RECTO-SIGMOID TUMOR PATHOLOGY AND DISORDERS OF NORMAL SEXUAL INTERCOURSE- POINTS OF VIEW

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Abstract:

Malignant tumors have a great histopathological diversity (adenocarcinomas, carcinoid tumors, lymphomas and sarcomas - the four major histopathological types), which generate localization, clinical presentation, prognosis, and treatment particularities.

In terms of oncological pathology, colorectal cancer is one of the most common types of malignancy in both sexes, accounting for 10% of all new cases diagnosed worldwide.

In men, the incidence is in third place, with an estimated 746,000 new cases per year, respectively 614,000 in women, in which it ranks second. In the global mortality hierarchy, colorectal cancer ranks fourth, with an estimated 649,000 deaths per year (1).

The incidence and mortality of this digestive neoplasm increase with age, more than 90% of newly diagnosed cases and, respectively, over 94% of deaths occur in people aged over 50 years.

The occurrence of colorectal malignancies in patients under the age of 40 is extremely rare, except for individuals with a genetic predisposition and those with acquired predisposing pathologies, such as chronic inflammatory bowel disease (2).

Colorectal cancer is a heterogeneous genetic pathology, in which the major feature is represented by genomic instability. Despite advances in understanding the tumor genome, colorectal cancer continues to rank second worldwide in mortality, due to the potential for metastasis and resistance to therapy. The involvement of molecular mechanisms in the formation of adenomas, with their possible transformation into carcinomas, and later into metastatic cancer, tends to be used for new therapeutic concepts (2).

Finally, the surgery of recto-sigmoid tumor pathology, through extensive pelvic interventions, resulting in significant organ and vascular-nervous lesions produced intraoperatively, is responsible for the appearance of sexual dysfunctions in men, especially of the erection one.

Keywords: *tumor, colon, surgical dissection, neurovascular lesions, sexual dysfunction*

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Anatomical data:

The sigmoid colon is an intraperitoneal organ and extends from the level of the iliac crest to the level of the S3 vertebra, where it continues with the rectum, which is in the minor pelvis.

In the abdomen, the sigmoid colon projects to the left iliac fossa and hypogastrium. It has the following anatomical relations: anterior-with the anterior abdominal wall and the ileal loops, posterior-with the iliac muscle, with the common and external iliac vessels, with the femoral and genito-femoral nerves, with the left genital vessels and the left ureter; laterally-with the iliac muscle, with the lateral half of the inguinal ligament, with the external iliac vessels, with the obturator nerve and with the ovary or with the vas deferens; medially-with the intestinal loops; inferior-with the urinary bladder.

Between the two peritoneal sheets of the sigmoid mesocolon, pass the sigmoid vessels and the superior rectal artery. The sigmoid arteries, branches of the inferior mesenteric artery, are in variable number, between 1 and 9 (Fig.1 a, b), (5,6).

Classically, 3 sigmoid arteries are described (upper, middle, and lower) which, right from the beginning, enter the mesosigmoid, where they are divided into ascending and descending branches, which anastomose between them. Vascular abnormalities (anatomical variants) must be well known by the surgeon, primarily to prevent heavy arteriovenous bleeding that may occur in a very narrow space, such as the pelvis, or in the curvature of the sacrum in men.

Venous drainage is performed through homonymous veins that flow into the inferior mesenteric vein.

