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BLOOD SUPPLING THE TESTICLES IN FERTILE PERIOD OF HUMAN'S LIFE

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In work, the sources of blood supply to the testicle on the way to its moving from the abdominal cavity to the scrotum during the fertile period of a person were investigated. A comparative anatomical assessment of the blood supply to the testicles of some mammals in different periods of their sexual development is also provided. The functional disorders in the human endocrine system at the stages of puberty after the determination of blood hormones were described.

On the basis of morphological studies carried out on fetus, variants of the departure of the testicular artery and percentage variants of branching of this artery on the trunk were established.

As a result of the study, the largest increase in the diameter of the testicular artery up to 0.7 mm was determined from the 5th to the 7th month of the fertile period of a human's life, as the variability of the angle of departure of the testicular arteria from the main vessel.

Options for branching the testicular artery into distributive and mixed groups are also proposed. The detailed morphological study of the intra-organ bed of the testicle, as a tubular organ, as well as the vessels that blood to the organs surrounding the testicles: epididymes, vas deferens, provides results of the work.

In the work, the effect of ligation vessels of the testicle, epididymes and vas deferens on the structure and function of the organs that provide blood supply, the author also investigated.

In the course of the experiment, it was proven that cutting the testicular arteries in not sexually immature animals leads to greater destruction of the seminiferous tubules than their ligation in sexually mature animals.

As a result of the experiment, the author proposed practical recommendations for operations on the testicles. In particular, to determine of the sectional level of the main feeding vessel responsibility to variants and groups of branching testicular arteries.

Key words: testicle, fertile period, sexual maturity, testicular artery, 17-ketosteroids.

Шарапова О.М. Кровообіг яєчок у плідному періоді життя людини

У цій роботі досліджені джерела кровопостачання яєчка на шляху його переміщення з черевної порожнини в мошонку в плідному періоді життя людини. А також надана порівняльно-анатомічна оцінка кровопостачання яєчок деяких тварин-ссавців у різні періоди їхнього статевого розвитку. Описані функціональні порушення в ендокринній системі людини на етапах статевого дозрівання після визначення гормонів крові.

На підставі проведених морфологічних досліджень на плодах людини встановлені варіанти відходження яєчкової артерії та процентне співвідношення варіантів розгалуження цієї артерії на стовбурі.

У результаті дослідження визначено найбільше збільшення діаметра тестикулярної артерії до 0,7 мм від 5-го до 7-го місяця плідного періоду життя людини, а також мінімальність кута відходження тестикулярної артерії від магістральної судини. Також запропоновані варіанти розгалуження тестикулярної артерії на розподільчу та змішану групи.

Результатами роботи стало детальне морфологічне вивчення внутрішньо-органного артеріального русла яєчка як трубчастого органу, а також судин, що кровопостачають органи, що оточують яєчко: над'яєчко, сім'яносна протока.

У роботі також автором досліджений вплив перев'язки тестикулярної, протокової та артерій сім'явидних проток на будову та функцію органів, що ними кровопостачаються. У процесі проведення експерименту доказано, що перерізка тестикулярних артерій у статевонезрілих тварин призводить до більшої деструкції сім'яних каналців, ніж перев'язка каналців у статевозрілих тварин.

У результаті проведеного експерименту автором запропоновані практичні рекомендації у разі оперативних втручань на яєчках. Зокрема, визначати рівень перерізу основного стовбура живлення яєчка стосовно варіантів та груп розгалуження тестикулярних артерій.

Ключові слова: яєчко, плідний період, статеве зрілість, тестикулярна артерія, 17-кетостероїди.

Introduction. One of the major problems faced by medical and biological science is the problem of continuing the full-fledged period of a person's life. In the course of physiological changes of the reproductive system, a special place is occupied by the

male seminal glands, which play an important role in the life of the male body, ensuring the processes of its development, reproduction, growth and aging [1, p. 278–279]. In recent years, the number of studies on the blood supply of male gonads causes of hypo-

gonadal conditions, infertility and sexual impotence [4, p. 160–162; 6, p. 19–20]. Special interest in this issue is also explained in connection with the operative treatment of many diseases, traumatic injuries and neoplasms of the testicle, as well as anomalies and violations has increased, since often acute and chronic testicular ischemia is one of the of natural migration, in which the testicular vessels retain features of the fetal period [3, p. 76–78].

