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Retropubic, laparoscopic, and robot-assisted radical prostatectomy: a multi-institutional comparative study

Amr A. Faddan[1,2,3], Mahmoud M. Shalaby[1], Mohamed Gadelmoula[1,4*], Younis Alshamsi[4], Daniar K. Osmonov[2], Nasreldin Mohammed[3], Adel Kurkar[1], Atif M. Abdel Latif[1], Paolo Fornara[3] and Klaus P. Jünemann[2]

Abstract

Background: The standard surgical treatment of localized prostate cancer (PCa) has been rapidly changed along the last two decades from open to laparoscopic and finally robot-assisted techniques. Herein, we compare the three procedures for radical prostatectomy (RP), namely radical retropubic (RRP), laparoscopic (LRP), and robot-assisted laparoscopic (RALRP) regarding the perioperative clinical outcome and complication rate in four academic institutions.

Methods: A total of 394 patients underwent RP between January 2016 and December 2018 in four academic institutions; their records were reviewed. We recorded the patient age, BMI, PSA level, Gleason score and TNM stage, type of surgery, the pathological data from the surgical specimen, the perioperative complications, unplanned reoperating, and readmission rates within 3 months postoperatively. Statistical significance was set at ($P < 0.05$). All reported P values are two-sided.

Results: A total of 123 patients underwent RALRP, 220 patients underwent RRP, and 51 underwent LRP. There was no statistically significant difference between the three groups regarding age, BMI, prostatic volume, and preoperative PSA. However, there were statistically significant differences between them regarding the operating time ($P < .0001$), catheterization period ($P < .001$), hospital stay ($P < .0001$), and overall complications rate ($P = .023$).

Conclusions: The minimally invasive procedures (RALRP and LRP) are followed by a significantly lower complication rate. However, the patients' factors and surgical experience likely impact perioperative outcomes and complications.

Keywords: Prostate cancer, Radical prostatectomy, Robot-assisted laparoscopic radical prostatectomy

1 Background

Radical prostatectomy (RP) is the surgical treatment of prostate cancer (PCa), which has been performed for more than 100 years [1]. Since its introduction in 1947 by Millin, radical retropubic approach (RRP) became the most popular and its morbidity reduced substantially after several detailed anatomic studies performed in fetal and adult cadavers in the late 1970s and the early 1980s provided critical insight into the periprostatic anatomy, especially that of the dorsal vein complex, the neurovascular bundle, and the striated urethral sphincter [2].

Fifty years later, Schuessler and colleagues in 1997 performed the first laparoscopic radical prostatectomy (LRP) that slowly rose in popularity and became a widespread minimally invasive alternative to RRP, due to its advantages, such as the lower blood loss and transfusion together with a shorter hospital stay, reduced catheterization time, better pain control and the faster return to everyday activities [3].

Claude C Abbou was the first to perform the robot-assisted laparoscopic approach (RALRP) in the year 2000 [4]. The robot offered improved visualization, increased dexterity, restored proper hand–eye coordination, and an

*Correspondence: mgad73@aun.edu.eg
[1] Department of Urology, Urology and Nephrology Hospital, Assiut University, Assiut 71516, Egypt
Full list of author information is available at the end of the article

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ergonomic position for the surgeon. Despite these well-recognized benefits, it has profound drawbacks such as the cost of acquiring and maintaining this new technology can be prohibitive [5].

Despite the wide diffusion of LRP and RALRP over the past 10 years in Europe and the USA, no consensus has been attained regarding the utility of RRP, LRP, and RALRP for localized PCa [6]. Several comparative studies done and stated that LRP and RALRP are associated with decreased operative blood loss, decreased risk of transfusion, and similar risk of positive surgical margin when compared with RRP [7, 8]. Herein, we present our experience with RRP, LRP, and RALRP regarding the perioperative outcomes and complications rates.

2 Methods

A total of 394 patients underwent RP between January 2016 and December 2018 in four academic institutions; their records were reviewed. All radical prostatectomies were done for organ-confined PCa and locally advanced PCa (T3) with a life expectancy for more than 10 years. Patients underwent salvage procedure for advanced PCa (pT4), previous prostate operations, and extraperitoneal RALP are excluded.

Radical prostatectomy was done under general anesthesia, performed according to the techniques described by Walsh, 1983 either RRP, extraperitoneal LRP, or transperitoneal RALP [9]. We recorded the patient age, BMI, PSA level, Gleason score and TNM stage, type of surgery, the pathological data from the surgical specimen, the perioperative complications, unplanned reoperating, and readmission rates within 3 months postoperatively.