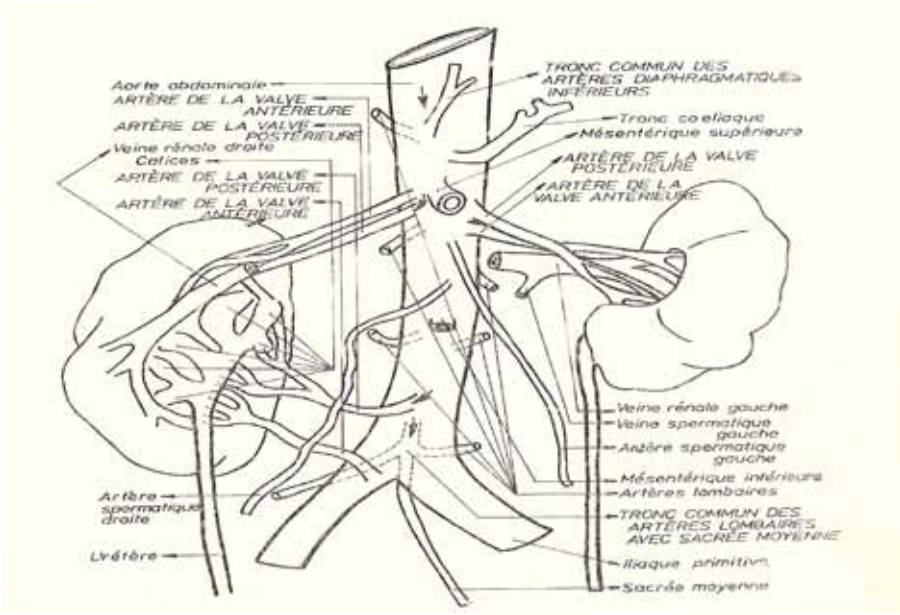

Fig. 1a Supernumerary arteries in the abdominal aortic system. They may cause clinical signs or are discovered during surgery or autopsy or during anatomical dissection of corpses.

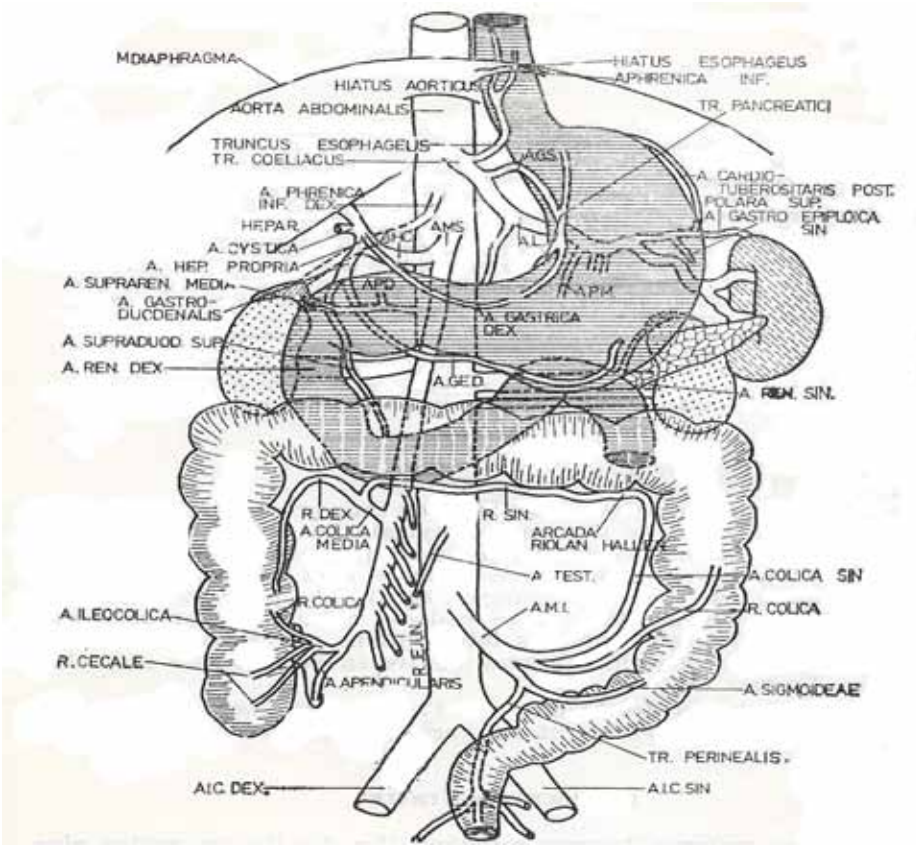

Fig. 1b Diagram of multiple abnormalities of the abdominal aortic system. They can be encountered while exploring a surgical or medical condition, accidentally or during abdominal surgery.

