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INJURY TO THE RECTUM DURING LAPAROSCOPIC RADICAL PROSTATECTOMY: IS IT A SERIOUS COMPLICATION?

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Introduction. Rectal injury is a serious intraoperative complication of radical prostatectomy (RP), with its reported incidence varying widely in the literature from 0 to 20.39%. Delayed diagnosis of rectal injury increases the risk of peritonitis, sepsis, and rectourethral fistula formation. The optimal strategy for prevention and management of this complication remains a matter of debate.
Aim. To analyze the causes of rectal injury during laparoscopic radical prostatectomy (LRP) and the efficiency of therapeutic measures based on the authors' own experience in comparison with the published literature.
Materials and methods. A retrospective analysis was performed of 519 LRP procedures carried out at a single center between 2014 and 2023. Intraoperative rectal injury was identified in 3 patients (0.58%). In all cases, LRP was performed via an extraperitoneal approach. A bubble test was used for intraoperative diagnosis of rectal injury. All defects were closed with a two-layer suture using absorbable material. Postoperative management included antibiotic therapy, parenteral nutrition for 6-9 days, and prolonged bladder catheterization for 9-14 days.
Results. The length of the rectal defect ranged from 1.0 to 3.5 cm. There was no need for conversion to open surgery or colostomy. No surgical complications, suture failure, or signs of oncological disease progression were recorded during a follow-up period of 46-113 months.
Discussion. Intraoperative rectal injury during LRP is a rare complication. Timely intraoperative diagnosis, including the use of a bubble test, and immediate two-layer closure of the defect make it possible to minimize the risk of severe postoperative complications and rectourethral fistula formation.
Conclusion. Previous radiation therapy and prior surgery increase the risk of rectal injury, whereas intraoperative closure of the defect usually does not require colostomy and rarely results in complications. The role of preoperative bowel preparation and parenteral nutrition in preventing suture failure remains unclear.

K e y w o r d s: *radical prostatectomy, iatrogenic rectal injury, intraoperative diagnosis, extraperitoneal approach*

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Introduction. Rectal injury is a serious complication of radical prostatectomy (RP). It has been reported in 0 to 20.39% of cases, with the incidence of rectal injury during RP varying substantially across studies [1]. During retropubic RP, rectal injury may occur mainly during apical dissection when attempting to create the posterior plane between the rectum and Denonvilliers' fascia [2], whereas during perineal RP the critical stage is dissection of the posterior surface of the prostate from the rectum. In contrast, during laparoscopic RP (LRP) or robot-assisted RP (RARP), rectal injury more commonly occurs during dissection of the seminal vesicles and creation of the posterior plane between the prostate and the rectal wall.

Rectal injury may be detected intraoperatively or diagnosed postoperatively after the onset of clinical symptoms. Regardless of the time of detection, it may significantly increase the risk of early postoperative complications such as peritonitis and sepsis, as well as delayed consequences such as rectourethral fistula (RUF) [3]. The later rectal injury is identified after RP, the greater the likelihood that the patient will require reintervention for temporary or permanent fecal and/or urinary diversion [4].

Given the low incidence of rectal injury during RP, uncertainty remains regarding the predisposing risk factors and optimal management of this complication.

Aim. To analyze the causes of rectal injury during LRP and the effectiveness of therapeutic measures based on our own experience compared with the published literature.

Materials and methods. The study included 519 patients with prostate cancer who underwent LRP in our clinic between 2014 and 2023. Intraoperative rectal injury was observed in 3 patients (0.58%). At the time of surgery, the patients were 61-71 years old (*Table 1*). In all patients, standard transrectal biopsy revealed prostate adenocarcinoma with a Gleason score of 6-7. Prostate-specific antigen (PSA) levels ranged from 7.1 to 13.2 ng/mL. One patient had previously undergone transurethral resection (TUR) for benign prostatic hyperplasia (BPH).

