Review

Functional urological complications after colo-rectal cancer surgery

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Abstract: Surgery for colo-rectal cancer is a common procedure, and it is associated with a high incidence of functional urological complications. These complications are due to damage to the pelvic nerves during mobilization of the rectum. In particular the sympatic and parasympatic innervation of the low urinary tract can be disrupted, both in male and female patients. The urological functional damage requires a correct diagnostic workout peri and post-operative and an adequate treatment strategy, in order to avoid permanent impairment. A nerve-sparing surgical approach to the rectum could minimize the entity of damage to the pelvic nerves. This technique is difficult, due the complex anatomy of the neural branches. The patient, not only the surgeon and the urologist, should be aware of the possibility of functional complications after rectal surgery, and informed upfront that such complications can be successfully prevented, monitored and treated

Key words: Rectal cancer; Rectal surgery; Neurological damage; Functional complications.

INTRODUCTION

Colo-rectal cancer is a common disease. The Incidence is estimated as 15.7 (male) and 10.4 (female population) / 100.000. The number of patients undergoing curative colorectal surgery has increased, due to the introduction of new surgical strategies, such as total excision of the mesorectum (TME), and confirmation that short surgical resection margins are acceptable.[1]

Surgical options for patients with cancer of the lower third of the rectum include anterior resection with anastomosis (AR), and abdomino-perineal resection (APR). Both procedures have a significant impact on the patients' quality of life, the stoma itself for obvious reasons, but also the presence of a low anastomosis, which can disrupt the normal rectal function. Urological dysfunction can also result from low rectal surgery. Urological dysfunction detected immediately after surgery requires correct diagnosis and appropriate treatment in order to avoid permanent impairment. The incidence of low urinary tract symptoms after colorectal surgery is between 20 and 40%, higher in male patients (M:F = 4:1) due to anatomical differences or the presence of benign prostate enlargement, which increase the possibility of neurological dysfunction in men. On the other hand, multiparous female patients can present with significant pelvic floor damage. Nevertheless, postoperative symptoms are often transient and usually only 10% of patients require medical or surgical treatment.

The aim of this study is to assess the incidence and magnitude of urological functional damage, in particular regarding the lower urinary tract, following surgery for rectal cancer. To this purpose, we reviewed the international literature available on this subject.

We searched the Medline for English language papers relating to human studies with no time limits based on the following search keywords: rectal neoplasm, rectal neoplasia, rectal adenocarcinoma, rectal cancer, colo-rectal cancer, urological dysfunction, functional urological dysfunction, voiding dysfunction, bladder dysfunction and low urinary tract symptoms.

BACKGROUND

Urinary dysfunction is a well-known complication of colo-rectal surgery. Increased understanding of the anatomical and physiological background and improved surgical techniques have lead to a reduction of complication rates.[2] As an example, utilizing the TME technique, the rectum is mobilized with a fine dissection along the pelvic fascia.[3] This technique was described by Enker[4] as a method of preservation of the autonomic plexus, in order to minimize urinary and sexual dysfunction. Recent studies confirm that the TME technique leads to a significant reduction in adverse side effects.[5] The use of different surgical techniques have also reduced the incidence of functional damage. In the late 80s the TME proposed by Headl et all[6] was introduced into surgical practice. It consisted of rectal dissection with total meso-rectal excision under direct vision. TME has soon become a widely utilized procedure, due to its success in curing the cancer combined with a better functional outcome. In contrast, the technique, utilized in the 70s, of extended rectal dissection was associated with severe urinary and sexual dysfunction, due to damage to the autonomic pelvic nerve plexus.[7] More recently, extended research into the anatomy and physiology of the pelvic nerves has provided extensive data and information, allowing a detailed mapping of the macroscopic neuro-anatomy of the pelvis.[8] Nevertheless, one possible negative aspect is the individual anatomical variability and morphological abnormalities of the pelvis, which can increase the challenge of correct intraoperative identification of the nerves. Finally, oncological extension of the disease and direct infiltration of the pelvic plexus can require the dissection of the nerves along with the tumour, potentially resulting in severe functional damage.

AUTONOMOUS PELVIC PLEXUS: ANATOMY AND PHYSIOLOGY

A layer of soft connective tissue, the mesorectum, which contains blood and lymphatic vessels and the rectal lymphnodes, surrounds the rectum. In its posterior part, a thin fascia, the visceral fascia, covers the mesorectum. The pelvic part, which is located posteriorly to the rectum and its own fascia, is covered by an additional thin fascia, called the parietal fascia. The visceral and the parietal fascia identify a space, the retro rectal space, filled by connective tissue. Resection of this tissue allows access to the retro rectal space and mobilization of the rectum. Both sympatic and parasympatic nerves constitute the pelvic nervous plexus. Sympatic roots originate from L2 and L3. They form first the aortic plexus (or superior hypo gastric plexus), and then the hypo gastric plexus below the parietal peritoneum at the level of the aortic bifurcation. Distal to the sacral pro-

