Long-term comparative outcome analysis of a Robot-Assisted Laparoscopic Prostatectomy with Retropubic Radical Prostatectomy by a single surgeon

Neeraja Tillu (drneerjatillu@gmail.com)
Asian Cancer Institute, Mumbai

Jagdeesh Kulkarni
Asian Cancer Institute, Mumbai

Research Article

Keywords: Prostatectomy, retropubic, Robot-Assisted Surgery, Prostate Cancer

Posted Date: April 25th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1553397/v1

Abstract

Objective

We aimed to give a comprehensive outcome analysis of robot assisted laparoscopic prostatectomies (RALP) performed by a single surgeon and compared it to retropubic radical prostatectomies (RRP) done by the same surgeon in a high-volume center.

Materials and Methods

Preoperative, perioperative, and postoperative data were collected prospectively and compared with retrospective retropubic radical prostatectomy data. Perioperative, oncological data and functional results in the first year were compared between the two groups. There were 547 RARPs between 4th August 2011 to 31st December 2018, and 428 RRPs between 1st January 1996 to 31st December 2009 which were included in this review.

Results

While the operation time was in favor of the open group (196 vs 160 min, $p<0.01$), the estimated blood loss (188 vs 316ml, $p<0.01$), blood transfusion rate (3% vs 7% $p=0.021$), hospital stay (4 days vs 7 days) and mean catheter duration (12 vs 15 days) were in favor of the robotic group. Majority of the complications belonged to Clavien-Dindo group II in both groups and rates were not significantly different. ($p=0.33$) 12-month continence rate was in favor of RALP group (98.3% vs 99.2%, $p <0.01$). Overall survival of the RALP cohort at 24 months was 99.8%, 60 months 96.1%, 84 months 87.3% , 96 months 81.3%), 108 months was 79.5%. Overall survival at 24 months was 99.8%, 60 months 96.1%, 84 months 87.3%, 96 months 81.3%, and 108 months was 79.5%.

Conclusion

RALP is a safe, minimally invasive technically feasible procedure with comparable functional and oncological outcomes. Our study showed superior perioperative and continence outcomes in RALP. However, despite its growing popularity, RRP still remains the gold standard in India due to its affordability and accessibility.

Introduction

The incidence of prostate cancer is rising in India. Overall, it is the third most common cancer in Indian males (1 in 125) and is still a significant cause of cancer-associated death [1]. Increased life expectancy combined with easily available PSA and decreased threshold for biopsy has increased its diagnosis [2]. Radical prostatectomy is the established treatment for localised prostate cancer. The first retropubic radical prostatectomy (RRP) was described by Millin in 1945 [3]. In 1985, Walsh demonstrated the first nerve-sparing retropubic radical prostatectomy [4]. Later In 1997, Schlusser et al reported a new technique of laparoscopic radical prostatectomy (LRP) [5]. Though the outcomes matched RRP's with the added

benefit of shorter hospital stay and reduced blood loss, LRP had a long learning curve, which became a limiting factor. In 2000, the first robot assisted laparoscopic radical prostatectomy (RALP) was performed with greater ease than the LRP, giving a strong impetus to this procedure [6]. Further, high-resolution three-dimensional vision and seven degrees of freedom for manipulation allowed a short learning curve. Although the first RALP in India was performed in All India Institute of Medical Sciences in 2005[7], robotic surgery was available at many centres after 2010. The SWOT analysis of robot-assisted surgery in India concluded that judicious use and standardised reporting of outcomes was key to the growth of this technology [8].

We report in this study a comprehensive analysis of the 547 RALPs and compare the

outcomes to our previous series of 428 open prostatectomies [9]. Our primary aim was to compare the pre-, peri- and postoperative results and functional outcome of the two techniques done by a single surgeon with a follow-up of up to 117 months. Our secondary aim was to analyse the overall and recurrence-free survival of the current series of RALP patients.

