchell DG, Bluemke DA Functional MR cholangiography: dignosis of functional abnormalities of the gallbladder and biliary tree. AJR, 2005, 184: 1563-1571
20. Făgărăşanu I, Bucur A, Bîrzu I Valoarea şi tehnica colangiografiei şi radiomanomatriei preoperatorii şi postoperatorii în distoniile căilor biliare şi în litiaza biliară. Chirurgia, 1954, 1: 115-124
21. Goor DA, Ebert PA Anomalies oj the biliary tree. Report of a repair of an accesory bile duct and review of the literature. Arch Surg, 1972, 104: 302-309
22. Hand BH Anatomy and functions of the extrahepatic biliary system. Clinics in Gastroenterol, 1973, 2: 3-29
23. Hjortsjö CH - The topography of the intrahepatic duct systems. Acta Anat, 1951, II: 599-615
24. Huang TL, Cheng YF, Chen CL, Lee TY Variants of the bile ducts: clinical application in the potential donor of living-related hepatic translation. Transplant Proc, 1996, 8: 1669-1670
25. Hyodo T, Kumano S, Kushihata F, Okada M, Hirata M, Tsuda T, Takada Y, Mochizuki T, Murakami T CT and MR cholangiography: advantages and pitfalls in perioperative evaluation of biliary tree. Br J Radiol, 2012, 85(1015): 887-896
26. Hyung Mo Lee, Seog Ki Min, Hyeon Kook Lee Long-term results of laparoscopic common bile duct exploration by

choledochotomy for choledocholithiasis: 15-year experience from a single center. Ann Surg Treat Res. 2014, 86(1): 1-6

27. Iancu I Căile biliare extrahepatice. In: Anatomie. Viscere. Litografia I.M.F. Iaşi, 1967, 271-278
28. Juvara I, Vereanu I Cancerul capului pancreasului şi calea biliară principală. Chirurgia, 1978, 27(6): 401-407
29. Kamina P Voies biliaires extrahépatiques, In: Anatomie clinique. Tome 3. Thorax . Abdomen. Ed. Maloine, Paris, 2007, 304 - 311.
30. Kamina P, Di Marino V Appareil excréteur de la bile. In; Abdomen. Appareil digestif et rein. Tome 2. Ed. Maloine, 1998, 39-50
31. Karakas HM, Ceic T, Alicioglu B Bile duct anatomy of the Anatolian Caucasian population: Huang classification revisited. Surd Radiol Anat, 2008, 30: 530-545
32. Keddie NC, Taylor AW, Sykes PA The termination of the common bile duct. Br J Surg, 1974, 61: 623-625.
33. Kitami M, Takase K, Murakami G, Ko S, Tsuboi M Types and frequancies of biliary tract variation associated with of a major portal venous anomaly with multi-detector row CT cholangiography. Radiology, 2006, 238: 156-166
34. Kumano S, Kushihata F, Okada M, Hirata M, Tsuda T, Takada Y, Mochizuki T, Murakami T CT and MR cholangiography: advantages and pitfalls in perioperative evaluation of biliary tree. Br J Radiol, 2012, 85(1015): 887-896
35. Limanond P, Ramam SS, Ghobrial RM, Busutil RW, Lu DSK The utility of MRCPin preoperative mapping of biliary anatomyin adult-to adult living related liver transplantdonors. J Magn Reson Imaging, 2004, 19: 209-215
36. Lindner HH, Pena VA, Ruggeri RA A clinical and anatomical study of anomalous termination of the common bile duct into the duodenum . Ann Surg, 1976, 184: 626-632
37. Lorabina M, Nottle P Extrahepatic biliary anatomy atlaparoscopic cholecystectomy: in aberrant anatomy important? ANZ, 2005, 75: 392-395
38. Mackawa N, Uchara H, Honda Y, Nishino I, Kyoi M, Kawakami K, Inoue T, Yamamoto M, Ucno T, Mibayashi I, Takoda R A case of intra-hepatic gallbladder detected by liver scintigram. Nipon Shokakibyo Gakkai Zasshi, 1978, 75: 1295-1298

