Морфологічні особливості дренажних систем яєчка

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Morphological features of drainage systems of the testicle

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Реферат

Мета. Визначити особливості організації морфологічних структур дренажних систем яєчка та їх роль у патогенезі чоловічого безпліддя.

Матеріали і методи. Структура та взаємозв'язки морфологічних параметрів дренажних систем яєчка досліджені на 71 біоптаті яєчка, забраного під час некропсії чоловіків зрілого віку (22 – 35 років). На гістологічних препаратах яєчок за допомогою морфометричної лінійки АМ–9–4 та сітки Стефанова на 25 точках виконували заміри зовнішніх діаметрів артеріол, капілярів, венул і нервів.

Результати. Тотальним дослідженням гістологічних зрізів препаратів сім'яного канатика в ділянці глибокого кільця пахового каналу отримано такі морфологічні дані: сумарну кількість великих судин у всіх зрізах препаратів склали 16 артерій загальною площею $51,3805 \times 10^{-3} \text{ мм}^2$; 28 вен загальною площею $38,2511 \times 10^{-3} \text{ мм}^2$; 18 артеріол загальною площею $2,8136 \times 10^{-3} \text{ мм}^2$; 30 венул загальною площею $2,2681 \times 10^{-3} \text{ мм}^2$; виявлено 4 нерви загальною площею $0,3686 \times 10^{-3} \text{ мм}^2$ та 4 нервових стовбури загальною площею $3,5801 \times 10^{-3} \text{ мм}^2$.

Висновки. Отримані дані гістологічного та морфологічного дослідження зразків сім'яного канатика підтверджують припущення, що в його проксимальному відділі розташовані більш значні за розміром і менш значні за кількістю кровоносні судини, а нерви, діаметр яких об'єктивно менше нервових стовбурів, більш виражені в напрямку дистального відділу сім'яного канатика.

Ключові слова: дренажні системи яєчка; безпліддя; хірургічні захворювання; морфометрія; сім'яний канатик; гістологічний препарат.

Abstract

Objective. To determine the peculiarities of organization of morphological structures of the drainage systems of a testicle and their role in pathogenesis of infertility in the men.

Materials and methods. The structure and interrelationship of morphological parameters of the drainage systems of a testicle were investigated in 71 biopsies of a testicle, excised during necropey in men of the adult age (22 – 35 yrs old). On histological preparations of testicles, using morphometric rule AM–9–4 and the Stefanov's net on 25 points, there were measured the external diameters of the arteriolas, capillaries, venules and the nerves.

Results. During total investigation of histological sections of the ductus deferens preparations in part of a deep ring of inguinal channel there were obtained following morphological data: the Abstract quantity of big vessels in all the sections of preparations consisted of 16 arteries with a general square $51.3805 \times 10^{-3} \text{ mm}^2$; 28 veins with general square $38.2511 \times 10^{-3} \text{ mm}^2$; 18 arteiols with general square $2.8136 \times 10^{-3} \text{ mm}^2$; 30 venulas with general square $2.2681 \times 10^{-3} \text{ mm}^2$; there were revealed as well 4 nerves of general square $0.3686 \times 10^{-3} \text{ mm}^2$ and 4 neural trunks of general square $3.5801 \times 10^{-3} \text{ mm}^2$.

Conclusion. The data obtained, concerning histological and morphological investigation of samples of ductus deferens confirms probability, that in its proximal part the blood-bearing vessels are present, which are bigger but lesser in number, while the nerves, diameter of which is objectively lesser than in the nerves trunks, are more pronounced in direction of distal part of ductus deferens.

Keywords: drainage systems of a testicle; infertility; surgical diseases; morphometry; ductus deferens; histological preparation.

The study principles of organization morphological features of drainage systems of the testicle, as structures of a male reproductive system, remain relevant directions of the clinical and morphological research [1 – 3]. It is well-known, that pathological changes in these systems are common in the structure of a testicular surgery and leads to the disorder of spermatogenesis and, consequently, to a male infertility [4 – 6]. In the analysis clinical and experimental data of pathogenesis of infertility in men, presence of general patterns was observed, which were based on the disturbances of drainage

systems of a testicle with its surgical diseases from a childhood period [7, 8].

S. A. Adelakun, et al [9] revealed an increase in sperm counts, percentage of motility, morphology and percentage of live sperm, blood level of follicle stimulating hormone, Luteinizing hormone and testosterone, hematological parameters, testis, epididymal and general body weights across the groups in a dose-dependent manner. The testis histoarchitecture showed normal cellular composition in their germinal epithelium, with sperm cells in the lumen and a normal interstitium.

