

Localisation and Preservation of the Autonomic Nerves in Rectal Cancer Surgery – Technical Details

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Rezumat

Localizarea și preservarea nervilor autonomi în chirurgia cancerului rectal – detalii tehnice

Lezarea iatrogenă intraoperatorie a nervilor autonomi pelvini urmată de disfuncții genitourinare consecutive sunt probleme binecunoscute apărute după excizia parțială/totală de mezorect pentru cancer rectal. Scopul lucrării noastre este să prezinte reperele anatomice importante pentru preservarea nervoasă în chirurgia oncologică rectală. Bazându-ne pe experiența noastră în chirurgia rectală și pe revizuirea literaturii, descriem și ilustrăm zonele cheie, de risc pentru lezarea nervilor autonomi în cursul exciziei totale de mezorect.

Cuvinte cheie: chirurgia cancerului de rect, nervi autonomi pelvini, chirurgie rectală cu preservare nervoasă

risk zones of autonomic nerve injury based on our experience in rectal surgery and on the revised literature.

Key words: rectal cancer surgery, autonomic pelvic nerves, nerve sparing rectal surgery

Introduction

Total mesorectal excision (TME) represents the gold-standard technique in rectal cancer surgery and it provides both maximal oncological efficiency (local control and long-term survival) and maintenance of a good quality of life. The optimal functional results consist in the preservation of the anal sphincter (sphincter saving surgery) and of the autonomic nerves (the so-called “nerve sparing surgery”) thus resulting in the decrease of the rate of sexual and urinary dysfunctions.

Rectal cancer treatment is associated with several risk factors causing genitourinary dysfunctions. These factors are related to: the patient (age; sex; socioeconomic, cultural and psychological factors), the pathology (location and local stage of the tumor) and especially to the treatment (neoadjuvant radiotherapy; chemotherapy; the type of the surgical approach-open/laparoscopic; quality of dissection) (1).

In order to decrease the postoperative urinary or sexual dysfunctions resulting from inadequate manipulation and consequently damage of the autonomic pelvic nerves, the rectal excision technique was standardized and the key anatomical zones at risk were defined (2,3,4). The “mesorectum” concept introduced by Thoma Ionescu and the “total mesorectal excision” technique described by RJ Heald support us to preserve the autonomic nerves and therefore to

Abstract

Iatrogenic surgical injury to pelvic autonomic nerves followed by genitourinary dysfunctions are well known problems after total/partial mesorectal excision for rectal cancer. The purpose of our paper is to present the useful anatomical landmarks for a safe nerve-sparing surgery in rectal oncology. Over the course of a total mesorectal excision we describe and illustrate the key

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reduce the incidence of urinary (from 10-30% to 0-5%) and sexual dysfunction (from 40-60% to 10-35%) (1,4,5). Some surgical particularities of the dissection and a good knowledge of the useful anatomical landmarks in TME increase the frequency of the nerves' identification without affecting the oncological outcome (6).

Anatomical and physiopathological review (2) (Fig. 1)

There are two anatomical levels in the lower pelvis, one located above the levator ani muscle - innervated by the autonomic nerves, and another below the levator ani muscles - with somatic innervation by the pudendal nerves (2). The autonomic pelvic plexus includes: the superior hypogastric plexus - SHP (sympathetic), the inferior hypogastric plexus - IHP (mixed) and the pelvic splanchnic nerves (parasympathetic) (1,2,7).

Superior hypogastric plexus (SHP)

It represents the upper part of the autonomic nervous pelvic system, being a continuation of the preaortic sympathetic trunk. The plexus comprises a nervous network of fibres originating from the spinal nerve roots T10 - L3. The SHP is located anterior to the body of L5 vertebra, being displaced on the left anterolateral side of the aorta and of its bifurcation (2,8).

Left and right hypogastric nerves (HN)

The two hypogastric nerves (right and left) originate from the SHP division underneath the promontory. They lead to the front of the sacrum and run at 1 cm from the median line, parallel and medial (at 1-2 cm) to the ureter and to the common iliac artery. They take an anterior inferior oblique direction with a concave path leading inwards (9). Their width varies from 5 mm up to 1 cm. The HN surround the mesorectum, run along the sidewall of the rectal proper fascia being covered by the endopelvic fascia and end as afferent fibres for the inferior hypogastric plexus (IHP) (1,2,8). The injury of the SHP or of the HN causes troubles of ejaculation (loss of this function, retrograde ejaculation), urgency and urinary incontinence, orgasm dysfunctions (1,2,10).

