2 Surgical Anatomy of Hemorrhoids

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Introduction

It is surprising that, in this era of advanced medical achievements, the etiology of one of the commonest human afflictions is not exactly known. Many theories have been advanced regarding the pathogenesis of hemorrhoids, but none is entirely satisfactory. The result of studies on the surgical anatomy of the anal canal is presented with the object of obtaining a clearer understanding of its function in the light of its anatomic structure. A knowledge of such a structural-functional relationship seems necessary for understanding anal pathologies, including hemorrhoids.

Surgical Anatomy

In a previous study, two hemorrhoidal venous plexuses could be identified: submucosal plexus and adventitial plexus. They are connected by communicating veins.

1. **Submucosal plexus:** The veins in the rectal submucosa were arranged in transverse rings along the whole of the rectum including its neck (Figs. 2.1 and 2.2). However, this configuration faded in the pectinate area to appear as a radiological blush (Fig. 2.1); the plexus in this area seemed to be interrupted by the attachment of the rectal neck (anal canal) cutaneous lining to the medial septum of the central tendon. Small side branches came out of the venous rings and penetrated the rectal muscle coat into the adventitia where they collected into multiple oblique veins to form the adventitial plexus. The submucosal plexus consisted of the three hemorrhoidal veins: superior, middle, and inferior; the sites of intercommunication of these veins could not be identified in the submucosa.
2. **Adventitial plexus:** This comprises oblique and vertically lying veins which intercommunicated, forming a plexus in the adventitia of the rectum and its neck (Figs. 2.3 and 2.4). The veins were larger than those of the submucosal plexus. The plexus was drained by the three hemorrhoidal veins; the sites of their communication could be identified. It was formed in the upper half of the rectum by branches of the superior hemorrhoidal vein, and in the lower half by both the superior and middle hemorrhoidal veins; whereas in the rectal neck it was formed by all three of the hemorrhoidal veins. Around the middle of the rectal neck, 3–6 oblique and sizeable "collecting veins" could be identified in the rectal adventitia. They collected into two veins which ascended on the sides to the back of the rectum and united to form the superior hemorrhoidal vein (Figs. 2.4 and 2.5).
3. **Communicating veins:** Two types of communicating veins were recognized: interhemorrhoidal and hemorrhoidogenital.

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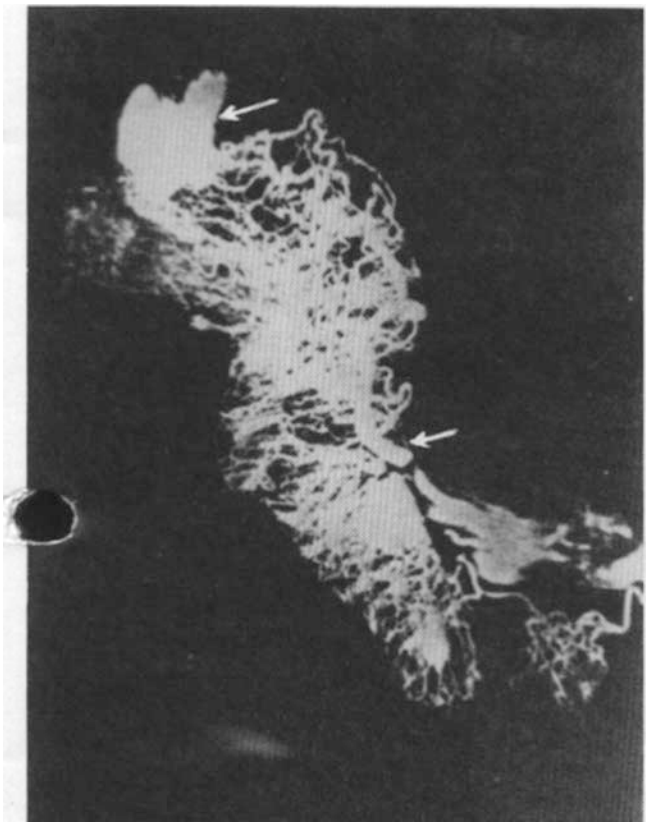

Figure 2.1. Cadaveric specimen showing the barium sulphate solution injected into the inferior mesenteric vein. It demonstrates that the rectal submucosal plexus extends alomg the whole of the rectum including its neck and is arranged in transverse venous rings. The upper arrow points to the superior hemorrhoidal vein.

