3D Laparoscopic Radical Prostatectomy in the Experience of the Urology Department of Zalău County Emergency Hospital The First 200 Cases

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ABSTRACT

Introduction and Objectives: Prostate cancer is the most common malignant tumor of the male genitourinary system and remains a major global health problem. Radical prostatectomy (RP) is one of the most effective treatments for localized disease. The emergence of three-dimensional (3D) laparoscopy has improved surgical precision, spatial orientation, and visualization. This study aimed to compare the perioperative, oncological, and functional outcomes of 3D laparoscopic radical prostatectomy performed using the transperitoneal and extraperitoneal approaches.

Material and Methods: A retrospective analysis was conducted on 200 patients with localized prostate adenocarcinoma who underwent 3D laparoscopic radical prostatectomy (LRP) at Zalău County Emergency Hospital between May 2019 and January 2025. Patients were divided into two groups according to the surgical approach: transperitoneal (n=80) and extraperitoneal (n=120). Perioperative parameters, postoperative recovery, urinary continence, and oncological outcomes were evaluated and compared. Biochemical recurrence (BCR) was defined as a PSA ≥ 0.2 ng/mL on two consecutive measurements.

Results: No significant differences were observed between the two groups regarding preoperative data, transfusion rate, lymph node positivity, or positive surgical margin rate. Mean operative time was shorter in the transperitoneal group (150 min) compared to the extraperitoneal group (180 min), while intraoperative blood loss was lower in the transperitoneal approach (120 mL vs. 170 mL). Gastrointestinal recovery (2 vs. 2.5 days), drainage tube duration (2 vs. 3 days), and hospitalization (5 vs. 7 days) were shorter in the extraperitoneal group. Urinary continence recovery rates at 6 months were similar between groups (87.18% vs. 83.72%). The rate of positive surgical margins was 17.5%, and biochemical recurrence occurred in 17.5% of cases at 6 months. All recorded complications were managed conservatively, without severe outcomes.

Conclusions: Both 3D transperitoneal and extraperitoneal laparoscopic radical prostatectomy approaches provide comparable oncological and functional outcomes. The transperitoneal approach offers better visualization and a wider working space, whereas the extraperitoneal approach is associated with shorter operative time, lower blood loss, faster recovery, and reduced hospital stay. The choice of surgical technique should be based on the patient's characteristics, surgeon's experience, and institutional resources.

Keywords: Prostate cancer, 3D laparoscopy, radical prostatectomy, transperitoneal approach, extraperitoneal approach,

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Introduction

Prostate cancer is the most common malignant tumor of the male genitourinary system and ranks second in incidence worldwide, surpassed only by lung cancer (1). Treatment for localized prostate cancer includes options such as active surveillance, surgery (radical prostatectomy - RP), radiation therapy, and hormone therapy (2). Among these, RP is considered one of the most effective methods for treating localized prostate cancer.

The first open radical prostatectomy (ORP) was performed in 1867 by Billroth (3). Over time, ORP became the standard method for the surgical treatment of localized prostate adenocarcinoma. In 1992, Schuessler and colleagues performed the first transperitoneal laparoscopic radical prostatectomy (4), and in 1997, Raboy reported the first extraperitoneal laparoscopic procedure (5).

Minimally invasive surgery offers advantages such as reduced intraoperative injury, clearer visualization of the surgical field, more precise identification of anatomical structures, and fewer postoperative complications (6).

It was only with the introduction of robotic-assisted radical prostatectomy (RALRP) that minimally invasive approaches began to rival ORP, which had been considered the gold standard in prostate cancer treatment until then (7).

However, the oncological and functional outcomes of open and laparoscopic surgery are comparable. The choice of surgical technique depends on the surgeon's experience, the service's equipment, the patient's overall health, and their preferences. For example, patients with reduced pulmonary function may encounter difficulties in tolerating pneumoperitoneum and may require open surgery due to complications such as bleeding or ventilation issues.

RALRP offers significant benefits, such as three-dimensional (3D) visualization and the use of robotic instruments that replicate the movements of the human wrist, facilitating procedures in optimal ergonomic conditions (8). However, the currently limited to the private sector and less available in the public sector due to high costs and limited accessibility. Studies suggest that 3D laparoscopy (3D LRP) is a viable alternative to RALRP, offering lower costs and similar oncological and functional outcomes (9).