All these patients underwent LRP via an extraperitoneal approach. In all cases, rectal injury was detected intraoperatively (*Fig. 1*). The bowel defect was closed

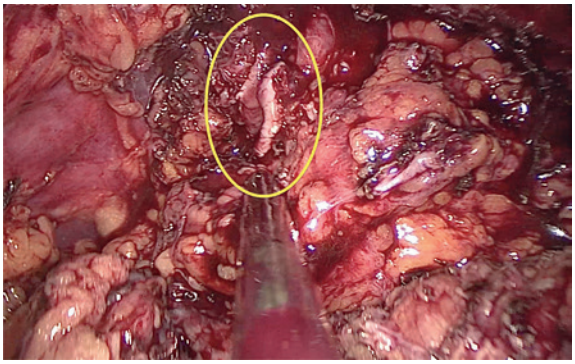


Fig. 1. Rectal injury detected during extraperitoneal LRP

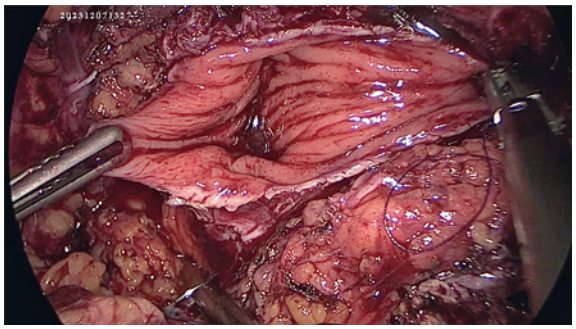


Fig. 2. Intraoperative view. Beginning of the first layer of the bowel suture

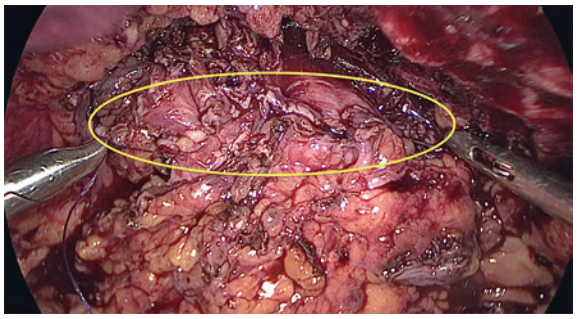


Fig. 3. Intraoperative view. Completion of the continuous suture

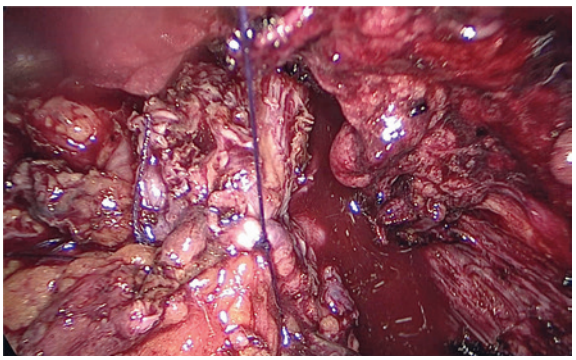


Fig. 4. Intraoperative view. Creation of the second layer with interrupted sutures

with a two-layer suture using absorbable polyglactin or polyglycolic 3/0-2/0 sutures (*Figs. 2-3*). The second layer was created with interrupted polyglactin sutures (*Fig. 4*). The vesicourethral anastomosis was then done in the standard manner (*Fig. 5*).

At the end of surgery, all patients with rectal injury underwent dilatation of the anal sphincter.

Results. No seminal vesicle invasion, lymph node involvement, or positive surgical margin was found in any of the three patients with rectal injury (*Table 2*). No postoperative surgical complications occurred in any patient. In the early postoperative period, all patients received parenteral nutrition for 6-9 days, antibacterial therapy, and low-molecular-weight heparins.

The urethral catheter was removed on postoperative days 9-14 after control cystography (*Fig. 6*). The patients were discharged from the hospital on postoperative days 10-15.

During follow-up of 46-113 months, none of the patients developed biochemical recurrence or signs of disease progression.

Discussion. In a systematic review of 88 selected studies out of 1806, the incidence of rectal injury during RP ranged from 0.10 to 4.71%. The incidence of rectal injury after RP gradually decreased with improvements in surgical technique and increasing experience, from 26% in 2003-2006 to 1.5-5.5% in 2009-2012. In most more recent studies, however, the incidence did not exceed 1% [5, 8, 11]. Moreover, in studies including more than 500 cases, the incidence ranged from 0.52 to 0.59% [1]. In our series, the incidence of rectal injury during LRP was 0.58%.

