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VASCULARIZATION OF MALE GONADS IN BLENNIUS PAVO (TELEOSTEI, BLENNIIDAE) AS REVEALED BY SCANNING ELECTRON MICROSCOPY OF VASCULAR CORROSION CASTS

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Abstract

The vascular architecture of male gonads of Blennius pavo is studied by scanning electron microscopy of vascular corrosion casts. Arterial supply to the gonads is by a branch of the first ventral segmental artery of the tail. From the surface of the gonads, this vessel gives rise to branches which supply testes, spermatic ducts, testicular glands, blind pouches, urogenital sinus and urogenital papilla. The testis has a rope-ladder-like capillary network around the seminiferous tubules, while in the testicular gland the capillary network is irregular in form. The spermatic ducts are found to have an exterior capillary network located in the compact connective tissue layer and an interior one, lying subepithelially. Urogenital sinus and urogenital papilla show a multilayered capillary network. Angioarchitecture in mature and immature gonads does not differ.

KEY WORDS: scanning electron microscopy, corrosion casts, gonadal vascularisation, Blennius pavo.

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Introduction

In many vertebrates the male gonads lack a detailed description of their vascularisation. Presently only testes and excurrent duct systems of the mouse (BALB/c strain) (14), of man (15), the testes and spermatic cords of the rat (Wistar King Albino) (17) and the testicular artery and pampiniform plexus of bulls (3) are investigated by SEM of vascular corrosion casts.

In teleost fish however the gross vascularisation of testes has been examined by Indian ink injections only in the roach (Rutilus rutilus L.), the pike perch (Lucioperca lucioperca L.), the pike (Esox lucius L.), the black seabrill (Rhombus maeoticus Pall.), Mesogobius batrachocephalus PALL. and Neogobius melanostomus PALL. (5). No microvascular patterns are reported. Based upon morphological and histological results of Eggert (2) and Patzner and Seiwald (12) the present study gives a description of the main vessels and the microvascular patterns of the gonads of male Blennius pavo using the method of scanning electron microscopy (SEM) of vascular corrosion casts (4, 8, 10).

Material and Methods

Seven sexually immature (total length: 82-105 mm, weight: 5.7-9.6 g) and four mature males (total length 111-138 mm, weight 10.0-11.7 g) of Blennius pavo were caught in the Gulf of Trieste (Italy) in baited traps or with quinaldine diluted in isopropanol according to Patzner (11). For vascular corrosion casting, animals were anaesthetized in an aqueous solution of MS 222 (ethyl m-aminobenzoate methanesulfonate; Sandoz, Switzerland), and injected intraperitoneally with 5000 I.U. heparin. Then the circulatory system was flushed with marine teleost Ringer solution (Forster and Hong 1958, cit. after (1)) via ventricle-ventral aorta. 2-3.5ml casting resin Mercox CL-2B (Dainippon Ink & Chemicals, Tokyo, Japan) diluted with methyl methacrylate monomer (4:1) (Fluka, Buchs, Switzerland) was injected with moderate hand pressure. When the injected resin had solidified the fishes were macerated in warm (40°C) 15% sodium hydroxide solution and 2% hydrochloric acid solution and rinsed several times in tapwater. Further steps were done routinely and are described elsewhere (7, 8). Gross vascularisation of gonads was examined in dry casts under the dissecting microscope; for investigation of microvascular patterns, casts (sectioned while in ice) were examined in the SEM. All SEM-work was done with 2.5-5kV accelerating voltage on a Cambridge Stereoscan 250.

Results

Gross vascularisation

Arterial supply. In *Blennius pavo* the male gonads (Fig. 1) are supplied via the first ventral segmental artery of the tail (Arteria segmentalis ventralis caudae prima). The unpaired trunk of this artery (Truncus arteriae segmentalis ventralis caudae primae) (Fig. 2a, tasvcp) arises from the dorsal aorta (Aorta dorsalis) (Fig. 2a, ad) at the level of the caudal third of the kidney and splits off first branches, the paired renal arteries (Arteriae renales) (Fig. 2b, ard) on the dorsal surface of the kidney. The unpaired trunk of the first ventral segmental artery of the tail in turn pierces the kidney in ventrocaudal direction. Arriving at the ventral surface of the kidney it starts to split off the following vessels (in order as listed):

a) Paired intercostal arteries (Arteria intercostalis dextra et sinistra) (Fig. 2b, aid) which run towards the lateral wall of the coelom and give off each a branch to supply the rectum (Fig. 2b, rr).

b) Paired ventral segmental arteries (Arteria segmentalis ventralis dextra et sinistra) (Fig. 2b, asvcpd) which run laterally in the hypaxonic musculature and give off each a branch also to supply the rectum (Fig. 2b, rr) and two branches to serve the body musculature (Fig. 2b, rm). With the most distal portions these segmental arteries supply subcutaneous connective tissue of the ventral body side, urogenital sinus and urogenital papilla.

c) Paired arteries (Arteria dorsalis vesicae testicularis posterior dextra et sinistra) (Fig. 2b, advtpd) which run on the caudodorsal surface of the testicular blind pouches.

d) A single gonadal artery (Arteria genitalis) (Fig. 2b, ag) which within the mesentery divides into five tributaries.