At work [10] was shown that testis followed the standard histological processing. In histomorphometry, total diameter, total area, epithelial height, luminal height and luminal area were analyzed.

A. T. Araújo Ramos, et al. [11] observed a decrease in seminiferous tubule diameter, as well as testis weight. These finds may be related with disorders of testosterone metabolism due to activation of immunological responses of macrophage, which inhibit the steroidogenesis.

Many studies [12, 13] on various organs have concluded that venous congestion (VC) causes severe organ dysfunction with elevation of oxidative stress relative to that of arterial ischaemia (AI). However, a comparison of the pathological effects of AI and VC on the testes has not been conducted. In the study of Hirai S. et al models of AI and VC and their reperfusion in rat testes, respectively, were developed and analysed.

V. U. Omoja, et al. [14] investigated in the histological study testicular degeneration, characterized by depopulation of seminiferous tubules and depletion of the spermatogenic cells.

Bo Deng, et al. [15] investigated the transplantation of interstitial cell suspension (ICS) on a sexual behavior. Based on the results of this study, it can be concluded that the loss of gonads drastically altered sexual behavior and sexual experience. Given declining libido in men after castration or due to other disorders, this study could lead to discoveries with possible implications for the improvement of the general sense of men's well-being.

Purpose of research to study and determine peculiarities of the organization of morphological structures of testicular drainage systems and their role in the pathogenesis of male infertility.

Materials and methods

Investigation of the structure and interconnections of the morphological parameters of testicular drainage systems was carried out at the morphological stage of the study. The material of the research was 71 biopsy samples of testicles, which were taken during necropsy of a mature age men (22 – 35 years old).

The Bioethics Commission on the protocol of the meeting of the Committee on Biomedical Ethics of the Dniprovskyi Medical Institute of Traditional and Alternative Medicine (No 1 from January 17, 2019) did not reveal violations of the moral and ethical norms during research work.

Morphological state of the testicular drainage systems was studied at the methods of coloring paraffin sections with hematoxylin – eosin by Malory–Slinchenko's method, followed after their study and morphometry under the microscope Bi-olam with a binocular attachment AY. On the histological samples of the testis, were carried out measurements with a using morphometric line model AM–9–4 and Stefanov's mesh on 25 points. External diameters of arterioles, capillaries, venules and nerves were measured. Finally, deduction per unit

Table 1. Total area (10^{-3} mm^2) and total number of nerves with vessels of a spermatic cord in the area of a deep ring of inguinal canal

Types of blood vessels and nerves	Preparation No 1a		Preparation No 1b		Totally		
	n	S	n	S	n	S	Sn
Arteries	8	16.6505	8	34.7300	16	51.3805	3.2113
Veins	17	23.6246	11	14.6265	28	38.2511	1.3661
Arterioles	11	1.8377	7	0.9759	18	2.8136	0.1563
Venules	16	1.1341	14	1.1340	30	2.2681	0.0756
Nerves	3	0.2200	1	0.1486	4	0.3686	0.0922
Nerve trunks	1	1.1322	3	2.4479	4	3.5801	0.8950

Note. n – quantity; S – total area; Sn – area of the 1st vessel/nerve (10^{-3} mm^2). Same in table 2, 3.

Fig. 1.

Preparation No 7 slice of fragments a spermatic cord in the area of a deep ring of inguinal canal. Coloring with hematoxylin and eosin. Increase under a microscope $\times 50$.

Fig. 2.

Preparation No 12 slice of fragments a spermatic cord in the area of a deep ring of inguinal canal. Coloring with hematoxylin and eosin. Increase under a microscope $\times 50$.

area of the interstitial tissue, arterioles, capillaries, venules and nerves was calculated.

The Pearson's correlation coefficients (r) with estimation of its significance level (p) and strength of correlation link were calculated.

Results

In the study a thorough histological and morphological examination of spermatic cord samples was performed on the three levels: a spermatic cord fragment in the deep ingot of the inguinal canal, an average third and a distal spermatic cord. In the total study of histological sections of the given preparations of a spermatic cord fragments in the region of a deep ring an inguinal canal, a numerous histological and morphological data were obtained (table 1, fig. 1, 2).

The total number of large vessels in all sections of the preparations was shown under the microscope: 16 arteries with total area $51.3805 \times 10^{-3} \text{ mm}^2$; 28 veins with area $38.2511 \times 10^{-3} \text{ mm}^2$; total area 18 arterioles were $2.8136 \times 10^{-3} \text{ mm}^2$; 30 venules – $2.2681 \times 10^{-3} \text{ mm}^2$; there were identified 4 nerve with total area $0.3686 \times 10^{-3} \text{ mm}^2$ and 4 nerve trunk with area $3.5801 \times 10^{-3} \text{ mm}^2$.