3D systems provide better depth perception, superior surgical precision, and improved spatial orientation, enhancing performance in complex laparoscopic procedures (10).

The choice of method depends on the patient's condition and the surgeon's experience. Although there are numerous studies comparing the effectiveness of LRP and RALRP, no clear consensus has been reached. Moreover, few studies compare the two types of 3D LRP, transperitoneal or extraperitoneal, directly.

In this context, the present study retrospectively analyzed the clinical and postoperative data of patients who underwent 3D LRP performed by the same surgical team at the Zalău County Emergency Hospital from May 2019 to January 2025. The aim was to compare intraoperative data, postoperative urinary control, tumor control, and complications associated with the transperitoneal and extraperitoneal approaches.

Materials and Methods

Study Type

This study was conducted as a retrospective analysis.

Clinical and postoperative data were analyzed from 200 patients with localized prostate adenocarcinoma who underwent 3D laparoscopic radical prostatectomy, both extraperitoneal and transperitoneal, performed by the same surgical team at Zalău County Emergency Hospital from May 2019 to January 2025. Pelvic lymphadenectomy was performed on high-risk patients.

The study included patients who met the following criteria: (1) a confirmed diagnosis of prostate cancer based on biopsy via puncture and subsequent histopathological analysis, (2) patients who underwent radical surgery for prostate cancer at our

hospital, with complete case information and postoperative follow-up, (3) adherence to the surgical indications specified in the updated urological guidelines.

Patients who were excluded from the study presented one or more of the following conditions: (1) associated medical conditions that could significantly affect survival, (2) diagnosis of other types of malignant tumors, (3) need for concomitant surgical interventions during the procedure, (4) history of major abdominal surgeries, (5) morbid obesity.

Preoperative Preparation

The stages of preoperative preparation included the following:

1. A detailed medical history and a complete physical examination were conducted. The administration of oral anticoagulants, long-term platelet aggregation inhibitors, or low molecular weight heparin was stopped at least 7 days prior to surgery. Blood pressure and blood glucose levels were controlled, and patients were advised to quit smoking and alcohol consumption before the procedure.
2. Standard tests were performed, including blood tests, urine tests, blood biochemistry, coagulation function evaluation, electrocardiogram, chest X-ray, and urological computed tomography. These investigations were necessary to assess the functioning of the patient's vital organs.
3. No intestinal preparation was required before the procedure. Prophylactic antibiotics were administered approximately 30 minutes before the procedure, and blood preparation was done according to the standard protocol.

Surgical Procedure Stages

For the transperitoneal approach, the patient was placed in a modified Trendelenburg position (head down, legs elevated), and a urinary catheter was inserted. The standard trocars of sizes 10 mm, 5 mm, and 12 mm were placed: supraumbilical, at the McBurney point on the right and left sides, and near the right anterosuperior iliac spine for the aspirator. In the Retzius space, a Harmonic or Ligasure energy source was used to dissect the fat from the surfaceof the prostate. The endopelvic fascia was identified and opened. The puboprostatic ligaments were sectioned. The dorsal penile venous complex was ligated with a V-loc 3-0 suture, secured with a Hem-o-lok polymer clip; then, the dorsal venous complex was sectioned using cold scissors.

The bladder neck was identified, isolated, and dissected. The seminal vesicles and deferent ducts were isolated and sectioned, followed by the incision of Denonvilliers' fascia, continuing with the prostate dissection in an anterograde manner. The lateral prostatic pedicles were sealed with Hem-o-lok clips and sectioned. A nerve-sparing approach was performed unilaterally or bilaterally, depending on the oncological indication. Finally, the prostate was completely excised and placed in an organ bag, and the vesicourethral anastomosis was performed in the Van Velthoven technique with continuous V-loc 3-0 suture on an 18 Ch silicon catheter with three ports. Pelvic lymphadenectomy was performed for high-risk cases. At the end of the procedure, a drain tube was placed in the perivesical space.

