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## INCIPIENCE OF ARTERIAL SUPPLY OF COMMON BILE DUCT IN PRENATAL PERIOD OF HUMAN ONTOGENESIS

### СТАНОВЛЕННЯ АРТЕРІАЛЬНОГО РУСЛА СПІЛЬНОЇ ЖОВЧНОЇ ПРОТОКИ В ПРЕНАТАЛЬНОМУ ПЕРІОДІ ОНТОГЕНЕЗУ ЛЮДИНИ

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**Abstract.** Peculiarities of structure and development of arterial vessels of common bile duct (CBD) has been researched on 68 series of histologic sections of embryos and 62 corpses of human fetuses and newborns. It has been established that since 7th week of prenatal period the origins of arterial supply of CBD are anastomotic branches of posterior pancreato-duodenal arcade and anterior superior pancreato-duodenal a. partially. Primordium of definitive structure of arterial vessels of intramural part of CBD is identified as intermuscular and subepithelial vascular plexuses, which situated around the basis of major duodenal papilla in fetuses 82,0-170,0 mm in parietal-coccygeal length.

**Key words:** common bile duct, arterial vessels, ontogenesis, human being.

**Резюме.** На 68 серіях гістологічних зрізів зародків і передплідів та 62 трупах плодів і новонароджених людини досліджено особливості будови та розвитку артеріальних судин спільної жовчної протоки (СЖП). Встановлено, що з 7-го тижня пренатального періоду джерелом артеріального русла СЖП є анастомози гілок задньої панкреато-дуоденальної аркади і, частково, передньої верхньої панкреато-дуоденальної артерії. Зачатки дефінітивної структури артеріального русла інтрамурального відділу СЖП виявляються у плодів 82,0-170,0 мм тім'яно-куприкової довжини у вигляді між'язового та субепітеліального судинних сплетень в окружності основи великого дуоденального сосочка.

**Ключові слова:** спільна жовчна протока, артерії, онтогенез, людина.

**Introduction.** The newest trends in the treatment of patients with surgical pathology of pancreato-biliary system are to expand the indications for use the modern minimally invasive procedures such as endoscopic retrograde cholangiopancreatography, endoscopic papillosphincterotomy, balloon dilatation, stenting, litoextraction etc. [1]. Along with the high efficacy of these methods, in 4,6% of patients some dangerous complications (postoperative pancreatitis, bleeding, perforation, cholangitis) occur, the combined share of them is higher in the neonatal period [6]. One of the risk factors of postoperative bleeding appearance is such morphological preconditions as damage of a vascular plexus formed by a great number of anastomoses between the branches of the upper and lower pancreatoduodenal (PD) arteries in the region of the intramural part of common bile duct (CBD) and the wall of duodenum [2, 5]. Research of new patterns of prenatal incipience of definitive anatomy of the choledochal-duodenal junction is actual for deep understanding the morphogenesis of its particular structures [4, 7]. A few morphological studies contain partial information about intrauterine development of blood vessels of the cranial parts of biliary tract mainly and surrounding structures, but can't give a comprehensive conception about morphogenesis of the blood vessels of a principal link of pancreato-biliary system [3].

Thus, identifying the peculiarities of morphogenesis of blood vessels of the intramural part of CBD and major duodenal papillae (MDP) during the early period of human ontogenesis is actual for modern morphological branch and has a practical interest for hepatobiliary surgery.

**The aim of research:** to find out peculiarities of incipience and morphogenesis of blood vessels of the intramural part of common bile duct and major duodenal papilla during the early period of human ontogenesis.

**Material and methods.** The investigation has been performed on 68 series of histologic sections of embryos from 8,0 mm to 79,0 mm in parietal-coccygeal length (PCL) and 62 corpses of human fetuses and newborns by using methods of microscopy, graphic reconstruction, microscopic preparation, injection of vessels, brighten up, radiography and corrosion. Objects age defined using tables by B.M. Patten (1959), B.P. Hvatova, J.N. Shapovalov (1969). Research has been conducted according to "Following the Ethical and Legal Standards and requirements during carrying out scientific morphological research" and the main theses of Helsinki Declaration of the World Medical Association on ethical principles of scientific and medical research involving human subjects (1964-2000) as part of the National Project "New Life - a new quality of maternity and childhood" and the State Program of transition of Ukraine from 01.01.2007 to the International System of Accounting and Statistics (Order of Ministry of Health of Ukraine №179 on 29.03.2006 "On approval the instruction on definition the criteria of perinatal period and live births and stillbirths, order registration of live births and stillbirths").