Materials And Methods

Robotic prostatectomy was done by a single surgeon (JNK) from 4th August 2011 to 31st December 2018. Patients were followed up till 31st October 2021. We compared these cases with our series of 428 open prostatectomy patients from 1st January 1996 to 31st December 2009 by the same surgeon and published earlier[9]. Institutional ethics committee approval was obtained. Data acquisition was from case forms, which were filled at regular intervals at admission and during subsequent follow-ups. The case report forms catalogued the demographic parameters like age, comorbidities, clinical variables, including prostate-specific antigen studies, biopsy Gleason score, clinical stage, pathological Gleason score and pathological staging. Total operative time, perioperative complications, hospital stay, blood loss, the requirement for blood transfusion and duration of the catheter. Complications were tabulated and classified based on Clavien Dindo classification. [10] Details of histopathologic assessment included final Gleason score, margin positivity, seminal vesicle and lymph node involvement. Gleason grade grouping was done according to grade group I (3 + 3), grade group II (3 + 4), grade group III (4 + 3), grade group IV (8) and grade group V (9–10). Patients were followed up at four weeks first, then three monthly for two years, and six-monthly till five years and annually after that. We obtained clinical history, imaging, PSA level, and information on potency and continence at each visit. We defined continence as wearing 0 pads or a one-liner throughout the day. A PSA above 0.2ng/ml was defined as biochemical recurrence. Adjuvant hormone therapy was given to patients with lymph node involvement and patients who developed metastasis.

METHOD

Da Vinci ® Si ™ system (Intuitive Surgical, Sunnyvale, CA) was used from 2011–2015; Da Vinci ®SHD from June 2015-December 2019. The conventional transperitoneal six-port approach has been performed

in all cases described by Vatikutti Institute[11] in the first 100 cases. In the subsequent 447 cases, the surgeon used Montsouri's laparoscopic technique with robotic modification. [12]Neurovascular bundle preservation was assessed according to the D'Amico risk classification and MRI. Urethrovesical anastomosis was modified using Van Velthoven's technique.[13] Modified posterior reconstruction of rhabdospincter was done in all cases. A 22F Foleys catheter was kept, and normal saline of 200 ml was instilled for the anastomosis challenge. The postoperative pathway included early ambulation without assistance, early resumption of oral diet and reasonable pain control. The urethral catheter was removed within 21 postoperative days.

DATA ANALYSIS

R Core Team (2021) software was used for data analysis. Continuous variables were presented as mean and standard deviation, categorical variables as a percentage. Numerical parameters between the two groups were compared with Student's t-test or the Mann–Whitney U test. A p-value < 0.01 was accepted for statistical significance. Survival analysis in the RALP cohort was done using Kaplan-Meier curves. Multivariate analysis was done using log-rank test. Overall survival was meant as survival from death due to any cause. Recurrence-free survival was defined as patients alive without clinical, pathological or radiological evidence of disease after radical prostatectomy. Increasing PSA levels, radiological evidence of progressive disease or death due to any cause was taken as an event. OS and RFS was calculated over 60,84 and 108 months.

Results

1. Clinical characteristics

There was no significant difference between the two groups regarding age, BMI, and comorbidities. The preoperative characteristics of the patient population were also similar [Table 1].

Table 1
Demographic data and preoperative characteristics of the two patient populations

Demographic data	**RALP (n = 547)**	**RRP (n = 428)**	**p-value**
Age (mean)	62.29(+/-6.21)	63.54(+/- 7.05)	0.71
Age (range)	51–80	44–84	–
BMI (range)	26–32	26–34	–
Comorbidities	304 (58%)	181 (42%)	
Hypertension	209 (38%)	121 (28%)	0.42
Diabetes	106 (19%)	40 (9%)	
IHD	36 (6%)	25 (6%)	
Clinical T staging	**RALP (n = 547)**	**RRP (n = 428)**	**p-value**
T1a + T1b + T1c	288 (52%)	177 (41%)	
T2a + T2b	69 (13%)	136 (32%)	0.33
T2c	140 (26%)	105 (25%)	
T3a + T3b	205 (9%)	10 (2%)	
PSA (ng/ml)	**RALP (n = 547)**	**RRP (n = 428)**	**p-value**
< 4	11 (2%)	39 (92%)	
4-9.9	110 (20%)	138 (32%)	0.30
10–20	233(43%)	144 (34%)	
> 20	193(35%)	107 (25%)	
Biopsy Gleason score	**RALP (n = 547)**	**RRP (n = 428)**	**p-value**
3 + 3	188(34%)	170(40%)	
3 + 4	150(27%)	97(23%)	
4 + 3	161(29%)	101(24%)	0.6
8	10(2%)	39(8%)	
9–10	38(7%)	20(5%)	