montory these fibres form the hypo gastric nerves, which run lateral to the ureter and the internal iliac artery, joining the pelvic autonomic plexus at the lateral pelvic wall. The parasympatic fibres originate from S3-S4 in the male, and from S2-S4 in the female and run along the erigentes nerves, which cross the sacral foramen and reach the pelvis and the inferior hyponastic plexus. This plexus is located anteriorly and laterally to the rectum, deep below the peritoneum, over the endopelvic fascia, which covers the levator anii muscle. The autonomic pelvic plexus, known also as inferior hypogastric plexus, is constituted by nervous tissue localized in the pelvic wall, in close proximity to the prostate and the seminal vesicles in the male. In the female, it is localized anteriorly and laterally to the rectum, running by the cervix and the vaginal fornix, and reaching the lateral vaginal wall and the bladder base. The main part of the plexus is localized at the level of the vaginal fornix. The autonomic sacral plexus is constituted by fibres coming from the hypo gastric nerve and from the sacral splancnic nerves, and gives origin to fibres for the genito-urinary organs and the rectum. The parasympatic fibres are involved in the erection mechanism, increasing the blood flow in the penis or in the vulva and vagina, and enhancing vaginal lubrication and erection of the clitoris and the labia. These fibres contribute also to the innervation of the detrusor muscle, and are therefore involved in the micturition mechanism. On the other hand, the sympatic fibres are related to ejaculation and to the rhythmic contraction of the genitals during orgasm, in the male and most probably also in the female. Moreover, the sympathetic fibres inhibit the detrusor muscle, and stimulate the contraction of the bladder neck, taking part, as a result, in the continence mechanism.[9, 10, 11, 12]

URINARY FUNCTION

The current rate of urinary dysfunction after surgery for rectal cancer is between 30 and 70%. Several factors, besides preservation of nerve fibres, are involved in the pathophysiology of mild urinary incontinence.[13, 14] Loss of sympatic innervation due to damage of the hypo gastric nerve, may be responsible, in the female, of urgency and/or stress incontinence. A number of studies published in the 70s and 80s have shown a high rate of *de novo* low urinary tract symptoms (8-70%), after abdominoperineal resection.[15, 16, 17, 18, 19]

Urodynamic characteristics of denervation damage have been reported in some recent studies, and identified as reduction of bladder compliance, detrusor hypo contractility, and reduced competence of the bladder neck.[20, 21, 22] Bladder dysfunction is a common complication of pelvic surgery. Functional urinary problems arise in 24-32% of patients after surgery for rectal cancer (Tab. 1). Damage to the visceral sacral nerves can lead to detrusor denervation and decreased bladder sensitivity. As a consequence, the patient may experience voiding dysfunction, overflow incontinence, and loss of bladder filling sensation. Additionally, the posterior bending of the bladder, which can occur during abdominoperineal resection, could lead to voiding dysfunction. Lower urinary tract infections can result from incomplete bladder emptying. Sympathetic denervation due to damage to the nerves of the hypo gastric plexus, can result in urgency and stress incontinence, or detrusor hyper reflexia, which can lead to a severe degree of bladder contraction. In some cases, these symptoms are present even before rectal surgery, as a result of patient age, chronic inflammation or other common clinical conditions including benign prostate enlargement and prostate cancer. Finally, damage to the pudendal nerves, even if not common after anterior rectal resection, can result in a reduction of bladder sensitivity and erectile dysfunction. Finally, it should be noted, that clinical symptoms of pelvic nerve damage could be mixed and not necessarily linked to damage of a specific neurological compartment. The resulting clinical effects are most often multiple, with different prevalence of one compartment over the others in different cases.

TABLE 1

Author	*Year*	*Patients n.*	*Female*	*Bladder dysfunction (%)*	*Erection dysfunction (%)*
Havenga [23]	1996	138	39	32	17
Maas [24]	1998	47	30	28	11
Maurer [25]	1999	60	36	24	24
Sterk [26]	2005	52	30	24,8	27

CONCLUSIONS

Bladder dysfunction is common after pelvic surgery, especially after surgery for rectal cancer. During dissection of the mesorectum, the rectum is mobilized, with possible damage to the sympatic and parasympatic nerves, which travel to the bladder and are involved in bladder function. It has been shown that surgical damage to the nerves of the hypo gastric plexus, the pelvic plexus and the cavernous nerves can also lead to low urinary tract dysfunction. The clinical manifestations can vary, according to location and extent of surgical damage. Permanent lesions can be observed following complete transection of the main nerves, while transient dysfunction can occur following traction of the main nerves or transection of the peripheral branches. There is a direct correlation between the clinical symptoms and the exact nature of the neurological damage produced, even thought currently it is not possible to localise the site of the damage based on the clinical symptoms.

A nerve-sparing surgical approach to the rectum could minimize damage to the pelvic nerves. This technique is however difficult, due the complex anatomy of the various neural branches.

Three areas can be identified as “high-risk” areas for neural damage: one in the abdomen and two in the pelvis. In the abdomen, the risk is linked to the ligation of the inferior mesenteric artery, which can result in damage to the hypo gastric plexus. At the level of the pelvis on the other hand, a critical surgical step is mobilization of the rectum posteriorly. Damage to the nerves erigentes is possible. These nerves run in proximity to the visceral fascia of the rectum. The lateral dissection can endanger the pelvic plexus, both at the sympathetic and parasympathetic level. Finally, the anterior mobilization of the rectum can result in damage to the cavernous nerves where the anterior rectal wall is separated from the prostate and the seminal vesicles only by the Denonvilliers fascia.

Deeper knowledge of the potentiality of neural damage during rectal surgery has contributed to the development of nerve–sparing techniques, such as the autonomic nerve preservation techniques (ANP). Several studies have shown that TME with ANP results in a reduced incidence of urinary dysfunction, compared to conventional surgery.

In conclusion, urinary complications after rectal surgery are becoming less frequent and are more often transient, due to a better understanding of the anatomy and physiology of the pelvic nerves, increased attention to the functional outcomes of oncological surgery, improved diagnostic tools and increased efficacy of pelvic floor rehabilitation programs. The patient, not only the colorectal surgeon and the urologist, should be aware of the possibility of functio-

nal complications, and informed prior to surgery that such complications can be successfully prevented, monitored and treated or that they may spontaneously revert back to normal with improvement of symptoms and a return to the pre-operative situation.

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