In the extraperitoneal approach, a dissection balloon was used to create the extraperitoneal space through an incision 2 cm above the pubic symphysis. The standard 10 mm, 5 mm, and 12 mm trocars were placed: subumbilical, at the McBurney point on the right and left sides, and near the right anterosuperior iliac spine for the aspirator. The operative times were similar to those of the transperitoneal approach.

Radical prostatectomy specimens were preserved in 10% formaldehyde solution and later sent to the pathology lab for analysis.

Stages of 3D Laparoscopic Radical Prostatectomy

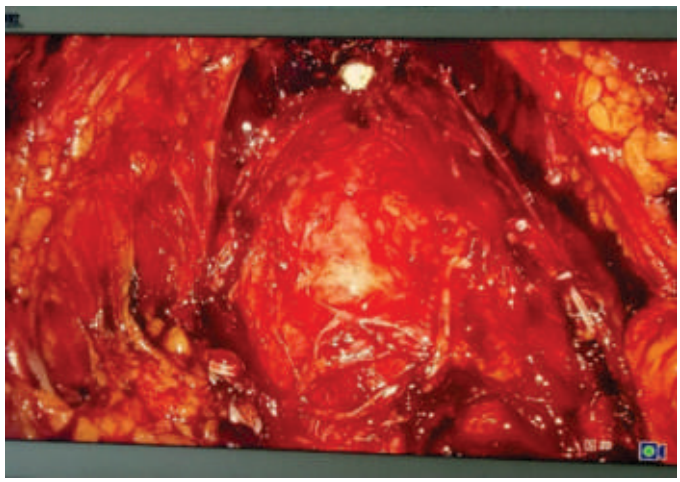


Figure 1: Laparoscopic Radical Prostatectomy Bed

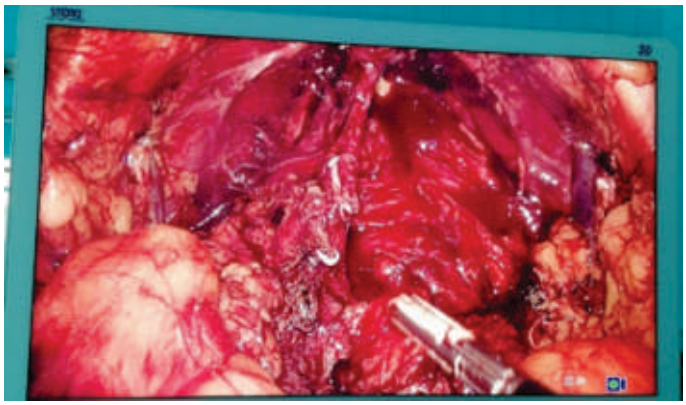


Figure 2: Neurovascular Bundle Preservation

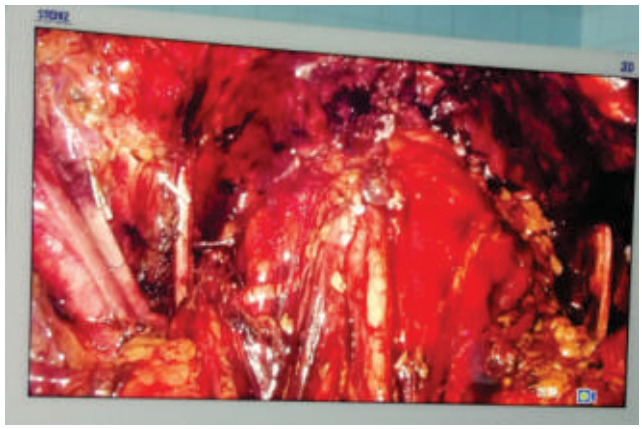


Figure 3: Pelvic Lymphadenectomy

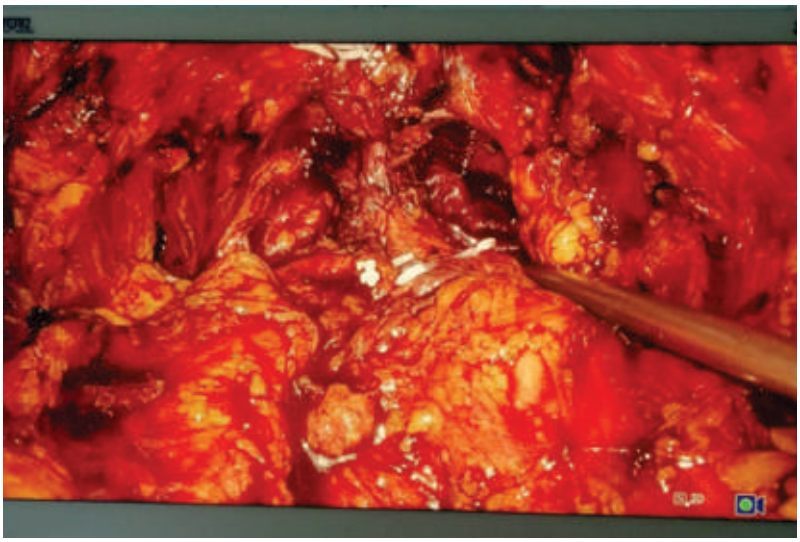


Figure 4: Final Appearance of the Urethrovesical Anastomosis

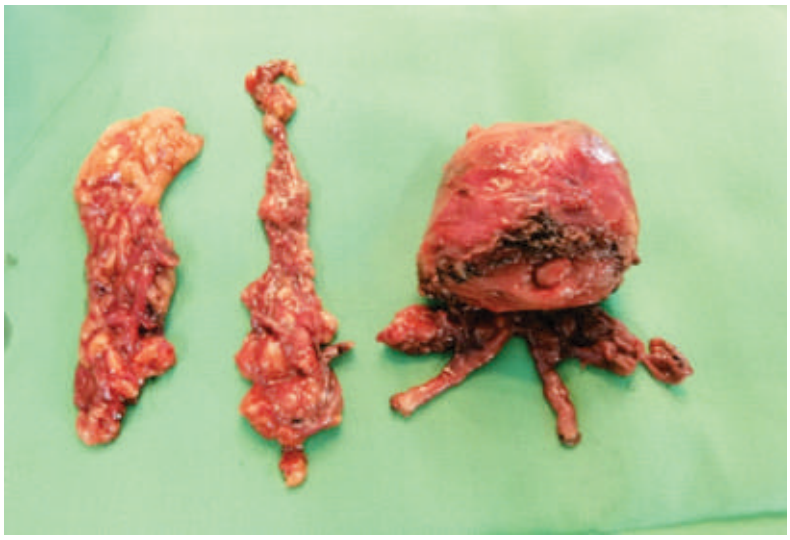


Figure 5: 3D Laparoscopic Radical Prostatectomy Specimen

Postoperative Management

To prevent postoperative infections and thromboembolic complications, patients were administered prophylactic antibiotics and low molecular weight heparin. Nutritional support was initially provided through intravenous infusions, followed by gradual reintroduction of normal feeding once intestinal transit resumed.

