ORIGINAL ARTICLE

Comparison of Functional and Oncological Outcomes in Open, Video Laparoscopic, and Robotic Prostatectomy at a Sistema Único de Saúde Facility

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ABSTRACT

Introduction: Prostate cancer is the second most common cancer worldwide among men. Among the various therapeutic modalities, radical prostatectomy is the primary treatment option, which can be performed using the following techniques: retropubic (RRP), perineal (RPP), video laparoscopic (VLP), and robot-assisted (RALP). RALP has gained widespread use in urology, primarily due to its technical advantages and superior functional outcomes, such as the maintenance of urinary continence and the preservation of erectile function. However, the oncological outcomes of RALP are comparable to those of RRP and VLP.

Objectives: To analyze the perioperative, functional, and oncological outcomes of prostatectomies performed via RRP, VLP, and RALP at a tertiary hospital in Curitiba, Paraná, Brazil.

Methodology: The study included 367 patients diagnosed with prostate cancer who underwent radical prostatectomy between 2016 and 2021, with 221 patients undergoing RRP, 118 undergoing VLP, and 37 undergoing RALP. Preoperative clinical data and outcomes of interest were assessed through a retrospective analysis of medical records.

Results: A lower frequency of sexual dysfunction was observed among patients who underwent RALP ($p=0.039$) and VLP ($p<0.0001$) compared to those who underwent RRP. However, the mean surgery time was longer for RALP compared to both RRP ($p=0.001$) and VLP ($p=0.001$). Regarding oncological outcomes, RALP demonstrated a higher frequency of free urethral margins ($p=0.033$). The other oncological, functional, and perioperative factors were statistically similar across the three types of surgery.

Conclusion: RALP is associated with a shorter hospital stay and a lower rate of sexual dysfunction up to one year after prostatectomy, compared to RRP. The oncological outcomes were generally equivalent across the techniques, with the exception of urethral margin status.

Keywords: Prostate cancer, Open radical prostatectomy, Robotic assisted radical prostatectomy, Laparoscopic radical prostatectomy, Positive margins.

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OBJECTIVE

To analyze the perioperative, functional, and oncological outcomes of patients undergoing radical prostatectomy using open (retropubic), video laparoscopic, and robot-assisted techniques from 2016 to 2021 at a tertiary hospital in Curitiba, Paraná, Brazil.

INTRODUCTION

Prostate cancer (PCa) ranks as the third most prevalent cancer globally (7.1%), trailing only lung and breast cancers[1]]. According to estimates by the Brazilian National Cancer Institute (INCA), during the triennium of 2020-2022, 66,000 new cases of prostate cancer are anticipated to emerge in Brazil annually. It stands as the most frequently diagnosed and encountered cancer in men, second only to non-melanoma skin cancer, thus constituting a significant public health concern[2]. In the modern era, patients with localized disease have access to diverse treatment modalities, including surgery, radiation, ablation, and active surveillance. Among the surgical options, four distinct approaches are available for the treatment of localized prostate cancer: retropubic (RPP) - the more traditional approach -, perineal (RPP), vídeo laparoscopic (VLP), and robot-assisted laparoscopic (RALP) radical prostatectomies[3].

Robotic surgery has been gaining increasing prominence worldwide across various medical specialties, being regarded as one of the most advanced techniques for minimally invasive procedures[4]. Since 1997, the Da Vinci Surgical System® has been employed in surgical procedures, characterized by its “master-slave” system, wherein all movements are entirely dependent on the surgeon’s commands[4]. Initially applied in procedures involving benign conditions like fundoplication and cholecystectomy, it quickly found its way into oncology centers; presently, its primary application lies in gynecological and urological neoplasia surgeries[5] [6]. The first robot-assisted urological surgery, a radical prostatectomy, was performed in 2000, demonstrating postoperative functional outcomes comparable to open surgery[7]. Subsequently, urology emerged as the field with the highest application of robot-assisted surgery, utilized in radical and simple prostatectomy, cystectomy, pelvic and retroperitoneal lymphadenectomy, treatment of pelvic organ prolapse, vesical diverticulectomy, ureteral reimplantation, adrenalectomy, and partial or total nephrectomy[8]. By 2010, over 40% of the United States had adopted robotic surgery for radical prostatectomy, illustrating its effectiveness and widespread implementation[5].

