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Intra- and early postoperative complications of laparoscopic and robot-assisted radical prostatectomy

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ABSTRACT

Radical prostatectomy is the gold standard for the treatment of localized prostate cancer. In the last decade, new surgical technologies have been actively implemented that certainly increases the efficiency of oncourological treatment. The rate of intra- and postoperative complications of radical prostatectomy yet remains quite high. In this regard, crucial tasks of modern urology are minimizing of their number and effective treatment. In the review article, intra- and early postoperative complications of laparoscopic and robot-assisted radical prostatectomy have been considered.

Keywords: radical prostatectomy; complications; lymphocele; anastomotic leakage; pelvic lymph node dissection.

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Интра- и ранние послеоперационные осложнения лапароскопической и робот-ассистированной радикальной простатэктомии

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АННОТАЦИЯ

Радикальная простатэктомия является золотым стандартом лечения локализованной формы рака предстательной железы. В последнее десятилетие активно внедряются новые хирургические технологии, что безусловно повышает эффективность лечения онкоурологических больных. Несмотря на это, частота интра- и послеоперационных осложнений радикальной простатэктомии остается достаточно высокой. В этой связи минимизация их числа и эффективное лечение становятся актуальными задачами современной урологии. В обзорной статье рассмотрены интра- и ранние послеоперационные осложнения лапароскопической и робот-ассистированной радикальной простатэктомии.

Ключевые слова: радикальная простатэктомия; осложнения; лимфоцеле; несостоятельность анастомоза; тазовая лимфаденэктомия.

Как цитировать

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INTRODUCTION

Prostate cancer (PC) is one of the most significant issues of modern medicine. This is due to both high incidence with a steady upward trend and late diagnosis with no radical surgical treatment possible. PC is the second leading type of cancer in males, accounting for 14.5% of cases, with trachea, bronchus and lung cancer being the first (17.4%) [1, 2]. In Russia, between 2007 and 2017, the PC mortality rate increased by 13.85% with an average yearly increase of 1.29% [2]. Despite the improved methods of PC diagnosis, including the introduction of prostate-specific antigen monitoring, late-stage PC diagnosis is still persistently high [2].

Radical prostatectomy (RP) is the gold standard of treatment for localized PC. The progress in surgical technology led to the active introduction of minimally invasive RP techniques. In 1997, Schuessler et al. [3] performed the first laparoscopic radical prostatectomy (LRP) and noted its benefits compared with the open surgery. Then, 4 years after, in 2001, Binder et al. [4] performed and published the results of robot-assisted radical prostatectomy (RARP).

As any other surgical technique, RP has a number of complications which can be divided into intraoperative, and early and late postoperative complications. With the introduction of laparoscopic and robot-assisted surgical technologies the number of complications decreased [5, 6]. Another important aspect of minimizing the number of complications is the learning curve. Thus, in the study by Ryabov et al. [7], the incidence of complications in LRP decreased after 65–150 surgeries and plateaued after 150–200 surgeries. In RARP, the incidence of complications decreased after 25–120 surgeries and plateaued after 50–200 surgeries [7]. The RP outcomes depended on both the experience of the operating surgeon and the overall number of surgeries performed in the department. It is worth noting that countries have different criteria for the number of surgeries in surgical training, making it impossible to define the lower threshold based on the published data.

During the surgical access to the abdominal cavity or preperitoneal space, such complications as intestinal or large vessel injury may occur. When performing pelvic lymph node dissection (PLND), there is a danger of injuring the iliac vessels, intestine, ureters, or obturator nerve. During prostate mobilization, the intestine and the bladder might be injured, and bleeding from the dorsal venous complex (DVC) can occur. Early postoperative complications include vesicourethral anastomotic leakage and lymphocele.

INTRAOPERATIVE COMPLICATIONS

There are two basic techniques to access the abdominal cavity in RP: open and laparoscopic. The laparoscopic access can be either direct using optic trocar or indirect using Veress needle.

Open access to the abdominal cavity was first described by Hasson in 1971 [8]. He also analyzed 17 publications concerning the results of this technique and compared those with the literature on laparoscopic access. The author noted that the incidence of infection in the umbilical region in open access was 0.4%, while the incidence of intestinal injury was 0.1%, and the incidence of vessel injury was 0%. In laparoscopic access, these values were 1%, 0.2%, and 0.2%, respectively [9]. In 2001, Schäfer et al. conducted a meta-analysis of the studies on direct and indirect laparoscopic access to the abdominal cavity including 14,243 subjects. In the study, intestinal and vessel injury occurred in 26 subjects (0.18%). In 4 cases, Veress needle was used, and in the other 22 cases trocar was used [10]. Catarci et al. [11] also analyzed the results of 12,919 laparoscopic surgeries and noted that the incidence of complications was 0.09% using Hasson's technique, 0.18% using Veress needle, and 0.27% using optic trocar.