2. Peri-operative characteristics

The intraoperative parameters in terms of mean blood loss, mean operative time and the total number of patients requiring blood transfusion differed significantly in the two groups. The mean hospital stay, and

mean catheter duration was also significantly different [Table 2].

Table 2
Comparison between perioperative parameters of the two groups

Peri-operative parameters	RALP (n = 547)	RRP (n = 428)	p-value
Mean blood loss	187.74 (+/- 32.15ml)	316.38ml (+/- 38.71)	< 0.01
Mean operative time	196.39(+/-27.62)min	160.05 (+/- 26.88) min	< 0.01
Number of patients requiring blood transfusion	18/547 (3.2%)	32/428 (7.47%)	
Mean hospital stay	4.44(+/- 1.33) days	6.9 (+/- 1.64) days	< 0.01
Mean catheter duration	12.47(+/- 2.92) days	14.58 (+/- 2.74) days	< 0.01

3. Complications

Complications were classified according to the Clavien Dindo classification system.[10] The most common complication was haemorrhage requiring perioperative blood transfusion (4%). [Table 3]

Table 3
Complications of RALP patients classified on the basis of Clavien-Dindo grade.

Complication	Clavien-Dindo grade	Incidence
INTRAOPERATIVE		
Blood Transfusion	II	18 (4%)
Lost needle (retrieved in the same surgery)	–	3 (1%)
Conversion to open	–	4 (1%)
POSTOPERATIVE (before discharge)		
Ileus	II	12 (2%)
Clot retention	IIIb	4 (1%)
POSTOPERATIVE (after discharge)		
Urine leak	I	14 (3%)
Wound infection	I	5 (1%)
Incisional hernia	IIIb	8 (2%)
Urinary tract infection	II	2 (1%)
Symptomatic lymphocele	IIIa	3 (1%)
Clip eroding through the anastomosis with migration into the bladder	IIIa	4 (1%)
Bladder neck contracture	IIIb	11 (2%)

Lost needle was retrieved in the same surgery in three cases. However, it prolonged intraoperative time. Four cases were converted to open because of equipment failure in two cases, haemorrhage in one case and a lost needle in the fourth.

Urine leak was treated by prolonged catheterisation. Lymphoceles which did not resolve on expectant management were drained using pigtail. Haemostatic clips were detected in three patients, 2–3 months after surgery and were retrieved cystoscopically. It formed a nidus for vesical calculus in one patient, which treated with cystolithotripsy six months after surgery. Bladder neck contracture was treated cystoscopically with a cold knife.

There was no significant difference in complications between RALP and RRP patients. [Table 4]

Table 4
Comparison between complications of RALP and RRP patients

Complications	RALP (n = 547)	RRP (n = 428)	p-value
Clavien I	19	10	
Clavien II	32	48	0.33
Clavien III a	7	16	
Clavien IIIb	23	25	
Urine leak	14	8	0.47
Bladder neck contracture	11	10	0.72

4. Pathological results

Standard reporting of radical prostatectomy specimens was followed (according to ADASP guidelines). Histopathology result comparison is showed significant difference in lymph node metastasis in the two groups [Table 5].

