Some features of the angioarchitecture of the testis in guinea-pig

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Abstract

The branches of the testicular artery in guinea pig were a main capsular artery and some capsular branches with oblique-longitudinal and transverse-longitudinal dispositions, and variable patterns at the lateral and medial surfaces of the testes. Subcapsular branches arose through the proper testicular artery or by the capsular artery and the subcapsular branches emitted: the extralbuginic blood vessels placed between the mesothelium layer and the proper dense albuginea layer of the testis capsule, the intralbuginic vascular vessels characterised by presence of arterial and venous segments inside the myostromal structure of the testis albuginea and the subcapsular and intratesticular sequential vessels which appeared as small arteries and veins, arterioles and venules and capillaries of the capillary trees. The last vessels, mainly the arterioles, venules and capillaries of the testis showed a complex pattern of disposition, in which was viewed parallel and perpendicular vessels concerning to the spatial orientation of the seminiferous tubules.

Key-words:
Guinea-pig.
Testis.
Testicular artery.
Pampiniform plexus.
Angioarchitecture.

Introduction

Previous researches had considered some distributive patterns to arterial branches from the testicular artery in man. So, subalbuginic branches of the testicular artery with a centripetal distributive pattern concerning to the parenchyma of the testis had been described[1,2]. The penetrating albuginic arterial branches mainly transmitted to the inner testis milieu through the rete testis myoconnective axis were described in domestic ruminants[3]. Presence of a main capsular artery as a direct continuity of the testicular artery was found in dog and rodents[2,4,5]. The longitudinal capsular artery lies on the epididymidis margin of each testis and distributed subcapsular branches which extended to the lateral and medial faces of the testes[5]. Furthermore, subalbuginic branches were formed by the testicular artery with a longitudinal or transversal disposition referring to the longitudinal axis of the testes, whose distributive pattern occurred through the vascular layer of the testicular capsule for the testicular stroma and parenchyma. The transversal subalbuginic testicular branches formed the intralobular arteries and these arteries formed arterioles which were followed by the capillary network of the testis. The testicular venous drainage followed a confluent vascular pattern being similar to the arterial distribution[4,5,6].

The capillary networks of the testes were characterised by different disposition of the capillaries concerning to the spatial disposition of the seminiferous tubules occurring perpendicular and parallel capillaries. These capillaries showed generally a hexagonal configuration with an anastomotic pattern observed among them[4,5,6].

In spite of the previous theoretical support concerning to the testes vasculature

in man and in other mammals, there was apparently a space to investigate the vascular pattern of the guinea pig's testes, which was the target of this study mainly at light microscope level.

Materials and Methods

Testes were initially collected from 6 adult guinea pigs after vascular perfusion of the pelvic arterial tree with colloidal carbon (Günther-Wagner, Hannover, Germany) in 4 animals or with 10% neutral aqueous formalin in 2 rodents. The testes were reduced and the samples were fixed in 10% neutral formalin for histologic studies. Another group of 10 guinea-pigs were arterially injected with diluted stained latex (Neoprene latex 670, Du Pont, Brazil), followed by formalin fixation for gross anatomy examination. The first group was conducted to light microscopic routine with Paraplast®(Oxford, Labware, USA) embedding and the histologic sections (7 to 20 m) were staining with HE, Masson's thricrome and Erlich's eosin. Also some samples were conducted to historesin®(Leica, Germany) embedding and thin sections (2 to 4 m) were stained by ferric hematoxylin and eosin or by toluidine blue 1.5%. Samples of the second group were processed as the paraplast embedding method for the first group, to comparative studies of materials without vascular contrasts. The testes of the third group, after postfixation, were dissected under a stereomicroscope (Olympus), and documented concerning to the gross anatomical vascular pattern.

