ISSN 2509-4327 (print)
ISSN 2510-4780 (online)

Deutscher Wissenschaftsherold
German Science Herald

№ 2/2020

Die Zeitschrift „Deutscher Wissenschaftsherold" ist eine Veröffentlichung mit dem Ziel ein breites Spektrum der Wissenschaft allgemeinverständlich darzustellen. Die Redaktionsleitung versteht sich als Vermittler zwischen Wissenschaftlern und Lesern. Durch die populärwissenschaftliche Bearbeitung wird es möglich unseren Lesern neue wissenschaftliche Leistungen am besten und vollständigsten zu vermitteln. Es werden Untersuchungen, Analysen, Vorlesungen, kurze Berichte und aktuelle Fragen der modernen Wissenschaft veröffentlicht.

Impressum
Deutscher Wissenschaftsherold – German Science Herald
Wissenschaftliche Zeitschrift
Herausgeber:
InterGING
Wiesenwinkel 2,
31785 Aerzen
Inhaber: Marina Kisiliuk
Tel.: + 49 5154 567 2017
Fax.: +49 5154 567 2018
Email: info@dwherold.de
Internet:www.dwherold.de
Chefredakeur:
Prof. Zamiatin P.M.
Korrektur:
O. Champela
Gestaltung:
N. Gavrilets

Auflage: № 2/2020 (September) – 20
Redaktionsschluss September, 2020
Erscheint vierteljährlich
Editorial office: InterGING
Wiesenwinkel 2,
31785 Aerzen
Tel.: + 49 5154 567 2017
Fax.: +49 5154 567 2018
Email: info@dwherold.de
Deutscher Wissenschaftsherold – German Science Herald is an international, German/English language, peer-reviewed journal and is published quarterly.
№ 2/2020
Passed in press in September, 2020
Druck: WIRmachenDRUCK GmbH
Mühlbachstr. 7
71522 Backnang
Deutschland

INDEXING: Index Copernicus, Google Scolar, Ulrich's Periodicals Directory, Fachzeitungen, MIAR.

http://miar.ub.edu/issn/2509-4327

DDC-UDC 616.314.5-018.4-037 DOI:10.19221/202024

Yuzko R.V.,
Slobodian O.M.
Department of Anatomy, Clinical Anatomy and Operative Surgery of the Bukovinian State Medical University, Chernivtsi, Ukraine

PECULIARITIES OF PERINATAL TOPOGRAPHY OF THE HEPATODUODENAL LIGAMENT COMPONENTS

Abstract. *A number of publications in the scientific periodical dealing with anatomical study of the structural components of the hepatoduodenal ligament are indicative of great interest of the scientific community in this issue. To determine macroscopic, anatomical and topographic peculiarities of the human hepatoduodenal ligament at the early period of ontogenesis, a complex of up-to-date methods of morphological study are used: macroscopic – for visual investigation of the state of the hepatoduodenal ligament components, injection of the vessels to study peculiarities and angioarchitectonic variants of the arterial components of the hepatoduodenal ligament, statistical – to determine peculiarities of morphological transformations of the hepatoduodenal ligament components and adjacent structures in different terms of the prenatal and postnatal periods of ontogenesis. Formation of the topography and syntopy variants of the hepatoduodenal ligament components (common bile duct, portal hepatic vein, proper hepatic artery) in fetuses and neonates is stipulated by close interrelations both between them and with the adjacent structures and organs. Additional components of the hepatoduodenal ligament are the common hepatic duct, cystic duct, right and left hepatic ducts, common hepatic artery found in 87,5 % of cases. Additional components of the hepatoduodenal ligament are more inherent for 6-10-month fetuses and neonates. During the perinatal period of ontogenesis the permanent components of the hepatoduodenal ligament are located in the sagittal plane in the following succession: the portal hepatic vein in all the cases is in the dorsal position concerning extra-hepatic bile ducts and arteries. In 60 % of observations the extra-hepatic bile ducts have a ventral position, and in 40 % of cases they have an intermediate position between dorsally located portal hepatic vein and ventrally located arteries. There are two types of arterial branching in the hepatoduodenal ligament during the fetal and early neonatal periods of ontogenesis: major one typical for early fetuses (75 %) and loose one found in the majority of cases of late fetuses and neonates (70 %).*

Key words: *hepatoduodenal ligament, portal hepatic vein, extra-hepatic bile ducts, perinatal period, fetus, anatomy, human.*

Introduction. A thorough investigation of the topographic-anatomical peculiarities, embryonic topography and perinatal anatomy of the organs and structures is essential not only to understand etiology and pathogenesis of mechanisms promoting development of congenital pathology, but to devise adequate methods of their correction. Considerable success has been achieved in modern development of hepatic surgery – one of the problematic fields of medicine. Nevertheless, partial resection of the liver remains one of the most complicated surgical procedures associated with certain topographic-anatomical peculiarities of the hepatoduodenal ligament components. Therefore, it should be noted that in spite of the methods of partial resection of the liver a surgeon is facing the issues of hemostasis associated with the development of both intra- and postoperative complications [1, 4].

