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Review article

Robot-assisted extraperitoneal laparoscopic radical prostatectomy: A review of the current literature

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Abstract

Prostate cancer remains a significant health problem worldwide and is the second highest cause of cancer-related death in men. While there is uncertainty over which men will benefit from radical treatment, considerable efforts are being made to reduce treatment related side-effects and in optimizing outcomes. The current gold standard treatment for localized prostate cancer remains open radical prostatectomy. Since the early 1990s, several teams have tried to explore less invasive surgical access. The first robotically assisted laparoscopic prostatectomy (RALP) case was reported in 2000. Enhancement of the ergonomics and optimization of the surgical vision provided by the robotic interface are some of the reasons that explain the worldwide wide spread of RALP. Although this procedure accounted for the vast majority of radical prostatectomies performed in United States, its diffusion is still limited in Europe. The cost for robot purchase and maintenance are obvious limiting factors for its expansion. According to the literature, the operating time and the blood loss are, once the learning curve is completed, similar to those of open or laparoscopic procedures. Hospital stay and time before bladder catheter removal are shorter compared with other approaches. Intermediate oncologic and functional outcomes do not show difference with the open or laparoscopic results. Given that these data are encouraging, the limited follow-up with RALP does not allow drawing any definitive statement in comparison with conventional techniques. The aim of our study was to underline the perioperative, oncologic, and functional outcomes of all extraperitoneal RALP series published.

Keywords: Prostatic neoplasms; Prostatectomy; Laparoscopy robotics; Extraperitoneal

1. Introduction

Prostate cancer is the most commonly detected male cancer and the second leading cause of male cancer deaths in the United States and Europe [1]. Its prognosis is directly related to stage at diagnosis and treatment. With the widespread diffusion of the screening for prostate cancer, the disease has been diagnosed more commonly in the organ-confined stage and in younger and healthier men [2]. Conventional treatment options include radical prostatectomy (RP), external beam radical radiotherapy, brachytherapy, and active surveillance with or without regular biopsy [3]. More recently, focal therapies such as cryoablation and high-intensity focused ultrasound have been introduced, but their oncologic effectiveness remains uncertain. Radical prostatectomy is an established and accepted treatment for localized and, more recently, for locally advanced prostate cancer. Overall 10-year PSA progression rates after RP are around 30% [3]. Recurrence rates are increased in men with a higher preoperative PSA, Gleason grade, or tumor stage, and if there are positive margins in the pathologic specimen. In an effort to further decrease the morbidity of open RP, a minimally invasive surgical approach to treating prostate cancer was first described by Schuessler et al. in 1997 [4]. These authors performed the first successful laparoscopic RP (LRP). With their initial experience, the authors noted the challenging nature of LRP, with long operative times and hospital stays. Although cancer cure with LRP was deemed comparable to that with RP, the authors concluded that LRP offered no significant advantage over RP. The LRP was revived only in the late 1990s, as European surgeons re-evaluated their outcomes and reported feasibility with excellent operative outcomes [5–8]. However, the technical demands of the surgery and the important learning

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Table 1
Patients' characteristics

Series	Number patients	Approach	Median age (year)	Median PSA (ng/ml)	Body Mass Index (kg/m^2)	Clinical stage T1c/T2a-c/T3 (%)	Biopsy Gleason Score <7/≥7 (%)
Joseph et al. [10]	325	Extraperitoneal	60	6.6	—	81/19/0	62/38
Rozet et al. [11]	133	Extraperitoneal	62	7.6	24.8	57/43/0	76/24
Ploussard et al. [12]	206	Extraperitoneal	63.3	8.8	26	85.5/13.5/1	65.5/34.5
Badani et al. [13]	2766	Transperitoneal	60.2	6.43	27.6	77.5/22/0.5	57.5/42.5

curve have prevented the widespread adoption of LRP by most urologic surgeons. Specifically, the reduction in the range of motion, two-dimensional vision, counter-intuitive hand-eye coordination between real and visible movements, and the reduced haptic sense are the main obstacles associated with a long learning curve. The recent introduction of advanced robotic devices such as the Da Vinci Surgical System (Intuitive Surgical, Inc., Sunnyvale, CA) into urologic surgery has added new hopes of reducing operative times and the learning curve for minimally invasive RP. Robotic-assisted LRP (RALP) offers the additional advantages of ×10 magnified binocular, three-dimensional visualization, motion scaling with tremor filtration, improved surgical ergonomics, and miniature wristed, articulating instruments with 7° of freedom. Such capabilities provide the benefits of improved precision and comfort, which potentiates easier dissection of tissue planes and meticulous suturing. The first robotic RALP was performed in 2000 by Binder and Kramer [9]. Subsequently, the procedure has undergone significant innovation and improvement, and its growth has been exponential in the last years. Almost a decade after the introduction of RALP, large and mature series from different institutions are now available.

This article reviews the development and introduction of extraperitoneal RALP, the results to date, and the possible future directions. The aim of our study was to underline the perioperative, oncologic, and functional outcomes of all extraperitoneal RALP series published.

2. Perioperative outcomes and complications

The patients' characteristics are reported in Table 1. The mean operative duration, estimated blood loss, blood transfusion rates, hospital stay, and overall complication rates for current extraperitoneal RALP series are presented in Table 2, [10–13]. It is difficult to compare operative duration among various series because of variations in reporting this variable to include set-up and/or pelvic lymph node dissection. The mean operative duration for current extraperitoneal RALP series were a range of 160–180 minutes [10–12].

Decreased intraoperative blood loss has been reported to be a hallmark advantage of LRP [5–8]. As most intraoperative blood loss originates from the venous sinuses, the tamponade effect created by pneumoperitoneum helps to diminish blood loss. In addition, early identification and precise ligation of vessels facilitates the limitation of blood loss. The estimated blood loss for current RALP series included in our review ranged from 196 to 609 ml. The blood transfusion rate varied from 0.5% to 3% [10–12].

The mean hospital stay is an important component of convalescence after surgery and often considered a measure of patient well-being. The mean hospital stay for current RALP series included in our review was from 1.5 to 5.4 days. The hospital stay for RALP series carried out in the USA is usually lower than in series from Europe, where patients often stay in the hospital until the urinary catheter is removed. The mean overall complication rate for RALP series was 10.5% (range 2%–19.4%) [10–12].

3. Oncologic outcomes

The PSM rate after RP is an independent predictive factor for biochemical recurrence, local recurrence, and the development of distant metastasis [14]. Therefore, the status of the SM is one of the most important outcomes to be evaluated in any surgical treatment proposed for prostate cancer. The pathologic stage distribution in the RALP series included in our review was 78% pT2 and 19.5% pT3 tumors. RALP had a mean overall PSM rate of 20% (range of

Table 2
Literature perioperative outcomes

Series	Number patients	Approach	Operative time (min)	Complications rate (%)	Blood loss (ml)	Conversion rate (%)	Hospital stay (days)
Joseph et al. [10]	325	Extra-peritoneal	180	2	196	—	—
Rozet et al. [11]	133	Extra-peritoneal	166	19.4	609	13	5.4
Ploussard et al. [12]	206	Extra-peritoneal	160.1	16.5	504	0.5	4.3
Badani et al. [13]	2766	Trans-peritoneal	154	12	100	—	1.2