(a) **Interhemorrhoidal veins:** The three hemorrhoidal veins intercommunicated in the submucosa at the capillary level, and in the adventitia of the rectum and its neck. Yet the exact communication site between the superior and middle hemorrhoidal veins in the submucosa could not be recognized, because the submucosal plexus extended uniformly down to the pectinate line (Fig. 2.1). The blush area below this line seemed to point to the inferior hemorrhoidal plexus (Fig. 2.4). However, in the rectal adventitia the communication sites were easily identified at the rectal neck between the three veins, and around the lower third of the rectum between the superior and middle hemorrhoidal veins.

(b) **Hemorrhoidogenital veins:** This is the name we gave to small veins which connected the adventitial hemorrhoidal with the prostatic or vaginal plexus. They varied in number from one to three veins on either side of the upper rectal neck. They lay in the rectal neck adventitia, and passed forward to reach the prostatic base and join the prostatic venous plexus (Figs. 2.2–2.5). In females, the veins proceeded to the side wall of the upper half of the vagina and joined the vaginal plexus. When the inferior mesenteric vein was injected with barium sulphate, the bladder wall in males (Figs. 2.2–2.4) and the vagina, uterus, and bladder in females were opacified through the hemorrhoidogenital

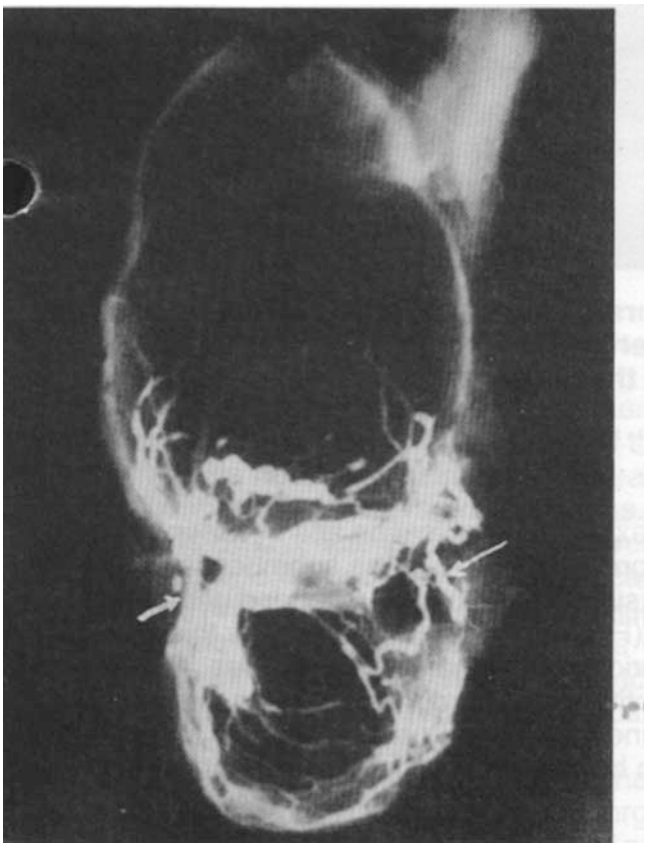

Figure 2.2. Transverse section of the rectum and urinary bladder after injecting the inferior mesenteric vein with barium sulphate and after being inflated with air and frozen. It shows the submucosal rectal plexus arranged in transverse rings. It also shows the hemorrhoidogenital veins (arrow). Observe that the bladder wall is opacified, the dye passing to it through the hemorrhoidogenital veins.

veins. The hemorrhoidogenital veins seemed to be valved, because they were unidirectional. They directed the blue plastic (Astralon) and the barium sulphate suspension from the hemorrhoidal to the prostatic plexus, but not in the reverse direction. Thus, when either of them was injected into the deep dorsal vein of the penis to the prostatic plexus, they could not be recovered in the hemorrhoidal plexus of any patient.

Collecting hemorrhoidal veins: Contrary to views of investigators [1, 2] that the "collecting hemorrhoidal veins" lie in the columns of Morgagni, our study demonstrated that they exist in the rectal adventitia. The columns are only plicate mucosal folds that result from both the fusion of the wide hindgut with the narrow proctodeum and the tonic action of the rectal neck sphincters. Two sites of portosystemic communication could be identified in the rectum: interhemorrhoidal and hemorrhoidogenital. The first one occurs between the three hemorrhoidal veins, both submucosally and adventitially. The communication site was identified in the adventitia but not in the submucosa. The portal blood is shunted through this communication to the internal iliac vein. The second communication is through the hemorrhoidogenital veins which connect the hemorrhoidal plexus with the prostatic or vaginal one. It seems that this