Some studies reported a higher incidence of rectal injury in patients older than 60 years compared with younger

Table 1

Main characteristics of patients with rectal injury during LRP

Patients	1	2	3
Age, years	61	71	64
PSA, ng/mL	8.4	13.2	7,1
Prostate volume, cc	78	90	31
Gleason score	7 (3+4)	6 (3+3)	7 (3+4)
pTNM stage	pT2cN0M0	pT2cN0M0	pT2bN0M0
Previous pelvic surgery	none	none	TUR of the prostate

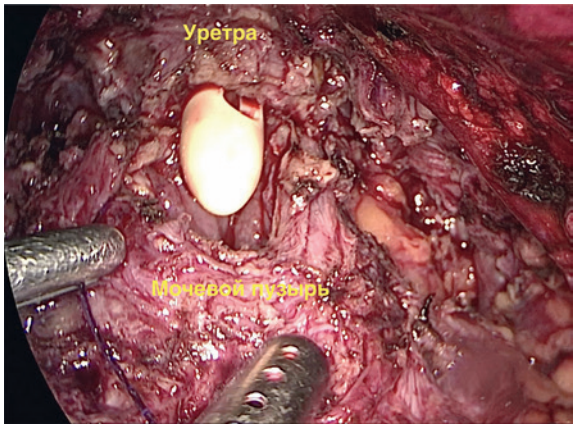


Fig. 5. Intraoperative view. Construction of the vesicourethral anastomosis

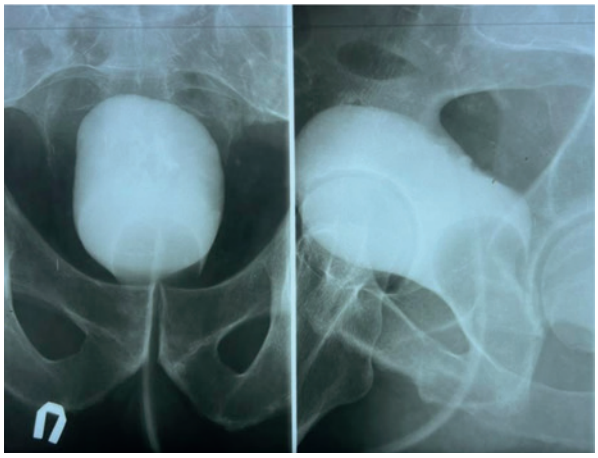


Fig. 6. Control cystogram 10 days after procedure

patients [1]. The age of our patients ranged from 61 to 71 years, which can be viewed neither as a contradiction of nor as confirmation of these data.

Although rectal injury may occur regardless of the surgical approach used, meta-analytic data showed that injuries were more frequent during transperitoneal procedures [1]. Other studies have also shown a higher risk of rectal injury in patients undergoing retropubic RP compared with those treated with LRP or RARP [5, 8, 11].

All three patients described above underwent LRP via an extraperitoneal approach, as did the vast majority of RP in our center. Today, the capabilities of conventional laparoscopic procedures, including three-dimensional imaging, 4K resolution with 30° optics or even a flexible-tip camera, allow to visualize and dissect the posterior plane at the level of the seminal vesicles, prostate, and its apex under direct vision with no less safety than in robotic surgery. Thus, the risk of rectal injury is minimized. In addition, the extraperitoneal approach substantially facilitates diagnosis if delayed rectal complications occur and partly mitigates their consequences by preventing diffuse peritonitis.

Most studies assessing perioperative outcomes of Retzius-sparing RARP did not specifically address rectal injury. Galfano et al. [19] reported in 2021 a rectal injury rate of 0.2% in a large series of 626 patients undergoing Retzius-sparing RARP, with all injuries detected in patients operated on by surgeons during the learning curve. Similarly, Abdel Raheem et al. [20] in 2018 reported a rectal injury rate of 0.3% in a series of 359 patients treated with Retzius-sparing RARP.

Previous pelvic radiotherapy for prostate cancer or other conditions has been associated with an increased risk of rectal injury. Several authors reported incidences ranging from 2 to 15% in patients undergoing RP [7, 11, 21]. Notably, in a multicenter, multi-surgeon study including 395 patients who underwent salvage RP (186 retropubic RP and 209 RARP), Gontero et al. [7] reported a rectal injury incidence of 2.96% after retropubic RP and 0.48% after RARP. None of our patients with bowel injury had undergone prior radiotherapy. At the same time, none of the at least seven patients operated on in our center after brachytherapy sustained rectal injury. This may reflect increased surgical vigilance in such cases.