Pelvic splanchnic nerves (PSN)

Each of the IHP receives several parasympathetic fibres in the pelvis arising from roots S2-S5 (splanchnic nerves or erector nerves of Eckard). Recently it has been shown that PSN contain also adrenergic fibres in about 30% of cases (2,11). The splanchnic nerves are responsible for erection, detrusor contractility, vaginal lubrication and arousal (10). These fibres pass through the sacral foramina, running inside the piriform muscles covered by the parietal fascia, then cross the retrorectal space forming the IHP together with the HN. Some branches of the pelvic plexus pass to the rectum through the so-called "lateral ligaments" (rectal wings) (1,2,9). The fibres are located in the postero-inferior part of the lateral ligaments and perforate the mesorectal fascia and enter in the mesorectal structure. These lateral ligaments are considered a condensation of

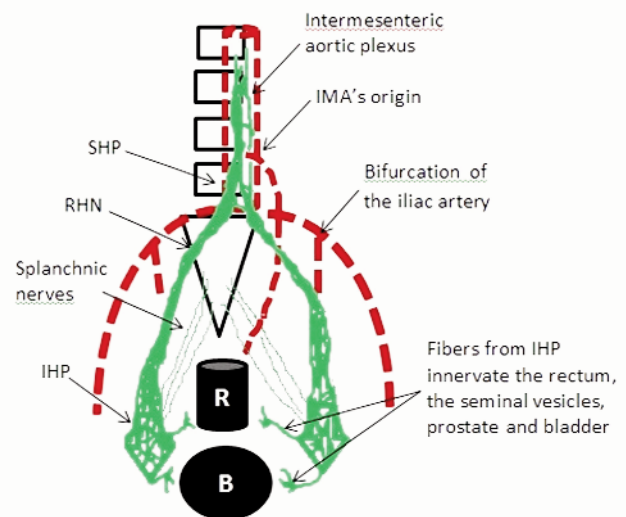


Figure 1. Anatomy - anterior view of the male autonomic nerves distribution. Abbreviations: IMA – inferior mesenteric artery; SHP – superior hypogastric plexus; HN – hypogastric nerve; IHP – inferior hypogastric plexus; R – rectum; B – urinary bladder [Drawer: Ștefan Andrei, after Volk M. et al (26)]

endopelvic connective tissue located on the anterolateral side of the subperitoneal rectum, in the extrafascial plane. The supero-anterior part of the ligaments contains the middle rectal artery, a small and inconstant vessel (2,8,14). Some authors do not consider the lateral ligaments to exist and others showed that the main component of the lateral ligaments are autonomic nerves passing to the pelvic plexus to the rectum, the middle rectal artery being inconstant or missing (2,9,12). Injury of PSN causes erectile dysfunction and reduces vaginal lubrication by decreasing the blood flow to the vagina and vulva (2).

Inferior hypogastric plexus (IHP)

The autonomic innervation of the pelvic organs and of the external genital area arises from the IHP, which is formed by parasympathetic visceral efferent fibres from the sacral center (S2-S5) and sympathetic fibres that arise from the thoracolumbar center (T10-L3) via the HN (8). It is a 3 x 4 cm peripheral integration center located extraperitoneally which forms a fenestrated triangle with a posterior base and an antero-inferior top (2,9). Its position is sagittal and, in the horizontal plane, the plexus is localized at the level of S4 and S5 (7). It lies laterally to the rectum, in the parietal fascia thickness and thus outside the mesorectal fascia (fascia propria), and its top is closed and postero-superior to the seminal vesicles and prostate in men and to the cervix and vagina in women (2,13).