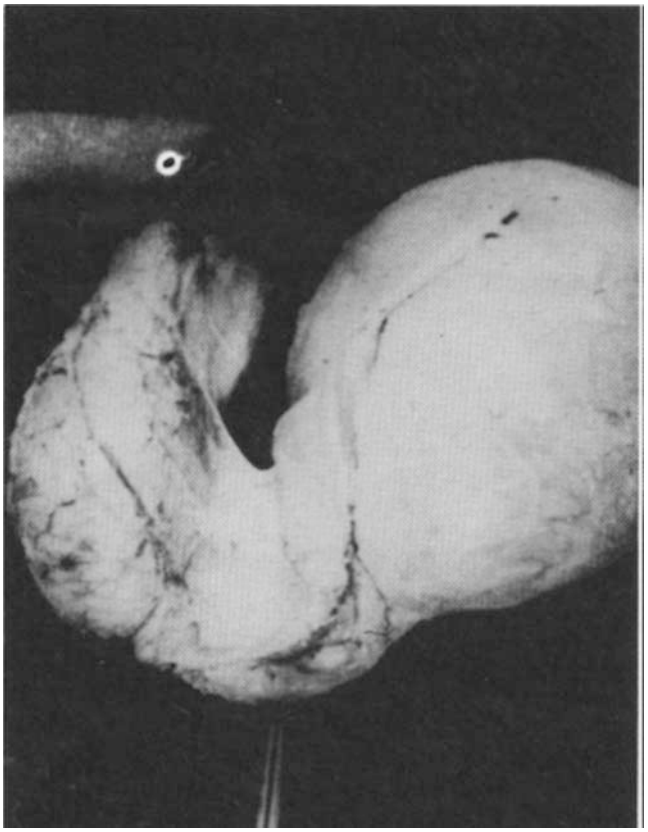

Figure 2.3. Cadaveric specimen of the rectum and its neck and the urinary bladder. The inferior mesenteric vein was injected with blue plastic (Astralon). The artery forceps points to the urethra. The specimen shows the adventitial hemorrhoidal plexus as well as the hemorrhoidogenital veins.

portosystemic connection is sizeable, because the urinary bladder, vagina, and uterus were opacified each time the inferior mesenteric vein was injected with barium sulphate (Figs. 2.2, 2.4, 2.5). In contrast to investigators [1, 2] who mentioned that the hemorrhoidal plexus is located in the lower rectum and anal canal and is only submucosal, the present study demonstrates that not only does it extend along the whole rectum and its neck but it is both submucosal and adventitial.

Being extensive, the plexus can absorb excess venous congestion along its entire length before it becomes varicose; furthermore, the varicosity would involve the whole venous plexus and not only its lower submucosal part. It simulates in this respect the diffuse congestion and varicosity of the pampiniform plexus in varicocele. This fact, and in addition the fact that the portal hemorrhoidal blood can work its way to the systemic circulation through two portosystemic shunts (interhemorrhoidal and hemorrhoidogenital), together tend to negate the theory of venous congestion in the lower part of the hemorrhoidal plexus as the primary event in hemorrhoidogenesis.

Our findings support the conclusion that hemorrhoids are a mucosal prolapse resulting primarily from the constricting effect of the anorectal band on the rectal neck [3]. They explain the rarity of hemorrhoids in portal hypertension; it has been found that the incidence of hemorrhoids in bilharzial liver cirrhosis patients does not differ from that in our normal population [1]. It also explains the