To avoid complications during surgery on the bile ducts with severe mechanical or obstructive jaundice is now an important issue of the abdominal surgery. The main task while performing this surgery is to provide derivation of bile from the liver to the alimentary tract with severe obstruction of the intra-hepatic ducts occurring due to scar strictures of the bile ducts,

congenital atresia, tumors, Echinococcus and other diseases in the bifurcation area of the bile and lobular hepatic ducts.

Making biliary-enteric anastomosis is the only possible way to treat mechanical/obstructive jaundice in patients with this pathology. Surgery on formation of anastomosis between the intra-hepatic ducts and gastrointestinal tract is complicated and is not often performed.

Liver resection in patients with severe obstruction of the bile ducts is known to be risky and traumatic due to a complicated access to the intra-hepatic ducts. Therefore, development of surgical access to the intra-hepatic ducts without liver resection is an urgent issue based on a detailed learning of their topography as well as topography of the hepatoduodenal ligament components [2, 5].

Nowadays stones in the gallbladder are found approximately in 10 % of adult population, more often among women at the age of 40 and older, and the number of complications remains invariably high. Therefore, qualitative radical treatment of patients with calculous cholecystitis is an important task of modern surgery. Solution of this task is based on a comprehensive examination of the topography of the gallbladder and extra-hepatic bile ducts. Irrespective the fact that every year the number of contraindications for laparoscopic cholecystectomy becomes smaller both with chronic and acute cholecystitis, general contraindications to perform endoscopy are the following: severe cardio-pulmonary pathology, coagulability or blood clotting disorders, peritonitis, inflammatory and infectious diseases of the abdominal wall, late terms of gestation. Though, in spite of the fact that the number of contraindications to perform laparoscopic cholecystectomy decreases quickly, the amount of postoperative complications remains comparatively high. Intraoperative complications stipulate transition to open surgery. Conversion ranges from 0,7 to 36 % cases. The main causes of conversion are: marked inflammatory process, commissural process, indications for choledochotomy, perforation of the gallbladder, injuries of the bile ducts and vessels, biliary-enteric abscesses, cancer of the gallbladder.

In spite of a considerable increase of the number of endovideosurgery, the number and severity of iatrogenic intraoperative complications increases as well. As far as experience of laparoscopic surgery is accumulated, surgeons state about high variability in the structure of the hepatoduodenal ligament components. Every case of atypical location of the anatomical structures of the hepatobiliary area often results in the development of severe complications. Therefore, anatomical examination of a number of specimens taken from this portion will enable to considerably decrease the risk of complications including iatrogenic ones as well [3, 6].

Objective: to determine peculiarities of chronological succession of temporal transformations in the formation of topography and syntopy variants in the hepatoduodenal ligament components of fetuses and neonates.

Materials and methods. The study was conducted on 70 fetuses (25 isolated complexes of the abdominal organs and 45 dead fetuses) and 10 dead neonates. Museum specimens taken from the M.H. Turkevych Department of Human Anatomy, Department of Anatomy, Clinical Anatomy and Operative Surgery of Bukovinian State Medical University were used for the study. Successful combination of medical and methodological approaches during the investigation provided favourable conditions to obtain reliable results. Without consideration of their formation and development it is difficult to understand individual features and topographic-anatomical interrelations as the experience gives evidence. Thus, to understand the formation of the hepatoduodenal ligament not a separate age group should be taken for the study, but the dynamics of formation should be followed beginning from the early period of ontogenesis till birth. To determine macroscopic, anatomical and topographic peculiarities of the human hepatoduodenal ligament at the early period of ontogenesis, a complex of up-to-date methods of morphological study are used: macroscopic – for visual investigation of the state of the hepatoduodenal ligament components, injection of the vessels to study peculiarities and angioarchitectonic variants of the arterial components of the hepatoduodenal ligament, statistical – to determine peculiarities of

morphological transformations of the hepatoduodenal ligament components and adjacent structures in different terms of the prenatal and postnatal periods of ontogenesis.