**Results and its discussion.** It has been established that primordium of MDP revealed on the medial wall of the upper curve of duodenum starting from 7th week of intrauterine development in embryos 19,0-24,0 mm PCL (fig. 1).

That primordium contains hepatopancreatic ampule (HPA) formed as a result of connection the anlage of CBD and ventral pancreatic duct. Some single capillaries were detected into the thickness of intestinal wall on right side and caudally to the HPA, it testified the beginning of the formation of the blood flow in this region. The source of primary blood supply of MDP are small branches of lower PD artery.

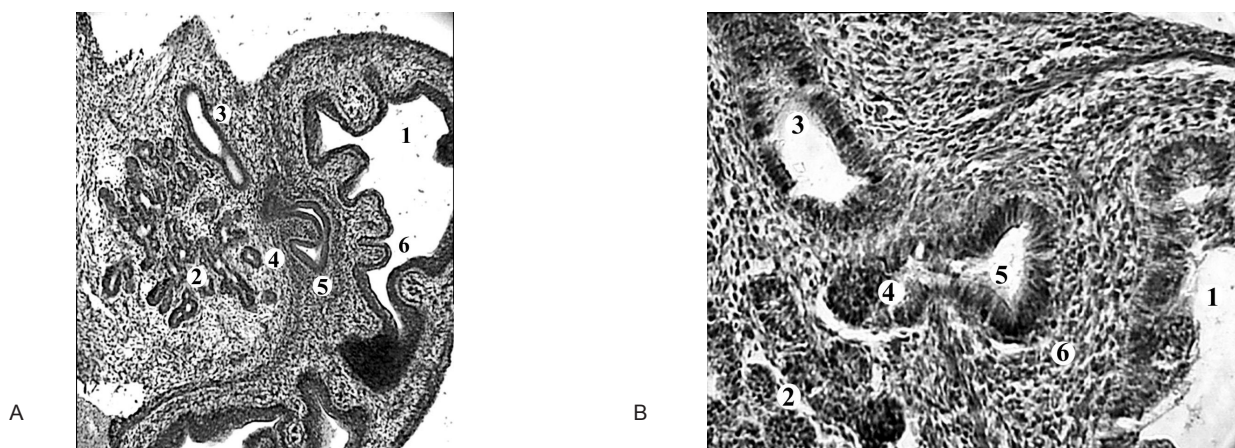


Fig. 1. Frontal sections of human embryo 19,0 mm PCL. Microphoto. Magnification: A  $\times 80$ , B  $\times 160$

1 – duodenum; 2 – pancreas; 3 – common bile duct; 4 – ventral pancreatic duct; 5 – hepatopancreatic ampule; 6 – primordium of major duodenal papilla.

Since 9th week of prenatal period in embryos 32,0-36,0 mm PCL the position of MDP is shifted to the border of middle and lower part of duodenum. Blood channels of choledochal-duodenal junction are formed by the arteries with a diameter up to 25  $\mu$ m, which are located between the circular bundles of mesenchymal cells to the left of HPA. In embryos 37,0-42,0 mm PCL the numerous blood capillaries were detected under the epithelial layer of HPA, indicating the beginning of subepithelial vascular plexus formation. In embryos 45,0-52,0 mm PCL the blood channels of intramural part of CBD and HPA are formed by the branches of two upper and one lower PD arteries. At the end of this period (embryos 55,0-72,0 mm PCL) the arcuate anastomoses were determined between the above-mentioned arteries to the left and caudally to the HPA.