The dorsal edge of the IHP is at the point of contact with the sacral roots, receiving afferences from it and its superior angle follows on from the homolateral hypogastric nerve (7,11,14). The rectum is innervated by the posterior part of the IHP through the lateral ligaments and the anterior portion of the plexus innervates the bladder, prostate, cervix and vagina. The dorsal part (which is in a superior position) is located at

the intersection between the vas deferens and the ureter, while the infero-anterior pole reaches the rectal propria fascia and the lateral margin of the Denonvilliers fascia (where the two layers of this fascia are joined). In the sagittal plane the plexus is positioned at this level below and anterior to the lateral ligaments (1,2,7). At the point where the levator ani muscle approaches the rectum, the plexus lies into a small triangularly-shaped space bordered by: the prostate or the vagina – anterior, the rectum – posterior and the levator ani muscle – laterally. In this position the plexus is closed to the rectal wall and the risk of iatrogenic damage is increased (2,11,14).

The efferent fibres of the IHP form the secondary pelvic visceral plexus and innervate: rectum, bladder, seminal vesicles, prostate, ureters, membranous urethra, corpora cavernosa, uterus and vagina (2,7,9). Plexuses for the different pelvic organs can hardly be distinguished intra-operatively as an individual structure.

In women the efferences of the IHP lead into the vesicovaginal septum and the rectovaginal septum. The efferent branches going to the bladder, the vagina, the uterus and the rectum are originating in two trunks exactly underneath the crossing point of the ureter and the uterine artery (7,9).

In men the cavernous nerves arise as branches that are located just anterior to the lateral margins of the Denonvilliers' fascia. They are mixed nerves responsible for the erectile function and are integrated into two neurovascular bundles (Walsh) which contains nervous fibres for the anterior pelvic organs. They are very close positioned between the rectum (posterior) and the prostate and the seminal vesicles (anterior), very close to the lower rectum and 1-3 cm outside the Denonvilliers fascia (1,2,15). The cavernous nerve pierces the urogenital diaphragm, parallel to the urethra (2).

The injury of the IHP can cause erectile dysfunction, dyspareunia and impaired sensation of pain and need to urinate (parasympathetic) or can cause difficulty in ejaculation (sympathetic).

The levator ani muscle nerve is a motor nerve situated in the thickness of the muscle which contributes to urinary continence. Its iatrogenic damage, especially in Miles operation, causes urinary incontinence (loss of sphincter tone) (2). The pudendal nerve (PR) contains somatic nerve fibres (sensory and motor) and autonomic sympathetic fibres originating from S1-S5 level (2,9,13). It lies in the pudendal canal in the thickness of the pelvic floor and goes through the ischio-anal fossa and divides each into 3 branches innervating the pelvic floor muscles, external anal sphincter and penis/clitoris. Injury of the PR determines urinary incontinence, orgasm disturbance or rectal incontinence (2,8,9).

The critical points of dissection for the autonomic nerves in TME

In rectal cancer surgery there are a few key areas at risk of harm to the autonomic nerves to consider. By performing a proper surgical technique directed to the preservation of the pelvic

autonomic nerves, with careful dissection in relatively avascular planes ("the holy plan") the genitourinary function is retained without compromise of oncologic clearance (4,16). In order to ensure the visualization and preservation of the nerves at the critical points, a specific point-by-point checklist during the surgery is required.

The operation usually starts with primary vascular approach, from medial to lateral meeting the first critical point of dissection where the autonomic nerves can be intercepted. This is related to the identification and ligation of the inferior mesenteric artery ligation (IMA). The SHP starts from the IMA origin and reaches the aortic bifurcation below (Fig. 2). Being located in a wide area of dissection the fibres of the sympathetic system are easier to recognize than the parasympathetic ones which are located deeper in the pelvis. By gentle tenting of the sigmoid colon ventrally, the thin layer of peritoneum that covers the aortic bifurcation and common iliac vessels is found to hold both hypogastric nerves, which become more visible just inferior to the promontory (7). The promontory and the aortic bifurcation are palpated both in open or laparoscopic surgery and the posterior parietal peritoneum is incised at this level on the projection line of the mesentery. The incision starts medial to the right iliac vessels and goes towards the duodeno-jejunal flexure (17). The sympathetic preaortic fibres located just below the peritoneum are pushed back with the other retroperitoneal structures using sharp maneuvers, and the origin of the IMA is visualized