When considering the wide array of available surgical treatment options for localized prostate cancer, a comprehensive analysis is essential, encompassing not only technical advantages and functional outcomes, which have already demonstrated superiority in robotics, but also oncological outcomes[5] [6]. It is widely accepted that positive surgical margins elevate the risk of biochemical recurrence of the neoplasm and subsequently worsen patient prognosis[9]. Thus, this article aims to compare functional, perioperative, and oncological outcomes of patients undergoing radical prostatectomy through RRP, VLP, or RALP techniques at a tertiary referral hospital.

METHODOLOGY

A total of 365 patients diagnosed with prostate cancer and who underwent radical prostatectomy at Erasto Gaertner Hospital (Curitiba, PR, Brazil) between 2016 and 2021 were included in this study. Erasto Gaertner is a tertiary hospital specializing in the clinical and surgical treatment of oncology patients. The study included men over 18 years of age, of any ethnicity, who were diagnosed with prostate cancer and underwent radical prostatectomy via RRP, VLP, or RALP. Exclusion criteria included patients who had undergone any prior prostate surgery and those whose medical records lacked sufficient information for analysis. The study received approval from the Research Ethics Committees of Erasto Gaertner Hospital and Universidade Positivo, under approval numbers 4,818,787 and 4,906,196, respectively.

Of the 365 patients, 211 underwent RRP, 118 underwent VLP, and 37 underwent RALP during the study period. All procedures were performed by the same surgical team. Clinical and pathological data were collected through retrospective chart review and included: patient age at surgery, prostate-specific antigen (PSA) levels, Gleason score, tumor staging according to TNM 8, pathological tumor staging, and comorbidities (diabetes mellitus, systemic arterial hypertension, obesity, and smoking). Outcome data included: length of hospital stay, surgery time, readmission to the emergency department, sexual dysfunction, urinary continence up to one year, and pathological analysis of the surgical specimen, including information on extraprostatic extension, neoplasia-free adipose tissue, perineural infiltration, angiolymphatic invasion, and surgical margin status (vesical neck, seminal vesicle, urethral, and circumferential/radial margins).

Preoperative clinical and tumor data were matched based on patient age at surgery, PSA levels, Gleason score, tumor staging according to TNM 8, pathological tumor staging, and comorbidities (diabetes mellitus, systemic arterial hypertension, obesity, and smoking).

Data were collected using Excel spreadsheets. Statistical analysis was performed using SPSS version 17.0. Continuous variables were expressed as mean ± standard deviation and compared using t-tests. Categorical variables were expressed as percentages and compared using the chi-square test or Fisher's exact test, as appropriate. P values of less than 0.05 were considered statistically significant.

RESULT

The preoperative clinical characteristics of the patients and tumor profiles are presented in Table 1. The mean age was 64 ± 3.7 years in the RRP group, 63.3 ± 7.1 years in the VLP group, and 62.0 ± 8.6 years in the RALP group. Additionally, PSA values between 4.1 and 10, Gleason score of 7 (3+4), pT2 staging, and TNM 8 stage IIB were the most common findings across all three groups. There were no significant differences among the RRP, VLP, and RALP groups, indicating that preoperative characteristics were well-balanced across the study populations (Table 1).