At the beginning of fetal period (in fetuses 82,0-170,0 mm PCL) blood supply of the intramural part of CBD and MDP provides by two vascular plexuses: subepithelial and intermuscular. Vessels of intermuscular plexus are located near the base of the MDP in perpendicular direction to its axis between circular and longitudinal bundles of the muscular sphincter of HPA. Vessels of subepithelial plexus form two tiers on the levels of circular bundles of muscular sphincter and epithelial layer of HPA. In 6th-month fetuses (205,0-230,0 mm PCL) the source of blood supply of MDP is several branches posterior PD arcade formed by the

anastomosis between upper posterior PD artery and posterior branch of lower PD artery. In 7-8th-month fetuses (235,0-306,0 mm PCL) a relative density of the vessels of MDP subepithelial plexus is greater near its base and decreases in the apical direction. A few vessels of MDP intermuscular plexus are located in horizontal plane around of papilla axis. At the end of this period in fetuses 312,0-373,0 mm PCL the blood channels of MDP are formed by two direct branches of posterior PD arcade and one branch of anterior PD arcade. Vessels of intermuscular plexus are located in the oblique-longitudinal direction between the circular fibers of muscular sphincter of HPA. Vessels of subepithelial plexus are oriented around the circumference of HPA radially.

In newborn (376,0 mm PCL and more larger) the blood vessels of MDP are formed mainly by branches of the posterior PD arcade, and 3-4 straight arterial vessels branch out from last one on the left and cranially in oblique-downward direction to the base of papilla. Aforementioned arteries are dichotomously divided, forming intermuscular and subepithelial plexuses into the thickness of MDP and give connective branches to the anterior superior PD artery, situated along the right wall of the intramural part of CBD in the cranial direction (fig. 2).

Considering obtained data for the prevention of postoperative bleeding and stenosis of the intramural part of CBD it is important to

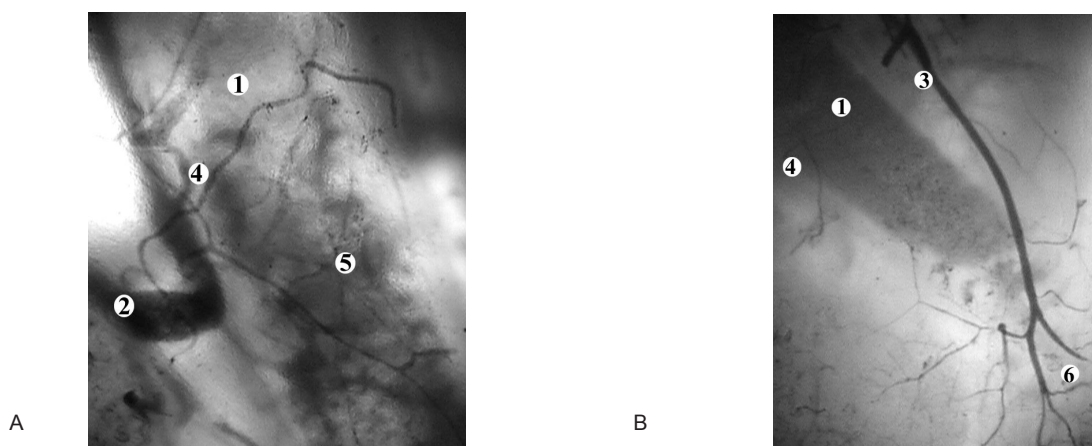


Fig. 2. Arteries of common bile duct in human newborns (injection of ink, brighten up). View: A – front ( $\times 20$ ), B – back ( $\times 8$ )

1 – common bile duct; 2 – pancreatoduodenal arcade; 3 – posterior superior pancreatoduodenal artery; 4 – external (intermuscular) vascular plexus; 5 – subepithelial vascular plexus; 6 – connective branches of vascular plexus of major duodenal papilla.

avoid damage of connective vascular branches during performing the invasive manipulations on MDP.

**Conclusions.** 1. In the early period of human ontogenesis the source of formation of blood vessels of the intramural part of common bile duct (CBD) are the anastomoses formed by individual branches of posterior pancreatoduodenal arcade and partially anterior superior pancreatoduodenal artery. 2. Anlage of definitive structure of arterial vessels of the intramural part of CBD identified at the beginning of fetal period as intermuscular and subepithelial vascular plexuses at the circumference of the basis of major duodenal papilla in fetuses 82,0-170,0 mm in parietal-coccygeal length. 3. Specific peculiarities of struc-

ture of the vascular plexus of the intramural part of CBD in newborns is the right-side position their connective branches, it is important to avoid damage of last ones while performing the invasive manipulations on the region of major duodenal papilla.

**Prospects of scientific research.** We consider it expedient to continue research the peculiarities of constitutional variants of vascular structure of major duodenal papilla during postnatal human ontogenesis.

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