In the study of histological sections preparations of fragments in a middle third of the spermatic cord, the following results were obtained (table 2, fig. 3, 4):

- total number of detected arteries was 22 with total area $15.6185 \times 10^{-3} \text{ mm}^2$;
- area of 46 veins – $17.2368 \times 10^{-3} \text{ mm}^2$;
- area of 34 arterioles – $3.350 \times 10^{-3} \text{ mm}^2$;
- area of 44 venules – $3.2993 \times 10^{-3} \text{ mm}^2$.

There were shown 6 nerves with a total area $0.4701 \times 10^{-3} \text{ mm}^2$ and 6 nerve trunks with area $6.22528 \times 10^{-3} \text{ mm}^2$.

In the study of histological sections preparations on a distal part of the spermatic cord, located directly in the posterior surface of testes, the results were shown in (table 3, fig. 5, 6).

The total number of arteries in all sections of the preparations was shown: 28 with total area $14.7552 \times 10^{-3} \text{ mm}^2$; 58 visualized veins – $22.8092 \times 10^{-3} \text{ mm}^2$; area of 42 arterioles – $1.2328 \times 10^{-3} \text{ mm}^2$; area of 50 venules – $1.950 \times 10^{-3} \text{ mm}^2$. There were identified 18 nerves with total area $1.1846 \times 10^{-3} \text{ mm}^2$, and 8 nerve trunks with area $7.1679 \times 10^{-3} \text{ mm}^2$.

Discussion

In comparative evaluation all morphometric results in the preparations, taken from different fragments of a spermatic cord the following regularities are established. The number of vessels and nerves increases in a direction of the distal part of a spermatic cord (fig. 7). Thus, in the structure total number of arteries, which was found in all 6 analyzed fragments, pro-

Table 2. Total area (10^{-3} mm^2) and total number of nerves with vessels of a spermatic cord at the level of a middle third of inguinal canal

Types of blood vessels and nerves	Preparation No 2a		Preparation No 2b		Totally		
	n	S	n	S	n	S	Sn
Arteries	12	7.3348	10	8.2837	22	15.6185	0.7099
Veins	28	10.1230	18	7.1138	46	17.2368	0.3747
Arterioles	16	2.1222	18	1.2278	34	3.3500	0.0985
Venules	19	1.7265	25	1.5728	44	3.2993	0.0750
Nerves	5	0.3032	1	0.1669	6	0.4701	0.0784
Nerve trunks	2	2.0843	4	4.1685	6	6.2528	1.0421

Fig. 3.
Preparation No 3 slice of fragments a spermatic cord in the area of a middle third. Coloring with hematoxylin and eosin. Increase under a microscope $\times 50$.

Fig. 4.
Preparation No 9 slice of fragments a spermatic cord in the area of a middle third. Coloring with hematoxylin and eosin. Increase under a microscope $\times 50$.

Table 3. Total area (10^{-3} mm^2) and total number of nerves with vessels of a spermatic cord at the level of distal third of the inguinal canal

Types of blood vessels and nerves	Preparation No 3a		Preparation No 3b		Totally		
	n	S	n	S	n	S	Sn
Arteries	15	7.8778	13	6.8774	28	14.7552	0.5270
Veins	32	11.5751	26	11.2341	58	22.8092	0.3933
Arterioles	19	0.5679	23	0.6649	42	1.2328	0.0294
Venules	22	0.9620	28	0.9880	50	1.9500	0.0390
Nerves	8	0.5273	10	0.6573	18	1.1846	0.0658
Nerve trunks	3	3.0843	5	4.0836	8	7.1679	0.8960

Fig. 5.

Preparation No 2 slice of fragments a spermatic cord in the proximal part. Coloring with hematoxylin and eosin. Increase under a microscope $\times 50$.

Fig. 6.

Preparation No 12 slice of fragments a spermatic cord in the proximal part. Coloring with hematoxylin and eosin. Increase under a microscope $\times 50$.

portion of the proximal part is 24.3% (16 from 66 arteries), proportion a middle third of the inguinal canal is 33.3% (22 from 66). Other 42.4% (28 from 66) arteries were detected in the distal part of the spermatic cord ($p < 0.05$ compared with the area of a deep ring of the inguinal canal).

The total number of veins (according to the results of research sections of the first and second preparations) in the proximal part is significantly less than in the median (28 against 46; $p < 0.05$) and distal part fragments a spermatic

cord (28 against 58; $p < 0.05$). The same trend was shown for the total number of arterioles and venules. It is the smallest in the areas of a deep ring of the inguinal canal (18 arterioles and 30 venules), and the largest in the distal part of a spermatic cord (42 arterioles and 50 veins, $p < 0.05$ in comparison with the proximal part). The largest differences between studied segments of a spermatic cord were found for the numerous identified nerves, majority of them was located in the distal part (18 from 28, i.e. 64.3% of the total number of nerves). The number of nerve trunks in the proximal part ranged from 1 to 3, in the middle part – from 2 to 4, while in the distal part – from 3 to 5 (table 1–3).