39. Maroş T Anatomia chirurgicală a coledocului terminal. Chirurgia, 1977, 26 (4): 303-308
40. Matusz P Căile biliare extrahepatice. In: Segmentarea hepatica, Ed. Orizonturi universitare, Timişoara, 1998, 51-53
41. Mentzer SH Anomalous bile duct in man. Based on a study of comparative anatomy. JAMA, 1929, 93: 1273-1277
42. Misra SP, Gulati P, Thorat VK, Vij JC, Anand BS Pancreatico-biliary ductal union in biliary diseases. An endoscopic retrograde cholangiopancreaticographic study. Gastroenterology, 1989, 96:907-912
43. Moore K, Dalley A Voies biliaires et vésicule biliaire. In: Anatomie médicale. Aspects fondamentaux et applications cliniques. Ed. De Boeck Université, Bruxelles, 2001, 272-277
44. Nagorney DM, Mc Ilrath DC, Adson MA Choledochal cysts in adults: clinical management. Surgery, 1984, 96: 656-663
45. Naritomi G, Kimura H, Konomi H, Takeda T, Ogawa Y, Chijiiwa K Multiseptate gallbladder as a cause of biliary pain. Am J Gastroenterol, 1994, 89: 1891-1892
46. Netter F Atlas of Human Anatomy. Ninth Printing. Ed. Novartis East Hanover, New Jersey, 1997, Plate 274-278
47. Northover JMA, Terblanche J A new look at the arterial supply of the bile duct in man its surgical implication. Br J Surg, 1979, 66: 379-384
48. Ohkubo M, Nagino M, Kamiya J, Yuasa N, Oda K Surgical anatomy of the bile ducts at the hepatic hilum as applied toliving donor liver transplantation. Ann Surg, 2004, 239: 82-86
49. Panaitescu V, Petrencic C – Structura ficatului. Căile biliare extrahepatice. In: Duodenul şi glandele anexe. Corelaţii morfo-clinice şi funcţionale, Ed. Litera, Bucureşti, 1988, 63-72; 93-113
50. Papilian V - Structura ficatului. Căile biliare. In: Anatomia omului. Vol. 2. Splanhnologia. Ed. BIC ALL, Bucureşti, 1998, 158-160; 165-173.
51. Park WW, Michels NA, Ghosh GM Blood supply of the common bile duct. Surg Gynecol Obstet, 1963, 117: 47-55
52. Poirier P, Charpy A Traité d'Anatomie Humaine. Tome IV, Ed. Masson, Paris, 1900, 770-789
53. Popescu ML, Vidulescu C Căile biliare intrahepatice. Căile Biliare extrahepatice. In: Popescu I. Chirurgia ficatului. Vol I. Ed.Universitară "Carol Davila", Bucureşti, 2004, 46-47; 75-78