One of the three patients had previously undergone TUR for BPH. According to meta-analysis, previous surgery for BPH and a large prostate volume were considered additional risk factors for rectal injury [1].

Prostate volume in our patients ranged from 31 to 90 cc. On the other hand, none of the patients treated during the study period with prostate volume greater than 150 cc had bowel injury. This is consistent with the findings of another single-center study by Mandel et al. [11], who found no correlation between prostate volume and rectal injury.

Other factors potentially increasing the risk of rectal injury include prior androgen deprivation therapy, pelvic fractures, and rectal surgery, because periprostatic fibrosis may complicate dissection of the posterior surface of the prostate [9]. In particular, patients with inflammatory

Table 2

Perioperative features in patients with rectal injury

Patients	1	2	3
Length of bowel defect	1 cm	1.5 cm	3.5 cm
Surgical approach	Extraperitoneal	Extraperitoneal	Extraperitoneal
Duration of parenteral nutrition, days	6	7	9
Duration of catheterization, days	9	10	14
Duration of hospitalization, days	10	11	15
Signs of disease progression	none	none	нет
Follow-up period, months	46	113	85

bowel disease and prior colorectal procedures, including colostomy closure, have been highlighted. Luciani et al. [22] reported 14 RARP procedures after colorectal surgery without rectal injury, but with conversion to open surgery in 21% of cases. In those cases, the authors used a retropubic approach.

None of our patients had prior colorectal surgery. At the same time, in interventions on similar patients in our center (five during the study period, including one after extirpation of the rectum), we observed no bowel injuries and did not perform conversion to open surgery. However, it should be noted that an extraperitoneal approach was used in all cases. Interestingly, obesity may reduce the risk of rectal injury by increasing the tissue plane between the rectum and the prostate [5]. However, Mandel et al. [11] found no correlation between body mass index and rectal injury.

Based on a large series of 24,178 RP, tumor-related risk factors for rectal injury were proposed: high preoperative total PSA, high Gleason score, lymph node involvement, and positive surgical margin - features typical of locally advanced disease [5, 11, 13]. From this standpoint, our patients did not have tumor-related risk factors. PSA levels ranged from 7.1 to 13.4 ng/mL, Gleason scores were 6, 6, and 7, respectively, and no positive surgical margin or lymph node involvement was identified in any case.

Current clinical guidelines do not define specific preoperative measures aimed at reducing the risk of rectal injury or minimizing its consequences. Some authors use bowel preparation to reduce the severity of subsequent infectious complications if rectal injury occurs [10, 17]. However, analysis of 35,099 RP cases in the Japanese database between 2007 and 2012 showed that bowel preparation did not affect perioperative complications associated with rectal injury during RP [16, 23]. We currently use bowel preparation before LRP only in patients at high risk of rectal injury: previous colorectal surgery or radiotherapy, stage T3 disease, involvement of more than 50% of the prostate or an apical lesion on biopsy or MRI, PSA above 15, and Gleason score 8 or higher. We observed no postoperative surgical complications in any patient after bowel repair during LRP. However, all cases presented here occurred during the period when bowel preparation was routinely used, making it impossible to determine whether it played a significant role in preventing complications.

The management and prognosis of rectal injury after RP differ considerably depending on whether it is detected intraoperatively or postoperatively. Intraoperative detection of rectal injury, as compared with postoperative detection, is strongly associated with a lower risk of severe postoperative complications and subsequent RUF formation [14]. Therefore, all intraoperative measures aimed at preventing and identifying rectal injury should be seriously considered. Careful dissection between the prostate and the rectal wall using cold scissors without monopolar coagulation, visualization of periprostatic fat during extrafascial dissection, and minimizing traction on the rectal wall in the presence of periprostatic adhesions may substantially reduce the risk of rectal injury [25, 26]. These maneuvers become especially important in the presence of extracapsular invasion, locally advanced disease, or pronounced adhesions, sometimes resulting from biopsy [24].

In many centers, including ours, a rectal tube is inserted immediately before the start of surgery to allow subsequent performance of a bubble test, which is mandatory in our center. After removal of the prostate and hemostasis, the pelvic cavity is filled with saline. Then 100-150 mL of air is introduced through the rectal tube. The appearance of bubbles clearly indicates rectal injury [12, 27]. In such cases, an additional two-finger digital rectal examination performed by the assistant allows more accurate assessment of the extent of injury [6]. It is also advisable to obtain a swab for identification of potential pathogenic flora and antimicrobial resistance in order to minimize the risk of postoperative infectious complications [25].

