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The human testicular artery and the pampiniform plexus — where is the connection?

Adam Skowroński, Kazimierz Jędrzejewski

Department of Anatomy, Medical University, Łódź, Poland

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The aim of the study was the microscopic evaluation of the human spermatic cord vessels, with special attention to the connection between the testicular artery and the veins of the pampiniform plexus. We used the corrosive cast method to visualise the angioarchitecture of the spermatic cord. Casts were evaluated using a scanning electron microscope. We observed that there is a narrow space (previously filled with the testicular artery wall), between the casts of the testicular artery and the veins of the pampiniform plexus. This area contains a capillary vessel net, which connects the testicular artery with the veins of the pampiniform plexus. There were no direct anastomoses between the testicular artery and the pampiniform plexus. We hypothesise that the capillary net described is the means of connection between the testicular artery and the pampiniform plexus, and that there can be a testicular artery net of its own vessels (vasa vasorum).

key words: testicular artery, pampiniform plexus, anastomoses, spermatic cord

INTRODUCTION

The study was conducted to confirm the presence of the arterio-venous anastomoses between the testicular artery and the pampiniform plexus in the human spermatic cord. The direct flow of blood between the testicular artery and the pampiniform plexus, bypassing the intratesticular vessels, has been shown in many studies. Most of them conclude that testicular flow depends on the presence, number and diameter of the contracting muscles of the intramural vessels in the testicular artery. The amount of blood flowing through the testicle seems to be one of the most important factors in spermatogenesis as well as in the endocrine function of the testicle. However, most of the available studies are based on animal material (both morphological and functional experiments), proving the presence of anastomoses between the testicular artery and the pampiniform plexus. In our experiments we examine human testicles for the presence and location of the anastomoses referred to. We also assume that they may have an important role in the pathogenesis of varicocele. In the studies available the coincidence of varicocele and infertility reaches 75%. The pathogenesis of varicocele might be connected with variations in venous drainage of the testis [1], although according to many records the anatomical changes in the structures of spermatic cord are responsible for the appearance of the disease.

MATERIAL AND METHODS

A total of 27 testicles (aged 23 to 73 years) were studied. The testicle, epididymis and spermatic cord were removed posthumously in one block, from 24

Address for correspondence: Adam Skowroński, Department of Anatomy, Medical University, ul. Narutowicza 60, 90–136 Łódź, Poland, tel: +48 42 686 61 76; fax: +48 42 612 40 69, e-mail: adams53@wp.pl

to 48 hours after death. Medical histories of individual cases were carefully studied to exclude specimens with any abnormalities in the urogenital organs. Initially all testicles were studied macroscopically. In the event of any morphological changes being observed, the specimens were excluded from the study. After careful preparation, the testicular artery was cannulated and the whole organ was perfused for 15 min with 100 ml of 0.9% sol. of NaCl to remove all blood remains from the vessels. Vessel endothelium was then preserved with 3% solution of glutaral aldehyde. Consequently the vessels were filled with the casting medium (Mercox®) using a syringe piston, until the resin flow of the testicular vein was noticed. The resin was prepared by mixing 100 ml of base with 5 ml of hardener for 30 sec. After polymerisation of the resin in 20°C for 24 hours maceration process was completed. The tissue was first digested by solution 30% KOH for 72 hours at the temperature of 50°C. Then the casts were rinsed several times with both tap and distilled water. After immersion in the distilled water, the casts were frozen at a temperature of –20°C. Frozen specimens were cut into 5 × 5 × 10 mm slices and prepared for scanning electron microscope examination in a standard procedure. Then the specimens were examined with a Philips scanning electron microscope 505 and pictured at various enlargements.

RESULTS

Each of the specimens examined contained testicular artery tightly surrounded by the pampiniform plexus (Fig. 1). The winding course of the testicular artery as well as the circular imprints on the surface of the testicular artery specimen were also visualised. We did not find any direct arterio-venous anastomoses between the testicular artery and the pampiniform plexus veins (Fig. 2). What was visible was a narrow seeming space between the testicular artery and the pampiniform plexus casts (Fig. 1, 2). We have to remember that this space, before tissue digestion, contained the wall of testicular artery. In every specimen examined this seeming space contained a thick net of capillary vessels (Fig. 3–5). SEM pictures clearly show that the vessel net referred to is connected with the testicular artery, as well as with the pampiniform plexus (Fig. 5–7). We can therefore conclude that there are numerous, indirect connections between the testicular artery and the pampiniform plexus in the human spermatic cord.