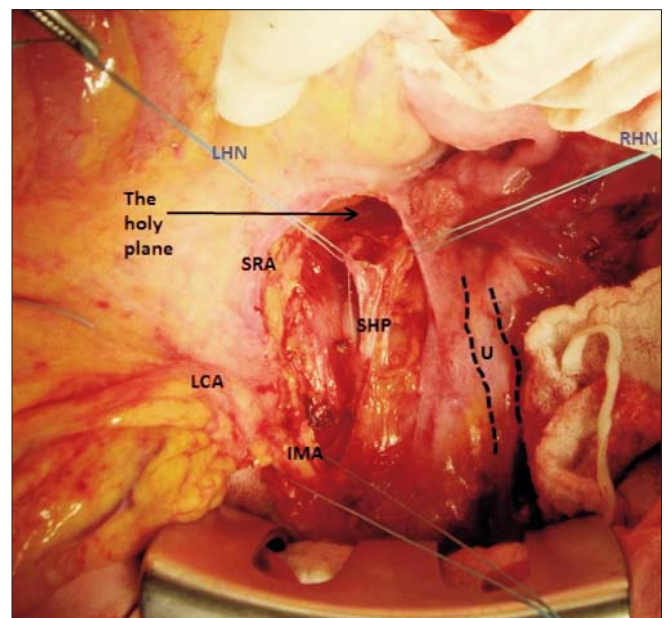


Figure 2. Open approach. The holy plane is opened in the retrorectal space, between the yellow color of the mesorectum covered by the mesorectal fascia (the shiny aspect) – anteriorly and the presacral fascia – posteriorly. Both HN and IMA elevated using rubber strings.

Abbreviations: IMA – inferior mesenteric artery; LCA – left colic artery; SRA – superior rectal artery; SHP – superior hypogastric plexus; LHN&RHN – left & right hypogastric nerves; U – right ureter. (Image belonging to the Colțea Surgery Department)

(Fig. 2). The artery is ligated at a distance of 1.5-2 cm to its origin from the aorta or strictly distal to the left colic branch (depending on the localization of the tumor) because of the SHP fibres that are lying in front of the aorta. By sparing the preaortic connective tissue and keeping a small artery stump, the preaortic plexus is preserved (2,9). The left trunk of the SHP runs along the left side of the aorta being closer to the IMA than the right trunk which is placed in the aortocaval plane (6). Mass clamping of the IMA at its origin with a vascular stapler increases the risk of iatrogenic damage of the left trunk of the plexus (2). The correct dissection plane is located just below the upper rectal vascular pedicle and is identified by gently pushing down the nerves climbing the artery (Fig. 2). The dissection is performed from medial to lateral along the areolar tissue between the sigmoid mesocolon and Gerota fascia (Fig. 3). During the dissections the ureter and gonadal vessels are visualized but they remain covered by the Gerota fascia. The anatomical area between the gonadal vessels and the ureter (laterally) and the aorta (medially) contains the SHP fibres (1,17,18). Normally the Gerota fascia is not opened and the fibres remain intact.

The left trunk of the SHP joins the right trunk on the anterior wall of the inferior segment of the aorta and forms the SHP which covers the interiliac and the presacral area (Fig. 3). At the level of the promontory this sympathetic presacral plexus divides into the right and left hypogastric nerves (Fig. 2). At the transition of the mesosigmoid to the mesorectum we meet a second risk area for the iatrogenic damage of the presacral plexus and the hypogastric nerves. The high posterior dissection of the rectum begins after entering the median point of the space placed approx. 2 cm anterior to the promontory. The anatomical landmarks for "the Heald's holy plan" developed in the presacral space are the pelvic parietal fascia which remains dorsally and the yellow color of the mesorectum covered by the mesorectal fascia (the shiny aspect) which are visualized ventrally (Figs. 2,3) (6,17,18). At the level of the promontory, the superior rectal artery is situated just anterior to the fascia propria, which maintains its posterior position to the vascular pedicle during the high posterior dissection in the right avascular plane (Fig. 2). The superior rectal artery act as a landmark to find the plane at the promontory level (2). If dissection is too posterior, in contact with the sacrum, the parietal preasacral fascia is opened increasing the risk of damaging both the presacral veins and the and the HN (9,16). If dissection starts too laterally, in contact with the ureter, we find ourselves in a wrong posterior plan as compared to the HN thus resulting in a higher probability to cut these nerves from posterior to anterior (Fig. 4) (1,2). As we know in the retrorectal area there is a loose layer between the fascia propria and that layer of parietal fascia containing the hypogastric nerves (the holy plan) but in many cases there is a further loose areolar tissue posterior to the hypogastric nerves, within the parietal fascia layers. The major risk is to enter in this wrong plan of dissection (7). If the HN appears to run into the mesorectum we are in a too posterior plane within the parietal fascia and it's necessary to develop a more anterior plane on the fascia, immediately