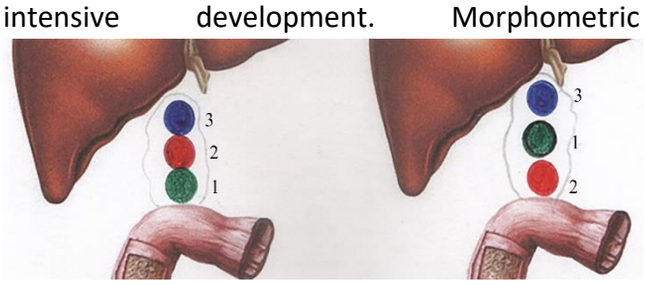
The material was divided into age groups according to the classification of the human ontogenesis periods approved by VII All-Union Conference on the Issues of Age Morphology, Physiology and Biochemistry (Moscow, 1965), periods of the intrauterine development suggested by G.A.Shmidt (1968) and considering the "Instruction on Determining Criteria of the Perinatal Period, Live and Stillbirth", approved by the Order of the Ministry of Health of Ukraine dated 29.03.2006, № 179.

Results. The branches of the common hepatic artery have the utmost ventral position in fetuses of 4-month intrauterine development (161,0-200,0 mm of PCL) in 5 cases out of 10 (50 %). In the rest 50 % of cases the similar position was typical for the extra-hepatic bile ducts. That is, in a half of cases the right gastric artery and the right branch of the proper hepatic artery cross the common bile, cystic, right and left hepatic ducts in the front – from the ventral side. On the contrary, in the rest half of cases the extra-hepatic bile ducts cross the branches of the proper hepatic artery and the right gastric artery in front, that is, having the most ventral position in the hepatoduodenal ligament complex.

Arterial vessels in 5-month fetuses of the intrauterine development (fetuses of 201,0-250,0 mm PCL) in the majority of cases (7 out of 10) (70 %) pass behind the extra-hepatic bile ducts. Only in three cases (30 %) the arteries have the ventral position respectively. Similar to that in 6-month fetuses the arterial vessels in the majority of cases (6 out of 10) (60 %) are found to pass in the dorsal position concerning the extra-hepatic bile ducts. Opposite topography is found in 7-month fetuses, when in six out of ten cases the arterial vessels are in the ventral position concerning the extra-hepatic bile ducts, that is, the right gastric artery, the right branch of the proper hepatic artery, cystic artery cross the common bile, cystic, common hepatic, right and left hepatic ducts in front. 8-month fetuses of the intrauterine development (351,0-400,0 mm of PCL) have similar topography of those 4-month fetuses, that is, in a half of cases the right gastric artery and branches of the proper hepatic artery including the cystic artery cross the extra-hepatic bile ducts: the common bile, cystic, right and left hepatic ducts from the ventral side. On the contrary, in the rest 50 % of cases the extra-hepatic ducts cross the branches of the proper hepatic artery and the right gastric artery in front, that is, they have the ventral position in the content of the hepatoduodenal ligament. In 9-month fetuses (401,0-450,0 mm of PCL) the arterial vessels in 6 cases (60 %) cross the extra-hepatic bile ducts and are in the ventral position concerning them, that is, the right gastric artery, the right branch of the proper hepatic artery, cystic artery cross the common bile, cystic, common hepatic, right and left hepatic ducts in front. Similar topography is found in 10-month fetuses (451,0-500,0 mm of PCL). The arterial vessels of neonates in 6 out of 10 cases (60 %) pass dorsally to the extra-hepatic bile ducts, that is, behind them (Fig. 1, 2).

The width of the hepatoduodenal ligament within its tubular structures changes from 4,0 mm at the beginning of the fetal period to 10,0 mm in neonates. The intensity of increasing the width of the hepatoduodenal ligament during the perinatal period is irregular. The most intensive increase occurs during the periods from 4 to 5 and from 8 to 9 months of the intrauterine development. These periods can be considered as the terms of an intensive development.

The length of the supra-duodenal portion of the common bile duct increases from1,5 mm at the beginning of the fetal period to 12,0 mm in neonates. Intensity of increasing the length of the supra-duodenal segment of the common bile duct is the highest in the period of 4-5 and 7-8 months. These periods are suggested to be the terms of its intensive development. Morphometric



А Б

Fig.1. Schematic diagram of the topography of the hepatoduodenal intestinal components in the structure of the hepatoduodenal ligament. А – ventral location of the extra-hepatic bile ducts; Б – ventral location of the arterial vessels. 1 – extra-hepatic bile ducts; 2 – arteries; 3 – hepatic portal vein.

