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## DEVELOPMENT OF PARAMESONEPHRIC DUCTS AND THEIR DERIVATIVES AT THE END OF EMBRYONIC PERIOD OF HUMAN ONTOGENESIS

**Abstract:** *The process of formation of paramesonephric ducts at the end of embryonic period of human ontogenesis is closely associated with the development of sexual glands, mid-kidney (archinephron or mesonephros) and hind-kidney (metanephros).*

**Key words:** *paramesonephric ducts, development, embryo, human.*

**Introduction.** Investigation of the derivatives of the paramesonephric ducts is not sufficient, although they are of great theoretical and practical value. They are especially important for learning the development and formation of topography of the uterine tubes, uterus and vagina [1-8].

**Objective:** to find out further development of mesonephric and paramesonephric ducts at the end of embryonic period of human ontogenesis.

**Materials and methods.** The study was conducted on 9 human embryos. Morphological and histological methods were used.

**Results.** An intensive growth of mid-kidneys is observed in embryos of 9,0-10,0 mm PCL accompanied by an increasing number of mesonephric bodies. An intensive growth of the sexual gland germs occurs. Cranial portions of the mesonephroses (archinephrons) are located dorsally and laterally from the lung germs. Mesonephric ducts are located on the lateral surfaces of the mid-kidneys, their lumen increases. Lateral longitudinal fissures become more visible. Medial longitudinal fissures are formed in this period. Not deep fissure appears between the sexual glands and mesonephric part of the sexual crest in embryos 9,5 mm PCL.

In embryos 10,0-11,0 mm PCL the borders of the longitudinal fissures come closer, and due to this fact paramesonephric ducts (Muller ducts) are formed. They look like tubes located in the parenchyma of the mid-kidney (mesonephros). Appearance of germs of the paramesonephric ducts activates the growth of gonad germs. Mesenchymal taeniae extend between the upper poles of the mid-kidneys and pleuroperitoneal

– diaphragmatic ligaments of mesonephroses. Cranial portions of paramesonephric ducts are located posteriorly and laterally, their external diameter ranges from 20,0 to 22,0 mcm. A characteristic feature of embryos 11,0 mm PCL is the onset of reduction of the mid-kidneys occurring in the cranial-caudal direction. It plays a crucial role in the formation of future male or female sex. This stage of human embryogenesis can be considered as one of the critical periods in development.

Mesonephros inflection is seen in embryos 11,5-12,0 mm PCL which is connected with occurrence of natural inflection of the embryo. Gonad germs are located on the anterior-medial surface of the mid-kidneys in the form of longitudinal crests. Densely spaced mesenchymal cells of the gonads transform into mesenchymal taeniae. The length of gonads is  $1,2 \pm 0,1$  mm, the thickness –  $220 \pm 10$  mcm. Lateral and medial fissures become deeper. Coelomic epithelium transforms into the external layer of the mid-kidneys, mesonephric and paramesonephric ducts.

In embryos 12,0 mm PCL the germs of paramesonephric ducts have inconsiderable lumen. The length of paramesonephric ducts is  $660 \pm 10$  mcm, their lumen is  $4 \pm 0,2$  mcm. Intensive formation of paramesonephric ducts is indicative of one of the critical periods in the development of embryos 11,5-12,0 mm PCL. Caudal-mesenchymal taeniae pass from the caudal portions of the gonads and mid-kidneys. Hind-kidneys (metanephroses) are dislocated upwards coming closer to the inferior poles of the mid-kidneys. The umbilical arteries are located

laterally from the hind-kidneys. Upper borders of the left sexual gland are located on the level of X thoracic rib, and the superior pole of the right sexual gland – on the level of the inferior border of the same vertebra. The inferior extremities of the sexual glands correspond to the level of II lumbar vertebra, and the inferior extremity of the left sexual gland is located higher than that of the right one. A vertical size of the left sexual gland is  $1,4\pm 0,01$  mm, a transverse size of the right sexual gland is  $1,3\pm 0,1$  mm. The transverse size in the medial portion is  $460\pm 20$  mcm.