Results

The testicular artery ends at the "vascular" point located on the cranial extremity of the epididymidis margin of each testis (Figure 1), in which the pampiniform plexus also arises. Just to the vascular point a longitudinal capsular artery had origin and extended along the dorsal margin until the caudal extremity of the testis. Arterial branches were formed directly from the testicular artery or from the capsular artery (Figure 1) and lied under the dense albuginic layer of the testicular capsula[7] to the medial and lateral surfaces of the testis (Figures 1, 2). Lateral branches showed predominately an oblique-transverse disposition (Figure 1), while medial branches presented mainly an oblique-longitudinal orientation (Figure 2). The venous vessels showed a similar pattern and all the vessels were observed in four positions, concerning to their testicular compartment disposition as follow. Blood vessels were observed: (1) outer to the tunica albuginea of the testis, located between the mesothelium layer and the proper dense albuginea (perialbugineal disposition, Figure 3); (2) inside the myoconnective architecture of the albuginea whose structure the vessels penetrate (intralbugineal disposition, Figure 4); (3) into the vascular layer of the testicular capsula (subalbugineal disposition, Figure 5), and, (4) inside the proper testicular structure (Figure 5). In the intratesticular distribution the blood vessels were observed as arterioles, venules and capillaries, mainly disposed in the interstitial tissues of the testis and rete testis complex. So, these inner testicular blood vessels formed by arterioles, capillary nets and venules were disposed mainly with parallel and perpendicular orientations concerning to the spatial orientation of the seminiferous tubules (Figure 6).

Discussion

The presence of a "vascular point" in the testes of guinea-pig being localised on the cranial extremity of the epididymidis margin of each testis, in which the testicular artery lost its anatomical individuality and also had origin the pampiniform plexus was seen. A similar vascular point had been also showed in the testis of albino rat, and was considered as the superficial reference to localise the cavitary and subalbuginic rete testis in this species[8].

Concerning to the presence of a capsular artery as direct continuation of the

testicular artery in guinea-pig, a similar pattern had been described for the dog[2,9] and for laboratory rodents such as the albino rat[4] and the golden hamster[5]. The capsular artery or the proper testicular artery gave origin to the subcapsular testicular branches mainly disposed transversely with distribution to the medial and lateral surfaces of the organ, similarly to observations related for the testis angioarchitecture in golden hamster[5].

The arterial subcapsular branches of the testis, independently of their mainly transverse, longitudinal or oblique orientations in both surfaces of the organ, penetrated into the testis through the testicular capsule[7], with a centripetal pattern concerning the proper testis as target organ which was similarly observed in the human testes[1].

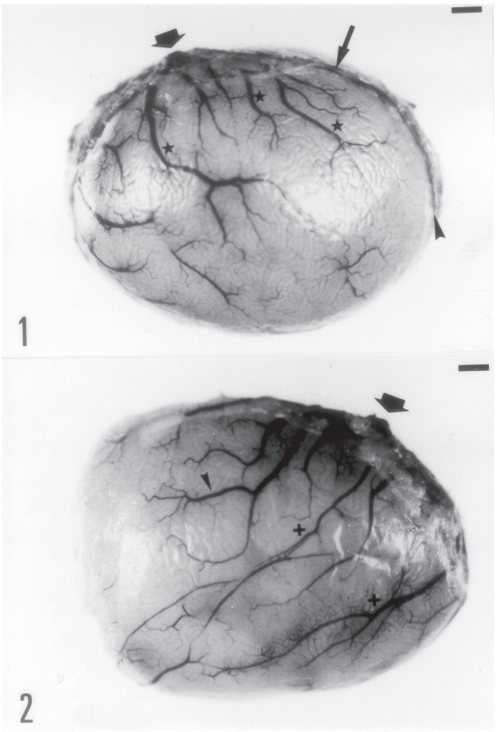
The subcapsular arteries perhaps had some correspondence to the penetrating testicular arterial branches described in some domestic ruminants, although these blood vessels in ruminants mainly penetrated the testis intimate through the testicular mediastinum[3]. Comparatively in guinea pig the testes mediastinum was not characteristic but a central myoconnective axis of the testes was seen starting at the vascular point and penetrating some extension through the medium testicular parenchyma in which the rete testis complex was observed[10]. The mediastinum axis was accompanied by the central artery of the testis, a direct branch formed by the testicular artery next to the testis vascular point.

