

10.1 General

This vascularisation plays an extremely important double role. It ensures not only the normal nutritional physiological circulation of this organ but also the functional circulation of the erectile bodies, which allows the intumescence and clitoral erection phenomena during sexual arousal in women.

10.1.1 The Arteries

The arteries mostly originate from the branches of the internal pudendal artery (internal shameful artery according to previous authors), which is, itself, one of the branches from the division of the hypogastric artery. This pudendal artery follows the same pathway as the pudendal nerve. With the pudendal veins, it is routed with the nerve, on the lateral wall of the true pelvis, against the inferior insertions of the obturator internus muscle, inside a fibrous canal: the pudendal canal of Alcock. It is then divided into the perineal artery and the dorsal artery of the clitoris. The bulbar artery originates from the deep branch of the perineal artery, at the level of the posterior edge of the anterior perineum. The arteries of the bulbo-clitoral organ are thus the bulbar artery and the dorsal artery of the clitoris.

10.1.1.1 The Bulbar Artery

It detaches from the deep perineal artery (of which it often forms the terminal branch) at the level of the ischio-bulbar triangle (Figs. 12.1 and 13.2). It is routed obliquely towards the posterolateral part of the bulb and thus irrigates the greater vestibular gland. It is then divided into several rami, which approach the convex part of the bulb, via its lateral surface. The deep perineal artery also emits a bulbo-urethral collateral vessel, whose bulbar ramus also contributes to the vascularisation of the bulb.

10.1.1.2 The Dorsal Artery of the Clitoris

This artery is the terminal branch of the internal pudendal artery. It has the same ischio-pubic trajectory as the homologous nerve (see Chap. 8). Once it has left the canal of Alcock, it appears at the level of the lateral part of the infra-pubic canal, under the arched ligament of Lauth, wrapped in a sort of fibrous cone, under a similar cone, from which emerges the homologous nerve. These fibrous structures, whose protective role seems obvious, are formed by splitting of the transverse ligament of the pelvis (ligament of Krause), which itself is formed by coalescence, in front of the urogenital diaphragm, of the superior and inferior fascias covering this diaphragm. It is necessary to recall, such as we have already observed, that the arterial cone is always located under the nerve cone and that the 2 cones are adjacent and separated by a common fibrous lamina, a genuine fibrous “spacer”, according to the expression employed by G. Paturet (Fig. 8.2). The artery then approaches the dorsal surface of the clitoris; extends along the homologous pillar, thus providing this pillar with the deep artery; then passes rapidly under the retrocrural fascia; and rises obliquely up to the angle of the clitoris. The artery then penetrates the base of the suspensory ligament (Fig. 12.3) and progressively passes on the dorsolateral part of the descending portion of the clitoral body. It is then routed towards the glans, inside the nerve, on either side of the superficial dorsal vein. Over this trajectory, it remains underneath the clitoral fascia, which separates it from the cell tissue of the prepuce. On the lateral walls of the descending portion, it provides branches perpendicular to its axis: circumflex branches. It then supplies the glans and its hood. Anastomoses exist between the branches of this artery and the distal rami of the superficial perineal artery (which vascularises the prepuce, the labia majora and labia minora). The vascularisation of the latter is particularly rich and thus explains the involvement of these formations in the turgescence phenomena and their extremely characteristic histological aspect.