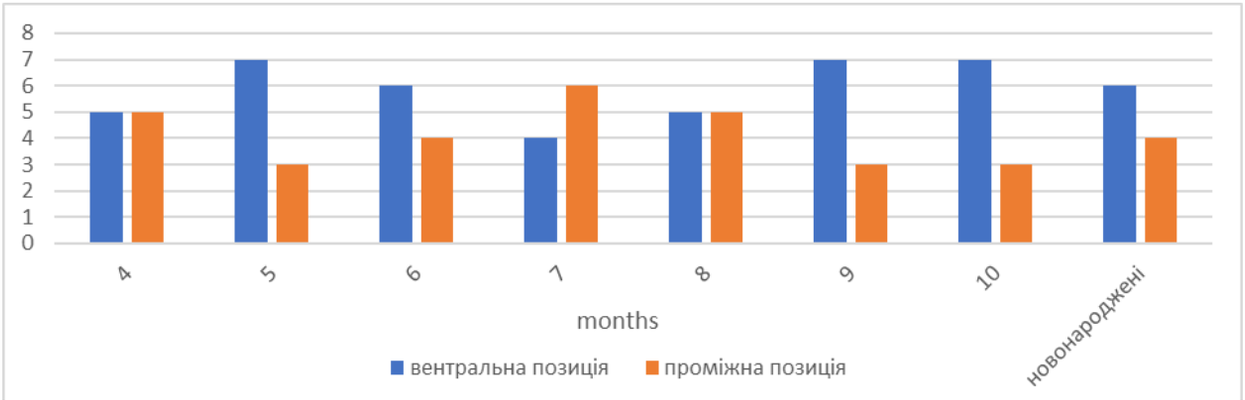


Fig 2. Topographic position of the extra-hepatic bile ducts in fetuses and neonates

parameters of the hepatoduodenal ligament during the perinatal period are presented in the Table.

The results of the skeletal-topographic examination performed by means of X-ray (Fig. 3) determined that the caudal extremity of the hepatoduodenal ligament is located on the level of the upper border of the twelfth thoracic vertebra. Its medial side is always projected on the level of continuation of the sternal line in the right to the anterior abdominal wall. The lateral wall of the ligament is projected differently depending on its width in the space between continuation of the median clavicular line and anterior axial line to the anterior abdominal wall. The cranial extremity of the ligament is projected on the middle of the body of the eleventh vertebra and coincides with the location of the liver porta.

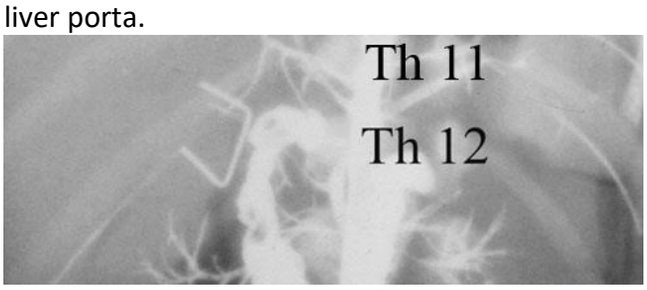


Fig. 3 Arteries and duodenum of the fetus (vessels and intestines are filled with injection mixture on the base of red lead). X-ray picture

Table

Morphometric parameters of the hepatoduodenal ligament during the perinatal period

Age (month)	Length of the hepatoduodenal ligament	Width of the hepatoduodenal ligament	Length of the gallbladder	Width of the gallbladder	Length of the upper portion of the duodenum	Width of the upper portion of the duodenum
4	5,22±0,50	3,29±0,22	5,88±0,27	2,05±0,18	5,25±0,05	3,24±0,06
5	8,55±0,68	6,49±0,28	8,72±0,70	2,30±0,13	6,33±0,23	4,23±0,09
6	7,62±0,48	6,18±0,21	11,25±0,45	3,03±0,16	6,35±0,18	4,87±0,13
7	10,25±0,48	7,95±0,47	13,60±0,88	3,80±0,22	6,96±0,15	5,28±0,08
8	15,17±1,04	10,28±0,51	18,50±0,67	4,40±0,14	6,98±0,16	5,33±0,08
9	20,80±1,20	11,92±0,37	20,80±0,25	5,09±0,09	8,91±0,15	5,68±0,10
10	27,91±1,09	16,99±0,79	21,39±0,57	5,32±0,13	9,66±0,12	6,56±0,16
Neonates	32,12±1,77	21,25±0,90	22,52±0,89	7,50±0,40	11,56±0,45	8,00±0,27

Discussion.