At the same time, at present, in the published works, the main attention was paid to the study of the topography of the testicular arteries in an adult [2, p. 10–13; 5, p. 589–590].

Information about the peculiarities of the formation of testicular vessels, the development of their anastomoses and potential properties, as well as about functional disorders of testicular nutrition are scanty and contradictory.

Therefore, questions about the possibility of crossing the testicular vessels and ways of revascularization of the testicle still remain debatable.

The following specific tasks in this work were set:

1. To study the peculiarities of the arterial bed of the testicle at the stages of its movement.

2. By means of a differentiated ligation, determine the value of individual vessels of this organ.

3. To provide a comparative anatomical assessment of the blood supply to the testicles of some laboratory animals in different periods of their sexual development.

4. To study functional disorders in the endocrine system due to impaired blood supply to the testicles during the stages of puberty.

5. Using the obtained indicators, to find specific ways of vascularization of the testicle during the surgical treatment of anomalies, traumatic injuries, thrombosis of blood vessels and its inflammatory diseases.

Materials and methods. This work consisted of two parts: morphological and experimental.

Topographic and anatomical studies of the blood supply of male gonads were conducted on 260 preparations-complexes from 130 cadavers of human fetuses aged from 2.5 months to the end of the fetal period. On 170 of them, an anatomical experiment was conducted with differentiated ligation of the main or auxiliary sources of nutrition of the testicle, on 140 – the development of intra-organ arterial branches was studied.

The experimental part of the work consisted in carrying out 4 series of experiments on immature and sexually mature guinea pigs and rabbits with trial laparotomy, transection of testicular, ductal, and

simultaneously those and other arteries. In addition, the topographic features of the formation of seminal arteries, starting from the fetal period and up to puberty were studied on 8 rabbits and 18 guinea pigs.

During the anatomical examination, the methods of preparation, injection of arteries with contrast materials, x-ray vasography, and the production of histological preparations stained with hematoxylin and eosin according to Van Gieson were used.

Assessment of the functional state of the gonads during their ischemia was carried out 1, 2, 3, 14, 30, 240 days after the operation for the excretion of individual fractions of 17-ketosteroids. Moreover, it was taken into account that 11-oxy-17-ketosteroids and dehydroepiandrosterone are metabolites of adrenal androgens, and androsterone and etiocholanolone are excreted mainly by the testes. Fractions of 17-ketosteroids were detected by the method of thin-layer chromatography.

Discussion. On the basis of morphological and angiographic studies, it was established that the testicular artery in fetuses, as well as in adults, was a branch of the abdominal aorta in 87.04% of cases, in 10.45% – renal, and in 2.51% – middle and lower adrenal. In 91.8% of cases, it left with one trunk and in 8.2% – with two.

The diameter of the testicular artery increased in leaps and bounds from 0.07 mm to 0.7 mm. Their most intensive growth was noted up to 4–5 and 6–7 months, that is, before the period of their movement from the abdominal cavity to the scrotum. At the same time, the angle of its departure decreased from obtuse to sharp, and the uniformly tortuous and arcuate course changed to a straight one. Its tortuosity was preserved only in the distal parts.

No less important is the question of the level of division of testicular arteries into testicular and accessory branches. When the testicle is located in the abdominal cavity, the division of the testicular artery more often occurred near the organ itself, when it was moved to the scrotum – sometimes along the path of the spermatic cord, then near the lower pole of the kidney.

For the first time, an attempt was made to systematize options for branching and anastomosis of testicular arteries, as they are of great importance in the development of collateral blood circulation in testicular ischemia. 18 branching variants of testicular arteries were identified, grouped into 2 groups: distributive and mixed. In the distributive form of branching, the testicular branch fed only the testicle, and the accessory one fed the epididymis, without anastomosing with each other.