The most common **vascular complication** often noted during surgery is inferior epigastric vessel injury. The injury usually occurs when inserting lateral trocars in the iliac regions and can be prevented with careful examination of the abdominal wall with a laparoscope before its insertion. The gas pressure in the abdominal cavity during surgery can tamponade the bleeding, which might not be visible until after the trocar is removed. It is strongly recommended to examine all the trocar openings for the presence of an ongoing bleeding before the laparoscope is finally removed after decreasing the intraabdominal pressure [11]. Various authors report the incidence of vessel injury in RP to vary from 0% to 6% [11–14].

External iliac artery and vein are also at risk of injury during PLND. The injury can occur either during the dissection or the insertion of the instruments without visual control. Ploussard et al. [15] investigated the incidence of iliac vessel injury and reported it to be 3% in 143 cases of RARP with extended PLND and 0.3% in 440 cases of RARP with standard PLND [15]. During lymph node dissection, it is crucial to visually control all the main vascular structures. The risk of injury to the iliac vessels is higher in the elderly with a history of hypertension and atherosclerosis leading to the formation of aneurisms and large atherosclerotic plaques.

One of the most severe and life-threatening complications of RP is **intestinal injury**, especially if not identified during surgery. Perforation which was not identified during the surgery usually occurs within the first 72 hours post-surgery, whereas thermal trauma usually occurs between Day 6 and Day 10 post-surgery. The symptoms might be non-specific and include vomiting, abdominal pain, pneumaturia, and the presence of feces in the urine [13, 14]. In the study by Stolzenburg et al. [12], intestinal injuries were reported to most often occur in the presence of adhesions when accessing the abdominal cavity

or inserting the lateral trocars. Rectal injury can occur during mobilization of the neurovascular bundle and the apex of the prostate. Haeuser et al. [13] analyzed the results of 6,522 cases of open RP and 6,522 cases of minimally invasive RP. In the open RP group, 58 cases of intestinal injury were reported, including 11 cases (0.17%) of small bowel injury, 20 cases (0.31%) of large bowel injury, and 27 cases (0.41%) of rectal injury. In the group of minimally invasive RP, 17 cases of intestinal injury were reported, including 7 cases (0.11%) of small bowel injury, 3 cases (0.05%) of large bowel injury, and 7 (0.11%) cases of rectal injury. In the meta-analysis conducted by Novara et al. [14], intestinal injuries were reported to occur in 0.1%–1.5% of cases.

A bladder injury is a rare and mild complication of RP. It occurs during the mobilization of the preperitoneal space in patients who underwent hernia repair using a mesh, and if excessive traction during prostatectomy is present. This complication can be visualized intraoperatively when checking the integrity of the anastomosis after vesicourethral anastomosis is formed.

PLND is a part of RP which is performed for definitive indications, which are rather strict. Extended PLND is indicated if the risk of lymph node involvement is higher than 5% according to Briganti, MSKCC, and Partin nomograms. The procedure results in relation to the oncologic outcome are currently under discussion; however, PLND is generally accepted to provide important prognostic information, which cannot be acquired through other methods available to date [16, 17]. Also, randomized clinical trials did not show extended PLND to be beneficial compared with limited PLND in terms of early oncologic outcomes [18, 19]. PLND can be performed either before or after RP. In our practice it is usually performed before RP, which is why we discuss the complications of the procedure performed before RP.

A ureteral injury is a rare complication of PLND. The study by Jhaveri et al. [20] described 3 cases of ureteral injury in 6,442 cases of RARP performed. The authors compared the results with the world literature and established the incidence of the complication to be 0.05%–1.6% in open retropubic prostatectomy and 0.5% in LRP. Ureteral injuries occur during PLND. The ureter can be partially injured or completely severed; thermal trauma to the ureter is also possible. It is worth mentioning, that the risk of ureteral injury is higher in laparoscopic access compared with retroperitoneoscopic access. Ureteral injuries might also occur when incising the posterior detrusor during bladder neck mobilization in the case of an enlarged prostate, or during the formation of a vesicourethral anastomosis. The risk of the complication is increased in patients who underwent transurethral resection of the prostate due to a shorter distance between the ureteral orifices and bladder neck, which might complicate the formation of anastomosis [20].