Examination of 80 specimens of dead fetuses and neonates determined certain peculiarities of the age perinatal anatomy of the hepatoduodenal ligament structures. Peritoneal duplication is fixed by its one extremity to the liver porta, and by another one – to the upper wall of the duodenum. Its complex includes the following

tubular structures: portal hepatic vein, branches of the common hepatic artery, and extra-hepatic bile ducts.

Optogenetic transformations of the complex of the hepatoduodenal ligament structures are indicative of age changes of its shape. “Narrow” and “wide” shapes of the ligament are suggested to differentiate. A narrow shape is characterized by its trapezoidal form, and its components pass practically parallel. A wide shape of the ligament is characterized by the availability of a branched network of the tubular structures – the components of the hepatoduodenal ligament crossing between each other. Age transformations of the ligament’s shapes are found in the study. At the beginning of the fetal period the fetuses of the 4-month intrauterine development (161,0-200,0 mm of PCL) in 80 % of cases have “narrow” ligament, that is, all its components are practically parallel to each other and cross at acute angles forming slit-like triangles including Calot’s triangle. The number of “wide” ligament in 5-month fetuses is already twice as many – 40 %. 6-month fetuses possess “early” or “narrow” ligament less than “wide” ligament which is found in 60%. This rate is preserved till the end of the perinatal period. In 7 and 8-month of the intrauterine development only 10% of the hepatoduodenal ligament out of 20 specimens was found to have “narrow” type of branching of the tubular components. Only one case of “narrow” ligament was found in 9-month fetuses. The “narrow” ligament was not found in fetuses of the 10-month of the intrauterine development and neonates.

Conclusions. 1. Formation of the topography and syntopy variants of the hepatoduodenal ligament components (common bile duct, portal hepatic vein, proper hepatic artery) in fetuses and neonates is stipulated by close interrelations both between them and with the adjacent structures and organs.

2. Additional components of the hepatoduodenal ligament are the common hepatic duct, cystic duct, right and left hepatic ducts, common hepatic artery found in 87,5 % of cases. Additional components of the hepatoduodenal ligament are more inherent for 6-10-month fetuses and neonates.

3. The skeletal-topographic caudal extremity of the hepatoduodenal ligament is located on the level of the upper border of the twelfth thoracic vertebra. Its medial side is always projected on the level of continuation of the sternal line in the right to the anterior abdominal wall. The lateral wall of the ligament is projected differently depending on its width in the space between continuation of the median clavicular line and anterior axial line to the anterior abdominal wall. The cranial extremity of the ligament is projected on the middle of the body of the eleventh vertebra and coincides with the location of the liver porta.

4. During the perinatal period of ontogenesis the permanent components of the hepatoduodenal ligament are located in the sagittal plane in the following succession: the portal hepatic vein in all the cases is in the dorsal position concerning extra-hepatic bile ducts and arteries. In 60 % of observations the extra-hepatic bile ducts have a ventral position, and in 40 % of cases they have an intermediate position between dorsally located portal hepatic vein and ventrally located arteries. There are two types of arterial branching in the hepatoduodenal ligament during the fetal and early neonatal periods of ontogenesis: major one typical for early fetuses (75 %) and loose one found in the majority of cases of late fetuses and neonates (70 %).

Список літератури:

1. Zatolokin VD, Perkov AA, Za EI. About a hemostasis at a resection of the left share of a liver Journal of experimental and clinical surgery. 2009;2(4):333-334.

2. Zatolokin VD, Grafov AK, Khalilov MA, Sheverdin NN, Alexeev AG. To the question of rational allocation of bilious channels of the left share of the liver. Russian journal of pediatric surgery, anesthesia and intensive care. 2015;5(2):13-9.

3. Batalova YuS, Kagan II, Nuzova OB. Anatomo;surgical basis for optimization of laparoscopic cholecystectomy technique. Perm Medical Journal. 2016;33(5):27-31.

4. Bednarsch J, Trauwein C, Neumann UP, Ulmer TF. Complication management after bile duct surgery. Chirurg. 2020 Jan;91(1):29-36. doi: 10.1007/s00104-019-01059-9.

5. Kadah A, Khoury T, Mahamid M, Assy N, Sbeit W. Predicting common bile duct stones by non-invasive parameters. Hepatobiliary Pancreat Dis Int. 2020 Jun;19(3):266-270. doi: 10.1016/j.hbpd.2019.11.003.

6. Röthlin M, Largiadèr F. The anatomy of the hepatoduodenal ligament in laparoscopic sonography. Surg Endosc. 1994 Mar;8(3):173-80. doi: 10.1007/BF00591825.

CONTENT:

Deutscher Wissenschaftsherold
German Science Herald

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet athttp://dnb.dnb.de

№ 4/2019 – 10
Passed in press in November 2019