

## Innervation Disturbances In Sphincter Preserving Surgery For Rectal Carcinoma And Our Experience Of Their Avoidance And Treatment

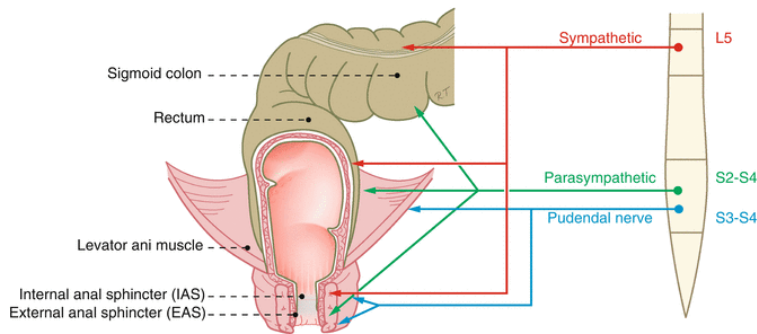
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### Introduction

Rectal cancer control and patient survival rate have improved tremendously with advances in surgical techniques and adjuvant therapy. Applying modern surgical principles, it is now possible to completely remove most rectal cancers, often sparing the anal sphincter and leaving the patient with relatively normal bowel and pelvic function. The emphasis in rectal cancer surgery is on preservation of sphincter function, with dissection performed within appropriate anatomic limits [1]. The colon and rectum are innervated by two different spinal pathways - the lumbar splanchnic and the sacral pelvic. The cell bodies of these splanchnic and pelvic afferents are located in the thoracolumbar (T10-L1) and lumbosacral segments (L6-S1), respectively. The autonomic nerve plexus of the pelvis is located on the anterolateral surface of the lower part of the rectum, surrounded by the endopelvic fascia. The autonomic nerves that supply the plexus reach it from the back, laterally to the midline, passing along the surface of the rectum. The rectum receives its autonomic nerves with its arterial blood supply, the superior rectal artery. The nerves of the pelvic plexus supply the genitourinary organs, which lie anterior to the rectum and in front of Denonvillier's fascia [2].



There are several risk sites where the innervation can be traumatized in low anterior resections [3]. First of all, during the ligation of the inferior mesenteric artery, the sympathetic nervous plexus - plexus aorticus can be injured. It lies under the fascia endoabdominalis superficialis. Therefore, it is recommended that during the ligation of a.mesenterica inferior, this fascia should not be disturbed, and it should be ligated above it. Next, care must be taken to not traumatize the hypogastric plexus in the region of the bifurcation of the aorta. It is situated under the fascia endoabdominalis superficialis. To avoid trauma to it, the dissection should be done above this fascia, and the fascial connection between the fascia propria recti and Waldeyer's fascia should be severed close to the fascia propria recti and not near the sacral promontory. During the lateral dissection of the rectum, care must be taken to not traumatize the n.hypogastricus dexter et sinister. The dissection should be done over the fascia endopelvica superficialis. When the right and left lateral connections of the rectum are severed, during its dissection, they must be severed near the rectum in order to preserve the autonomic innervation of the genitourinary organs. During dissection of the anterior rectal wall from the prostate and seminal vesicles, the plexus pelvinus may be injured. These nerve fibers are located in close proximity to the lateral parts of the seminal vesicles and under the capsule of the prostate gland, that is, in front of Denonvillier's fascia. In order not to injure them, it is necessary to separate the rectum between the front sheet of the fascia propria recti and Denonvillier's fascia. These techniques were confirmed in our practice by Prof. V. Dimitrov, a doyen in the treatment of colorectal carcinomas. By following these rules, postoperative complications, such as anal incontinence, functional disorders of the bladder, sexual disorders, constipation, have drastically decreased.

### **Anal Incontinence**

Disturbances in defecation and anal continence after sphincter-preserving operations on the rectum due to carcinoma.

The most important factors for anal continence are:

- The pressure in the anal canal at rest and voluntary tension of the anal sphincters - at rest the anal tension is 10-93 mmHg (average 44 mmHg), and during voluntary contraction 18-181 mmHg (average 75 mmHg).
- The anorectal angle - when normal, an angle of 80-90 degrees is formed between the anal canal (physiological) and the distal third of the rectum, open backwards. In the event that the angle is straight, partial anal incontinence may occur, with a fully preserved sphincter-anal complex.
- The capacity of the rectum.

- The sensory mechanism of the anus and rectum.
- The motility of the column.
- Faecal volume and consistency - the maximum possible volume in healthy people can reach up to 400 ml.

In sphincter-preserving operations on the rectum for carcinoma, with the removal of the rectum and most of the sigmoid, all these factors for normal anal continence are disrupted, and the normal reservoir function is also removed. Any entry of faecal masses into the neorectum immediately activates the defecation reflex, gradually, the body adapts. A new normal anorectal angle is created, and a new reservoir is formed above this angle. When the adaptation period takes a long time, cleansing enemas are recommended. After the enemas, colonic peristalsis slows down and spontaneous defecation becomes rare.