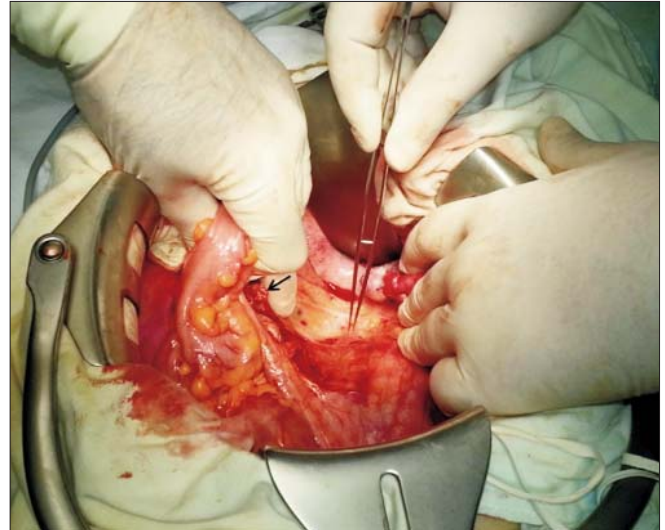


Figure 3. Open view. The IMA artery was divided just distally to the left colic artery origin (arrow) and the finger is in contact with the rectal artery in order to find the holy plane. The preaortic sympathetic fibres are included in the preaortic connective tissue (surgical instrument on the SHP division).

(Image belonging to the Colțea Surgery Department)

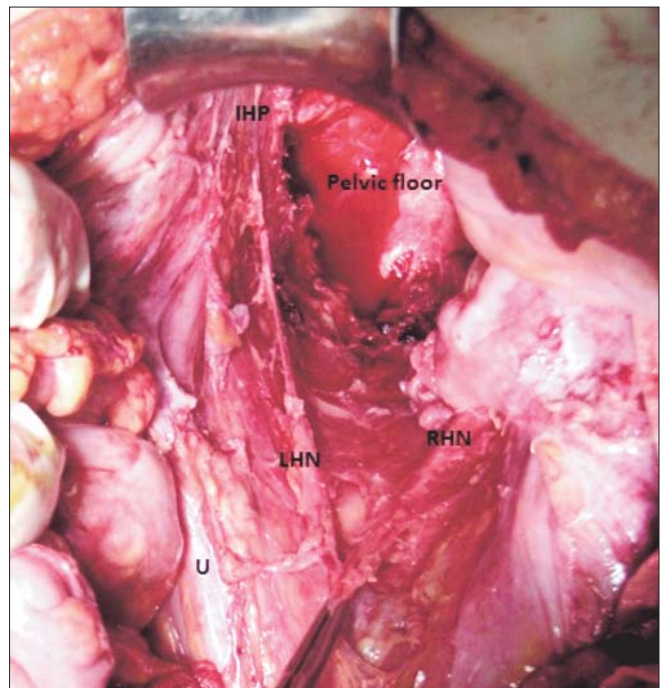


Figure 4. Open view after specimen removal. Surgical instrument on the SHP's division. The ureter is laterally tractioned. The HN are followed till they enter the deep layers of the parietal fascia to plunge into the IHP.

Abbreviations: SHP – superior hypogastric plexus; LHN&RHN – left & right hypogastric nerves; IHP – inferior hypogastric plexus; U – left ureter

(Image belonging to the Colțea Surgery Department)

posterior to the superior rectal artery (12). Isolated lesions at this level cause impaired ejaculation but, maintaining a quasi-normal erection (1).

Going down in the avascular retrorectal plane, the low posterior sharp dissection of the rectum identifies the rectosacral ligament which is inconsistent in appearance and is usually found in the form of multiple discrete connective tissue fibres between the parietal fascia at the level of S4 (preasacral fascia) and propria fascia, 3-5 cm to the anorectal junction (Fig. 5) (9,12). Distal to this ligament the mesorectum, with the contained rectal tube, angulates anteriorly and therefore below the horizontal part of the rectum there is a wide space without any risk of nerve damage in this area (12).