Patients were mobilized early, within the first 24 hours postoperatively. The surgical drain was removed when the drained fluid volume decreased to below 50 ml/day. In the event of anastomotic fistulas, they were treated conservatively, and the drain was removed afterward. The urinary catheter was removed 14 days postoperatively.

To support continence rehabilitation, all patients were instructed to perform pelvic floor exercises after the removal of the urinary catheter.

Monitoring Parameters

Relevant clinical data were collected and compared for the two patient groups, including: age, body

mass index (BMI), prostate-specific antigen (PSA) level, clinical stage of the disease, duration of surgery, estimated intraoperative blood loss, Gleason score, surgical margin, presence of lymph node metastasis, pathological stage, perioperative complications, length of hospitalization, time for gastrointestinal function recovery, urinary function control, and biochemical recurrence rate (BCR).

Monitoring and Follow-up

Patients were scheduled for periodic follow-up visits at the outpatient clinic, which included measurement of serum PSA levels. Biochemical recurrence (BCR) of prostate cancer was defined as a serum PSA level ≥ 0.2 ng/mL at two consecutive visits.

Urinary function recovery was considered achieved in the absence of the need for urinary pads or when only one pad per day was used preventively.

Results

Comparison of Preoperative Data

Patients were divided into two groups based on the surgical approach used: the laparoscopic extraperitoneal group (n = 120) and the laparoscopic transperitoneal group (n = 80).