Table 5
Histopathological result comparison between the two groups

Gross pathological examination	RALP (n = 547)	RRP (n = 428)	p-value
Positive surgical margin	92 (16.8%)	98(23.2%)	0.017
Seminal vesicle invasion	152 (27.7%)	161 (37.6%)	0.38
Metastasis to lymph nodes	20 (3.6%)	91 (21.2%)	< 0.01
Pathological staging	**RALP (n = 547)**	**RRP (n = 428)**	**p-value**
Organ confined PT2a + b + c/LN-	190	161	
PT3a (LN-)	205	76	0.47
PT3b (LN-)	152	100	
LN+	20	91	
Pathological Gleason's score	**RALP (n = 547)**	**RRP (n = 428)**	**p-value**
3 + 3	60 (11%)	115 (27%)	
3 + 4	205 (37%)	136 (31%)	
4 + 3	125 (23%)	84 (20%)	0.47
8	76 (14%)	41 (10%)	
9–10	81 (15%)	52 (12%)	

5. Continence

There was a significant difference between the 12-month continence rate of the two groups [Table 6]. The time taken by RALP patients to achieve continence is shown in Fig. 1.

Table 6
Comparison between continence rate of the two groups at 1,3, and 12 months.

	RALP (n = 547)	RRP (n = 428)	p-Value
1-month continence rate	196 (38.2%)	145 (33.9%)	0.52
3-month continence rate	430 (83%)	325 (75.9%)	0.32
12-month continence rate	508 (99.2%)	420 (98.3%)	< 0.01

6. Survival analysis of the RALP cohort:

The median follow up was 69.7 months (Range- 18.4–117.0 months). Overall survival was 96.1% (93.9–97.6%CI), 87.3% (82.9–90.6 at 0.95CI) 79.5% (73.2–84.4% at 0.95CI) at 60, 84 and 108 months respectively [Fig. 2]. Log-rank analysis of the variables showed clinical stages (T1,T2, T3) [A], biopsy Gleason grade groups (I,II,III,IV, V) [B], clinical PSA groups (< 4,4.1–10,10.1–20,>20)[C] and pathology specimen Gleason grade groups (I,II,III,IV,V) [D] had a significant impact on overall survival [Fig. 3].

Recurrence-free survival of the cohort was 65.4% (61%-69.4% at 0.95CI), 38.6% (34.0-43.2% at 0.95CI) and 9.3% (6.6–12.6 at 0.95CI) at 60, 84 and 108 months respectively [Fig. 4]. Log-rank analysis of the variables showed only biopsy Gleason grade groups (I,II,III,IV, V) [b], and pathology Gleason grade groups (I,II,III,IV,V) [d] had a significant impact on recurrence- free survival [Fig. 5].

In the RRP study, the seven year overall survival, prostate cancer specific survival, and event free survival rate was 83.2%, 82.8% and 69.9%, respectively. EFS was defined as patients alive without events. Increasing PSA levels or radiological evidence of progressive disease or death due to any cause was taken as an event. Prostate CSS was defined as survival from death attributed to complications of prostate cancer.

Discussion

Since its initial report on a series of 190 patients by Kumar et al. [7], the adoption of RALP in India has been on the rise. With its small incision, RRP remains the procedure of choice for most centres in India due to its cost-effectiveness. We got access to the robotic surgery in the second half of 2011, and from then on majority of the RPs are done robotically; however, open RRPs are still performed by the author (JNK). In the last 25years (1996–2021), we performed RRPs till 2011 and RALPs after that. Further, we used two types of robots (SI and SHD). Therefore, we had the chance to compare two large cohorts and report our observations. We also believe our series has the most extensive comparison of RALP with RRP by a single surgeon in India.

Demographic and preoperative parameters (Table 1) did not show significant variation in the two patient cohorts despite the patient populations being diagnosed in different periods, except that the number of operations has increased over time. Surgical technique-wise (Table 2), RALP clearly showed a significant reduction in blood loss and transfusion rates. Reasons postulated are- enhanced visualisation of prostatic apex, exact visualisation of the dorsal venous complex for passage of ligature, and the effect of pneumoperiperitoneum. Reported blood loss in studies ranges from 50-2500ml.[14, 15] Our study concurs with literature that RALP is advantageous in blood loss and transfusion rates. mean surgical duration for RALP reported previously ranges from 105-540min [16, 17]. However, in our series, operative time was significantly longer in RALP than RRP, which could be accounted for the time required for docking and getting acquainted with the robotic platform, the learning curve and initial experience by the surgical team.