During LRP, rectal injury may occur early during mobilization of the seminal vesicles and posterior surface of the prostate. In such cases, some authors recommend immediate repair of the rectum before further mobilization of the prostate [18]. In all our cases, however, the bowel wall was sutured after removal of the prostate and placement of the specimen into a retrieval bag, because this provided much better spatial conditions for bowel suturing. However, regardless of the approach, the rectal defect should be closed before formation of the vesicourethral anastomosis [14]. The defect is usually closed with a two-layer suture using absorbable polyglactin or polyglycolic 2-0 or 3-0 sutures [6, 14]. The use of endoscopic clips and fibrin glue has also been described [28]. In the transperitoneal approach, the omentum or a peritoneal flap harvested from the lateral pelvic wall may be used to separate the rectal suture line from the anastomosis [24, 27]. We did not use additional materials to separate the suture lines, because all LRPs were performed via an extraperitoneal approach. However, none of our patients developed suture failure or fistula formation.

There is controversy regarding indications for colostomy in patients with rectal injury during RP. According to some investigators, only 10% of patients with rectal injury underwent colostomy [5, 11, 15]. Primary colostomy should be considered in patients with large rectal defects (>2 cm), prior radiotherapy, or previous surgery for BPH, as well as when infiltration of the rectum by prostate cancer is suspected [27]. However, these features cannot be considered absolute indications for colostomy. One of our patients had previously undergone TUR of the prostate, and in another, used here as an example, the bowel defect was about 5 cm. Nevertheless, simple two-layer closure of the defect was successful in both and did not lead to any surgical complications.

In the postoperative period, some authors recommend a liquid diet starting on postoperative day 1, with gradual dietary advancement after day 3, along with broad-spectrum antibiotic therapy [11]. In addition, some investigators suggest prolonging catheterization to two weeks or more, followed by cystography [11, 26, 27]. The duration of catheterization in our patients was 10-15 days. We routinely perform cystography before catheter removal in all patients, regardless of intraoperative features or complications.

The greatest risk of severe, potentially fatal surgical complications is posed by rectal injury that is not recognized during prostatectomy and is diagnosed later in the postoperative period after symptoms develop. Some marginal bowel injuries caused by modern energy devices, such as impedance-controlled bipolar coagulation or ultrasonic dissectors, may go unnoticed even with a bubble

test. These devices may effectively seal the bowel defect, and perforation may occur several days later.

The most severe consequences, including peritonitis, may develop in cases in which RP was performed via a transperitoneal approach [27]. Early symptoms include abdominal pain, fever, tachycardia, tachypnea, hypotension, and even oliguria. These manifestations may be accompanied by leukocytosis, thrombocytopenia, and elevated serum inflammatory markers [29].

Some authors believe that defects smaller than 1.5 cm may be managed conservatively with broad-spectrum antibiotics, prolonged bladder catheterization for 1-3 months, and parenteral nutrition, provided there are no signs of peritonitis or sepsis. However, the development of fever, peritonitis, pelvic abscess, and other infectious complications requires immediate surgical treatment, including colostomy and closure of the rectal defect [4, 30, 31]. Larger defects or injuries involving the urethral sphincter require immediate surgery. Nevertheless, a substantial proportion of patients develop rectourethral fistulas in the following weeks both after conservative treatment and after delayed surgical treatment for rectal injury [4, 5, 30, 31].

In one of our patients, the bowel defect measured about 3.5 cm. However, intraoperative closure of the injury, combined with preoperative bowel preparation and parenteral nutrition for 10 days postoperatively, allowed to avoid subsequent rectourethral fistula formation.

Conclusion. Intraoperative rectal injury during LRP is rare. Previous radiotherapy and rectal surgery are potential additional risk factors for injury. It is possible that LRP performed via an extraperitoneal approach is associated with a lower risk of rectal injury.

Intraoperative detection and closure of the defect are not indications for colostomy and in the absolute majority of cases do not lead to postoperative complications.

The role of preoperative bowel preparation and subsequent parenteral nutrition in preventing suture failure and RUF formation in cases of rectal injury during RP remains insufficiently clarified.

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