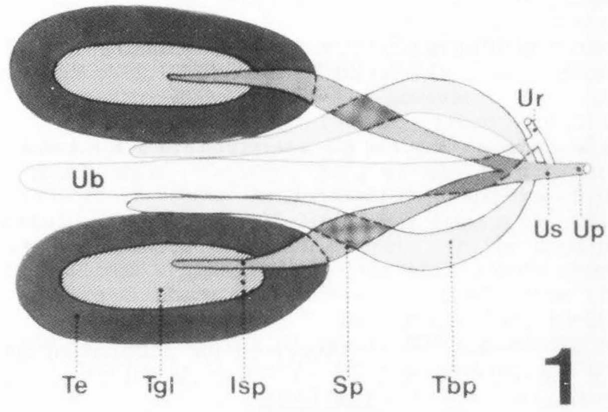
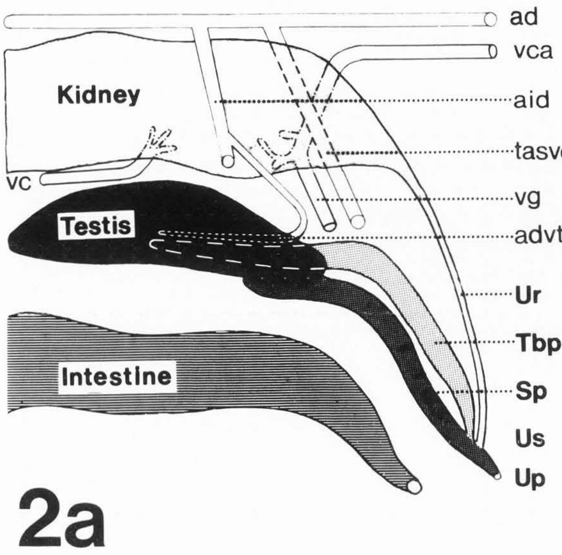


Fig. 1. Diagram of the male gonads of *Blennius pavo*. Ventral view. Isp-intermediate part of the spermatic duct, Sp-spermatic duct, Tbp-testicular blind pouch, Te-testis, Tgl-testicular gland, Ub-urinary bladder, Up-urogenital papilla, Ur-ureter, Us-urogenital sinus.

These vessels then course along the mesorchia and arrive at the gonads half way of their longitudinal extension. Two of the five tributaries (Arteria testicularis dextra et sinistra) (Fig. 2b, atd) turn craniad and supply testes, testicular glands, proximal spermatic ducts and cranial parts of the testicular blind pouches. Two tributaries (Arteria ventralis vesicae testicularis dextra et sinistra) (Fig. 2b, avvtd) run caudad and supply the caudal parts of the testicular blind pouches and distal spermatic ducts. The fifth tributary (Arteria rectalis medialis) (Fig. 2b, arm) continues within the mesentery towards the rectum, where it dichotomizes to supply the dorsal rectum. One of these vessels forms an anastomosis with the dorsal intestinal artery (Arteria dorsalis intestinalis).

Further paired intercostal arteries (Fig. 2a, aid) arise from the dorsal aorta at the level of the caudal third of the kidney; i.e., one segment before the first ventral segmental artery of the tail. Each intercostal artery splits off an anterior dorsal artery of the testicular blind pouches (Arteria dorsalis vesicae testicularis anterior dextra et sinistra) (Fig. 2a, advtad) which runs on the craniodorsal surface of the blind pouches.

The second ventral segmental artery of the tail which in *Blennius pavo* arises from the dorsal aorta like the first one with an unpaired trunk (Truncus arteriae segmentalis ventralis caudae secundae) then divides into paired ventral segmental arteries (Arteria segmentalis ventralis caudae