In the laparoscopic 3D transperitoneal group, the mean age of patients ranged from 50 to 72 years, and the BMI was ≤ 30 kg/m^2. The preoperative PSA level was ≤ 17 ng/mL. Regarding the Gleason score, 20 patients had a score ≤ 6, 70 patients had a score of 7, and 30 patients had a score ≥ 8. Among them, 15 cases were classified as stage T1, 85 cases as stage T2, and 20 cases as stage T3. Thirty patients had a history of abdominal surgeries, and twenty of them had received neoadjuvant hormonal therapy prior to surgery.

In the laparoscopic 3D extraperitoneal group, patients had a mean age ranging from 55 to 74 years, and a BMI ≤ 30 kg/m^2. The preoperative PSA level was ≤ 15 ng/mL. The Gleason score was ≤ 6 for 18 patients, 7 for 37 patients, and ≥ 8 for 25 patients. From this group, 10 cases were classified as stage T1, 55 as stage T2, and 15 as stage T3. Twenty patients had a history of abdominal surgeries, and fourteen patients had received neoadjuvant hormonal therapy before surgery. No significant differences were found between the preoperative data of the two groups (Table 1).

Table 1: Perioperative Data of the Patient

Parameter	Laparoscopic 3D Transperitoneal Group (n=80)	Laparoscopic 3D Extraperitoneal Group (n=120)
Age (years)	50-72	55-74
Body Mass Index (BMI)	≤ 30 kg/m²	≤ 30 kg/m²
Preoperative PSA Level (ng/mL)	≤ 17	≤ 15
Gleason Score	≤ 6: 20 patients 7: 70 patients ≥ 8: 30 patients	≤ 6: 18 patients 7: 37 patients ≥ 8: 25 patients
Clinical Stage (T)	T1: 15 cases T2: 85 cases T3: 20 cases	T1: 10 cases T2: 55 cases T3: 15 cases
History of Abdominal Surgery	30 patients	20 patients
Neoadjuvant Hormonal Therapy	20 patients	14 patients

Comparison of Intraoperative and Postoperative Data

Regarding intraoperative parameters, no significant differences were identified between the laparoscopic 3D transperitoneal group and the laparoscopic 3D extraperitoneal group concerning blood transfusion rate, lymph node positivity rate, or surgical margin positivity rate. Additionally, there were no significant differences in terms of pathological Gleason score, postoperative clinical stage, and perioperative complication rates.

Regarding complications, the laparoscopic 3D transperitoneal group recorded three cases of urinary fistula, one case of uroperitoneum occurring 10 days postoperatively, which required laparoscopic drainage, one case of septic urinary condition secondary to involvement of the right ureteral orifice at the uretrovesical anastomosis site, for which percutaneous nephrostomy was performed, and one case of enterocutaneous fistula due to involvement of a bowel loop after drainage tube removal, which required reintervention via laparoscopic approach. One case of incidental rectal injury was reported, for which laparoscopic double-layer suturing was performed. In the laparoscopic 3D extraperitoneal group, four cases of urinary fistula were reported, one large lymphocele requiring drainage, two conversions due to large prostate volume, prominent dorsal venous complex, and obesity, and one case of incidental rectal injury, for which laparoscopic double-layer suturing was performed. All affected patients recovered with conservative treatment. No cases of ureteral injuries were reported in either group.

Compared to the laparoscopic 3D extraperitoneal group, patients in the laparoscopic 3D transperitoneal group had a longer operative time, a longer gastrointestinal recovery period, a longer duration of drainage tube retention, and a longer hospital stay.