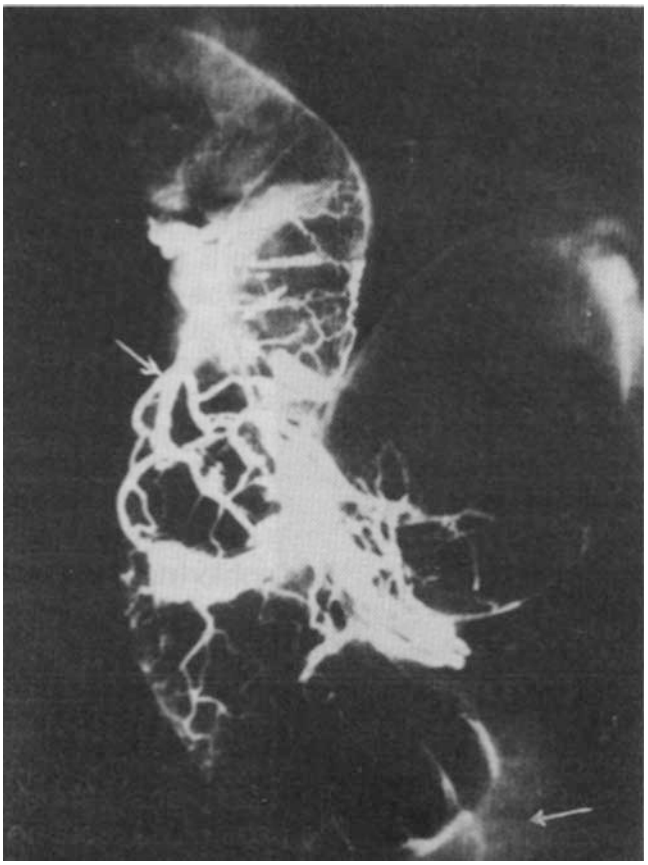

Figure 2.4. Barium sulphate injected into the inferior mesenteric vein. The oblique large veins are those of the adventitial plexus, whereas the upper small transverse veins belong to the submucosal plexus. The pectinate area shows the radiological blush (lower arrow). The bladder wall is opacified through the hemorrhoidogenital veins. The upper arrow points to the superior hemorrhoidal vein.

rarity of rectal bleeding in these patients, compared with esophageal bleeding.

Portosystemic circulation in the rectum: Under normal physiologic conditions, the submucosal hemorrhoidal plexus drains into the adventitial one, and the latter into the three hemorrhoidal veins. Because of the submucosal and adventitial intercommunication of the three veins in the rectal neck, and the presence of the hemorrhoidogentital veins, portal blood may drain into the systemic circulation, particularly when the rectum contracts at defecation. This was proven in a recent study [4] in which a contrast medium was injected into the rectal neck submucosa of normal living subjects; the dye showed in the vesicoprostatic and vesicovaginal plexus. Systemic blood, however, cannot drain into portal blood, as was verified in the present study. When either barium sulphate or blue plastic was injected into the deep dorsal vein of the penis, it could not be recovered in the hemorrhoidal plexus. This is probably due to the presence of valves in the middle and inferior hemorrhoidal veins, which direct the blood to the systemic circulation, and not vice versa. Unlike elsewhere, portal blood shunted from the rectum and left colon to the systemic circulation seems to be harmless from the metabolic viewpoint, because this blood carries no nutritives.

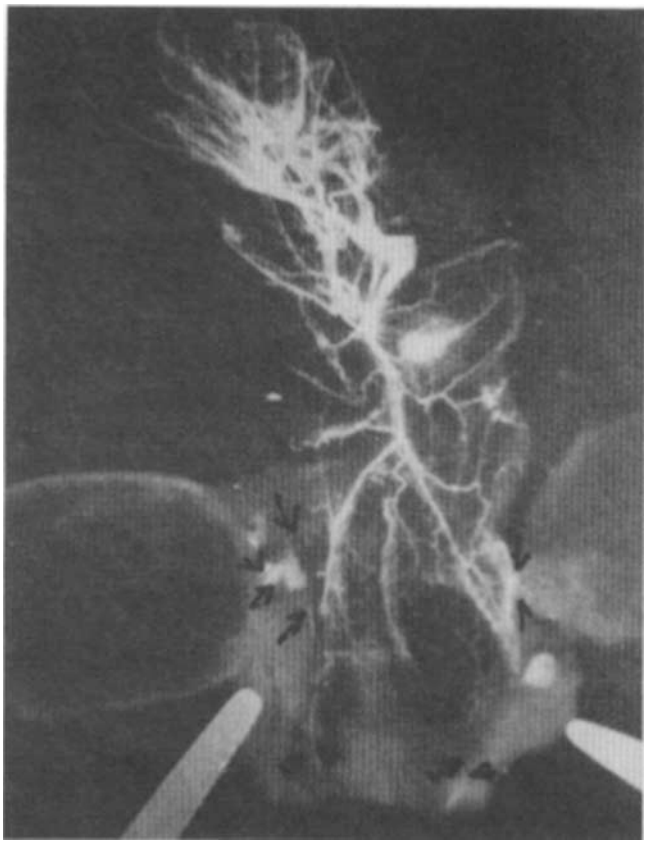

Figure 2.5. Barium sulphate injected into the inferior mesenteric vein. The rectum and urinary bladder were inflated, frozen, and bisected. The artery forceps points to the urethra. The specimen shows the "collecting veins." The upper arrows point to the hemorrhoidogenital veins, through which the bladder wall is opacified. The lower arrows point to the inferior hemorrhoidal plexus.