A third important key risk zone is found at the level of the high lateral dissection of the mesorectum after opening the laterorectal reflection of the peritoneum. The lateral dissection is best done after the posterior dissection has gone as far as possible (12). At this time of dissection the first step is to identify and spare the HN. By traction and counter-traction we identify the areolar plane between the fascia propria and pelvic fascia and continue the dissection on the fascia propria which is previously identified in the retrorectal space. The separation of the two layers, fascia propria and the endopelvic parietal fascia, is made through the areolar (avascular) plane starting from the retrorectal space, just in contact with the fascia propria. Some authors consider the fascia propria as the landmark for dissection rather than the loose areolar tissue (the "holy plan") outside it (12). The HN can be visualized relatively well running from the bifurcation previously highlighted and both HN may be elevated using a rubber string at the level of the promontory in order to have the nerves under direct vision (8). They run parallel to the ureter, 1-2 cm medially, underneath the internal iliac vessels (12). The parietal fascia containing the hypogastric nerve is the same layer of fascia that contains the IHP and from which the lateral ligaments are formed (7). The HN are followed till they enter the deep layers of parietal fascia to plunge into the IHP (Fig. 4), gently easing the adherent nerves laterally off the mesorectal fascia.

The dissection goes anterior for the identification and complete dissection of the seminal vesicles and of the area behind the prostate (Figs. 6, 7). The rectum is posterolaterally counter-tractioned on the vesicular area. The dissection passes to a low anterior level, which is a new risk area for the autonomic nerve damage. The fascia of Denonvilliers (rectovesical in the male and rectovaginal in the female) is displaced anterior to the propria fascia and is formed by the fusion of two layers of peritoneum which are white and quite distinct in young patients. It is not so easy during surgery to separate its components in elderly patients, after neoadjuvant radiotherapy, in very low huge tumors or a narrow pelvis (12). RJ Heald's concept of the Denonvilliers' fascia resection, that he considers to represent the anterior surface of the mesorectum, is maintained for some authors only for the anterior located cancers, this one being an extramesorectal plan with an increased risk of nerve damage (2,4,5,17,19). For the posterior and lateral rectal tumors the

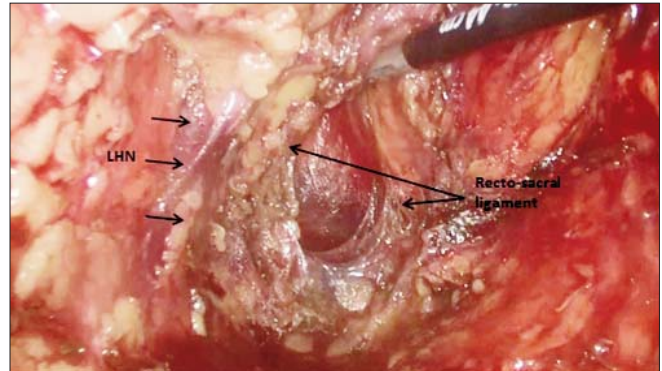


Figure 5. Laparoscopic retrorectal view. The recto-sacral ligament is dissected from the propria fascia in its median portion. The LHN is covered by the endopelvic fascia. Abbreviation: LHN– left hypogastric nerve. (Image belonging to the Colțea Surgery Department)

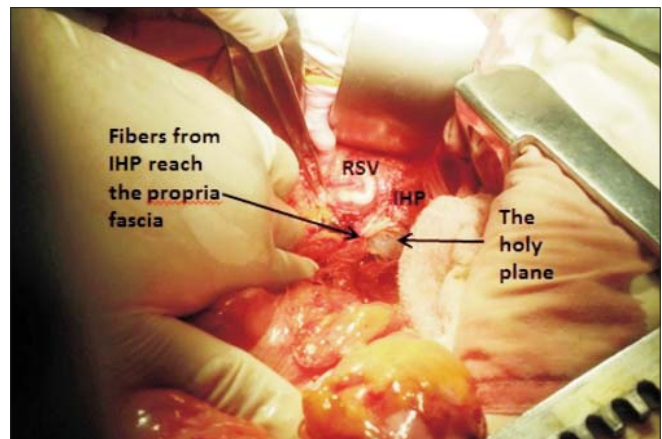


Figure 6. Open view – anterolateral dissection. Fibres from the anteroinferior pole of the IHP running to the rectum are divided at the point of contact with the fascia propria. This pole is in contact with the lateral margin of the Denonvilliers fascia. Abbreviation: RSV– right seminal vesicle. (Image belonging to the Colțea Surgery Department)