Table 1 - Preoperative Clinical and Tumor Characteristics

Characteristics	Open (N=210)		VLP (N=118)		Robotic (N=37)		Open vs. Robotic	VLP vs. Robotic	Open vs. VLP
							p value	*p value*	*p value*
Age									
Average ± SD	64 ± 3,7		63,3 ± 7,1		62,0 ±8,6		0,165	0,422	0,354
PSA									
0 to 4,0	13	(6,2)	7	(5,9)	1	(2,7)	0,605	0,869	0,300
4,1 to 10,0	90	(42,9)	59	(50,0)	18	(48,6)			
GLEASON									
6	18	(8,6)	16	(13,6)	4	(10,8)	0,945	0,880	0,161
7 (3+4)	74	(35,2)	50	(42,4)	14	(37,8)			
7 (4+3)	61	(29,0)	26	(22,0)	10	(27,0)			
8, 9 e 10	57	(27,1)	26	(22,0)	9	(24,3)			
Staging									
pT1	0	(,0)	2	(1,7)	0	(,0)	0,055	0,364	0,082
pT2	150	(71,4)	90	(76,3)	32	(86,5)			
pT3	60	(28,6)	26	(22,0)	5	(13,5)			
TNM 8									
I	9	(4,3)	9	(7,6)	4	(10,8)	0,131	0,215	0,401
IIA	7	(3,3)	6	(5,1)	0	(,0)			
IIB	63	(30,0)	44	(37,3)	14	(37,8)			
IIC	41	(19,5)	21	(17,8)	8	(21,6)			
IIIA	11	(5,2)	4	(3,4)	2	(5,4)			
IIIB	36	(17,1)	16	(13,6)	0	(,0)			
IIIC	26	(12,4)	14	(11,9)	6	(16,2)			
HTN									
NO	92	(44,0)	60	(50,8)	19	(52,8)	0,330	0,839	0,253
YES	117	(56,0)	58	(49,2)	17	(47,2)			
DM									
NO	176	(84,2)	106	(89,8)	34	(94,4)	0,105	0,399	0,161
YES	33	(15,8)	12	(10,2)	2	(5,6)			
Obesity									
NO	206	(98,6)	113	(95,8)	34	(94,4)	0,106	0,740	0,114
YES	3	(1,4)	5	(4,2)	2	(5,6)			
Smoking									
EX-Smoker	24	(11,5)	13	(11,0)	3	(8,3)	0,286	0,369	0,971
Not Smoker	164	(78,5)	94	(79,7)	32	(88,9)			
Smoker	21	(10,0)	11	(9,3)	1	(2,8)			

Source: Compiled by the authors.

In terms of oncological outcomes, we observed a significantly higher frequency of neoplasia-free surgical margins at the urethral site in the RRP group (88.8%) compared to the RALP group (75%, p=0.003). However, there was no significant difference between the RRP and VLP groups (p=0.628) or between the VLP and RALP groups (p=0.116) (Table 2). The absence of extraprostatic extension (72.1% in RRP, 75.2% in VLP, and 70.3% in RALP), perineural infiltration (23.6% in RRP, 29.1% in VLP, and 21.6% in RALP), angiolymphatic invasion (91.3% in RRP, 96.6% in VLP, and 89.2% in RALP), and neoplasia-free adipose tissue (100% in RRP and VLP, and 97.1% in RALP) were similar across all groups. Additionally, the frequency of neoplasia-free margins at the vesical neck (93.2% in RRP, 91.3% in VLP, and 91.7% in RALP), seminal vesicle (83.3% in RRP, 89.7% in VLP, and 91.9% in RALP), urethral (88.8% in RRP, 100% in VLP, and 75% in RALP), and radial circumference (57.6% in RRP, 66.4% in VLP, and 51.4% in RALP) were similar among the groups evaluated (Table 2).