On the other hand, differently from the testis angioarchitecture of man and some ruminants, previous commented, in guinea pig interlobular or intralobular dispositions of the testicular subcapsular blood vessels were not clearly evident because testicular lobules had not been typically defined in this species according other observations[10].

Descriptions of the testes blood vessels patterns such as the perialbugineal (subalbugineal) and intralbugineal dispositions here characterised, were not showed in the literature. Although, the testicular artery and vein (pampiniform plexus) in guinea-pig showed an extralbugineal disposition at the level of the spermatic cord, similarly observed in some mammals[11,12,13,14].

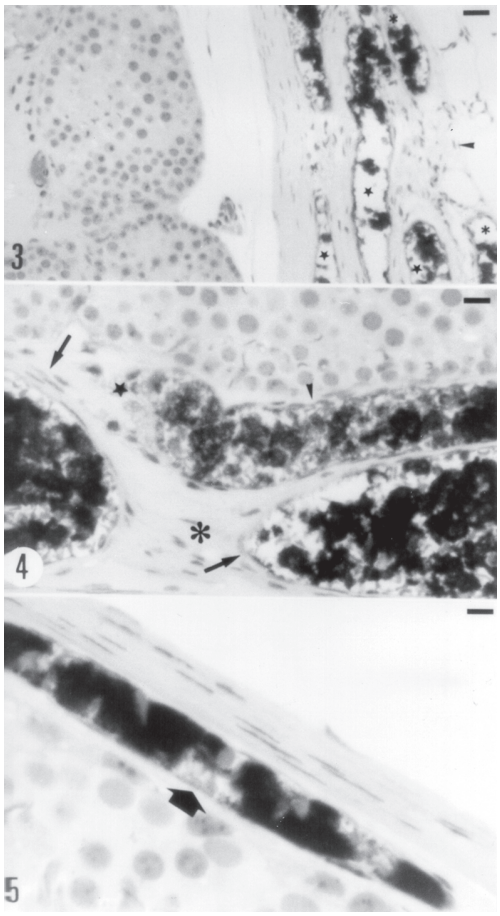
Relatively to distribution of vascular segments of the testicular blood vessels into the vascular layer of the testicular capsule, this pattern was similarly described in other rodents[4,6,7,12]. The branching of the vessels was observed in side the proper testicular structure of the guinea pig according to our results.

Finally, features of intratesticular distribution and orientation of blood vessels such as arterioles, venules and capillaries were