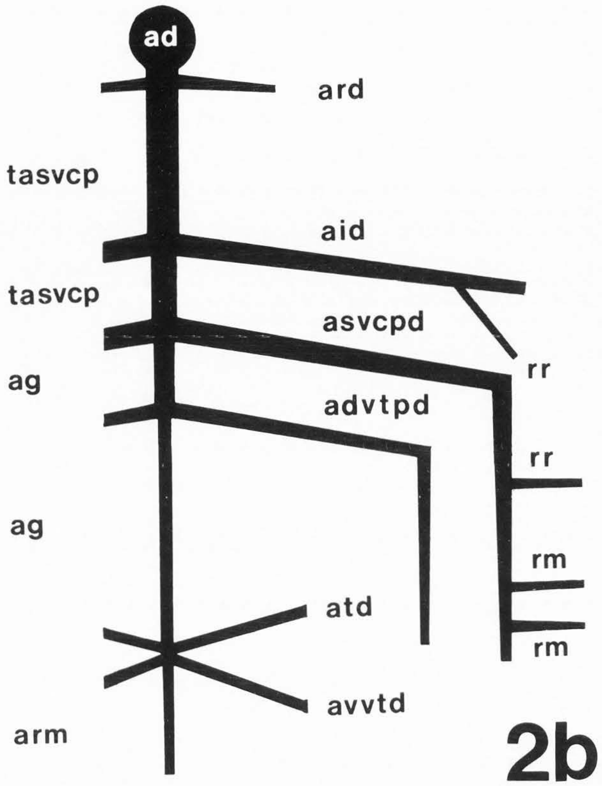


Fig. 2. Diagram of main supplying vessels of male sex organs of Blennius pavo. Sp-spermatic duct, Tbp-testicular blind pouch, Up-urogenital papilla, Ur-ureter, Us-urogenital sinus. ad-Aorta dorsalis, advtad-Arteria dorsalis vesicae testicularis anterior dextra, advtpd-Arteria dorsalis vesicae testicularis posterior dextra, ag-Arteria genitalis, aid-Arteria intercostalis dextra, asvcpd-Arteria segmentalis ventralis caudae prima dextra, ard-Arteria renalis dextra, arm-Arteria rectalis medialis, atd-Arteria testicularis dextra, avvtd-Arteria ventralis vesicae testicularis dextra, rm-Ramus muscularis, rr-Ramus rectalis, tasvcp-Truncus arteriae segmentalis ventralis caudae primae, vc-Vena cava posterior, vca-Vena caudalis, vg-Vena genitalis.
Fig 2a. Lateral view. Left = rostral

Fig 2b. Scheme of the ramification pattern of the first ventral segmental artery of the tail. Top = dorsal. Symmetric (left) vessels are omitted.

secunda dextra et sinistra). These vessels supply the hypaxonic musculature and the subcutanous tissue of the ventral side of the body, as well as distal parts of the urogenital papilla.

Dorsal, lateral and ventral segmental arteries have secondary segmental veins (Fig. 3) localized in their tunica media. These intramural vessels are formed by capillaries which arise from the primary segmental arteries.

Venous drainage. Collecting veins follow a course similar to that of corresponding arteries. The first ventral segmental vein of the tail (Vena segmentalis ventralis caudae prima), the gonadal vein (Vena genitalis) (Fig. 2a, vg) and the intercostal veins (Vena intercostalis dextra et sinistra) do not join to form a common venous trunk. Instead the ventral segmental veins and gonadal vein empty individually into the caudal vein (Vena caudalis) (Fig. 2a, vca) at the ventral side of the caudal end of the kidney. The intercostal veins (Vena intercostalis dextra et sinistra) split up at the lateral side of the caudal end of the kidney to form the renal portal system. From the dorsal surface of the testicular blind pouches two to three pairs of venules (Venula dorsalis vesicae testicularis) depart. Each pair joins to form a common trunk which runs towards the ventral surface of the kidney, where it splits up into renal capillaries. Urogenital sinus and urogenital papilla are drained only from the first ventral segmental vein of the tail.

Main vessels of the gonads

Arteries. The paired, caudad running ventral arteries of the testicular blind pouches (Arteria ventralis vesicae testicularis dextra et sinistra) course along the medioventral side of the spermatic ducts. They branch into arterioles at acute angles which then supply the testicular blind pouches (Arteriolae vesicae testicularis). These arterioles cross the dorsal surface of the spermatic duct, arrive at the ventral side of the testicular blind pouches and then run transversely on its lateral and medial curvatures.

The arterioles of the spermatic duct (Arteriolae ducti spermatici) arise either from the ventral arteries of the testicular blind pouches or from arterioles which supply the blind pouches (see above). Spermatic duct arterioles run transversely or form longitudinal vessels on the dorsal and ventral side of the duct.

The arterioles which supply the urinary bladder (Arteriolae vesicae urinariae), branch off from the ventral arteries of the blind pouches as well as from arterioles of the testicular blind pouches in the same manner as spermatic duct arterioles. They also form longitudinal vessels on the ventral side of the urinary bladder.

Distally each ventral artery of the testicular blind pouches branches off into three to four vessels which supply the caudal ends of the testicular blind pouches and the proximal portions of the urogenital sinus.

The paired testicular arteries (Arteria testicularis dextra et sinistra) first run along the medioventral side of the spermatic ducts. Branching patterns of arterioles arising from testicular arteries and supplying the testicular blind pouches, the spermatic ducts and the urinary bladder are the same as those abutting from the ventral arteries of the testicular blind pouches. Testicular arteries, upon reaching the testes and testicular glands, course along their ventromedial sides, have gradually decreased diameters and are slightly undulating until they arrive at the cranial end of the testes. Here they form a capillary network supplying the cranial end of the mesorchium. From the testicular arteries, testicular arterioles (Arteriolae testiculares) branch asymmetrically at right angles: these arterioles either penetrate vertically through the testicular glands into the testes or they cross the testicular glands and supply the peripheral portions of the testes only. For the slightly undulating arterioles of the testicular blind pouches, the same patterns of origin are given. They also cross testicular glands and testes and run towards the ventral side of the testicular blind pouches. Arterioles supplying the urinary bladder branch off only from the left testicular artery and course along the ventral surface of the urinary bladder.

Each anterior and posterior dorsal artery of the testicular blind pouches splits off four to five arterioles perpendicularly which run transversely or longitudinally on the dorsal surface of the testicular blind pouches. Moreover the anterior dorsal arteries of the testicular blind pouches split off some arterioles serving the ventral side of the kidney.