Table 2 - Results obtained from the comparison between RRP, VLP, and RALP

Outcomes	Open		VLP		Robotic		Open vs. Robotic	VLP vs. Robotic	Open vs. VLP
	N	%	N	%	N	%	*p value*	*p value*	*p value*
ONCOLOGICAL OUTCOMES									
Extraprostatic extension									
Not evidenced	150	(72,1)	88	(75,2)	26	(70,3)	0,818	0,550	0,545
Present	58	(27,9)	29	(24,8)	11	(29,7)			
Neoplasm-free adipose tissue									
Neoplasm Free	199	(100,0)	115	(100,0)	34	(97,1)	0,170	0,069	n.a.
Present	0	(,0)	0	(,0)	1	(2,9)			
Perineural Infiltration									
Not evidenced	49	(23,6)	34	(29,1)	8	(21,6)	0,797	0,376	0,275
Present	159	(76,4)	83	(70,9)	29	(78,4)			
ONCOLOGICAL OUTCOMES									
Angiolymphatic Invasion									
Not evidenced	190	(91,3)	113	(96,6)	33	(89,2)	0,672	0,077	0,071
Present	18	(8,7)	4	(3,4)	4	(10,8)			
Surgical Margin of the Bladder Neck									
Committed	14	(6,8)	10	(8,7)	3	(8,3)	0,745	0,946	0,543
Neoplasm Free	191	(93,2)	105	(91,3)	33	(91,7)			
Surgical Margin of the Seminal Vesicle									
Committed	35	(16,7)	12	(10,3)	3	(8,1)	0,180	0,701	0,110
Neoplasm Free	174	(83,3)	105	(89,7)	34	(91,9)			
Urethral Surgical Margin									
Committed	23	(11,2)	15	(13,0)	9	(25,0)	0,033	0,116	0,628
Neoplasm Free	182	(88,8)	100	(87,0)	27	(75,0)			

Radial Circumferential Surgical Margin									
Committed	**89**	**(42,4)**	**39**	**(33,6)**	**18**	**(48,6)**	**0,478**	**1.000**	**0,121**
Neoplasm Free	**121**	**(57,6)**	**77**	**(66,4)**	**19**	**(51,4)**			
PERIOPERATIVE OUTCOMES									
Hospitalization time (days)									
Average ± SD	**3**	**± 1,01**	**2,8**	**± 1,40**	**2**	**± 1,2**	**0,0007**	**0,304**	**<0,0001**
Readmission ED									
No	**156**	**(75,7)**	**91**	**(77,1)**	**26**	**(74,3)**	**0,854**	**0,729**	**0,777**
Yes	**50**	**(24,3)**	**27**	**(22,9)**	**9**	**(25,7)**			
Surgery time (min)									
Average ± SD	**191**	**± 95,3**	**183**	**± 97,4**	**238**	**±63,3**	**0,001**	**0,001**	**0,448**
FUNCTIONAL OUTCOMES									
Urinary continence									
Continence preserved	**128**	**(64,3)**	**76**	**(66,7)**	**25**	**(69,4)**	**0,553**	**0,757**	**0,675**
Incontinent	**71**	**(35,7)**	**38**	**(33,3)**	**11**	**(30,6)**			
Sexual dysfunction									
No	**51**	**(24,3)**	**42**	**(35,6)**	**15**	**(40,5)**	**0,039**	**0,586**	**0,029**
Yes	**159**	**(75,7)**	**76**	**(64,4)**	**22**	**(59,5)**			

Source: Compiled by the authors.

Regarding perioperative data, we observed a lower average hospital stay for the RALP group (2 ± 1.2 days, p=0.0007) and VLP group (2.8 ± 1.4 days; p<0.0001) compared to the RRP group (3 ± 1.01 days), with no difference between RRP vs. RALP groups (p=0.304). The surgery time was longer in the RALP group (238 ± 63.3 minutes) compared to the RRP (191 ± 95.3 minutes; p=0.001) and VLP groups (183 ± 97.4 minutes; p=0.001), with no difference in time between the RRP vs. VLP groups (p=0.448). The need for readmission to the emergency department was similar among the evaluated approaches.

Regarding functional outcomes, we observed a lower frequency of early sexual dysfunction among patients who underwent surgery via RALP (59.5%) compared to RRP (75.7%; p=0.039). The same trend was observed between VLP (66.4%) and RRP (p=0.029), but there was no difference between the VLP and RALP groups (p=0.586). Urinary incontinence rates were similar among the evaluated surgical methods.

DISCUSSION

For a long time, open surgical techniques were prioritized over laparoscopic procedures in oncological surgeries due to the steeper learning curve and the presumed higher risk of tumor dissemination associated with the latter. Over the years, it became evident that laparoscopic techniques were safe and offered benefits such as shorter hospital stays and reduced postoperative pain for patients. Concurrently, robotic-assisted surgery emerged as a promising option. Our findings suggest that robotic-assisted laparoscopic prostatectomy (RALP) may have advantages over open

radical prostatectomy (RRP) in terms of shorter hospital stays and reduced sexual dysfunction. Additionally, RALP showed non-inferiority compared to video-assisted laparoscopic prostatectomy (VLP), except for the neoplasia-free surgical margin at the urethral site. However, both RRP and VLP were superior to RALP in terms of shorter surgery times.