54. Puente SG, Bannura CG Radiological anatomy of the biliary tract: Variations and congenital abnormalities. World J Surg, 1983, 7: 271-276
55. Quintana EV, Labst RI Ectopic drainage of the common bile duct. Ann Surg, 1974, 180: 119-123
56. Regimbeau JM, Panis Y, Couinad C, Kardache M, Pocard M, Brouland JP, Valleur P Sinistroposition of the gallbladder and the common bile duct. Hepatogastroenterology, 2003, 50 (49): 60-61
57. Richer JP, Faure JP, Maurichau-Beaucant M, Dugue T, Maillot N, Kamina P, Carretier M Anomalous pancreatico-biliary ductal union whith the cystic bile duct. Surg Radiol Anat, 1998, 20: 139-142
58. Ritchie AWS, Crucioli V Double gallbladder with cholecystocolic fistula: a case report. Br J Surg, 1980, 67: 145-146
59. Rouvière H., Delmas A. - Voies biliaires. In: Anatomie humaine. Descriptive, topographique et fonctionnelle. Tome 2. Tonc. 14e édition, Ed. Masson, Paris, 1997, 450-459
60. Santos Ferreira AD, Mendes JC Le triangle de Budde-Calot et l'artère cystique. Bull Assoc Anat, 1969, 143: 1487-1494
61. Schűnke M, Schulte E, Schumacher U, Voll M, Wesker K Atlas d'Anatomie. Prométhée. Cou et organes internes. Ed. Maloine, 2007, 208-213
62. Senecail B, Texier F, Kergastel I, Patin-Philippe I Variabilité anatomique et anomalies congénitales de la vésicule biliaire: étude échographique sur 1823 patients. Morphologie, 2000, 84(264): 35-39
63. Severn CB A morphological study of the development of the human liver. II. Establishment of liver parenchyma, extrahepatic ducts and associated venous channels. Am J Anat, 1972, 133: 85-108
64. Sieber WK, Wiener ES, Chang J Double choledocus with ectopic drainage into the stomach. A rare congenital anomaly of the biliary ductal system. J Pediatr Surg, 1980, 15: 817-818
65. Standring S Gray's Anatomy. Galldbladder and biliary tree; In: The Anatomical Basis of Clinical Practice. Ed. Elsevier-Churchill Livingstone, Edinburg, 2005, 1227-1230

66. Streeter GL Developmental horizons in human embryos. Age groups XI to XXIII. Contributions to embryology. Carnegie Institution, Washinton, 177-181.
67. Takahashi S Types and Frequencies of Biliary Tract Variations Associated with a Major Portal Venous Anomaly: Analysis with Multi-Detector Row CT Cholangiography. Radiology. 2006, 238(1): 156-66
68. Testut L, Latarjet A. Traité d'Anatomie Humaine, Tome IV, 9ème édition, Ed. Doin, Paris, 1949, 656-666
69. Testut L. - Appareil excréteur de la bile. In: Traité d'Anatomie Humaine. Tome quatrième. Appareil de la digestion. Appareil uro-génital. Glande à sécrétion interne. Embriologie. Ed. Gaston Doin, Paris, 1923, 315-325; 338-361
70. Tomulescu V Patologia benignă a căilor biliare extrahepatice. In: Popescu.I, Beuran M-Manual de chirurgie, vol. II , Ed. Universitară „Carol Davila", Bucureşti. 2007, 737-760
71. Ţurai I, Gerota D Chirurgia căilor biliare extrahepatice. Ed. Med., Bucureşti, 1957
72. Vlad M Carrefour-ul biliopancreatic. Ed. Modelism, Bucureşti, 1999
73. Voiculescu B. Căile biliare intrahepatice. In: Popescu I. Chirurgia ficatului. Ed. Universitară „Carol Davila", Bucureşti, 2004, 29-31
74. Wietzke-Braun P, Braun F, Müller D, Lorf Th, Ringe B, Ramadori G Adult-to-adult right lobe living donor liver transplantation: comparison of endoscopic retrograde cholangiography with standard T2-weighted magnetic resonance cholangiography for evaluation of donor biliary anatomy. World J Gastroenterol, 2006, 12(36): 5820-5825
75. Yamaguchi M Congenital Coledochal cyst. Analysis of 1443 patients in the Japanese literature. Am J Surg, 1980, 140: 653-657
76. Yamamoto T, Matsumoto J, Hashiguchi S, Yamaguchi A, Sakoda K, Taki C Multiseptate gallbladder with anomalous pancreaticobiliary ductal union: a case repor. World J Gastroenterol, 2005, 11 (38): 6066-6068
77. ******** Terminologia Anatomica. International Anatomical Terminology. Ed. Thieme. Stuttgart. New York, 1998, 56