Operative drains were usually removed between the 3rd and the 5th postoperative day. A cystogram was performed on the 7th postoperative day to assess the integrity of vesicourethral anastomosis, and the urethral catheter was removed if no leakage appeared in the cystogram. The patients were usually discharged on the 8th postoperative day.

Statistical analysis was performed using the IBM SPSS Statistics (Version 21.0. Armonk, NY: IBM Corp). A descriptive and comparative statistical analysis of pooled data by using the Mann–Whitney *U* test was used to compare medians, the independent *t* test and one-way ANOVA were used to compare means across the groups, and the Chi-squared test and Fisher's exact test were used for bivariate analysis. Correlations between different items in our study were done using Spearman or Pearson correlation coefficient. Multivariate analysis: logistic regression was applied for significant variables. Statistical significance was set at ($P < 0.05$). All reported *P* values are two-sided.

3 Results

A total of 123 patients underwent RALRP, 220 patients underwent RRP, and 51 underwent LRP. The patient demographic data for the three groups are compared in Table 1. The main bulk of the cases is from the second and third institutions, as the robotic surgery is not available in the first and recently added to the fourth one. According to match-pairing, there was no statistical significance between the groups regarding the age, BMI, the preoperative prostatic volume, and the preoperative PSA.

Table 2 shows the perioperative data. A statistically significant difference between the groups detected in all the operative parameters mainly the nerve-sparing technique, lymph node dissection (LNDs), the hemoglobin (Hb) and hematocrit (Hct) loss, and the operative time. The nerve-sparing procedures were more frequent in patients underwent RALRP (74%) and the lymph node

Table 1 Patients' characteristics

	RALP	RRP	LRP	Overall	*P* value
No. of cases	123	220	51	394	
Age (yr.): Mean ± SD	67.8 ± 6.6	67.4 ± 6.8	65.6 ± 6.2	67.4 ± 6.7	.133
BMI (kg/m^2): Mean ± SD	26.9 ± 3.6	27.4 ± 4.1	27.7 ± 3.5	27.3 ± 3.9	.634
BMI (%)					.102
Normal (18.5–24.9)	31.3	24.7	19.6	31.5	
Overweight (25–29.9)	52.2	41.8	60.8	47.1	
Obese (30 or greater)	16.4	23.5	19.6	21.3	
ASA score (%)					.024
I	3.8	5.9	3.9	5.1	
II	77.5	73.5	94.1	77.6	
III	18.8	20.6	2	17.3	
PSA (ng/mL): median	7.5	8.8	7.9	8.1	.204
Prostatic volume (cm^3): Mean ± SD	44.1 ± 21.6	41.7 ± 20.1	44.5 ± 20.7	42.8 ± 20.7	.502

Table 2 Perioperative data

	RALP	RRP	LRP	Overall	*P* value
Nerve sparing (%)	74	45.5	21.6	51.3	<.0001
LND_S (%)	88.6	96.4	41.2	86.8	<.0001
Operative time (min): Mean ± SD	295.5 ± 58.5	223.7 ± 50.8	171.2 ± 61.2	239.4 ± 68.6	<.0001
Hb loss (g/dl): Mean ± SD	3.7 ± 1.7	4.2 ± 1.4	2.1 ± 0.7	3.7 ± 1.6	<.0001
Hct loss (%): Mean ± SD	10.3 ± 4.7	12.1 ± 4.4	6.8 ± 3.1	10.8 ± 4.7	<.0001
Catheter time (days): Mean ± SD	8.4 ± 4.3	10.4 ± 5.6	11.8 ± 9.4	9.9 ± 6	<.001
Hospital stay (days): Mean ± SD	9.9 ± 4	13.6 ± 9.2	11.1 ± 2.6	12 ± 7.5	<.0001

Hb hemoglobin, *Hct* hematocrit level, *LNDs* lymph node dissection

dissection was more frequent in patients underwent RRP (96.4%). The catheterization time was the statistically significant difference between all groups in favor of RALRP; however, the LRP group had shorter hospitalization time which also statically significant.

Overall, there was a statistically significant difference between all the groups regarding the postoperative pathological evaluation except the Gleason's score. The results are summarized in Table 3. A pT2 were more frequently diagnosed in patients who underwent RALRP; however, pT3 were more in the RRP group. Patients underwent RRP had a worse oncological outcome as about 25% of them were N1 and 36.5% had positive surgical margins.