Embryos 13,5 mm PCL have certain peculiarities in anatomical interrelations between the constituents of the urogenital complexes: mid-kidneys occupy a central position, they considerably protrude into the coelomic cavity gradually separating from the posterior wall of the trunk. Paramesonephric ducts grow in the caudal direction, their length is  $1,2\pm 0,01$  mm, width –  $120\pm 4$  mcm. Sizes of the hind-kidneys increase. Urogenital complexes are separated by the dorsal mesentery. Pleuroperitoneal fold is connected with the cranial pole of the mid-kidney by means of diaphragmatic ligament of the mesonephros. Taeniae extend downwards from the caudal portions of the mid-kidneys and sexual glands. They are further transformed into appropriate habenulae of the sexual glands. The length of the right mid-kidney is  $2,8\pm 0,02$  mm, and the length of the right sexual gland is  $1,2\pm 0,01$  mm. The length of the left mid-kidney is  $2,9\pm 0,01$  mm, and the left sexual gland –  $1,3\pm 0,01$  mm.

In embryos 14,0-14,5 mm PCL the lumen of paramesonephric ducts near the urogenital sinus is practically absent, which should be considered as a stage of physiological atresia. The diameter of the lumen of paramesonephric ducts on the level of the upper third of the mid-kidneys is  $4\pm 0,1$  mcm, and on the caudal level from this position –  $2\pm 0,05$  mcm. Retention or absence of recanalization of ducts can cause their retardation or absence which is one of the critical periods in the development of these structures. Sexual glands and mid-kidneys present a single complex of an elongated oval shape. The size of sexual gland increases and they begin isolate themselves from the mid-kidneys. Longitudinal depressions are formed between them and mid-kidneys in the form of lateral and medial fissures. The germ of

the hind-kidney is located medially concerning gonadomesonephric complex. The size of the mid-kidneys grows considerably. A vertical size of the left kidney is  $2,6\pm 0,2$  mm, the right one –  $2,4\pm 0,1$  mm. The cranial extremity of the left mid-kidney corresponds to the level of I thoracic segment, and the cranial extremity of the right mid-kidney – to the level of II thoracic segment. Lower extremities of the mid-kidneys are located on the level of I sacral segment. Mid-kidneys are characterized by appearance of larger mesonephric bodies and tubules in the caudal portion. 24 pairs of arterial vessels from the dorsal aorta pass to the mid-kidneys. Habenula of the sexual gland is clearly seen. The hind-kidney is located between the posterior wall of the coelom and caudal portion of the mid-kidney. The diameter of the lumen of mesonephric ducts is  $8\pm 0,2$  mcm, and paramesonephric ducts –  $10\pm 0,2$  mcm. The cranial portions of the urogenital complexes are located inferior from the pleuroperitoneal folds. The caudal portions of the above mentioned complexes reach the pelvic portion of the coelom. In the cranial portions germs of the gonads are located on the anterior surfaces of the mid-kidneys. At the same time the process of reduction of the mid-kidneys is initiated. It occurs in the cranial-caudal direction.

In embryos 15,0 mm PCL urogenital taeniae including mesonephric and paramesonephric ducts protrude over the internal surface of the coelom. The process of their separation begins. Habenula of the sexual gland becomes  $420\pm 6$  mcm long. The caudal extremities of the paramesonephric ducts are detected on the border between the medial and inferior thirds of the mid-kidneys. Enlargement of the size of the adrenal glands results in dislocation of the urogenital complexes laterally.

**Conclusions.** 1. Embryos 13,0-14,0 mm PCL have certain peculiarities in anatomical interrelations between the constituents of the urogenital complexes: mid-kidneys occupy a central position, they considerably protrude into the coelomic cavity gradually separating from the posterior wall of the trunk, and are characterized by appearance of larger mesonephric bodies and tubules in the caudal portion.

2. At the end of the embryonic period formation of paramesonephric ducts occurs in

close morphological connection with the development of sexual glands, mid-kidneys and hind-kidneys.

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