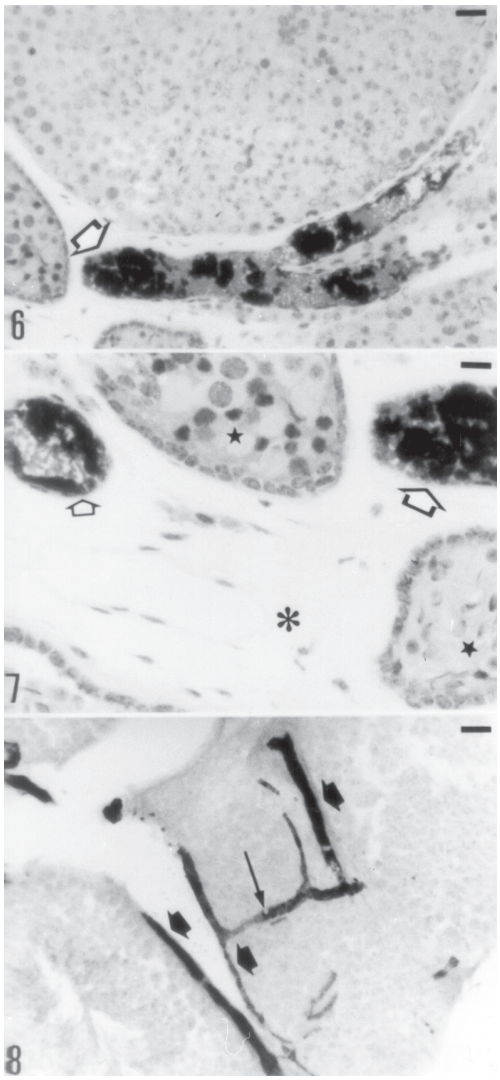


Figures 1 - 2 - Arterial distribution to the dorsal margin, lateral surface (1) and medial surface (2) of the guinea pig's testis. Indicated: vascular point (large arrow), main capsular branch (long arrow), lateral branches (stars) and the end of the capsular artery (large arrowhead) in 1: x 4.1, and, vascular point (large arrow), transverse-oblique arterial branches (small arrowhead) and longitudinal-oblique branches (+) in 2: x 4.8

found in guinea pig testis. All these microscopic vessels were mainly viewed with parallel and perpendicular orientations relatively to the spatial dispositions of the seminiferous tubules and also of the channels and chambers of the cavitary-labirinthyc rete testis15, in this species. Moreover, hexagonal disposition mainly of the testicular parallel and perpendicular capillaries were noted in guinea pig similarly a rope-ladder with similar pattern verified in[6].



Figures 3 - 4 - Microvasculature of the guinea pig's testis and adnexa at the level of the spermatic cord (in 3: HE, x 100) and inside the structure of the testicular capsule (4: albuginea level), showing: arterial segments of the testicular artery (stars) surrounded by venous segments of pampiniform plexus (with colloidal carbon inside their lumen), and loose connective interstitial tissue (*) in 3 . In 4 (HE, x200), are showed: extracapsular vessels (*) and intratunical vessels (stars) and also the mesothelium boundary of the testicular capsule in 4



Figures 5 - 6 - Two intralbuginic (*) vascular segments (arrows) and one intratesticular venule (arrowhead) close related (star), in 5 (HE, x400). In 6 are showed near the Rete testis structures (stars) two venules, one disposed parallel (arrow) to the channels and the other oriented perpendicular to the channels and chamber (large star), of the guinea pig's Rete testis (HE, x 400)

Características da angioarquitetura do testículo de cobaios

Resumo

Os ramos da artéria testicular em cobaio são uma artéria capsular principal e alguns ramos capsulares com disposições oblíqua-longitudinal e transversa-longitudinal, mostrando um padrão distributivo variável em ambas as superfícies dos testículos. Os ramos subcapsulares se originam da própria artéria testicular ou da artéria capsular, sendo que estes ramos subcapsulares emitem vários outros ramos com disposição estratigrafica variável. Assim, se notam vasos sanguíneos extraalbugínicos colocados entre o estrato mesotelial e o próprio estrato denso da albugínea. Os vasos intra-albugínicos são caracterizados como seguimentos arteriasis e venosos dispostos na intimidade da albugínea testicular. Os vasos subcapsulares e intratesticulares sequentes aos anteriores aparecem na intimidade do testículo como pequenas artérias e veias, arteríolas e vênulas e capilares das redes capilares. Os vasos intratesticulares mostram um padrão complexo de disposição, sendo vistos, especialmente os capilares, com orientação espacial paralela ou perpendicular em relação aos túbulos seminíferos os quais circundam.

Palavras-chave:
Cobaio.
Testículo.
Artéria testicular.
Plexo pampiniforme.
Angioarquitetura.

References

1 ERGÜN, S.; STINGL, J.; HOLSTEIN, A. F. Microvasculature of the human testis in correlation to Leydig cells and seminiferous tubules. **Andrologia**, v. 26, p. 255-262, 1994.

2 JORANSON, Y.; EMMEL, V. E.; PILKA, H. J. Factors controlling the arterial supply of the testis under experimental conditions. **Anat. Rec.**, v. 41, p. 157-176, 1929.