Table 4 summarizes the percentage of the incidence of postoperative complications for each group. A statistically significant difference between the groups in some specific complications; anastomotic insufficiency, surgical site infections (SSIs), and unplanned reoperation rate.

Our data show that the patients underwent RALRP were more likely to have nerve-sparing procedures, longer operating time, and higher intraoperative vascular injuries than others RP. However, they are less likely to have positive surgical margins (PSMs), overall complications, anastomotic insufficiency, open conversion, and unplanned reoperation.

Patients who underwent RRP were likely to have LNDs, the greater number of removed LN, about 45% of patients were T3, and 25% of patients were N1, Hb and Hct loss, PSMs, longer hospital stay, higher overall complications, unplanned reoperation, and readmission rate and SSIs.

Patients underwent LRP unlikely to have positive lymph nodes, nerve-sparing procedures and so had

Table 3 Postoperative pathological data

	RALP	RRP	LRP	Overall	*P* value
pT stage (%):					.011
T2	70.7	54.3	62.7	60.6	
T3	29.3	45.7	37.3	39.4	
N stage (%):					< .0001
Nx	11.4	3.6	58.8	13.2	
N0	80.5	70.5	41.2	69.8	
N1	8.1	25.9	0	17	
Gleason score (%):					.065
< 6	0.8	0.9	0	0.8	
6	21.1	22	27.5	22.4	
3 + 4	25	28	41	31.9	
4 + 3	27	20	19.6	22.7	
≥8	15.4	28.4	11.8	22.2	
No. of lymph node removed					
Mean ± SD	14.8 ± 9.2	24.2 ± 11.5	12.6 ± 8.7	20.5 ± 11.7	< .0001
Margins (%)					.021
Positive	22.7	36.5	25.5	30.8	
Negative	77.3	63.5	74.5	69.2	

Table 4 Overall and specific complications after RPs

	RALP	RRP	LRP	Total	*P* value
Total complicated cases: No. (%)	47 (38.2)	118 (53.6)	24 (47.1)	189 (48)	.023
Open conversion: No. (%)	3 (2.4)	0	2 (3.9)	5 (1.3)	< .0001
Vascular injuries: No. (%)	2 (1.6)	1 (0.5)	1 (2)	4 (1)	.450
Rectal injury: No. (%)	2 (1.6)	4 (1.8)	1 (2)	7 (1.8)	.986
Anastomotic insufficiency: No. (%)	10 (8.1)	38 (17.3)	13 (25.5)	61 (15.5)	.009
Hemorrhagic complications: No. (%)	4 (3.3)	1 (0.5)	0	5 (1.3)	.058
Postoperative urinary retention: No. (%)	0	2 (0.9)	1 (2)	3 (0.8)	.372
Lymphocele: No. (%)	10 (8.1)	25 (11.4)	1 (2)	36 (9.1)	.099
Thromboembolic complication: No. (%)	2 (1.6)	4 (1.8)	1 (2)	7 (1.8)	.986
Urinary tract infections: No. (%)	1 (0.8)	4 (1.8)	0	5 (1.3)	.499
SSIs: No. (%)	5 (4.1)	28 (12.7)	2 (3.7)	35 (8.9)	.011
Ileus: No. (%)	3 (2.4)	2 (0.9)	1 (2)	6 (1.5)	.520
Transfusion: No. (%)	7 (5.7)	11 (5)	2 (3.9)	20 (5.1)	.887
Postoperative urethral stricture: No. (%)	1 (0.8)	2 (0.9)	1 (2)	4 (1)	.768
Postoperative ureteral stricture: No. (%)	0	1 (0.5)	0	1 (0.3)	.673
Death: No. (%)	0	2 (0.9)	0	2 (0.5)	–
Reoperations rates: No. (%)	9 (7.3)	37 (16.8)	4 (7.8)	50 (12.7)	.022
Readmission rates with 3 months: No. (%)	6 (4.9)	12 (5.5)	2 (3.9)	20 (5.1)	.897

shorter operating time; however, they likely to have anastomotic insufficiency and longer catheter time.

4 Discussion

The minimally invasive RP has comparable cancer control outcomes of open prostatectomy, besides faster convalescence, decreased blood loss and transfusion rates, decreased postoperative pain, and shorter catheterization time [10–12]. The techniques for LRP have been well developed and refined the learning curve becomes shorter than once reported [13].