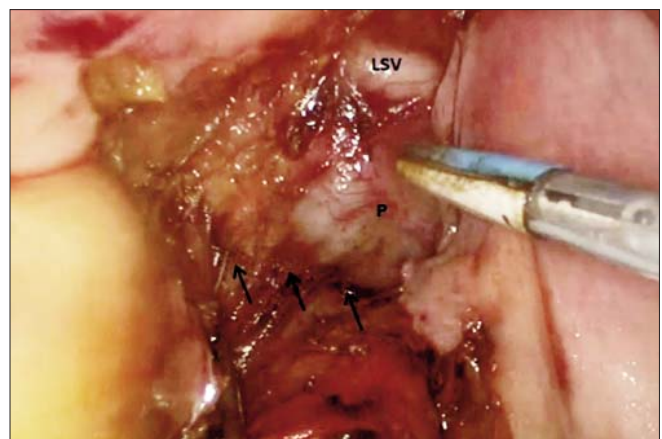


Figure 7. Laparoscopic view of the deep anterior dissection. The posterior layer of the Denonvilliers fascia is tractioned dorsally and the shiny anterior layer covers the prostate. The dissection is performed between the two layers (arrows). Abbreviation: LSV– left seminal vesicle; P – prostate. (Image belonging to the Colțea Surgery Department)

Douglas pouch and the rectum are moderately pulled posteriorly highlighting the Denonvilliers' fascia and entering in the middle of it (between its layers) or posteriorly (in contact with the propria fascia) (Fig. 7) (17,19,20). These are safer planes of dissection for the autonomic nerves than the one which is carried out anterior to the ventral layer of the fascia. Therefore the entire rectoprostatic fascia (or its ventral layer) is left intact on the prostate and seminal vesicles and not on the anterior surface of the rectum (21). The dissection in front of Denonvilliers' fascia is at risk for the nerves especially on the lateral edges which are not clearly defined and where there are connective adhesions with the propria fascia thus resulting in an improper plane (2,12,15,19). The autonomic nerves (the Walsh neurovascular bundles) are at risk at this level because they lie laterally just anterior to the Denonvilliers fascia which is the only anatomical structure that separates the rectum from the nerves. Then the neurovascular bundles go down toward the urethra at the apex of the prostate. The safer technique to ensure the nerve's integrity is to keep the contact with the propria fascia, which is the landmark for this level as well (12). Below the rectoprostatic fascia the mesorectum ends and the correct plane of dissection is along the muscular wall of the rectum. In summary there is no consensus related to the proper anterior anatomical plane of dissection and the two main planes used are: the mesorectal plane situated immediately outside the fascia propria and the extramesorectal plane, anterior to the Denonvilliers fascia that is resected, which presents a high risk of iatrogenic nerve damage (2,12). The questions asked are whether these planes are easily differentiated and which should be used and when? (21). Most opinions recommend to perform the extramesorectal resection (anterior to the rectoprostatic fascia) only when there is a risk of leaving a tumour-positive anterior resection margin, assuming the risk of damage to the cavernous nerves (2,16,17,19,21).

Laparoscopy at this level presents clear advantages as compared to the open approach, especially with the side-view telescope 45° (Fig. 7) (16,17,22). This area of dissection is a place where robotic surgery can make a contribution in the future, using robotic prostatectomy experience (2,23). Nerve's damage in this area leads to the development of male impotence, while women experience pain and discomfort on intercourse and orgasm disorders following vaginal denervation and mucosal reduced lubrication (1). Finally the dissection passes distally down to the ano-rectal junction (12).