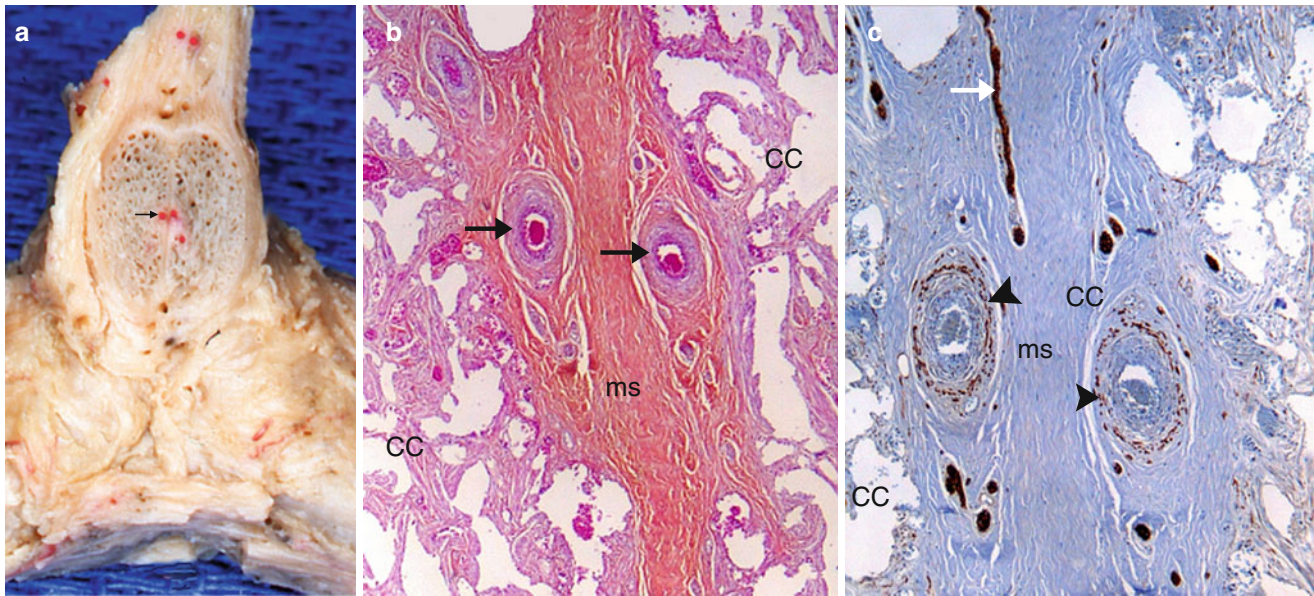


Fig. 10.1 The deep arteries of clitoris. (a) Situation of the deep arteries (black arrow) on a frontal section of the clitoral body, just after the joining of crura. (b) Microscopic aspect of the deep arteries, included in the fibrous tissue of the median septum (classical staining by HEAS). (c) Another aspect of the deep arteries: staining of the section by PS100. CC corpora cavernosa, ms median septum, right black arrows they show the deep arteries of clitoris, black arrowheads they show the veg-

etative nerve in the arteries' wall, white right arrow it shows a nervous ramus oriented in the axis of the median septum and innervating this structure. Note: on (a) the position latero-septal of the deep arteries, their conjunctive wrapping connected with the median septum; on (b) the intra-septal position of the arteries; on (c) the rich vegetative innervation of the arteries

10.1.1.3 The Cavernous Artery

English authors refer to this artery as the deep artery of the clitoris. It generally originates from the dorsal artery of the clitoris, shortly after the point where this vessel reaches the clitoral pillar. It can also originate from the pudendal artery itself, along the ischio-pubic trajectory of this vessel, which then seems to have 2 terminal branches, the dorsal artery of the clitoris and the cavernous artery. In the first case, it is very short. In the 2nd case, it is longer and can measure more than 2 cm. When it is a collateral vessel of the dorsal artery of the clitoris, it detaches from this vessel almost nearly at a right angle and penetrates the clitoral pillar via its lateral surface (Fig. 8.5). It rapidly divides inside the pillar into 2 rami, a proximal ramus, referred to as recurrent, which irrigates the pillar and the pre-angular ascending portion of the body, and a distal ramus, which follows the direction of the clitoral body, in the centre part of the corpus cavernosum. It can remain single or divide into 2 or 3 rami. In the corporeal corpora cavernosa, these cavernous arteries approach the median septum and remain in contact with it via a connection consisting of a fibrous crown, appendage of this septum.¹ The branches originating from the cavernous artery, and which have penetrated the right pillar, remain on the right of the septum. The branches originating from the

artery, and which have penetrated the left pillar, remain on the left. In his dissections, Kobelt observed, with great frequency, a retro-cavernous anastomotic arch joining together the 2 right and left cavernous arteries. From this arch originate "2 small rami, which deeply penetrate the corresponding corpus cavernosum and which would be the true deep arteries of the clitoris". In any case, the cavernous arteries are of great importance for the operation of the corpora cavernosa, which is demonstrated not only by their size but also and especially by the very rich vegetative innervation of their wall (Fig. 10.1).