3 GODINHO, H. P.; CARDOSO, F. M.; NOGUEIRA, J. C. Paterns of parenchymal ramification of the testicular artery in some ruminants. **Anat. Anz**., v. 133, p. 118-124, 1973.

4 GUNN, S. A.; GOULD, T. C. Vasculature of the testes and adnexa. In : GREEP, R. O.; ASTWOOD, E. B. **Handbook of physiology**. Baltimore: William and Wilkins, 1975. p. 117-172.

5 OLIVEIRA, C.; ORSI, A. M.; VICENTINI, C. A.; DUARTE, H. E. Microvascularização testicular no hamster (Mesocricetus auratus). **Naturalia**, v. 16, p. 103-109, 1991.

6 SETCHELL, B. P.; MADDOCKS, S.; BROOKS, D. E. Anatomy, vasculature, innervation, and fluids of the male reproductive tract. In : KNOBIL, E.; NEILL, J. D. **The Physiology of reprodution**. 2. ed. New York: Raven Press, 1994. v. 1, p. 1063-1175.

7 STEINBERGER, E.; STEINBERGER, A. Spermatogenetic function of the testis. In: GREEP, R. O.; ASTWOOD, E. B. **Handbook of Physiology**. Baltimore: Williams and Wilkins, 1975. p. 1-19.

8 DYM, M. The mammalian rete testis. A morphological examination. **Anat. Rec.**, v. 186, p. 493-524, 1976.

9 DUARTE, H. E. **Vascularização e angioarquitetura do testículo do cão *(Canis familiaris)***. 1992. 82 p. Tese (Doutorado em Ciências) - Instituto de Biociências, Universidade Estadual Paulista, Botucatu,1992.

10 BEU, C. C. L. **Características estruturais da rede testicular de cobaio *Cavia porcellus***. Botucatu, 1999. 78 p. Dissertação (Mestrado em Ciências) - Instituto de Biociências, Universidade Estadual Paulista, Botucatu, 1999

11 CARVALHAL, R.; BORELLI, V.; MIGLINO, M. A. Irrigação do testículo em eqüino da raça puro-sangue inglês. **Braz. J. Vet. Res. Anim. Sci.**, v. 37, p. 355-365, 2000a.

12 CARVALHAL, R.; BORELLI, V.; MIGLINO, M. A. Estudo morfológico do funículo espermático em ovinos da raça Corriedale (Ovis aries, L.). **Braz. J. Vet. Res. Anim. Sci.**, v. 37, p. 348-354, 2000b.

13 DUARTE, H. E.; ORSI, A. M.; SILVA, T. P. Considerações sobre a disposição dos vasos sanguíneos no funículo espermático e no testículo do cão *(Canis familiaris)*. **Revista Ciênc. Bioméd.**, v. 14, p. 89-96, 1993/94.

14 FOZ FILHO, R. P. P.; FERNANDES FILHO, A.; BORELLI, V. Características morfológicas do funículo espermático do burro *(Equus asinus x Equus caballus)*. **Braz. J. Anim. Sci. Vet. Res**., v. 36, p. 183-187, 1999.

15 BEU, C. C. L.; ORSI, A. M.; GREGORIO, E. A.; MATHEUS, S. M. M.; BASSO, N. A. A scanning electron microscopic study of the Rete testis of guinea pig. **Acta Anat.**, v. 162, p. 194-198, 1998.

16 KORMANO, M.; SUORANTA, H. An angiographic study of the arterial pattern of the human testis. **Anat. Anz.**, v. 128, p. 69-76, 1971.

17 WEERASOORIYA, T. R.; YAMAMOTO, T. Three-dimensional organization of the vasculature of the rat spermatic cord and testis. A scanning electron-microscopic study of vascular corrosion casts. **Cell Tiss. Res.**, v. 241, p. 317-323, 1985.