DISCUSSION

De Graff in XVII century was the first to suggest the existence of a connection between the testicular artery and the pampiniform plexus. He injected

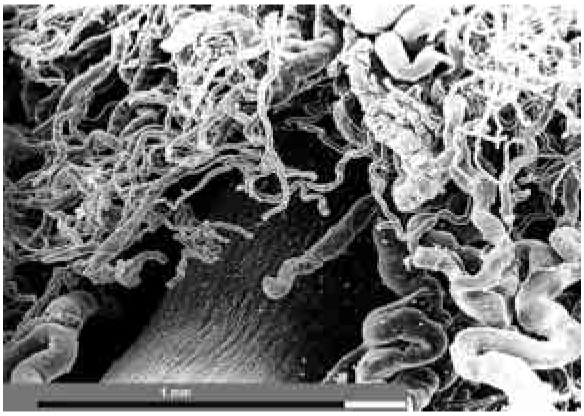

Figure 2. Space between the testicular artery and the veins of the pampiniform plexus.

Figure 1. Testicular artery surrounded by the veins of pampiniform plexus.

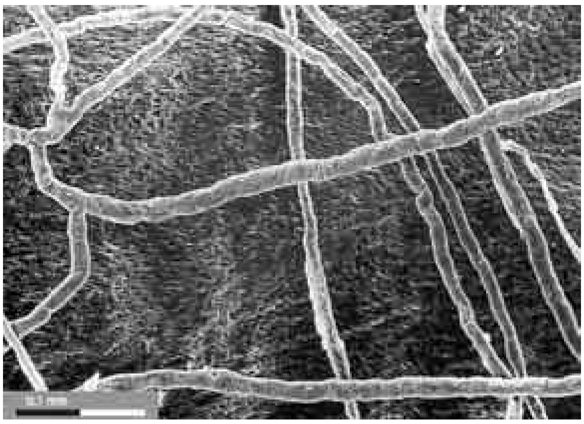

Figure 3. Capillary vessels on the surface of the testicular artery.

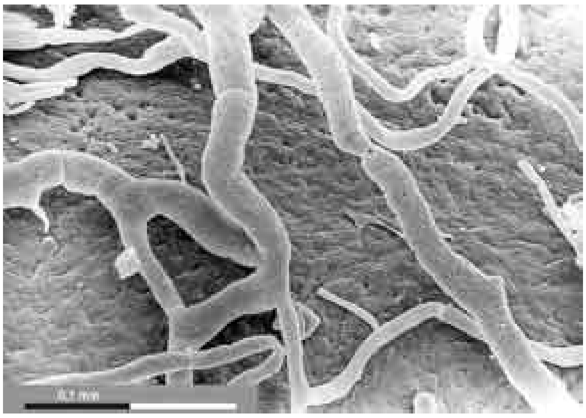

Figure 4. Capillary vessels on the surface of the testicular artery.

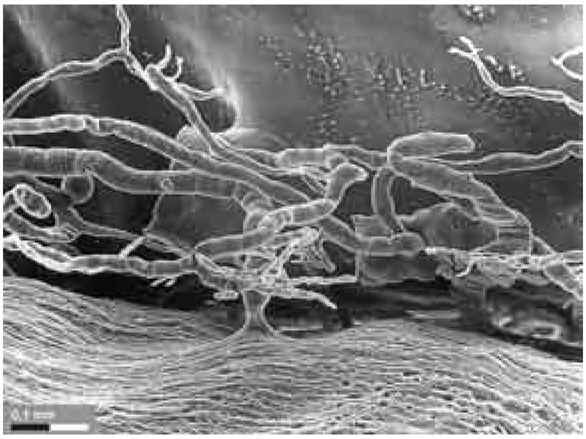

Figure 5. Capillary vessels surrounding the cast of the testicular artery.