Each cavernous artery gives, in the ipsilateral corpus cavernosum, the helicine arteries. In turn these arteries branch into capillaries which vascularize the trabecular structures of the cavernous tissue. These helicine arteries are very specific: (a) they open directly in the sinusoidal spaces and (b) they have a structure adapted to cavernous physiology: Indeed, their wall has a particular longitudinal smooth muscle layer made of helical fibre bundles (hence their name), thickened intermittently and forming heightenings of the intima,² the "intimal cushions"³ of von Ebner. These cushions modulate the arterial flow by serving as valves. Under

¹They can also penetrate and be routed within the septum.

²See footnote 1.

³The helicine arteries are part of the "polsterarterien" of the German authors (G. Paturet).

the effect of parasympathetic nerves, these cushions relax, allowing the inflow of arterial blood and the rapid filling of the cavernous sinusoids prelude to the swelling and erection of clitoris.

10.1.1.4 The Arteries of the Hood and Prepuce

These are the arteries of the anterior part of the vulva, which therefore vascularize the anterior part of the labia majora and labia minora. These arteries are not only distal rami of the superficial perineal arteries but also rami from nearby arteries, which have crossed the genito-femoralis sulcus: external pudendal arteries (collateral branches of the femoral artery) and obturator artery (collateral branch of the internal iliac artery). Rich anastomoses exist between all these vessels and the small terminal rami of the dorsal artery of the clitoris, as well as at the level of the hood of glans as of the clitoral frenula.

10.1.2 The Veins

They specifically receive venous blood from the draining of the corpora cavernosa and the sub-albugineal veins. Two venous circulations drain the clitoris: the deep venous circulation and the superficial venous circulation.

10.1.2.1 The Deep Vein of the Clitoris

It consists of the junction of the venules from the corpora cavernosa (Fig. 7.2), especially the venules which are routed along the corporeal septum and the venules which drain the pillars. This vein can be single or divide into 2 superimposed veins. It leaves the bulbo-clitoral organ at the level of the median part of the retro-crural region (Fig. 8.4). It has a significant size of around 2 mm in diameter. It is directly routed under the subpubic urethral plate or in a split, whose protective role seems obvious and through which it is possible to see it by transparency (Fig. 13.4). This vein perpendicularly receives other venous branches in a ladder-type configuration. It passes very rapidly under the ligament of Lauth, in the infra-pubic region, and reaches the infravesical venous plexus (plexus of Santorini),⁴ which drains itself in the internal pudendal veins and vesical veins. Thus, the deep venous circulation of the clitoris ends at the pelvic venous networks. This is why a pelvic phlebography method by intra-clitoral injection of a contrast product has been described: **pelvivenography** (S. Petkovic), a method which can be used to obtain excellent pelvic phlebographies, in cases of thrombosis or compression by pelvic tumours.

⁴This infravesical venous plexus anastomoses with the urethral, vaginal and uterine venous plexuses.

10.1.2.2 The Superficial Dorsal Veins of the Clitoris

They are routed along the dorsal surface of the clitoral body, parallel to the homologous arteries, under the clitoral fascia. In most cases, they are multiple and arranged against the dorsal surface of the albuginea of the corpora cavernosa and, therefore, a little deeper than the above-mentioned arteries. They are generally positioned in the same horizontal plane but can also be placed according to an oblique plane (Fig. 12.3). They receive the veinlets, which drain the venous reticulum of the glans and the circumflex branches from the lateral surfaces of the body of the clitoris, branches whose role is to establish an anastomotic system between the corporeal veins and the veins of the intermediate network. The superficial dorsal veins cross through the base of the suspensory ligament and then drain themselves into the nearby venous networks, especially the obturator veins, such as demonstrated by Kobelt (Fig. 10.3). One of these veins, more dorsal than the previous veins and especially with the largest diameter (2–3 mm), is the median superficial dorsal vein. After having penetrated the suspensory ligament of the clitoris (Fig. 12.3), this vein anastomoses with the superficial venous network of the abdominal wall.