Each first ventral segmental artery of the tail gives rise to a single arteriole, which supplies the dorsal surface of the testicular blind pouches immediately in front of the fusion area with the unpaired spermatic duct. Distally the first ventral segmental arteries of the tail ramify into arterioles supplying lateral regions of urogenital sinus and urogenital papilla and further run transversely in ventral and dorsal areas. Arterioles of the right and left ventral segmental artery form anastomoses on the dorsal side of the sinus urogenitalis. Distal parts of the urogenital papilla have arterioles derived from the second ventral segmental artery of the tail. These vessels run longitudinally.

Veins. In general veins run parallel to corresponding arteries. Testes, testicular glands, cranial regions of the

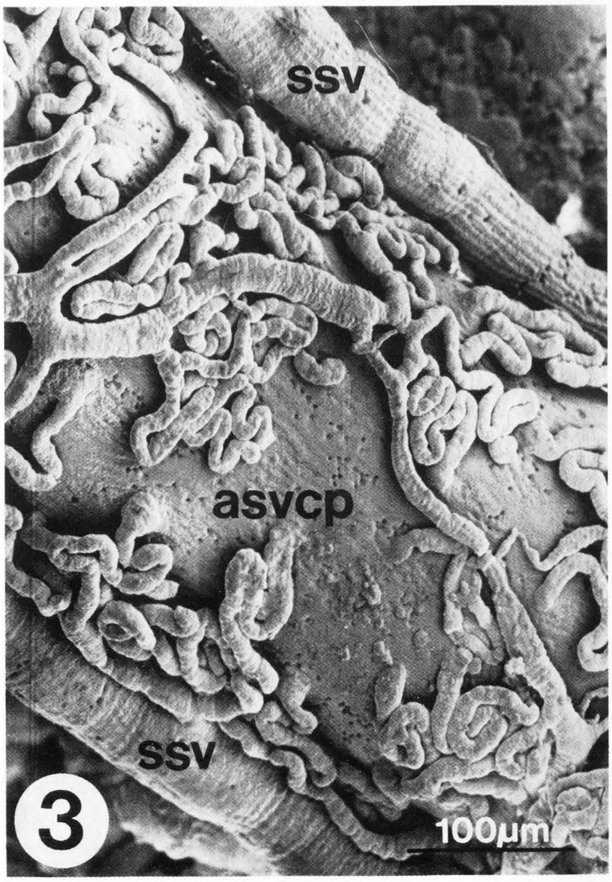


Fig. 3. Secondary segmental venules (ssv) in the wall of the first ventral segmental artery of the tail (asvcp). Vascular corrosion cast.

testicular blind pouches and the proximal spermatic duct are drained via the testicular veins (Vena testicularis dextra et sinistra); the caudal parts of the blind pouches and the distal spermatic duct via the ventral veins of the testicular blind pouches (Vena ventralis vesicae testicularis dextra et sinistra). The venules, which empty into these vessels follow a course parallel to the corresponding arterioles; however, there are no venules which come from the cranial end of the testicular blind pouches and cross over testes and testicular glands to empty into the testicular veins. In contrast the cranial portions of each testicular blind pouch are drained by a single venule (Venula vesicae testicularis) which runs longitudinally along the ventral side of the blind pouches. The vessel joins urinary bladder venules and empties into the testicular veins at the caudal end of the testes. Testes and testicular glands are drained via short venules (Venulae glandulae testicularis) located medioventrally on the testicular gland which empty into testicular veins. Testicular venules (Venulae testicularis) do not empty into the testicular veins, but divide to form the capillary network of the testicular gland. No anastomoses exist between urogenital sinus venules or between corium venules as is the case in the corresponding arterioles.

Microvasculature of male gonads

Testis. All testicular vessels (arterioles, venules and capillaries) are located in the interstitial tissue. Adjacent seminiferous tubules share a single layer of capillaries. The proximal portions of testicular arterioles which reveal sphincters and the testicular vein form anastomoses. Testicular arterioles run parallel to the seminiferous tubules and divide Y-like into capillaries (Fig. 4). According to their arrangement two types of capillaries can be identified; i.e., type I and type II capillaries: Type I run longitudinally but not strictly parallel to the seminiferous tubules and are termed intertubular capillaries (Fig. 5, itc). These capillaries undulate over the length of two or three seminiferous tubules. Type II are called peritubular capillaries (Fig. 5, ptc) and connect undulating intertubular capillaries in a rope-ladder-like manner. Capillaries join Y-like to form testicular venules (Fig. 5), which run parallel to the seminiferous tubules. In the testicular glands these venules split up again to form a tortuous capillary network (Fig. 6).

Spermatic duct. Spermatic ducts reveal two capillary networks: an exterior one in the compact connective tissue layer and an interior subepithelial one. Arterioles coming from the testicular arteries and the ventral arteries of the testicular blind pouches, pierce the compact connective tissue layer and divide Y-like in a coarse-meshed, one layered capillary network (Fig. 7). These capillaries run centripetally in the interior, loose connective tissue layer, where they split up Y-like into a fairly straight and parallel running, dense subepithelial capillary network (Fig. 8). The capillaries of the interior network undulate and lie close to the luminal epithelium. They join in a Y-like manner to form venules. Vessels of the exterior capillary network very seldom empty into these venules. Sometimes spermatic duct arterioles and venules form anastomoses. The distal, unpaired part of the spermatic duct lacks a subepithelial capillary network. It has only a single, coarse-meshed capillary layer.