The lateral low dissection involves the risk of damaging the inferior hypogastric plexus (Fig. 6). Once the anterior dissection is complete this step of dissection becomes easier (12). The plane of dissection is carried out on an imaginary line drawn between the seminal vesicles, anteriorly, and the origin of the HN, posteriorly. The rectum is moderately tractioned medially with gentle lateral counter-traction and this actions conduct to the loose areolar plane just outside the fascia (12,16,19). The "lateral ligaments" are located 2-3 cm below the lateral reflexion of the peritoneum and can be palpated between the fingers and sectioned without ligation (they rarely contain a notable vessel) at the contact

with the propria fascia (Fig. 6) (7,9,12,24). At this level the IHP is situated at a mean distance of 1-2 cm from the propria fascia (7). Excessive traction on the rectum "moves" the IHP in the dissection field by tenting the ligaments (2,12). The IHP must remain covered in a layer of parietal fascia in order to remain intact and the major risk of its damage is when the dissection is too close to the parietal pelvic fascia. Blind mass clamping or ligation on the pelvic sidewall contributes to the lateral mesorectal damage and creates a false impression of "rectal wings" which represents in fact the remaining mesorectum on the pelvic wall (1). In such cases IHP is inevitably damaged. At this level we prefer performing dissection with scissors or Ligasure because plexuses are close to the dissection field and electric current does not dissipate away. The dissection goes down to the pelvic floor except in tumors in the upper rectum where the mesorectum is divided at 5 cm below the inferior edge of the tumor (12). The surface of the levator ani muscle is exposed all around the rectum and then the rectum is transected.

Splanchnic nerve damage at the sacral roots level is rare in TME and can occur only if there is a large oncologic dissection with extended iliopelvic lymphadenectomy, concept which is not preferred today. Levator ani and pudendal nerve damage is a complication of the abdomino-perineal rectal amputation of the rectum (involving important tissue sacrifices) and not of the proper total mesorectal excision.

Conclusions

Total mesorectal excision is widely accepted as standard technique in rectal cancer (25). It produces better oncological outcomes compared to non-standardized surgery with acceptable morbidity rates. Before introduction of TME, the incidence of the genitourinary dysfunctions were high. The anatomical knowledge of the pelvic autonomic nerves distribution (sympathetic and parasympathetic) is the basis of the TME with nerve sparing technique in rectal cancer. All pelvic autonomic nerves should be preserved in a standard total mesorectal excision unless there is evidence of tumor involvement into nerve structures which requires deliberate sacrifice of the nerves. The pattern of injury depends not only on the direct damage of the nerves, as they may also be injured due to the excessive traction or prolonged electrocoagulation. Surgical performance requires not using digital blind dissection and the technique should include identification and preservation of the nerves based on the anatomical landmarks. The functional results are maximal in the preservation of total autonomic nerve system. A complete mesorectal specimen with an integral propria fascia is proof of a correct mesorectal excision with nerves spared (Figs. 8, 9).

As a summary, in order to determine where the nerve injury takes place most often during TME, four main key zones of risk were described. Two risk zones for sympathetic nerve damage are known: in the abdomen – during ligation of the IMA and at the time of high posterior rectal dissection adjacent to the hypogastric nerves. The other two zones



Figure 8. Specimen after high anterior resection for an upper rectal tumor (partial mesorectal excision). The stumps of the inferior mesenteric vein (IMV) and of the inferior mesenteric artery (IMA) are shown (arrows). The vessels are divided at their origins. The uniform aspect of the shiny mesorectal fascia indicates a correct excision in the holy plane.
(Image belonging to the Colțea Surgery Department)



Figure 9. Specimen after abdominoperineal resection for an ultralow rectal tumor. The propria fascia is complete.
(Image belonging to the Colțea Surgery Department)

are more susceptible to iatrogenic damage: while dissecting laterally deep in the pelvis near the IHP (parasympathetic nerves) and particularly during low anterior dissection of the rectum, away from the seminal vesicles and prostate adjacent to the cavernous nerves (2,16,12,21). A deeper rectal dissection (in abdominoperineal or low anterior resections) is associated with a higher rate of nerves' trauma, especially in the deep anterior area, as compared to the anterior resection for upper rectal cancer (21). The mesorectal plane is better defined posteriorly than anteriorly. This is the most difficult point of dissection technique-wise notably in men with narrow pelvis and bulky tumors or in intraoperative bleeding which requires prolonged diathermy control (4,16,20,22).

Preoperative planning in rectal cancer surgery includes patient counselling regarding the possibility of developing post-operative genitourinary dysfunctions. Colorectal surgeons need also to be more aware of the details of the surgical anatomy of the rectum and surrounding pelvic structures in order to improve the functional outcomes of pelvic oncologic surgery (21).

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