10.1.2.3 The Veins of the Intermediate Network

They ensure the communication, such as shown by Kobelt, between the veins, which detach at the level of the inferior surface of the corpus cavernosum of the clitoris and the veins arranged at the level of the superior surface of the spongy body. These parallel and vertical veins, organised as organ pipes, detach obliquely with respect to the corporeal axis. They have large diameters and are in contact with the thin arterial rami. They are often organised in 2 more or less symmetrical, right and left parallel rows (Fig. 5.18). These veins of the intermediate network connect the veins of the commissure of the bulbs and the veins of the infra-clitoral residual spongy part (ic rsp).

10.1.2.4 The Veins of the Spongy Bulbs and of the “ic rsp”

They are the draining pathways of the spongy body. For the bulbs, these veins are, in the front region, the veins of commissure of the bulbs and, in the back region, the “veins of the posterior bulge of the bulb” (Kobelt): The latter are drained, according to this author, by the venules of the major vestibular gland, in the lower rectal veins and therefore in the venous internal pudendal network. The veins of the ic rsp drain themselves not only via the communications with the intermediate venous network but also into the venules of the frenula and labia minora. All of the veins of the bulbo-clitoral organ have connections with:

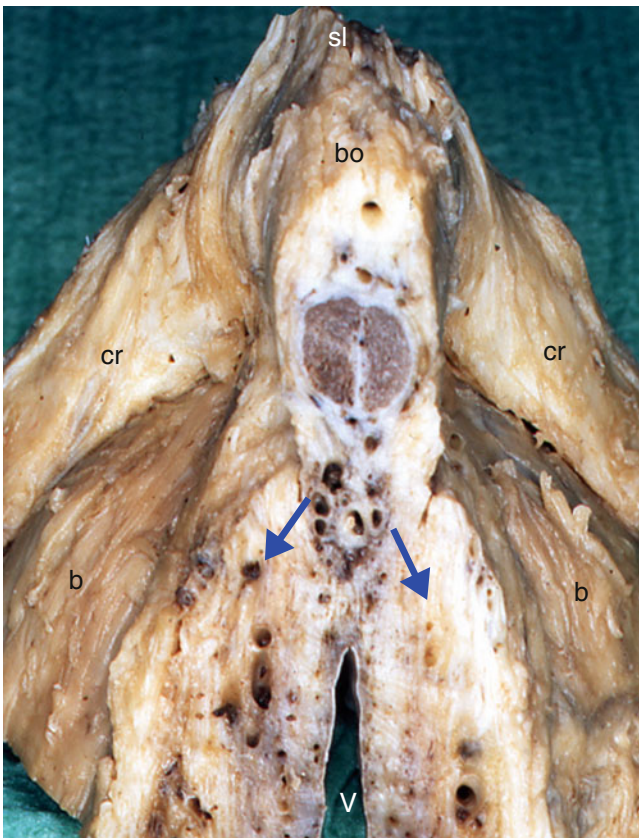


Fig. 10.2 Coronal section through the clitoral body and the vestibule showing the vascular connections (*blue arrows*) between the vessels of the RSP and those of the vestibular walls. *b* bulb, *bo* clitoral body, *cr* crus clitoridis, *sl* suspensory ligament, *V* vestibule

- On the one hand, the veins of the labia majora, the labia minora and the vestibule (all these veins end at the affluents of the curved end of the great saphenous vein, at the obturator veins and at the superficial perineal veins) (Fig. 10.2)
- On the other hand, the urethral veins and the veins of the peri-vaginal plexuses (Fig. 10.3)

10.1.2.5 The Veins of the Hood and Prepuce

They are drained essentially by the superficial dorsal veins of the clitoris. There is also an accessory drainage by the tributaries of the great saphenous vein.