Urogenital sinus and urogenital papilla. Arterioles of the sinus urogenitalis and the urogenital papilla split up Y-like into transversely orientated, slightly tortuous capillaries (Fig. 9), interconnected by capillaries running perpendicularly to these transversely oriented capillaries (Fig. 10). The capillary networks of urogenital sinus and urogenital papilla are both multilayered, and have similar architecture. Also, both are located in the loose connective tissue layer. Capillaries join in a Y-like manner to form venules. The capillary networks of the unpaired spermatic duct, the urethra, and of the testicular blind pouches continue into the capillary network of the urogenital sinus.

Discussion

Main vessels of the male gonads

In studying main vessels of male and female gonads in some teleosts Juszczyk distinguishes three basic types of vascularization, each of which he divides into subtypes (5). The main supplying vessels of the male gonads of Blennius pavo arise from the first ventral segmental vessel of the tail. The vascularization therefore corresponds to type IIa of Juszczyk and thus is like that in the roach (Rutilus rutilus) and the carp (Cyprinus carpio) (5). This type reflects a high specialization of gonadal blood supply, because a single artery and a single vein give rise to all gonadal blood vessels. In contrast in the representatives of the family of Gobiidae Mesogobius batrachocephalus and Neogobius melanostomus whose habits and reproductive behaviour are similar to species of the family Blenniidae, the gonadal blood vessels arise from five to twelve intercostal vessels (type Ia) (5).

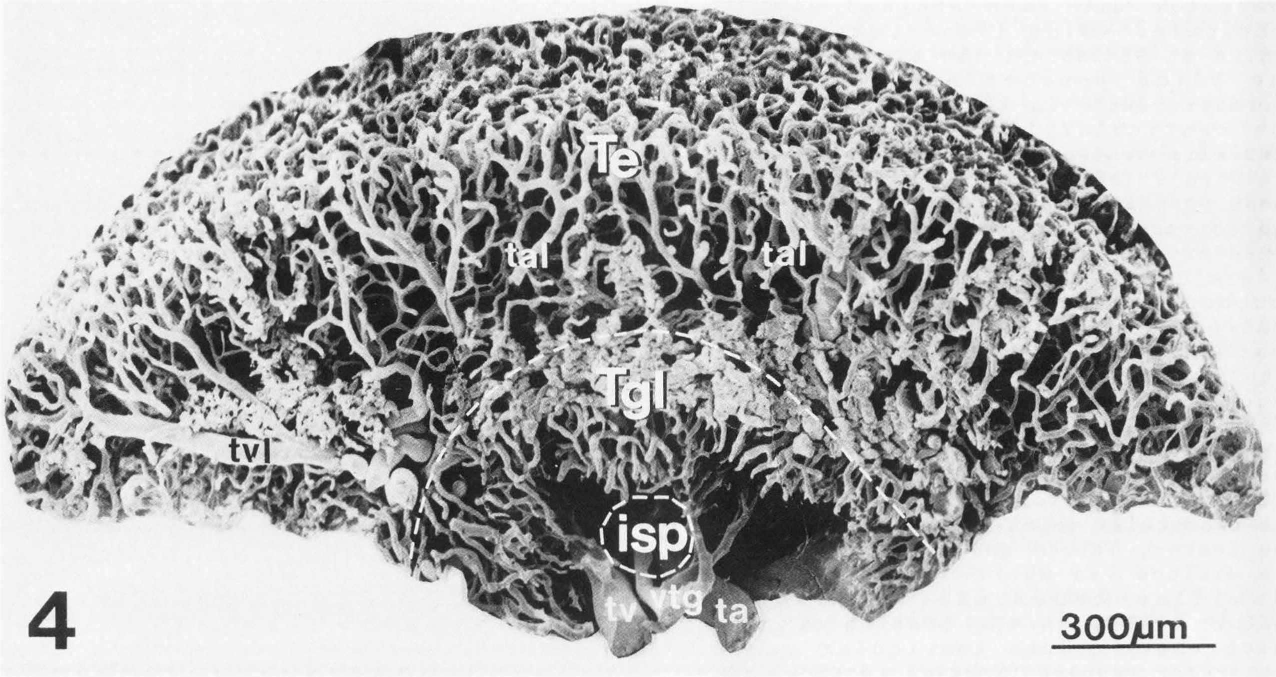


Fig. 4. Cross-section of testis and testicular gland. Vascular corrosion cast. Isp-intermediate part of the spermatic duct, Te-testis, ta-testicular artery, tal-testicular arteriole, Tgl-testicular gland, tv-testicular vein, tvl-testicular venule, vtg-venule of the testicular gland.