The lymph nodes that drain the lymph from the colon are divided into four groups: epicolic-subserosal, paracolic-on the path of the marginal arch, intermediate-on the mesenteric arteries and their branches and, respectively, central-at the origin of the mesenteric arteries.

Regarding innervation, the sigmoid colon receives sympathetic and parasympathetic vegetative innervation. The sympathetic innervation comes from the lumbar and sacral level, the fibers reaching the lower aortic and mesenteric plexuses, through the lumbar splanchnic nerves. From these plexuses, the fibers reach the colon via the periarterial plexuses.

The parasympathetic innervation comes from the sacral level S2-S4.

The pelvic splanchnic nerves (erectors) originate here, providing nerve fibers that ascend through the inferior hypogastric plexus, superior and then inferior mesenteric, these fibers then reaching the colon through the periarterial plexuses (3).

The rectum is the last segment of the bowel, presenting two portions: the rectal ampulla-the more dilated upper portion, which, after crossing the perineum, continues with the second portion, namely the anal canal, which, anatomically, is delimited superior by the line dentate (pectinate) and lower than the ano-cutaneous line. The surgical anal canal has as its upper limit the place through which the rectum crosses the anal lifting muscles.

The rectum is delimited superiorly by the sigmoid colon, at the level of the S3 vertebra, and inferiorly by the anal orifice, having a length of about 15 cm and a width of 6-7 cm, in the most dilated portion.

In the sagittal plane, the rectum has two curves; initially, the rectum descends into the sacro-coccygeal curvature and has an anterior concave curvature (sacral flexure), then the rectum crosses the anal lifting muscle and continues with the anal canal. At this level, it has a posterior concave curvature (perineal curvature). In the frontal plane, the rectum has three curves, which determine the appearance of folds inside (the Houston valves). The lower and upper curves are concave on the left, and the middle is concave on the right. As the rectum continues with the anal canal, the lumen narrows, so that the smooth rectal mucosa folds into 6-10 longitudinal columns, which are called Morgagni columns (Fig.2). The base of the anal columns is joined by the anal valves, and all the anal valves form the pectinate line. Above each anal valve are formed the crypts or anal sinuses in which the anal glands open (3).

The rectal ampulla is a pelvic organ, being partially covered by the visceral peritoneum and having an initial intraperitoneal segment and one in the small (minor)- the subperitoneal pelvis.

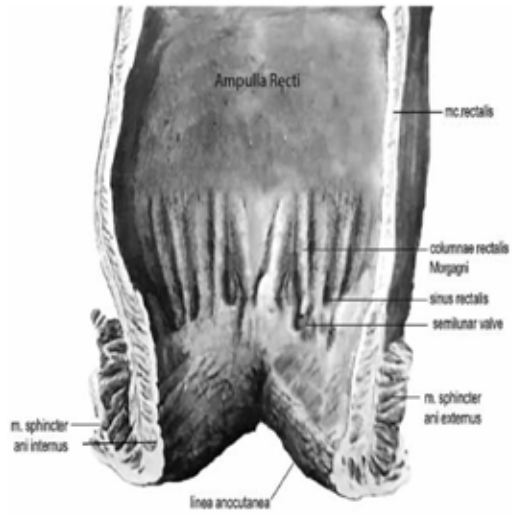

Fig. 2 Remaining rectal segment after rectal resection. The secretion of remaining anal canal mucous glands is deposited in the rectal ampulla, in the sinuses and rectal columns and near the anal orifice. In the biological product harvested from the anal area, Proteus mirabilis colonies were found on the culture media in 78% of cases. This secretion, as well as the presence of the colostomy, are factors of sexual inhibition, especially in the first 2-3 years postoperatively, respectively during the accommodation period of the sexual partner.

The intraperitoneal segment is covered by the peritoneum on the anterior and lateral sides, the peritoneum on the anterior side of the rectum is folded on the bladder- in male- and on the posterior vaginal and uterine wall-in female. This forms the bottom of the Douglas fold. The anterior anatomical relations of the intraperitoneal segment are represented by the ileal loops and the sigmoid colon, the bottom of the bladder (in man), respectively the posterior face of the uterus, the uterine tubes, the ovaries and the posterior vaginal wall (in woman). The lateral relations are represented

by the reflection of the peritoneum from the rectum on the pelvic wall, forming the pararectal fossae, in which we find ileal loops and sigmoid colon (3).