Between 1962 and 2002, the average life expectancy in the German population increased from 67.1 to 75.6 years in men and from 72.7 to 81.3 years in women with an average gain of approximately 2.2 years per decade in both genders [14]. The mean age of men that underwent RP in our study was 67.4 ± 6.7 years at the time of surgery; these men generally had a life expectancy of at least 10 years.

Regarding the BMI, approximately 68% of our patients were overweight and obese, so they had an increased risk of morbidity and mortality according to the literature [15].

The available literature suggests that the duration of RP procedures decreases with surgeon experience and skill; however, the operating time is longer in RALRP compared to other RP, thus also in all publications due to docking time and learning curve and time which may reach about 60 min [16].

RALRP eases the performance of watertight urethrovesical anastomosis allows for earlier removal of the Foley catheter. The average time until catheter removal in the RALRP series is 6 to 12 days that matches our results [17].

Hospitalization time after surgery remains one of the critical components to medical expenditures for a given surgical procedure and is considered an indicator of a quick recovery and constitutes one of the criteria that patients use to evaluate the success of the surgery. As in our study, a statistically significant difference between groups was found for the length of hospital stay in favor of RALRP.

PSMs after RP are uniformly considered an adverse outcome associated with the failure of the surgery to achieve the cure of the PCa [18]. Our data show that patients who underwent RRP were more likely to have PSMs; however, this can be attributed to the inclusion of higher stage and nodal disease in the RRP group.

The data presented in the literature showed that the perioperative parameters and the main complications rates are better in RALRP than the other types which match with our study; others reported longer hospitalization and catheterization times, and higher complication rate with RALRP [19–21].

Open conversion from a minimally invasive approach to an open procedure, due to failure to progress or uncertainty of dissection planes, usually occurs during a surgeon's early experience and not considered a complication by many [22].

The unplanned reoperation (UR) within 30 days of radical prostatectomy was 1.2%. Unplanned reoperation was significantly lower in the minimally invasive radical prostatectomy (MIRP) group (1.1% vs. 1.5%, *P* value 0.01). Bleeding, wound dehiscence, and acute retention were the most common indications for UR. In our study, the reoperation rate was 12.7% (Table 4); the main causes for unplanned reoperations were SSIs 42%, lymphocele 36%, bleeding complications 8%, and others 4% [23].

There are some limitations in our study such as comparing the RALRP, LRP, and RRP performed by different surgeons with variable experience. Another limitation of this current study was that it was designed to compare only the perioperative and pathological and not the functional results. As it is a retrospective review of our database, non-randomization and even selection bias might impact our study.

5 Conclusion

Our results and the published data show that RALRP and LRP are followed by a significantly lower complication rate. However, the patients' factors, selection bias, and surgical experience likely impact perioperative outcomes and complications.

Abbreviations

PCa: prostate cancer; RP: radical prostatectomy; RRP: radical retropubic prostatectomy; LRP: laparoscopic radical prostatectomy; RALRP: robot-assisted laparoscopic radical prostatectomy; BMI: body mass index; PSA: prostate-specific antigen; LNDs: lymph node dissection; SSIs: surgical site infections; PSMs: positive surgical margins; MIRP: minimally invasive radical prostatectomy; UR: unplanned reoperation.

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Authors' contributions

AAF developed the concept of the manuscript and contributed to drafting and revision. MMS developed the concept of the manuscript and contributed to drafting and revision. MG developed the concept of the manuscript and contributed to drafting and submission. YA developed the concept of the manuscript and contributed to drafting and revision. DKO developed the concept of the manuscript and critical revision. NM developed the concept of the manuscript and critical revision. AK developed the concept of the manuscript and revision. AMA developed the concept of the manuscript and revision. PF developed the concept of the manuscript and critical revision. KPJ developed the concept of the manuscript and critical revision. All authors read and approved the final manuscript and revisions for submission.

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Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The need for approval for this study was waived by the Ethics committees at Assiut, Kiel, and Martin-Luther universities and Al Qassimi Hospital, based on its retrospective nature.

Consent for publication

Done and approved.

Competing interests

The authors declare that they have no competing interests.

Author details

[1] Department of Urology, Urology and Nephrology Hospital, Assiut University, Assiut 71516, Egypt. [2] Department of Urology and Paediatric Urology, University Hospital Schleswig-Holstein, Campus Kiel, Kiel, Germany. [3] Department of Urology and Kidney Transplantation Center, Martin-Luther University, Halle (Saale), Germany. [4] Department of Urology, MOH-Al Qassimi Hospital, Sharjah, United Arab Emirates.