Arterial pattern of the anorectum: A study of the arterial pattern of the anorectum [6] has shown that the superior rectal artery (SRA) and vein were enclosed in a fibrous sheath which was connected to the posterior rectal surface by an anterior mesorectum containing the "transverse rectal branches," and to the sacrum by an avascular posterior mesorectum (Fig. 2.6). Small lymph nodes were scattered alongside the anterior mesorectum. The SRA gave rise to four branches: transverse rectal, descending rectal, rectosigmoid, and terminal (Figs. 2.6, 2.7). The transverse rectal arteries arose from the SRA in 24 specimens and from the descending rectal artery in eight. They were distributed to the upper half of the rectum. The rectosigmoid artery was distributed to the descending limb of the sigmoid colon and rectosigmoid junction. We found two terminal branches in 21/32 cadavers and three in 11/32. They communicated in the lower half of the rectum. The inferior rectal arteries were present in all the dissected cadavers, while the middle rectal arteries could be identified in only 50% of the cadavers. Two arterial patterns were recognized: annular in the upper rectal half provided by the transverse rectal arteries, and plexiform in the lower half supplied by the SRA terminal branches.

The above anatomical facts lend credence to the theory of hemorrhoidal etiology being arteriovenous communications (corpora cavernosa).

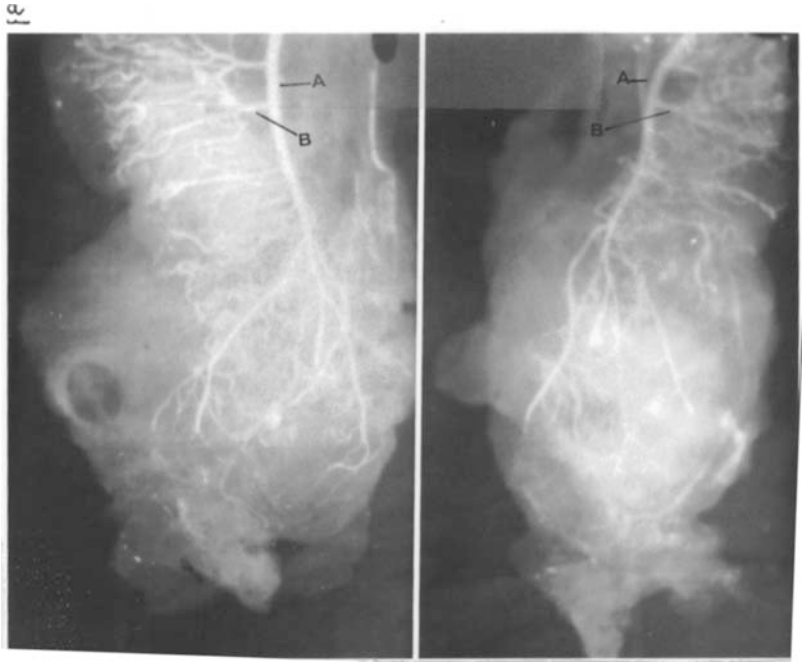

Figure 2.6. Arteriogram showing the SRA (A) giving rise to the transverse rectal branches. (B) The terminal branches of the transverse rectal arteries do not anastomose anteriorly, and this results in the formation of a "bloodless line." The SRA terminates at the mid-rectum, giving rise to three branches. (a) Lateral view. (b) Anteroposterior view.

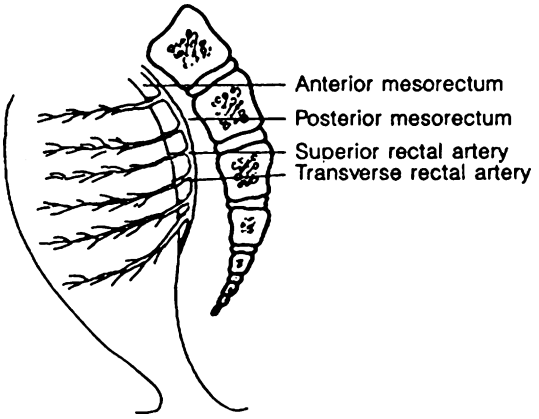

Figure 2.7. Diagrammatic illustration of the SRA giving rise to the transverse rectal arteries and two terminal branches.

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