In the pelvis, subperitoneally and anteriorly, in man there are the seminal vesicles, the vas deferens, the ureters and the base of the bladder, and between the rectum and these structures there is the Denonvilliers recto-vesico-prostatic fascia. In woman, the anatomical relation is with the posterior vaginal wall, separated from the rectum by the recto-vaginal septum (3).

The lateral anatomical relations are with the inferior hypogastric plexuses and with the middle rectal arteries, and the posterior anatomical relations are made with the presacral fascia, with the middle rectal vessels, with the lateral sacral vessels, with the sympathetic nerve fibers chains and with the sacred spinal nerves. At the subperitoneal space, the rectum is surrounded by adipose tissue called the mesorectum, which is covered on the outside by the mesorectal fascia or the rectum's own fascia.

Inside the mesorectum, there are the terminal branches of the superior rectal vessels and lymph nodes (3). When the rectum is dissected, due to sectioning of the vascular elements, ischemia of the perineal muscle planes occurs, affecting the anal orifice and the perianal area, respectively the base of the penis (morpho-pathophysiological changes), with the necessary repercussions.

The anal canal has the following anatomical anterior relations: in woman - the lower part of the vagina and the tendon center of the perineum, and in man - the tip of the prostate, the membranous urethra, the deep transverse muscle of the perineum, the bulb of the penis, the tendon center of the perineum. Posteriorly, the anal canal is related to the ano-coccygeal ligament, and laterally-to the ischio-anal fossa. The ischio-anal fossa is a space that surrounds the anal canal and its sphincterian complex, on the outside.

The arterial vascularization of the rectum is configured by several arterial sources, respectively by the upper, middle, and lower rectal arteries. The superior rectal artery represents the continuation of the inferior mesenteric artery. It descends through the sigmoid mesocolon and then crosses from the lateral to the medial, the left common iliac vessels, descends posteriorly from the rectum and at the level of S3 divides into two branches - right and left. The terminal branches cross the rectal muscles to reach the submucosa. In the submucosa it anastomoses with the ascending branches of the lower rectal artery. The middle rectal artery separates from the internal iliac artery or its branches, usually from the inferior bladder artery (in man) and from the uterine artery (in woman).

The inferior rectal artery detaches from the internal pudenda artery at the level of the Alcock canal, from here the trajectory becomes transversal, from the lateral to the medial, at the level of the ischio-anal fossa, perforates the sphincter and reaches the submucosa of the anal canal. Here it anastomoses with branches from the upper rectal artery.

The blood of the rectum and anal canal is drained by three veins: the superior rectal vein, the middle rectal vein and the inferior rectal vein. The superior rectal vein drains the blood from the rectum and the upper portion of the anal canal into the superior mesenteric vein. The middle rectal vein drains the blood

of the lower rectum and the upper portion of the anal canal into the internal iliac vein, and the inferior rectal vein drains the blood from the lower portion of the anal canal into the internal venous vein and then into the internal iliac vein.

The innervation of the rectum is ensured mainly by the nerve fibers coming from the inferior mesenteric plexus; it contains both sympathetic and parasympathetic fibers.

These nerve fibers accompany the upper rectal artery. The rectum also receives nerve fibers from the lower hypogastric plexus, located in its lateral parts, subperitoneally.

The anal canal receives somatic information through the lower rectal nerve, which detaches from the internal pudendum nerve.

The rectum and anal canal have a complex innervation with a role in continence and defecation (3), and, from a surgical point of view, the sectioning of the vascular-nervous structures modifies the morpho-physiology of the genital organs.

Colorectal carcinoma is a malignant epithelial tumor, originating in the bowel, which, by definition, infiltrates, through the muscularis mucosae, the submucosa of the colon or rectum.