10.1.3 The Lymphatic Vessels

The lymphatic vessels were not well known⁵ or not known at all, but were then studied in a masterly way, at the

⁵We only knew that the lymphatic vessels of the hood and prepuce are dependent on the superficial inguinal lymph nodes, in particular the supero-medial lymph nodes (Rieffel).

beginning of last century, by 2 well-known anatomists: Cunéo and Marcille. In our era, there is renewed interest in these vessels due to their involvement in inflammatory and infectious phenomena (adenitis and lymphangitis), which can result from piercings (performed in dubious asepsis conditions) of the hood or the glans itself, and also in the frightening neoplastic pathologies affecting external female genitalia.⁶

The pathways draining the lymph of the glans clitoridis (lymphatic vessels of the glans) originate, as observed during our own injections, from a very thin and very tight plexiform network (Fig. 10.4). This network ends at 3 or 4 trunks, which pass under the clitoral fascia, parallel to the deep dorsal vein up to the suspensory ligament of the clitoris. These trunks anastomose in the base of the ligament, thus forming a true plexus from which are formed 2 groups of collectors: femoral collectors to the femoral ring (crural canal) and inguinal collectors to the inguinal ring (inguinal canal).

The **femoral collectors** pass under the femoral fascia, against the fascia of the pectinate muscle and end in the medial lacunar lymph node(s), located inside the common femoral vein, below or on the same level (lymph node of Cloquet) as the medial part of the vascular lacuna of the femoral ring. These collectors can cross the femoral ring and end at a lymph node located inside the external iliac vein, in the pelvis, just above the ring.

The **inguinal collectors** are very few (generally there is only a single collector). They penetrate the inguinal ring and pass under the round ligament. They drain into a lymph node located above the deep inguinal ring, pushed against the external iliac artery (external iliac lymph node).

As for the **pubdental lymphatic collectors**, it could be believed that they contribute to the drainage of the entire lymph of the bulbo-clitoral organ, when, in actual fact (according to research conducted by Cunéo and Marcille), they only perform the lymphatic drainage from the distal part of the urethra and spongy part (bulbs, in particular) of the organ to the hypogastric lymph nodes.

⁶Given the structure of the bulbo-clitoral organ and tissues that compose it, three categories of primary malignant tumours can affect it: carcinomas, sarcomas and melanomas. We also find in the literature some cases of benign tumours, including haemangiomas, glomus tumours and neuromas.