In 2021, the National Committee for the Incorporation of Technologies in the Unified Health System (SUS) maintained its 2018 decision not to adopt robotic surgery as an available technique for performing radical prostatectomies to treat prostate adenocarcinoma within the public healthcare system. Nevertheless, 7.7% of prostatectomies within SUS are robot-assisted, mainly performed in hospitals with non-governmental funding, such as philanthropic institutions or through donations. This is the case with the hospital in our study, which is one of the eight centers in Brazil that have adopted this technique for SUS patients. The Da Vinci Surgical System® was implemented at the end of 2016, and the limited duration of using this new technology, combined with its lack of SUS funding, explains the smaller sample size of RALP in our study.

All interventions included in the study were performed by the same surgical team, ensuring consistency in evaluating the outcomes. The longer surgical time associated with the robotic technique compared to VLP and RRP is likely due to two factors: first, the additional time required for stages such as anesthesia, patient positioning, and robot arm attachment (docking); and second, the learning curve associated with this recent technology, which requires experience to fully realize its potential. As a result, robotic procedures tend to take longer.

However, the increased surgical time did not lead to a higher incidence of perioperative or postoperative complications in our study. In a retrospective cohort of 1,062 patients, RRP was identified as an independent risk factor for complications and hospital readmission. Such outcomes may be attributed to the lower inflammatory response and sympathetic activation associated with RALP and VLP compared to RRP, leading to faster recovery. Our data showed that hospital stays were shorter for RALP and VLP compared to RRP, with an average reduction of one day. Regarding readmission to the emergency department, there was no statistical difference among the three techniques, with rates ranging from 22.9% in VLP to 25.7% in RALP. Our findings align with current literature, which shows that robotic surgery is associated with lower blood loss, reduced need for blood transfusions, and shorter hospitalization times.

The factors that most influence quality of life after radical prostatectomy are the reduction in erectile function and urinary continence. Both conditions are complex and multifactorial, which is why there is still some divergence in the literature. Regarding functional outcomes, there was no statistical difference in the rate of patients who maintained early urinary continence. However, there was a trend toward improvement in favor of robotic surgery (69.4% of patients who underwent RALP maintained continence, compared to 64.3% in RRP and 66.7% in VLP). Similar outcomes were found in systematic reviews, which indicated that continence rates are similar regardless of the surgical technique. Nonetheless, some studies suggest that RALP results in a higher rate of urinary continence preservation.

In terms of sexual function, despite the nerve-sparing approaches used in

RRP, most patients experience some loss of erectile function. This finding was confirmed by our study, which showed that both RALP and VLP are superior to RRP in preserving erectile function. There was no significant difference between RALP and VLP. Similar outcomes have been found in clinical studies and meta-analyses, although recent systematic reviews suggest that the surgical technique may not significantly impact this postoperative functional outcome.

The assessment of positive surgical margins (PSMs) is crucial when comparing surgical modalities, as PSMs are directly proportional to increased biochemical recurrence, the need for salvage therapies like radiotherapy and hormone therapy, and, consequently, worse patient prognosis. Our results indicate the non-inferiority of RALP in terms of extraprostatic extension, neoplasia-free adipose tissue, perineural infiltration, angiolymphatic invasion, and surgical margins at the vesical neck, seminal vesicle, and radial circumference, compared to VLP and RRP. However, the result for the urethral margin favors RRP over RALP, likely due to the learning curve associated with robotic surgery, as mentioned earlier. Except for the urethral margin, our oncological outcomes are consistent with current literature, which suggests that oncological results are satisfactory regardless of the surgical technique. However, in 2012, Tewari et al. published a meta-analysis involving 286,876 patients that demonstrated the superiority of robotic techniques in terms of PSMs.