It has been established that interruption of the internal anal sphincter does not lead to anal incontinence, as its function is taken over by the external anal sphincters. The studies of A. Shafik from 1990 prove this claim. With partial rupture of the anal sphincters, anal tone is restored after a longer period of time, at the expense of hypertrophy of the preserved muscle fibers, but with a complete interruption of the sphincter muscle fibers, anal incontinence remains permanent. By restretching the anal sphincters, they can restore their function. Pelvic muscle afferents are found in both the distal colon and rectum and adapt more slowly to sustained distension than splanchnic muscle afferents, which are found only in the distal colon. Furthermore, aging has been shown to be associated with impaired visceral sensory perception in response to mechanical stimulation of the rectum [4], while diabetes-induced faecal incontinence is associated with impaired rectal sensation.

Anal incontinence could be:

- I degree (mild) – the patients release gases uncontrollably, and when the stools are liquid-mushy, together with the gases, a scant amount of feces is released.
- II degree (medium) – patients cannot actively retain not only gas, but also liquid-mushy stools.
- III degree (severe) - patients do not retain gas and feces at all.

Operative treatment is applied in case of complete interruption of the anal sphincters. In our practice for the past 5 years, with the observance of techniques to preserve the anal innervation and sphincter complex, making a new sphincter from mm.graciles [5], due to complete rupture of the anal sphincter muscles, is already an unnecessary operative technique. Compliance with all techniques and careful dissection of the structures preserves the anal sphincter muscles to a large extent. Due to these reasons, we have not had to make a J pouch anastomosis for the past 5 years. The safest and simplest remedy for anal incontinence, for now, remains cleansing enemas. In the beginning, they are prescribed daily, and after a few months, colonic peristalsis slows down.

Patients are recommended to do the following:

- In case of mild muscle damage, we recommend patients a program of exercises and other therapies to restore muscle strength. Their purpose is to improve the control of the anal sphincter, as well as the awareness of the desire to defecate. Such are the exercises of Kegel that strengthen the muscles of the pelvic floor. Multiple studies support Kegel exercises as the most effective method and first choice therapy for patients with urinary incontinence. The effects are usually present within four to eight, even ten weeks.

- Antidiarrheal medications such as loperamide hydrochloride (Imodium AD) and diphenoxylate and atropine sulfate (Lomotil)
- Biofeedback. Trained physical therapists teach simple exercises that can increase muscle strength in the anus.
- Sacral Nerve Stimulation (SNS).
- Posterior tibial nerve stimulation (PTNS / TENS).
- Vaginal balloon (Eclipse System). This is a pump-type device inserted into the vagina. The inflated balloon puts pressure on the rectal area, which reduces the number of episodes of fecal incontinence.
- Kegel's balls: small, spherical balls that are inserted into the vagina and the main purpose is to keep them there.
- Radiofrequency therapy. Known as the Secca procedure, this involves delivering temperature-controlled radiofrequency energy to the wall of the anal canal to help improve muscle tone.

More often after surgical treatment of rectal carcinoma, as well as after stoma closure, we observe constipation in patients.

### **Constipation**

Postoperative constipation results from intraoperative disruption of the innervation of the left half of the colon [6,7]. It is often seen after abdomino-anal resections when the entire left half of the colon is mobilized to form a neorectum.

Postoperative constipation is divided into the following degrees:

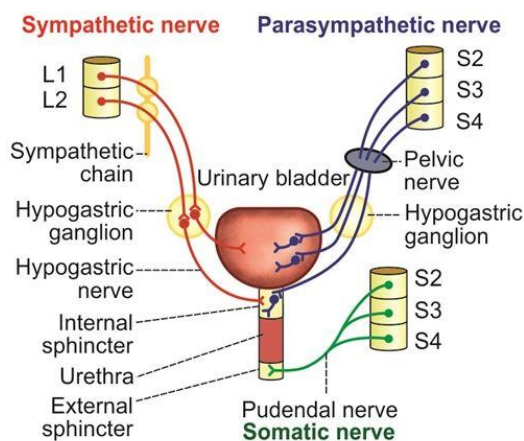
- First degree (mild form) – after taking a cleansing agent, there is effective defecation.
- Second degree (medium form) – after taking several therapeutic doses or several types of laxatives, there is effective defecation.
- Third degree (severe form) – after taking huge amounts of cleansing agents, there is no effective defecation. In this case, colon cleansing is done only with enemas with large amounts of water.

In our practice, for the last 5 years, we often encounter first-degree constipation in the postoperative period. We often see it after anterior resections and low anterior resections. In this case, taking a purgative like Ol.ricini, placing Bisacodyl, taking Dufalac per os achieves the necessary effective defecation. In our practice, the early taking of appropriate measures to reduce the risk of complications has a good result. For this reason, in the early postoperative period (first-second postoperative day), we prescribe Ol.ricini or Bisacodyl.