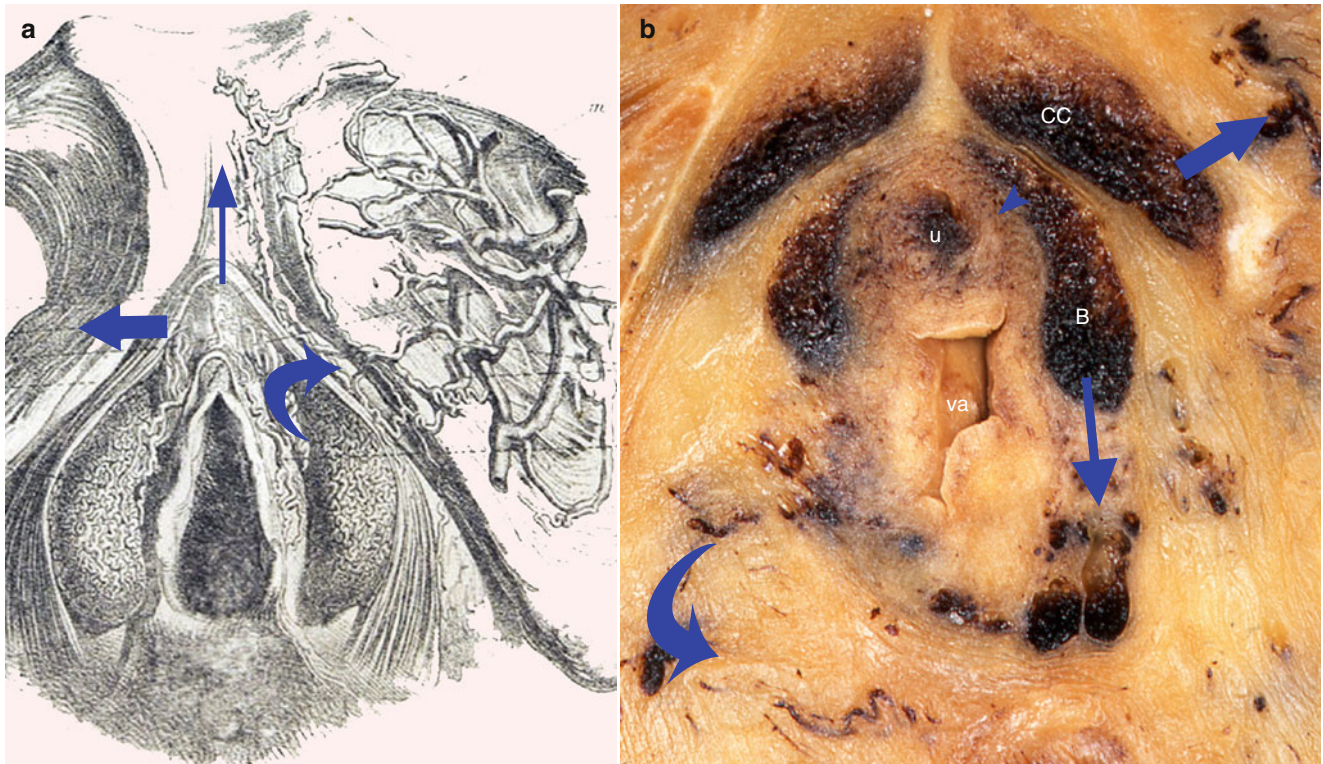


Fig. 10.3 Venous connections of female erectile bodies. (a) Drawing (from Kobelt) of a dissected vulva. *Large and short right arrow* connections with the tributaries of the great saphenous vein and femoral vein. *Thin right arrow* connections with the veins of the anterior abdominal wall. *Curved arrow* connections with the venous network of the obturator foramen. (b) Transverse section of the pelvis through female erectile

bodies. *Large and short right arrow* connections with the tributaries of the internal iliac vein. *Thin right arrow* connections with the vaginal venous plexus. *Curved arrow* connections with the rectal venous plexus. *Arrowhead* connections with the urethral veins (draining to the vesical plexus and the internal pudendal vein). *B* bulb, *CC* corpus cavernosum, *u* urethra, *va* vagina

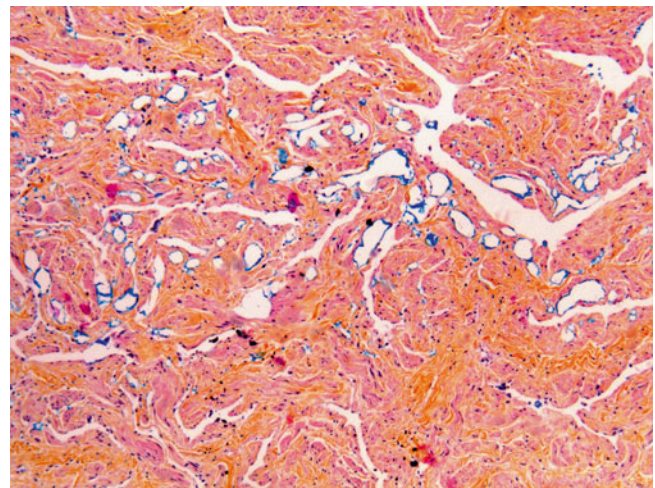


Fig. 10.4 Histologic aspect of the lymphatic vessels of the clitoris (coronal section of the glans clitoridis). Patent blue injection. Note the abundance of fine lymphatic vessels in contact with the vascular spongy network