Table 2: Comparison of Intraoperative and Postoperative Data of the Patients

Parameter	Transperitoneal Approach (n=120)	Extraperitoneal Approach (n=80)
Intraoperative Transfusion Rate (n)	7	10
Positive Lymph Nodes (n)	5	3
Positive Surgical Margin Rate (n)	17	15
Gleason Score on Prostatectomy Specimen (n)		
≤ 6	20	18
7	70	37
≥ 8	30	25
Pathologic Stage (T) (n)		
T1	15	10
T2	85	55
T3	20	15
Perioperative Complications (n)	7	8
Blood Loss (ml)	120	170
Surgical Duration (min)	150	180
Gastrointestinal Recovery Time (days)	2.5	2
Drainage Tube Retention Time (days)	3	2
Hospitalization Duration (days)	7	5

Discussion

Prostate cancer represents a major global health issue, having a significant impact on the life and health of men. In 2003, Salomon and colleagues (11) introduced the concept of "trifecta" in evaluating postoperative outcomes of radical prostatectomy (RP), which includes: effective tumor control, restoration of urinary continence, and preservation of sexual function. This set of criteria provides a broad perspective on the progression of patients after surgery and has been widely adopted to compare the outcomes of different surgical techniques for RP.

As technologies and surgical methods have evolved to improve the quality of life for patients, more rigorous standards have been proposed to evaluate the effectiveness of radical prostatectomy. Thus, the initial "trifecta" criteria were expanded into a model with five performance indicators, including: tumor control, maintenance of urinary continence, preservation of sexual function, positive margin rates, and the incidence of postoperative complications.

In this context, this study aimed to assess the effectiveness of 3D laparoscopic extraperitoneal and transperitoneal radical prostatectomy based on these five essential criteria: oncological control, urinary function, sexual function recovery, positive margin rates, and the frequency of surgical complications.

A commonly used indicator to evaluate the effectiveness of tumor control after surgery is biochemical recurrence (BCR). According to the European Association of Urology and American Urological Association guidelines, the prostate-specific antigen (PSA) level in patients with prostate cancer who have undergone radical prostatectomy (RP) should be below 0.2 ng/mL. A PSA value ≥ 0.2 ng/mL, confirmed by two consecutive postoperative measurements, indicates biochemical recurrence. BCR is considered a predictive factor for recurrence and metastasis in prostate cancer, being correlated with the patient's prognosis (12).

A multicenter study conducted on a sample of 496 patients reported biochemical recurrence rates of 9.8% at 3 months and 8.6% at 12 months after surgery (9). In this study, the biochemical recurrence rate at 6 months was 17.5%.

Urinary incontinence is one of the frequent complications following RP, having a significant impact on the physical and psychological health of patients and affecting postoperative quality of life. Recovery of urinary control is an essential parameter for evaluating the success of surgery. A study by Clements and colleagues on a cohort of 3945 patients showed that 86% of patients regained urinary control at 6 months and 91% at 12 months postoperatively (13).

In this study, the rates of recovery of urinary control in the 3D laparoscopic transperitoneal group were 56.41%, 76.92%, and 87.18%, and in the 3D laparoscopic extraperitoneal group, they were 58.14%, 74.42%, and 83.72%, immediately after surgery, at 3 months, and at 6 months, respectively. No significant differences were observed between the two groups, suggesting that the type of surgical approach does not significantly affect the recovery of urinary function.

Erectile Dysfunction (ED) is a commonly encountered complication after radical prostatectomy (RP), and its evaluation is complex due to the multiple variables involved, such as the patient's age, preoperative erectile function, and preservation of the neurovascular bundles during surgery. The incidence of postoperative ED varies significantly in the literature, ranging from 14% to 90%, depending on the definitions used and the characteristics of the studies (14).

In the present study, the recovery rate of sexual function at 6 months after surgery was similar between the 3D laparoscopic transperitoneal and extraperitoneal radical prostatectomy groups, being 10%. The time required for full recovery of erectile function can exceed one year and, in some cases, may take longer. The limitations of the study include the lack of systematic preoperative sexual function assessment and the relatively high average age of the patients (57–72 years).

The presence of a positive surgical margin (PSM) indicates the detection of tumor cells at the edge of the surgical specimen, highlighted by special staining and microscopic analysis. PSM is an independent risk factor for biochemical recurrence and an indicator of the surgical intervention's effectiveness. Patients with positive margins have an increased risk of biochemical recurrence and tumor progression (15).

The rate of PSM after laparoscopic prostatectomy is approximately 20%, according to the literature (16). In the present study, the rate of PSM after 3D laparoscopic radical prostatectomy was 17.5%, which is lower than that reported in other studies, probably due to the small number of cases analyzed and variations in the surgeons' technical skills and pathological interpretation. The type of surgical access, whether transperitoneal or extraperitoneal, does not influence the occurrence of positive margins. In this study, positive margins were predominantly observed at the apex of the prostate.