### **Functional Disorders of the Urinary Bladder**

The lower hypogastric plexus is a fan-shaped structure located laterally from the rectum on the fascia of the m.levator ani. Nerves emerging from the proximal part of the plexus follow the internal iliac vessels and reach the prostate dorsolaterally. The innervation of the urethra and corpora cavernosa has two origins: one follows the ejaculatory duct and seminal vesicle, reaching the proximal urethra and prostate from the dorsal part; the other follows the inferior vesical artery to reach the prostate laterally, and then forms the neurovascular bundle on either side of the

prostatic fascia, spreading to the pelvic floor muscles and corpora cavernosa along with the distal urethra [8]. The detrusor receives a sparse supply of noradrenergic nerves. Conversely, the smooth muscle of the terminal ureter is well supplied by this type of autonomic nerves. In some cases, this muscle forms a complete collar, which may be responsible for obstruction of the ureter. The terminal ureter is innervated by noradrenergic nerves. Compared to the detrusor, bladder neck smooth muscles receive a dense noradrenergic nerve supply, especially in males [9].



Bladder dysfunction often occurs after surgical interventions with extirpation of the rectum. The main cause remains trauma to the neurovegetative system of the bladder [10-12]. In the case of partial damage to the parasympathetic fibers, after 3-4 weeks of the operation the difficulty during urination may disappear, but the reduced tonus of the detrusor may remain for longer. This can be detected by the presence of residual urine in the bladder. In case of bilateral damage to the parasympathetic innervation, irreversible disturbances in the function of the urinary bladder occur in the type of atonic (areflexic) bladder. The clinical picture of damage to the parasympathetic innervation is characterized by a large amount of residual urine. Secondary urinary incontinence from overstretching of the sphincters – ischuria paradoxa. The urge to urinate is absent or poorly preserved. Impaired innervation reduces the sensitivity of the bladder mucosa to a minimum and sharply reduces the contractile function of the detrusor. The urge to urinate is present with partial disruption of the parasympathetic innervation, but urination occurs with deviations from the norm. Sympathetic fibers in the plexus vesicalis and plexus prostaticus are often damaged. But most of the sympathetic fibers of the plexus hypogastricus inferior go directly to the bladder, and a smaller part of them are included in the plexus vesicalis. This explains the lesser damage to the sympathetic innervation of the bladder [13]. Injury to the inferior hypogastric plexus and its higher branches results in isolated damage to the sympathetic innervation. This causes a disturbance in the reservoir function of the bladder. In case of severe damage mainly to the sympathetic innervation is manifested by urinary incontinence, the residual urine is absent or in insignificant quantity. The urge to urinate is absent or barely marked. In severe damage to both sympathetic and parasympathetic innervation, there is urinary incontinence, a weakened urge to urinate, and a moderate amount of residual urine. Since the rectum and the bladder have the same reflex arc, great importance is attached to the reflex influence of the bladder from the operation itself. The common source of innervation of the bladder and the rectum creates the possibility of pathological viscerovisceral reflexes occurring after operations of the rectum. It should be

noted that postsurgical removal of the rectum, the removal of supporting structures of the bladder from behind, is also important [14]. A deviation is created between the cervix of the bladder and the prostatic part of the urethra, and the bladder falls back. This leads to secondary atony of the bladder, due to a disturbed distribution of the detrusor's expelling forces. Our expertise shows that in the first days after rectal surgery, detrusor hypotension is common. In this case, in order to allow the bladder to rest, we leave the urethral catheter for a longer time and do not remove it earlier than a week after the operation. Sometimes an additional factor is the inflammatory process in the presacral region, which causes hypotension, due to involvement of the autonomic nerve pathways and the back wall of the bladder. In this case, we apply parasympathomimetics, beta-blockers and drugs that restores the bladder. It is mandatory to treat the uroinfections. Our expertise has shown that in the presence of accompanying diseases such as benign prostatic hyperplasia, prostate adenoma, sclerosis of the bladder's cervix, narrowing in the initial part of the urethra, in these cases even minor damage to the parasympathetic innervation leads to difficulties in the micturition.

### **Sexual Disorders**

It is known that the control of the ejaculation process is by the sympathetic nerves, and the erection by the parasympathetic nerves. Because the rectum is in close proximity to this innervation, its extirpation is associated with major intraoperative trauma to the pelvic innervation. The most common areas where sympathetic innervation can be damaged and how to avoid injuring them have already been established. The parasympathetic innervation is disrupted most often when the lateral parietal pelvic fascia is torn, when it does not fall into a plan, during lymphatic dissection in the obturator zone, where the integrity of the nn.erigentes is violated, or when removing locally advanced tumor processes [15,16]. In case of damage to the plexus pelvinus, the sympathetic and parasympathetic innervation is disturbed simultaneously. With complete interruption of sympathetic innervation, there is a lack of ejaculation. With incomplete interruption of sympathetic innervation, there is retrograde ejaculation - entry of seminal fluid into the bladder. With complete or partial damage to the parasympathetic innervation, there is a complete absence or partial violation of erection. Intraoperative damage to the seminal vesicles and spermatic cord, as well as severe inflammatory processes in the pelvis, lead to permanent loss of ejaculatory function. Our observations indicate that a thorough knowledge of the anatomy of the rectum and its innervation is extremely necessary for the correct surgical behaviour.

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