The stance of CONITEC (the National Committee for the Incorporation of Technologies) on the cost-effectiveness of robotic surgery in the Brazilian public health system (SUS) is challenged by a recent article published in the journal *Value in Health*. Using Markov transition models validated by the Brazilian Society of Urology, the authors concluded that although robotic prostatectomy is more expensive, it leads to improved clinical benefits related to quality of life due to reduced complications and better clinical outcomes. Similar analyses conducted in the United Kingdom also concluded that RALP is more cost-effective than open and laparoscopic prostatectomy, primarily due to the lower risk of biochemical recurrence.

This study has several limitations. As a retrospective study, it is subject to inherent biases associated with this study design. Additionally, the limited number of patients in some groups, particularly the RALP group, might have influenced some results. To mitigate these limitations, the sample was matched for various clinical and tumor factors, and all evaluated procedures were performed by the same surgical team.

CONCLUSION

Our findings indicate that despite the longer surgical time, RALP is associated with shorter hospital stays and a lower rate of erectile dysfunction up to one year after prostatectomy. However, the neoplasia-free surgical margin at the urethral site was less favorable for RALP compared to other surgical techniques.

Specifically, in terms of perioperative outcomes, RALP had a longer surgical time compared to RRP and VLP. Hospitalization time was significantly shorter for the minimally invasive techniques (VLP and RALP) compared to RRP. Complications, as measured by returns to the emergency department, were similar across all three techniques.

Regarding functional outcomes, the study found better preservation of erectile function following minimally invasive radical prostatectomies (VLP and RALP) compared to RRP. However, there was no significant difference in urinary continence outcomes, which contrasts with some findings in the literature.

In terms of immediate oncological outcomes, based on the anatomopathological analysis of surgical margins, all three techniques were equivalent concerning extraprostatic tumor extension, perineural infiltration, angiolymphatic infiltration, neoplasia-free adipose tissue, and neoplasia-free surgical margins at the vesical neck, seminal vesicle, and radial circumference. The only statistically significant difference was observed in the neoplasia-free surgical margin at the urethral site, which was more frequent in RRP and VLP compared to RALP.

Finally, it is important to highlight the need for further studies with larger samples, long-term follow-up, and cost-effectiveness evaluations to provide more definitive results on the advantages of RALP in the treatment of prostate cancer within the Brazilian context.

REFERENCES

1. BRAY, Freddie; FERLAY, Jacques; SOERJOMATARAM, Isabelle; SIEGEL, Rebecca L.; TORRE, Lindsey A.; JEMAL, Ahmedin. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. **CA: A Cancer Journal for Clinicians**, *[S. l.]*, v. 68, n. 6, p. 394–424, 2018. DOI: 10.3322/CAAC.21492. Disponível em: https://onlinelibrary.wiley.com/doi/full/10.3322/caac.21492. Acesso em: 5 jun. 2022.
2. INCA (Instituto Nacional de Câncer José Alencar Gomes da Silva). (2019). Estimativa 2020 : incidência de câncer no Brasil / Instituto Nacional de Câncer.
3. CORONATO, Eric E.; HARMON, Justin D.; GINSBERG, Phillip C.; HARKAWAY, Richard C.; SINGH, Kulwant; BRAITMAN, Leonard; SLOANE, Bruce B.; JAFFE, Jamison S. A multi-institutional comparison of radical retropubic prostatectomy, radical perineal prostatectomy, and robot-assisted laparoscopic prostatectomy for treatment of localized prostate cancer. **Journal of Robotic Surgery**, *[S. l.]*, v. 3, n. 3, p. 175–178, 2009. DOI: 10.1007/S11701-009-0158-2.
4. LANE, Tim. A short history of robotic surgery. **Annals of the Royal College of Surgeons of England**, *[S. l.]*, v. 100, p. 5–7, 2018. DOI: 10.1308/rcsann.supp1.5.
5. BASIRI, Abbas; DE LA ROSETTE, Jean Jmch; TABATABAEI, Shahin; WOO, Henry H.; LAGUNA, M. Pilar; SHEMSHAKI, Hamidreza. Comparison of retropubic, laparoscopic and robotic radical prostatectomy: who is the winner? **World Journal of Urology**, *[S. l.]*, v. 36, n. 4, p. 609–621, 2018. DOI: 10.1007/s00345-018-2174-1. Disponível em: https://doi.org/10.1007/s00345-018-2174-1.
6. GHEZZI, Tiago L.; CORLETA, Oly C. 30 Years of Robotic Surgery. **World Journal of Surgery**, [S. l.], v. 40, n. 10, p. 2550–2557, 2016. DOI: 10.1007/s00268-016-3543-9.
7. PASTICIER, Gilles; RIETBERGEN, John B. W.; GUILLONNEAU, Bertrand; FROMONT, Gaëlle; MENON, Mani; VALLANCIEN, Guy. Robotically assisted laparoscopic radical prostatectomy: feasibility study in men. **European urology**, *[S. l.]*, v. 40, n. 1, p. 70–74, 2001. DOI: 10.1159/000049751. Disponível em: https://pubmed.ncbi.nlm.nih.gov/11528179/. Acesso em: 27 maio. 2022.
8. MIKHAIL, David; SARCONA, Joseph; MEKHAIL, Mina; RICHSTONE, Lee. Urologic Robotic Surgery. **Surgical Clinics of North America**, *[S. l.]*, v. 100, n. 2, p. 361–378, 2020. DOI: 10.1016/j.suc.2019.12.003. Disponível em: https://doi.org/10.1016/j.suc.2019.12.003.
9. KARAKIEWICZ, Pierre I. et al. Prognostic impact of positive surgical margins in surgically treated prostate cancer: multi-institutional assessment of 5831 patients. **Urology**, *[S. l.]*, v. 66, n. 6, p. 1245–1250, 2005. DOI: 10.1016/J.UROLOGY.2005.06.108. Disponível em: https://pubmed.ncbi.nlm.nih.gov/16360451/. Acesso em: 27 maio. 2022.