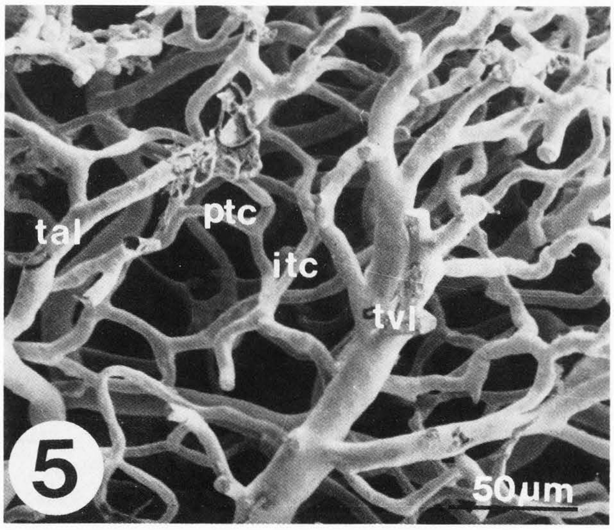


Fig. 5. Microvascular patterns of the testis (cross-section). Vascular corrosion cast. itc-intertubular capillary, ptc-peritubular capillary, tal-testicular arteriole, tvl-testicular venule.

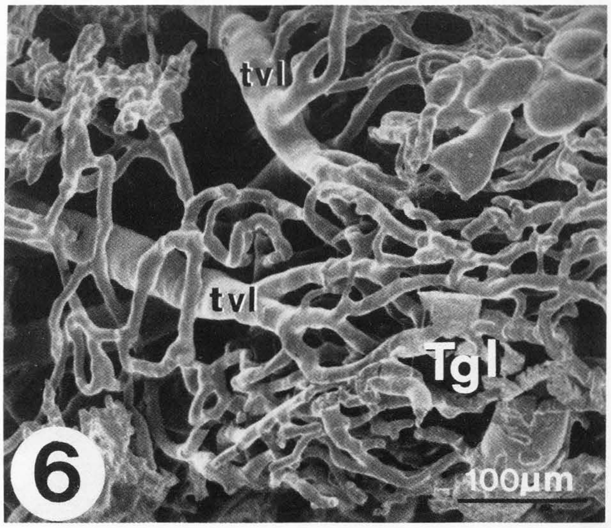


Fig. 6. Testicular venule (tvl) splitting up into the capillary network of the testicular gland (Tgl). Vascular corrosion cast.

This segmental blood supply of gonads is considered as a more primitive one.

With respect to the longitudinal arrangement of the main gonadal vessels *Blennius pavo* equals the roach (*Rutilus rutilus*), carp (*Cyprinus carpio*), Black sea brill (*Rhombus maeoticus*), and Black sea flounder (*Pleuronectes flesus luscus*) (5). However, topography of gonadal vessels, ramification patterns into

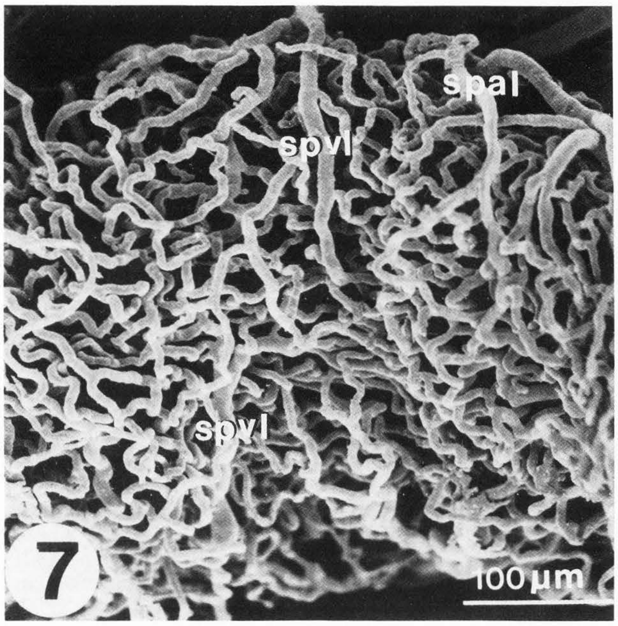


Fig. 7. Exterior capillary network of the spermatic duct. spal-spermatic duct arteriole, spvl-spermatic duct venule. Vascular corrosion cast.

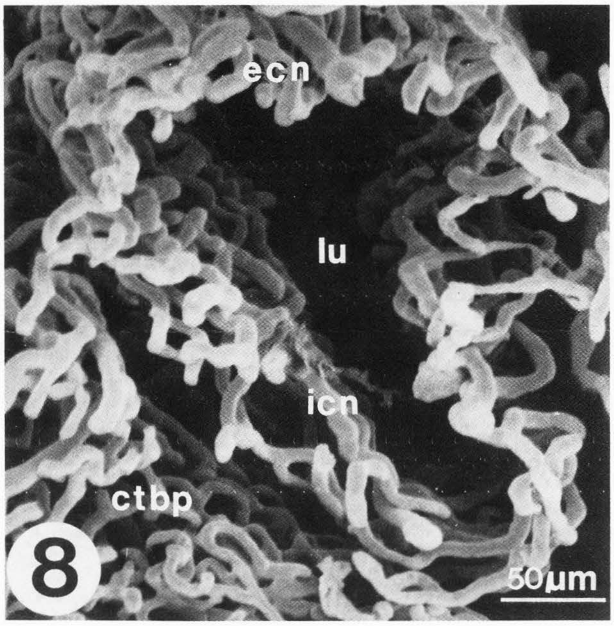


Fig. 8. Spermatic duct (cross section). Vascular corrosion cast. ctbp-capillary network of testicular blind pouch, ecn-exterior capillary network, icn-interior capillary network, lu-lumen.