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References

1. Young HH (2002) The early diagnosis and radical cure of carcinoma of the prostate. Being a study of 40 cases and presentation of a radical operation, which was carried out in four cases. (Reprinted from Bull Johns Hopkins University, vol XVI, pg 315-321, 1905). J Urol 168(3):914–921
2. Campbell MF, Walsh PC, Wein AJ (2012) Campbell-Walsh Urology: Vol. 3, Chapter 100, 10th edn. Saunders Elsevier, Philadelphia, PA, pp 2771–2788
3. Hoznek A, Menard Y, Salomon L et al (2005) Update on laparoscopic and robotic radical prostatectomy. Curr Opin Urol 15(3):173–180
4. Abbou CC, Hoznek A, Salomon L et al (2001) Laparoscopic radical prostatectomy with a remote-controlled robot. J Urol 165(6 Pt 1):1964–1966
5. Eichel L, Ahlering TE, Clayman RV (2004) Role of robotics in laparoscopic urologic surgery. Urol Clin North Am 31(4):781–792
6. Sridharan K, Sivaramakrishnan G (2018) Prostatectomies for localized PCa: a mixed comparison network and cumulative meta-analysis. J Robot Surg 12(4):633–639
7. Parsons JK, Bennett JL (2008) Outcomes of retropubic, laparoscopic, and robotic-assisted prostatectomy. Urology 72:412–416
8. Sugihara T, Yasunaga H, Horiguchi H et al (2014) Robot-assisted versus other types of radical prostatectomy: population-based safety and cost comparison in Japan, 2012–2013. Cancer Sci 105:1421–1426
9. Walsh PC, Lepor H, Eggleston JC (1983) Radical prostatectomy with preservation of sexual function: anatomical and pathological considerations. Prostate 4(5):473–485
10. Eastham JA, Scardino PT, Kattan MW (2008) Predicting an optimal outcome after radical prostatectomy: the Trifecta Nomogram. J Urol 179(6):2207–2210
11. Patel VR, Sivaraman A, Coelho RF et al (2011) A new concept for reporting outcomes of robot-assisted laparoscopic radical prostatectomy. Eur Urol 59(5):702–707
12. Trabulsi EJ, Guillonneau B (2005) Laparoscopic radical prostatectomy. J Urol 173(4):1072–1079
13. Martina GR, Giumelli P, Scuzzarella S et al (2005) Laparoscopic extraperitoneal radical prostatectomy–learning curve of a laparoscopy-naive urologist in a community hospital. Urology 65:959–963
14. Klenk J, Rapp K, Büchele G et al (2007) Increasing life expectancy in Germany: quantitative contributions from changes in age- and disease-specific mortality. Eur J Public Health 17(6):587–592
15. Calle EE, Rodriguez C, Walker-Thurmond K et al (2003) Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. N Engl J Med 348(17):1625–1638
16. Alenizi AM, Valdivieso R, Rajih E et al (2015) Factors predicting prolonged operative time for individual surgical steps of robot-assisted radical prostatectomy (RARP): a single surgeon's experience. Can Urol Assoc J 9(7–8):E417–E422
17. Novara G, Ficarra V, Rosen RC et al (2012) Systematic review and meta-analysis of perioperative outcomes and complications after robot-assisted radical prostatectomy. Eur Urol 62(3):431–452
18. Yossepowitch O, Briganti A, Eastham JA et al (2014) Positive surgical margins after radical prostatectomy: a systematic review and contemporary update. Eur Urol 65(2):303–313

19. Dindo D, Clavien P (2008) What is a surgical complication? World J Surg 32(6):939–941
20. Rozet F, Jaffe J, Braud G et al (2007) A direct comparison of robotic-assisted versus pure laparoscopic radical prostatectomy: a single-institution experience. J Urol 178(2):478–482
21. Ficarra V, Novara G, Artibani W et al (2009) Retropubic, laparoscopic, and robot-assisted radical prostatectomy: a systematic review and cumulative analysis of comparative studies. Eur Urol 55(5):1037–1063
22. Bhayani SB, Pavlovich CP, Strup SE et al (2004) Laparoscopic radical prostatectomy: a multi-institutional study of conversion to open surgery. Urology 63(1):99–102
23. Sarhan A, Shabsigh A (2015) The impact of surgical technique on unplanned reoperation after open and minimally invasive radical prostatectomy: analysis of the NSQIP database. J Am College Surg 221(4, Supplement 1):S174

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