10. Brierley J, Gospodarowicz M, O'Sullivan B. The principles of cancer staging. **Ecancermedicalscience**. 2016 Nov 24;10:ed61. doi: 10.3332/ecancer.2016.ed61. PMID: 28101141; PMCID: PMC5215238.
11. CHANG, Steven L.; KIBEL, Adam S.; BROOKS, James D.; CHUNG, Benjamin I. The impact of robotic surgery on the surgical management of prostate cancer in the USA. **BJU International**, *[S. l.]*, v. 115, n. 6, p. 929–936, 2015. DOI: 10.1111/bju.12850.
12. CONITEC, Ministério da Saúde (Brasil). Sistema cirúrgico robótico para cirurgia minimamente invasiva: Prostatectomia radical. Relatório de Recomendação, [S. l.], p. 46, 2018. Disponível em: http://conitec.gov.br.
13. JOHNSON, Brett; SOROKIN, Igor; SINGLA, Nirmish; ROEHRBORN, Claus; GAHAN, Jeffrey C. Determining the Learning Curve for Robot-Assisted Simple Prostatectomy in Surgeons Familiar with Robotic Surgery. **Journal of endourology**, *[S. l.]*, v. 32, n. 9, p. 865–870, 2018. DOI: 10.1089/END.2018.0377. Disponível em: https://pubmed.ncbi.nlm.nih.gov/30062904/. Acesso em: 16 jul. 2022.
14. PORCARO, Antonio Benito et al. Predictors of complications occurring after open and robot-assisted prostate cancer surgery: a retrospective evaluation of 1062 consecutive patients treated in a tertiary referral high volume center. **Journal of Robotic Surgery**, *[S. l.]*, v. 16, n. 1, p. 45, 2022. DOI: 10.1007/S11701-021-01192-W. Disponível em: /pmc/articles/PMC8863696/. Acesso em: 17 jul. 2022.
15. DU, Yuefeng; LONG, Qingzhi; GUAN, Bin; MU, Lijun; TIAN, Juanhua; JIANG, Yumei; BAI, Xiaojing; WU, Dapeng. Robot-assisted radical prostatectomy is more beneficial for prostate cancer patients: A system review and meta-analysis. **Medical Science Monitor**, *[S. l.]*, v. 24, p. 272–287, 2018. DOI: 10.12659/MSM.907092.
16. Tewari A, Sooriakumaran P, Bloch DA, Seshadri-Kreaden U, Hebert AE, Wiklund P. Positive surgical margin and perioperative complication rates of primary surgical treatments for prostate cancer: a systematic review and meta-analysis comparing retropubic, laparoscopic, and robotic prostatectomy. **Eur Urol.** 2012 Jul;62(1):1-15. doi: 10.1016/j.eururo.2012.02.029. Epub 2012 Feb 24. PMID: 22405509.
17. CAO, Lan; YANG, Zhenyu; QI, Lin; CHEN, Minfeng. Robot-assisted and laparoscopic vs open radical prostatectomy in clinically localized prostate cancer: perioperative, functional, and oncological outcomes: A Systematic review and meta-analysis. **Medicine**, *[S. l.]*, v. 98, n. 22, 2019. DOI: 10.1097/MD.0000000000015770. Disponível em: /pmc/articles/PMC6709105/. Acesso em: 13 jun. 2022.