A comparative analysis of the metric characteristics vessels and nerve plexus at the different levels of a spermatic cord showed opposite tendencies.

It was found that the largest sizes of large vessels are demonstrated in the proximal part of a spermatic cord: average area of one artery in this area ($3.2113 \times 10^{-3} \text{ mm}^2$) in 4.52 times more than in the middle part ($0.7099 \times 10^{-3} \text{ mm}^2$) and in 6.09 times more than area of the artery in the distal part of a spermatic cord ($0.527 \times 10^{-3} \text{ mm}^2$), located directly on the back surface of the testicle (fig. 8).

The average area of one vein in the proximal part of a spermatic cord ($1.3661 \times 10^{-3} \text{ mm}^2$) is in 3.65 times more that in the middle part of a spermatic cord ($0.3747 \times 10^{-3} \text{ mm}^2$) and in 3.47 times more than in the distal part ($0.3393 \times 10^{-3} \text{ mm}^2$). The average size of the arterioles in the deep ring of the ingui-

Fig. 7.

Structure a quantitative composition of blood vessels and nerves, shown in the different parts of a spermatic cord: * – $p < 0.05$ in comparison with the distal part; # – $p < 0.05$ compare with area of a middle third of inguinal canal, %.

Fig. 8.
The average area of one vessel /nerve, found on the different parts of a spermatic cord.

nal canal ($0.1563 \times 10^{-3} \text{ mm}^2$) is in 1.59 times higher, and area of venules ($0.0756 \times 10^{-3} \text{ mm}^2$) is practically the same as the size of such vessels located in the middle third of a spermatic cord ($0.0985 \times 10^{-3} \text{ mm}^2$ and $0.0750 \times 10^{-3} \text{ mm}^2$) respectively. The arterioles and venules, which are located in the distal part of a cord, have the smallest sizes – $0.0294 \times 10^{-3} \text{ mm}^2$ and $0.0390 \times 10^{-3} \text{ mm}^2$.

Indicators of the average size of the nerve trunks and nerves throughout the length of a spermatic cord did not differ significantly. Moreover, the area of the nerve was on average on 9.7 – 13.6 times less than the area of nerve trunk. As a whole, analyzing indicators of the total area of vessels from different parts of a spermatic cord, it should be noted that area of arteries and veins is greatest in the proximal part. Their percent in the total area of all arteries was found in 6 preparations ($81.7542 \times 10^{-3} \text{ mm}^2$) is 62.9% (51.3805 from $81.7542 \times 10^{-3} \text{ mm}^2$) while in the middle part – 19.1%, in distal part – 18.0%. About 48.9% of the area occupied by veins was shown on the area of a deep ring an inguinal canal.

The total area of arterioles and venules is highest in the middle third of the cord, and the smallest in the distal part. At the same time, the total area of the nerves is the smallest in the proximal part ($0.3686 \times 10^{-3} \text{ mm}^2$, i. e. 18.2% of the total area of all detected nerves). It is slightly larger in the middle part ($0.4012 \times 10^{-3} \text{ mm}^2$ or 23.2%) and the largest number in the distal part ($1.1846 \times 10^{-3} \text{ mm}^2$ or 58.6%). The total area of the nerve trunks is tends to increase in the direction of the distal part of a spermatic cord, which is closer to the posterior surface of the testicle (fig. 9).

Conclusion

1. The obtained results of the histological and morphological study spermatic cord samples confirms that in the proximal part there are more significantly size and less significant number of blood vessels, and nerves whose diameter is objectively smaller than the nerve trunks, are more significantly shown in a direction of the distal part of a spermatic cord.

2. The thicker nerve mesh in the proximal part of a spermatic cord determines peculiarities of the structure vein venous plexus of a testicle; in some cases. A well-defined variety of blood vessels for the arterial and venous stream diverse caliber is shown, which provides sufficient blood supply of the testicle in its various positions.

Fig. 9.
Structure of indicators total area of the vessels and nerves on the different parts of a spermatic cord.

3. Nerves at all three levels of the studied preparations are located in a close proximity to the venous vessels, sometimes adhering closely to the walls of venous vessels, which is obviously makes it possible to isolate a vascular–nerve bundle with well–marked larger vessels and at the same time to provide a greater number of nerves, adjacent to these blood vessels.

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