An obturator nerve injury is a rare complication of RP which occurs during PLND. Gözen et al. [21] reported only 5 cases of obturator nerve injury in 3,558 cases of PR. Three cases (0.1%) occurred in 2,531 cases of LRP, and the other 2 (0.1%) occurred in 1,027 cases of RARP. Rassweiler et al. [22] reported complications related to the nerve injury to occur in 1.1% of RARP cases (1,243), and in 0.3% of LRP cases (1,243). The injury might be due to nerve electrocoagulation, total severance, or clip compression. In the case of total nerve severance, tension-free epineural anastomosis formation is recommended [23, 24].

Bleeding from the dorsal venous complex (DVC) can be considered a part of RP. In the procedure, the greatest blood loss occurs during the mobilization of the DVC. The amount of blood loss may be significantly decreased with appropriate surgical experience, more precise mobilization, dorsal venous complex ligation, and increased CO_2 pressure [25, 26].

EARLY POSTOPERATIVE COMPLICATIONS

Checking the integrity of the vesicourethral anastomosis is a mandatory step in RP. **Anastomotic leakage** is confirmed by the presence of urine collection in the perivesical fat. To form a secure anastomosis using simple interrupted sutures, the number of sutures should be at least 7–9. Special attention should be paid to the posterior wall of the anastomosis which is the most likely location of the urine leakage. After anastomosis is formed, it is necessary to check its integrity by injecting 100–150 mL of fluid through the urinary catheter. If a small leak is present, additional sutures can be placed. In severe cases of anastomotic leakage, it is recommended to dismantle the anastomosis and form a new one [14, 27–30]. The meta-analysis conducted by Novara et al. [14] showed the incidence of anastomotic leakage to vary greatly during early postoperative period after RP ranging from 0.1% to 6.7%. Pompe et al. [31] reported the presence of urine leakage in 43 (3.2%) of 1,341 patients who underwent RP.

Anastomotic leakage can cause acute urinary retention after the removal of the urinary catheter with a possible hematoma formation. This is why cystography is recommended before the urinary catheter removal [32].

One of the common early complications of RP with PLND is **lymphocele** [33]. The condition is classified as clinically significant and non-significant. Lymphocele develops due to lymphatic fluid leakage from severed lymphatic vessels into contained spaces. During the postoperative period, clinically significant lymphocele can cause pelvic pain, impaired urinary flow, lower extremity edema, and even hydronephrosis. The incidence of lymphocele is higher after extended PLND compared to limited PLND [34]. Infected lymphocele is often accompanied

by fever [35]. The incidence of lymphocele after RARP varies greatly from 1.2% to 29% [14], being higher in extraperitoneal access compared with intraperitoneal [34].

Even though RP is the surgery of choice for patients with localized PC, it has a number of complications as a surgical treatment method. The incidence of complications can be decreased with improvement of surgical techniques (laparoscopic and robotic surgery, nerve-sparing approaches, lateral access and access conserving the Retzius space, anterior and posterior reconstruction, anastomosis formation), equipment (3D- and 4K-visualisation, controlled ultrasound and bipolar techniques, disposable instruments, type and quality of suture material, consumables), and surgical training. Coordinated work of the operating team, multidisciplinary approach (urologists, surgeons, vascular surgeons, radiologists, and other specialists), and timely identification of intra- and postoperative complications allow avoiding negative consequences for the patient. It is also crucial for the surgeon to be familiar with all the nuances throughout the procedure.

CONCLUSION

This article describes the most common intraoperative and early postoperative complications of LRP and RARP. Intraoperative complications might arise during the surgical access, lymph node dissection, or nerve-sparing or non-nerve-sparing mobilization of the prostate. Surgeons continuously face those complications both while learning the technique and after reaching the plateau of the learning curve. Treatment of the complications is a separate matter for discussion due to a great diversity of available approaches. The choice of the approach is determined by the method prevalence and the individual experience of the surgeon and the hospital. Timely comprehensive approach in treatment of complications and during rehabilitation is the key to minimizing the consequences for the patient.

ADDITIONAL INFO

Authors' contribution. All authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study. Personal contribution of each author: O.A. Isaev — search and analysis of literary data, writing the text of the manuscript; P.S. Kyzlasov — concept and design of the study, analysis of literary data, editing the text of the manuscript; V.P. Sergeev, E.E. Gallyamov, D.I. Volodin, A.A. Korobov, E.V. Pomeshkin — search and analysis of literary data, editing the text of the manuscript; I.V. Kuzmin — analysis of literary data, editing the text of the manuscript.

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