In relation to the depth of tumor infiltration, with own muscularis and the presence or absence of metastases in the regional lymph nodes (2), the number of vascular-nervous sections, as well as the interest of adjoining genitals, may be lower or higher.

With the disappearance of sensitive tissue-receptors, including the testosterone ones, the penile erection no longer occurs. An example is given that if the operator does not enter, as correctly, in the cleavage plan, the seminal vesicles could be damaged.

The surgical treatment:

Colorectal cancers are mostly adenocarcinomas, and surgical resection is the only curative approach.

The purpose of the surgery is to excise the primary tumor together with the lymph nodes that drain the respective colonic segment, which means that, automatically, by dissecting the tumor, the vascular-nervous formations are sectioned, sometimes producing lesions of the genitals, which will directly influence sexuality.

The surgical resection margins: the limit of oncologically safe surgical incision, in the case of the colon, is of 5 cm. Thus, the resected colon segment must include at least 5 cm more than each pole of the tumor.

In general, the resection margins are much wider, a situation imposed for the complete excision of the mesocolon, because a central vascular ligature can determine the devascularization of a much wider colonic segment.

The lymphadenectomy has a curative role through the excision of the tumor-invaded lymph nodes, but also a prognostic role through the information it provides in order to guide the multimodal oncological treatment; for a correct TNM staging, adequate analysis of at least 12 lymph nodes is necessary, thus avoiding substadialization (2).

For neoplasms located in the sigmoid colon, patients benefit from left hemicolectomy

with central vascular ligation of the lower mesenteric artery, and in cases with multiple comorbidities, segmental sigmoid colectomy is also considered, which, although inferior in terms of oncological principles, provides an overall survival rate similar to left hemicolectomy with central vascular ligation.

The incidence of tumors with local invasion is about 70% of cases of colorectal cancer, a situation in which the tumor adheres to an anatomical structure in the vicinity, in the remaining 30% of cases these adhesions are inflammatory.

The impossibility of intraoperative differentiation of adhesion types leads to the indication of block resection, studies showing that the separation of these structures during surgery leads to a local recurrence rate of about 100% and a marked decrease in survival at 5 years (2).

Left hemicolectomy with complete excision of the mesocolon and central vascular ligation by open approach is the recommended intervention in cancers of the left colon.

This intervention involves resection of the distal segment of the transverse colon, descending colon and sigmoid to the level of the upper rectum, 2-3 cm from the sacral promontory (2).

Rectal tumors affect the last 15 cm of the bowel, having similar characteristics to colonic tumors from a genetic, biological, and morphological point of view.

The anatomical area of the rectum may have variants or peculiarities, related to the retroperineal position in the small pelvis, with possible close relationships with the urogenital tract, the vegetative nervous system, and the anal sphincter, making surgical access difficult.

Surgery for rectal tumors requires careful dissection in anatomical planes, any deviation to the medial from the dissection plane results in increased local recurrence rate, and lateral deviations in the dissection plane determine comorbidities related to damage to adjacent nerve structures; in men, erectile dysfunction (sexual impotence) occurs, and bladder dysfunction may appear in both sexes (Fig. 3).

At the sacrum promontory level, the hypogastric nerves are identified, which descend into the pre-sacral space in the shape of the letter "Y". Keeping these nerve fibers intact is necessary in order to preserve sexual and urinary functions. The dissection is continued posteriorly; Waldeyer's presacral fascia is divided and dissected continuously under direct visual control, down to the coccyx. Postero-lateral mobilization of the rectum is performed by dissection from posterior to lateral, a maneuver necessary to be gently performed to maintain the integrity of the endopelvic fascia as well as to preserve the pelvic splanchnic nerves.

To complete the antero-lateral dissection, it is necessary to open the bottom of the Douglas fold and to place the patient in the anti-Trendelenburg position. In the antero-inferior dissection, the Denonvilliers fascia is previously incised on the midline, being considered the anterior limit of the mesorectum and a constituent part of the resection piece. In the case of tumors located in the rectum, the Denonvilliers fascia can be kept lower in order to reduce the risk of injury to the periprostatic pelvic nerves. The middle rectal artery, depending on its size, can be ligated or electrocoagulated.