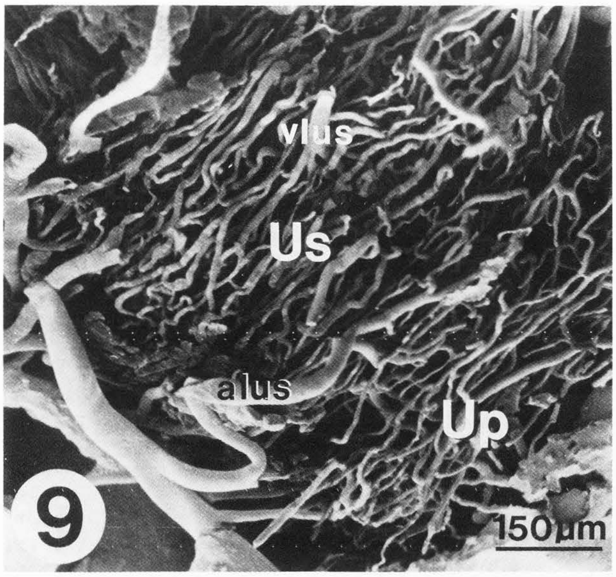


Fig. 9. Urogenital sinus (Us) and the urogenital papilla (Up). Dorsal view. Vascular corrosion cast. alus-arteriole of the urogenital sinus, vlus-venule of the urogenital sinus.

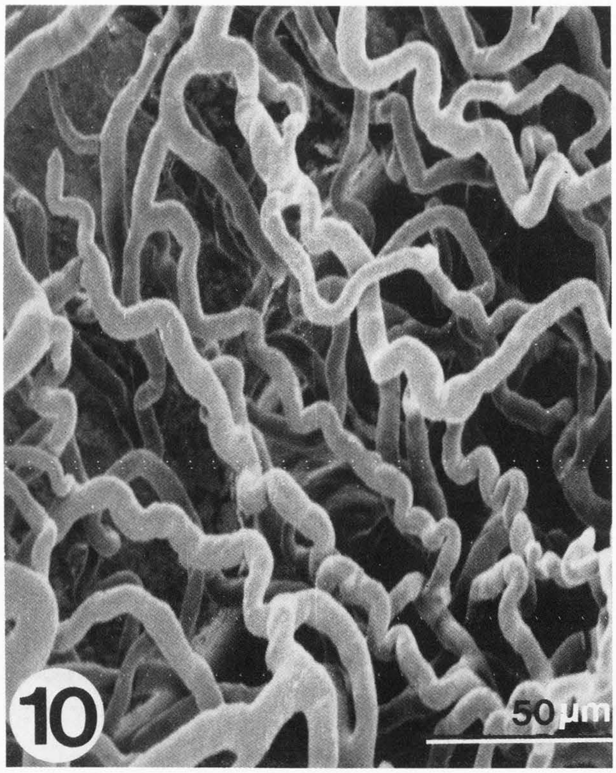


Fig. 10. Capillary network of the urogenital sinus. Vascular corrosion cast.

arterioles and patterns of how venules fuse to form veins differ. The longitudinal arrangement of gonadal blood vessels in Blennius pavo is also considered to be a more specialized pattern than the transversal arrangement of gonadal blood vessels in Mesogobius batrachocephalus, Neogobius melanostomus, Perca fluviatilis and Esox lucius whose blood vessels supply only limited areas of the gonads (5). Comparing the type of gonads and the angiomorphology Juszczyk concludes that phylogenetic development of gonads is less expressed in angioarchitecture than in the type and structure of gonads themselves (5).

The arrangement of secondary segmental vessels is similar to that of Osphronemus goramy (16) and the glass cat-fish (Kryptopterus bicirrhis) (13). Steffensen et al. (13) observed that when blood passes from primary to secondary vessels a plasma skimming effect occurred and considered this to be important in stress situations (16), in osmoregulation or aquatic surface breathing (13).

Testis

In Blennius pavo, the capillary network of the testis shows a rope-ladder-like type of structure, similar to that reported for the rat (6, 9, 17) and the mouse (14) which testes have a similar arrangement of the seminiferous tubules like those in the family of Blenniidae (2). In contrast to the rodent seminiferous tubules which have about six intertubular vessels (6, 9, 14), those in Blennius pavo have only three or four intertubular capillaries. Suzuki distinguishes two types of peritubular capillary arrangement (14): the testicular type and the deferential type. While in the former the peritubular vessels are shared by adjacent tubules, in the latter peritubular capillaries penetrate into the subepithelial layer and cylindrically encircle each tubule. In Blennius pavo the testes have the testicular type of vascularization. The A-V anastomoses between testicular arterioles which reveal clear sphincters and the testicular vein points out the structural prerequisite for regulation of local testicular blood flow: thus in case of sphincter contraction the testes are bypassed and blood directly drains into the testicular vein. These patterns are theoretically the structural basis for a functional connection between testis and testicular gland which enable incretoric testicular products to pass through testicular venules and capillaries towards the testicular glands.