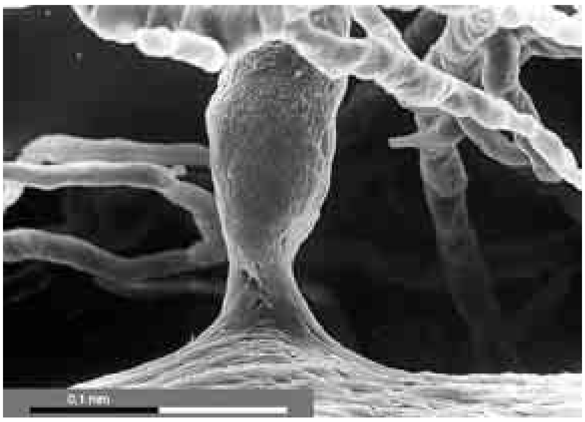

Figure 6. Vessel connected with the testicular artery.

the testicular artery after ligature of the distal part of the spermatic cord and noticed that injection of the testicular artery also causes pampiniform plexus vein distension [2]. Ohtsuka [7], in his experiment, describes vessels of the pampiniform plexus forming a thick net around the testicular artery in

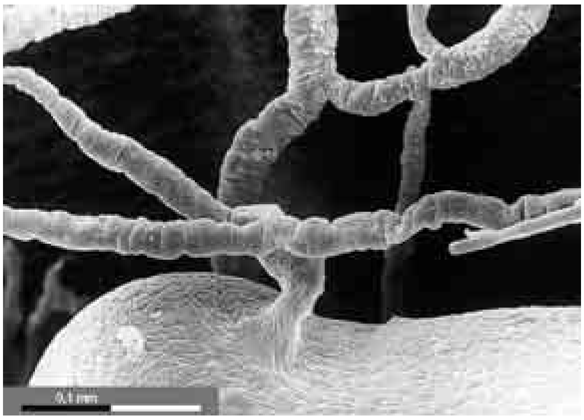

Figure 7. Vasa vasorum connected with the testicular artery.

the rat. Incontrovertible evidence of the connection between the testicular artery and the pampiniform plexus veins came with Noordhuizen-Stassen et al. [5, 6] experiments. They measured blood flow, testosterone concentration and haemoglobin oxygen saturation in the proximal and distal part of the testicular artery and veins of the pampiniform plexus in the boar, bull and ram. By their calculations there had to be a way to carry blood directly from the testicular artery into the pampiniform plexus veins, bypassing the testicular circulation. Murakami et al. [4] examined the walls of the testicular artery in mice and rats using a transmission electron microscope combined with light microscope examination. They also found the presence of capillary channels between the testicular artery and the pampiniform plexus. They examined the spermatic cords of the bull using both light and SEM microscopy, proving that functional arterio-venous anastomoses do exist in the bovine spermatic cord. Rerkamnuaychoke et al. [8–10] examined anastomoses between the testicular artery and the pampiniform plexus in different species such as the golden hamster, boar and tree shrew. In our experiment we found a capillary vessel net which, in our opinion, is located in the tunica media and tunica adventitia of the testicular artery, which means that the vessels are actually a kind of "vasa vasorum", in this particular case the testicular artery's own vessels. We think this net might serve as the functional anastomoses between the testicular artery and the pampiniform plexus veins. Going further, we suppose that the imprints on the surface of the vessels mentioned are caused by smooth circular muscles located in the testicular artery wall. These muscles may then regulate the flow of the blood bypassing the testicular circulation.

CONCLUSIONS

We have not found any direct anastomoses between the testicular artery and the pampiniform plexus. What we found, though, was a thick capillary vessel net with a connection with the testicular artery as well as with the pampiniform plexus. This vessel net is located inside the testicular artery wall. It is possible that the vasa vasorum of the testicular artery provides the way to connect the testicular artery with the veins of pampiniform plexus. These results should encourage us to further experiments to examine the vascular structure of the human spermatic cord.

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