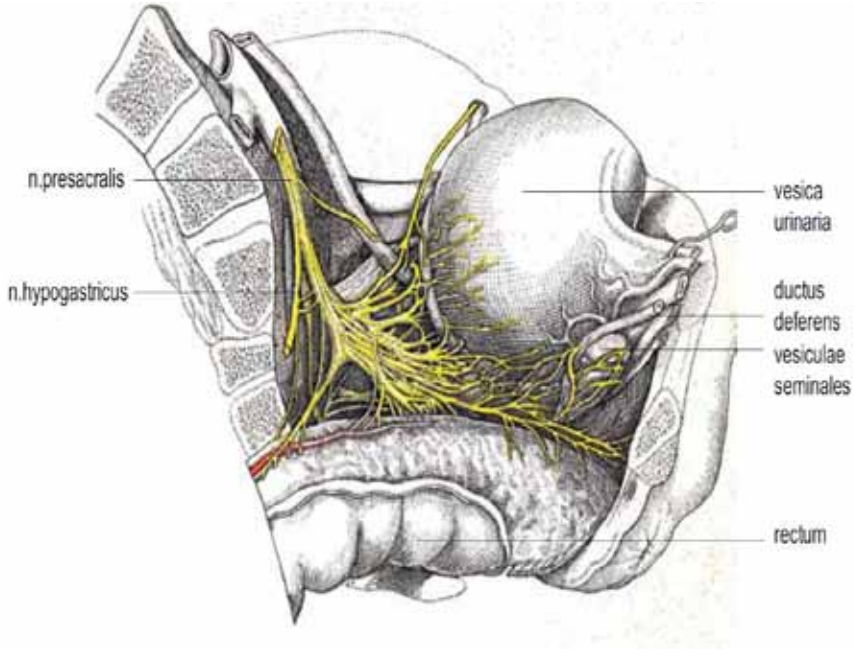

Fig.3 Nerve branches innervating the rectum and the bladder that could be sectioned intraoperatively (Adapted after Latarjet and Bonnet 1931, JCS,Vol.2, No.3-4/2019)

The pelvic nerves include: the sacral plexus (originating at the lumbar level L4, L5, S1, S2 and S3), which ensures the innervation of the pelvic muscles and lower limbs), the pudendum plexus (originating at the sacral level S2, S3 and S4), (Fig.4a, b), fibers are intended for the pelvic viscera and genitals and the autonomic pelvic plexuses (the upper hypogastric plexus and the lower hypogastric plexus) - intertwined with the previous ones. The superior hypogastric plexus consists of sympathetic thoraco-lumbar nerve fibers (responsible for ejaculation, in men) and is located in the extraperitoneal connective tissue, anterior to the bifurcation of the aorta and the left common iliac vein, near the L5 vertebra and promontory; it has the shape of a triangle with a cranial tip, and the hypogastric nerves (right and left) detach from the lower angles. Each hypogastric nerve terminates in a lower hypogastric plexus (right and left).

These plexuses contain, in addition to the sympathetic fibers, parasympathetic fibers from the S2, S3 and S4 segments; these parasympathetic fibers ensure an erection in men. Each inferior hypogastric plexus is located laterally to the rectum, prostate, seminal vesicles, and the back of the bladder-in men and, respectively, laterally to the rectum, cervix, vaginal fornix and the back of the bladder-in women.

The branches of the lower hypogastric plexuses ensure the innervation of the rectum, bladder, prostate, seminal vesicles, urethra, and corpora cavernosa. The cavernous nerves

are grouped in a nerves bundle, having a direct path to the postero-lateral portion of the prostate; from this level, the nerves accompany the capsular arteries and veins, climb to the top of the prostate, and pass through the urogenital diaphragm.

The pelvic plexuses are located laterally and posteriorly to the seminal vesicles, so the seminal vesicles are, intraoperatively, the benchmark for plexus identification. Also, the cavernous nerves can be identified postero-laterally of the prostate and antero-laterally of the rectum, due to their constant association with the prostatic arteries and capsular veins, with which they form a vascular-nervous bundle (4).