Therefore, the ligation of the testicular artery, below the branch of the accessory artery led in such cases to complete ischemia of the organ. In the mixed form, which occurs only in 20% of cases, both branches of the testicular artery nourish both the epididymis and the testicle, forming numerous intra-organ anastomoses between them, which are additional ways of restoring collateral blood circulation.

Penetrating under the albuginea tunica, the branches of the testicular artery are divided in the parenchyma of the gland into submembrane, intermembrane and intramembrane arteries and arterioles. In the seminiferous tubules of the testicles, the vascular network is built as in tubular organs, forming longitudinal peritubular arterioles and capillaries. Their transverse branches cover the seminiferous tubule, partially penetrating its membrane. The formation of the intra-organ arterial bed of the testis ends already before the period of gender differentiation, the inter-organ – only up to 6–7 months of fetal life.

From 2.5 months, in addition to the main source of nutrition, the testicle acquires additional nutrition, also changing in the process of its migration. Thus, the diameter of the cremasteric artery and the ductal artery increased in leaps and bounds. The angle of departure of the cremasteric artery from the lower epigastric was increased. It should be noted that, going along the back wall of the inguinal cord, the cremasteric artery fed 2–3 branches of the genital branch of the femoral-genital nerve, which provides reciprocal relations between the muscles of the inguinal cord and the abdominal wall. Therefore, the community of the cremasteric artery is important not only for the nutrition of the testicle, but also for its innervation during migration.

As for the artery of the vas deferens, along with the increased tortuosity of its distal sections, an increase in the diameter of the main anastomosis between its ascending branch and the accessory artery at the tail of the epididymis was noted. The specified anastomoses were already detected from 3 months. However, in an anatomical experiment with ligation of the testicular artery, their potential became apparent only before moving the testicle into the scrotum.

When studying the peculiarities of the development of seminal arteries in guinea pigs and rabbits, the same observations as in humans were found. Therefore, these animals were used in conducting an

experiment with the transection of seminal vessels in order to clarify the results of anatomical studies.

The study of the excretion of 17-ketosteroids in a control group of animals made it possible to conclude that starting from the period of infancy and reaching puberty, the androgenic function increased, especially during the period of moving the testicles into the inguinal passages in 1.5 months and until puberty in 5–6 months.

When studying the histological structure of this series of testicles, it was found that 20 minutes after the operation, the testicles were slightly increased in size, their vessels were dilated, swelling of the cells of the spermatogenic epithelium was revealed. On the second or third day, areas that were devoid of blood vessels, accumulation of interstitial Leydig cells, and desquamation of the spermatogenic epithelium appear. One month after the operation, the proliferation of the vascular network of the testicular parenchyma, the degeneration of the spermatogenic epithelium was revealed. However, the Leydig cells were saved.

In more distant terms, by 3–4 months, the testicular parenchyma degenerates and is replaced by fat or connective tissue. At the same time, the epididymies, practically does not suffer.

Closing the vas deferens does not affect the function and structure of the testes in both sexually mature and immature animals.

Simultaneous ligation of the testicular and ductal arteries, regardless of the age of the animal, leads to necrosis and death of the testicles, as well as epididymal atrophy.

Results. The testicles of immature animals are subject to more significant destruction when the seminal arteries are cut than those of sexually mature animals, which is more likely due to the less developed potential possibilities of collateral blood circulation, as well as the high sensitivity of the undifferentiated epithelium to ischemia.

In addition to the theoretical significance, the above facts have practical significance, as they provide a reason to cross the inguinal cord at the superficial inguinal ring during surgical interventions on the undescended gonad. The level of cutting the main source of the testicle must be chosen in accordance with the options and groups of branches of the testicular arteries.

The evaluation of the functional movements of the endocrine glands, both before and after surgical interventions on them, requires further studying.

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