Spermatic duct

In Blennius pavo the spermatic duct has two capillary networks. A coarse-meshed exterior network thought to nourish the peritoneum and connective tissue layers and a dense, subepithelial network which because of its vicinity to the secretory epithelium of the spermatic duct (2) might be controlling the high metabolic demands of this epithelium, which produces an unknown secretion. Since the blood flow is centripetal, venules collect blood from the subepithelial capillary network. In the mouse (14) and in man (15), the spermatic duct also has two capillary networks, the interior subepithelial capillary network is supplied by arterioles, the exterior one forms a venous plexus in the muscular layer altogether resulting in a centrifugal blood flow.

In Blennius pavo the lack of a capillary network in the unpaired section of the spermatic duct closely correlates with the obvious secretory inactivity of this part (2).

Urogenital sinus and urogenital papilla

In accordance with Eggert we also did not find sinusoids in the urogenital papilla (2). From this we also exclude a possible erection of this organ.

Acknowledgements

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Discussion with Reviewers

R. Christoffersen: The implicit reason for this investigation, given in the introduction, seems to be that no one has performed vascular casts of the male gonads in this fish before. I do not find this a good reason, since there is an infinite amount of experiments that have not been performed yet. Could you please explain why you have chosen the male gonads in particular and Blennius pavo in general as a subject of investigation?

Authors: The male gonads of Blennius pavo have accessory testicular organs: testicular blind pouches and testicular glands (12). The function of testicular blind pouches is yet unknown. Testicular glands synthesize steroids and store lipids, but further functions also remain obscure (20). Knowledge of microvascular patterns of testicular blind pouches and testicular glands and of gross vascular transport routes to and from these organs will give further information.

R. Christoffersen: This is an old problem: You made your resin infusions with "moderate hand pressure". In my experience, moderate hand pressure means 50-250 mm Hg intraarterially when infusing Mercox manually, i. e. "moderate" to me is irrelevant. What is relevant is that Figs. 3-6 and Fig. 9, there are extravasations of resin, indicating that infusion pressure was too high. Could you please explain why you have not standardized the infusion pressures used so that your different specimens and specimens from other investigators can be compared?

Reviewer V: Under M&M's part - how did you know what pressure to use to inject the Mercox into the fish circulation? You wrote only "injected with moderate hand pressure". How many cc/min was injected? Were you concerned with over- or under-pressure? Figure 6 - the upper left and right corners appear to have blow out-areas in your casts; how do you interpret these areas?

Authors: Because of the varying diameters of bulbus arteriosus and ventral aorta (depending on length and weight of fish) resin injections had to be made with canulas having different luminal diameters. Thus also using "constant" injection pressures or flow rates different conditions are given in each casting. We agree that areas shown in Fig. 6 are extravasations resulting from over-pressure. Ultrastructural investigations of testicular capillaries (not published yet) in no case showed any vascular perforations or weakened endothelial structures.

R. Christoffersen: You use the terms artery/ vein, arteriole/venule, and capillary without defining the terms or giving a reference to such a definition. Is it possible for you to define the macro- and microvasculature as observed with SEM of vascular casts in terms of luminal diameter, branching pattern, imprint pattern of endothelial cells, and to correlate it to the structure of the vascular wall as observed with other morphological techniques? I believe that this could reduce the confusion of terminology that exists among vascular founders presently, and also that it could facilitate a dialogue between vascular founders and physiologists, pathologists, and morphologists, working with sectional anatomy.

F. Suzuki: How can you distinguish artery and vein? Are the vertical patterns and dimples in Fig.3 characteristic to this fish artery. What structure makes these dimples?

Authors: Beside the endothelial imprint patterns characteristic also for mammalian arteries and veins (18) we also trace vessels from their origin to their end to be able to distinguish positively arteries and veins. Concerning the dimples in Fig. 3 we presently do not yet know which structures make them.

F. Suzuki: Double capillary networks in the testis and the testicular gland are very interesting. Can we call the connecting venules "testicular portal venules"?

Authors: All testicular venules split up again to supply the capillary network of the testicular gland. So we better call these vessels "testicular gland portal venules".

V. H. Gattone: Please define the characteristics used for differentiating immature and mature fish and describe any gonadal vascular differences between these stages.

Authors: Blennius pavo has an annual gonadal cycle with spawning time from May to July (19). These testes are termed mature then. Quantitative parameters of gonadal vascularisation as diameter of main vessels and capillaries and intercapillary distances were not investigated yet.

F. Suzuki: The arrangement of the testicular capillaries seems not appropriate to be called as "rope ladder-like" since the regularly arranged intertubular capillaries are not sufficient in number.

Authors: Each seminiferous tubulus has three or four intertubular capillaries, which run longitudinally to the seminiferous tubulus. For investigation of the arrangement of intertubular capillaries we used stereopairs of scanning electron micrographs.

Additional References

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