The superior hypogastric plexus (containing sympathetic fibers responsible for ejaculation) may be damaged during ligation of the inferior mesenteric artery. When there is no palpable lymphadenopathy along the lower mesenteric artery, ligation of the artery is done above or below the origin of the left colic artery.

When ligation of the inferior mesenteric artery is made from the origin of the aorta, it is preferable that the nerve threads located immediately behind the artery be separated by sharp dissection.

During posterior dissection of the mesorectum, there is a risk of damage to the hypogastric nerves, which contain purely sympathetic nerve fibers.

The correct dissection is made in the loose connective tissue located immediately outside the mesorectal fascia. In the avascular space between the rectal sheath and the presacral fascia, detachment is easy and there is no bleeding; hypogastric nerves are located immediately outside this plane and can be damaged if the anatomical plan is not followed or if a blunt dissection is performed or if the bleeding is not rigorously controlled and, as a result, there is no good visualization of the dissection plan.

During lateral dissection, excessive traction of the rectum brings the lower hypogastric plexus up and to the medial, exposing it to damage during ligation/electrocoagulation of the middle rectal artery and sectioning of the lateral ligament.

Damage to the parasympathetic fibers at this level leads to erectile dysfunction in male, and vaginal dryness (followed by dyspareunia) in female.

Extensive lymphadenectomy, which includes the lymph nodes in the lateral compartment (surgical procedure recommended by Japanese authors) has a major risk of damaging these nerves, which, at this level, contain both sympathetic and parasympathetic fibers.

The anterior dissection occurs in the narrow space between the rectum (located posteriorly) and the seminal vesicles and prostate (located anteriorly).

During dissection at this level or during hemostasis in this difficult area, the cavernous nerves are exposed to damage; these nerves contain mainly parasympathetic fibers, and their damage leads to erectile dysfunction.

The anterior dissection can take place in three planes: perirectal, mesorectal and extramesorectal.

The perirectal (perimuscular) plane is located in the immediate vicinity of the rectal

muscles, but inside it's own rectal fascia; it is not a proper anatomical plan, and dissection with this location causes a high rate of local recurrence.

The mesorectal plane is an anatomical plan, in which the rectal fascia separates from the Denonvillers fascia, but it is not as obvious as in the lateral and posterior portion of the rectum.

The extra-mesorectal plane involves the resection of the Denonvillers fascia; the prostate and seminal vesicles are visualized previously, but the risk of injury to the cavernous nerves is high. As the anterior mesorectum is thin, for oncological reasons, the systematic dissection of the anterior Denonvilliers fascia is justified.

Therefore, to minimize the risk of urogenital sequelae, the previous dissection of the Denonvilliers fascia is indicated only in cancers of the anterior wall of the rectum, for posterior or lateral location tumors being preferable to use the mesorectal plane (4).