18. STANFORD, Janet L.; FENG, Ziding; HAMILTON, Ann S.; GILLILAND, Frank D.; STEPHENSON, Robert A.; ELEY, J. William; ALBERTSEN, Peter C.; HARLAN, Linda C.; POTOSKY, Arnold L. Urinary and sexual function after radical prostatectomy for clinically localized prostate cancer: the Prostate Cancer Outcomes Study. **JAMA**, *[S. l.]*, v. 283, n. 3, p. 354–360, 2000. DOI: 10.1001/JAMA.283.3.354. Disponível em: https://pubmed.ncbi.nlm.nih.gov/10647798/. Acesso em: 17 jul. 2022.
19. ILIC, Dragan; EVANS, Sue M.; ALLAN, Christie Ann; JUNG, Jae Hung; MURPHY, Declan; FRYDENBERG, Mark. Laparoscopic and robot-assisted vs open radical prostatectomy for the treatment of localized prostate cancer: a Cochrane systematic review. **BJU International**, *[S. l.]*, v. 121, n. 6, p. 845–853, 2018. DOI: 10.1111/bju.14062.
20. STOLZENBURG, Jens Uwe et al. Robotic-assisted Versus Laparoscopic Surgery: Outcomes from the First Multicentre, Randomised, Patient-blinded Controlled Trial in Radical Prostatectomy (LAP-01). **European urology**, *[S. l.]*, v. 79, n. 6, p. 750–759, 2021. DOI: 10.1016/J.EURURO.2021.01.030. Disponível em: https://pubmed.ncbi.nlm.nih.gov/33573861/. Acesso em: 6 out. 2022.
21. FARIA, Eliney Ferreira; ROSIM, Ricardo Papaléo; DE MATOS NOGUEIRA, Ernesto; TOBIAS-MACHADO, Marcos. Cost-Effectiveness Analysis of Robotic-Assisted Radical Prostatectomy for Localized Prostate Cancer From the Brazilian Public System Perspective. **Value in Health Regional Issues**, *[S. l.]*, v. 29, p. 60–65, 2022. DOI: 10.1016/J.VHRI.2021.06.009.
22. LABBAN, Muhieddine; DASGUPTA, Prokar; SONG, Chao; BECKER, Russell; LI, Yanli; KREADEN, Usha Seshadri; TRINH, Quoc Dien. Cost-effectiveness of Robotic-Assisted Radical Prostatectomy for Localized Prostate Cancer in the UK. **JAMA Network Open**, *[S. l.]*, v. 5, n. 4, p. E225740, 2022. DOI: 10.1001/JAMANETWORKOPEN.2022.5740. Disponível em: /pmc/articles/PMC8980901/. Acesso em: 16 jul. 2022.

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TRD, BPM, BCCOM, JCK, NCN, WGCN, FAA, and VBP contributed to the research design. BPM, JCK, and NCN contributed to the collection of patient data. TRD, BCCOM, WGCN, and VPB contributed to result interpretation, manuscript writing, and formatting. FAA and TRD contributed to the discussion section and final manuscript review. FAA conducted the statistical analysis.

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