Surgical complications associated with 3D laparoscopic radical prostatectomy usually include bleeding, febrile syndromes, intestinal obstruction, rectal injuries, anastomotic fistula, urinary incontinence, and erectile dysfunction (ED). Among these complications, in the 3D laparoscopic transperitoneal group, cases of urinary fistula, septic status, and intestinal obstruction, as well as rectal breach, were reported, while in the 3D laparoscopic extraperitoneal group, anastomotic fistula, large lymphocele, and rectal breach were reported. All patients were successfully treated with conservative therapy, without the appearance of severe complications.

Due to the retrospective nature of the study, some minor complications were not included, which may explain the lack of statistical differences between the groups. Based on previous research, it can be concluded that the incidence of intestinal complications is higher with the transperitoneal laparoscopic approach compared to the extraperitoneal approach (17).

The perioperative data analyzed included surgical duration, intraoperative bleeding, resumption of intestinal transit, drain tube maintenance, and postoperative hospitalization duration. The surgical time for 3D laparoscopic radical prostatectomy was, on average, 60 minutes shorter than that of 2D laparoscopic prostatectomy, likely due to the benefits provided by 3D visualization, which contributes to a reduction in the duration of the uretrovesical anastomosis.

In this study, the surgical time for the 3D laparoscopic transperitoneal radical prostatectomy group (120 ± 30 min) was significantly shorter compared to the 3D laparoscopic extraperitoneal radical prostatectomy group (150 ± 30 min). The use of the AirSeal system in the transperitoneal laparoscopic approach ensures a larger working space and a shorter surgical time. Additionally, the recovery of gastrointestinal function was faster in the extraperitoneal laparoscopic group (1.5 days) compared to the transperitoneal laparoscopic group (2 days). These results can be attributed to the 3D extraperitoneal laparoscopic approach, which is not affected by abdominal adhesions and reduces intestinal mobilization.

The duration of the surgical procedure can significantly impact postoperative recovery and the rate of perioperative complications, which is why the extraperitoneal approach presents an advantage over the transperitoneal approach in this regard.

Regarding the estimated blood loss, the study by Bejrananda (18) on 266 patients showed a higher intraoperative volume in the extraperitoneal group (500 - 1200 ml) compared to the transperitoneal group (300 - 537 ml), with the difference being statistically significant.

In this study, blood loss was higher in the extraperitoneal group (170 ml) compared to the transperitoneal group (120 ml), with a statistically significant difference, likely due to the learning curve associated with the extraperitoneal access.
The experience and competence of the surgeon and the surgical team play a crucial role in determining surgical time and blood loss, which may explain the variations reported in different

studies.

Regarding drain tube retention time, the transperitoneal laparoscopic group showed a higher average (3-4 days) compared to the extraperitoneal laparoscopic group (2-4 days), as well as a longer postoperative hospitalization (7 days in the transperitoneal group versus 5 days in the extraperitoneal group), both differences being statistically significant.

The reduced drain tube suppression time in the extraperitoneal approach can be attributed to the extraperitoneal approach itself, which limits postoperative fluid accumulation and facilitates drainage. Additionally, a shorter hospitalization period is associated with the absence of direct access to the peritoneal cavity and a quicker gastrointestinal recovery after surgery.

Conclusions

The 3D laparoscopic radical prostatectomy techniques, both extraperitoneal and transperitoneal, present comparable oncological and functional outcomes. The transperitoneal laparoscopic approach offers the advantage of a larger working space, clearer anatomical landmarks, reduced tension in the vesicourethral anastomosis, and easier access for performing a high-quality lymphadenectomy. On the other hand, the extraperitoneal laparoscopic approach stands out due to a more comfortable operative position, reduced surgical time, lower blood loss, and shorter hospitalization. Since this technique does not enter the abdominal cavity, it is not affected by pre-existing adhesions.

Both methods offer distinct benefits and should be considered, promoted, and utilized in practice. The choice of the optimal procedure must take into account the specific characteristics of each patient, as well as the surgeon's experience and preferences.

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