During the operation, several moments

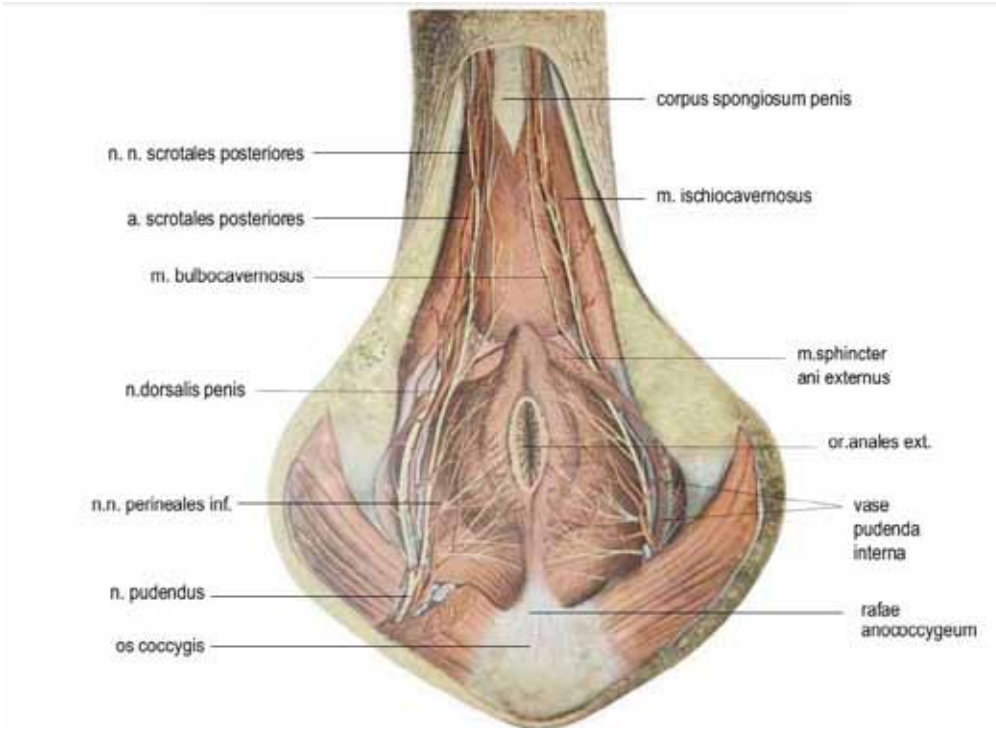

Fig. 4a Nerve threads and vascular branches which, by surgical sectioning, modify the morpho-functionality of the penis, causing sexual dysfunctions (Adapted after Sobotta- Figge Vol.III, Part I, 1.963, JCS, Vol.2,No.2/2019)

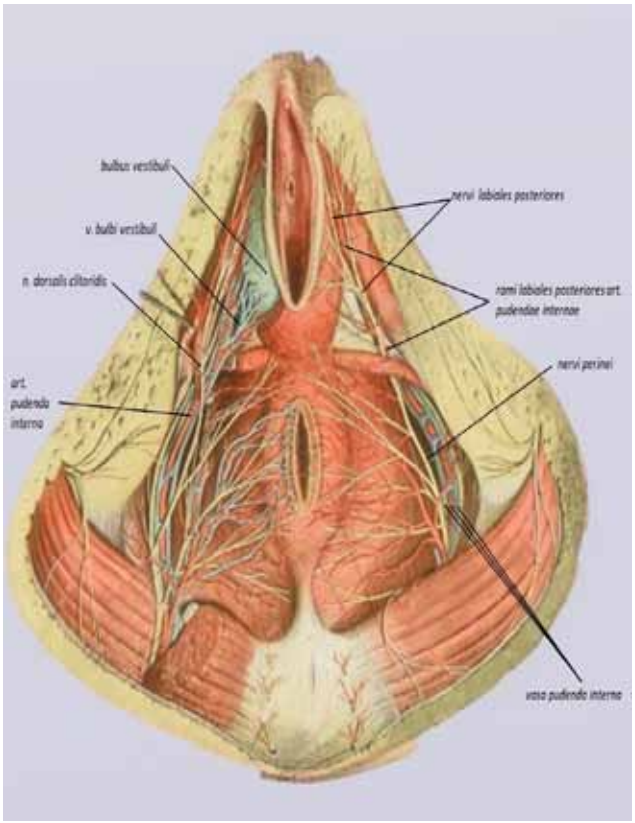

Fig. 4b Perineal vascular-nervous elements, which by surgical sectioning, modify the vulvo-vaginal morphophysiology (after Sobotta- Figge Vol.III, Part I, 1.963)

with increased risk of pelvic nerve damage can be identified, especially the sectioning and ligation of the inferior mesenteric artery, performed simultaneously with the anterior, posterior, and lateral dissection of the rectum, with possible repercussions such as sexual dysfunction (especially erectile dysfunction).

In this context, pelvic and rectal surgery are often associated with sexual and urinary postoperative complications (7). Rigorous observance of the anatomical principles of dissection minimizes the risk of injury to these nerve structures and the occurrence of consecutive urogenital complications