Early recovery, minimal ileus and improved pain control contributed to the statistically significant impact on mean hospital stay between the two groups, which is in keeping with the previous studies. [14, 18]

This is due to rapid recuperation offered by improved pain control. However, our mean length of stay is longer (four days) than most series due to patient preference. Ward expenses in Indian patients undergoing RALP are covered by private health insurance in major cities, which partly contributes to the longer stay. Moreover, some patients prefer going home catheter-free. In the study by Strother et al. [19], 90% of the cases studied were discharged home within days 0–2. Nelson et al. reported no significant difference between LOS of RRP and RALP patients (1.09 vs 1.03 days).[20]

The catheter duration between the RALP and RRP patients in our study was statistically significant, in favour of RALP patients. Rocco et al. reported that the clinical importance of the difference in catheter duration between robotic and open prostatectomy was limited.[15]

We used Clavien Dindo classification (Tables 3 and 4) as a standardised tool to compare our complications. The difference in the complications between the two groups in our study was not statistically significant. In a prospective trial by Di Pierro et al. [21] significant complication rates for RRP and RALP were 28% and 7%, respectively; minor complication rates were 24% and 35%, respectively[21]. Ryu et al. reported fewer Clavien III complications in RALP than RRP[22].The difference in the urine leak in the two cohorts was not significant in our study. However, we stopped doing a routine cystogram prior to catheter removal after 100 cases in RALP patients.

Pathological findings of the specimens (Table 5) showed a difference in the positive surgical margin rates between the groups (17% in RALP vs 23% in RRP). This can be attributed to the superior visualisation of the robotic system, resulting in minor trauma to the prostatic capsule. Di Pierro et al. [21]described PSM rates of 16% with RALP group, and 32% with RRP group, Tewari et al.[23] 9% in RALP vs 23% in RRP and Parsons et al. [24]reported no significant difference in PSM rate between the two groups.

There was a significant difference in 12-month continence rates favouring the RALP group. This is consistent with the findings of numerous studies in the literature. [25, 26]We performed reconstruction of the posterior part of the rhadosphincter, described by Rocco et al.[27], preservation of maximal urethral length by careful apical dissection [28] and water-tight urethrovesical anastomosis. [15].

Our study is similar to that published by Şimşir et al. who compared 204 RARPs and 755 RRPs from 2007 and 2019. [29] In their study, the operation time was shorter in the open group (117 vs 188 min), and estimated blood loss (328 vs 150 ml), blood transfusion rate (12 vs 2), and re-operation rate (6 vs 0) were in favour of the robotic group. Mean length of hospital stay, urine leak rate, complication rate and the 12th-month continence rate were better in the robotic group.

Chen et al. who reported 500 RALP cases by one surgeon and analyzed factors affecting functional and oncological outcomes. They reported BCR PSA, postoperative Gleason score and pathological T staging as independent risk factors for BCR [30]. In another study by Asimakopoulos et al. [31], 1627 patients underwent RALP from 2005 to 2010. RFS at 12, 24, 48 and 60 months after RALP were 94.6%, 91.2%,

79.3% and 73.1%, respectively. PSA, pathologic Gleason score, pathological T staging and PSM were significant independent predictors of RFS. This is in concordance with our study.

Although the survival curves of two cohorts in our study were not comparable, the OS at 84 months is similar in both groups (87.3% in RALP vs 83.2% in RRP). This reflects on little or no change in overall survival of patients undergoing radical prostatectomy, despite difference in the time periods and type of surgery.

LIMITATIONS

The study's primary limitation is that it is a prospective case comparison with retrospective cohorts. The cohort is from a different decade where the investigative modalities were not comparable. Although the surgeon is the same, the surgeon's abilities in robotic and open surgeries may be different. Lastly, we could not assess the erectile function of the RALP patients consistently, which could not be incorporated in our study.

Conclusion

In conclusion, our findings demonstrate that RALP is a safe, minimally invasive, technically feasible procedure with comparable functional and oncological outcomes. Our study showed superior perioperative and continence outcomes in RALP. However, despite its growing popularity, RRP remains the gold standard in India due to its affordability and accessibility. Oncological outcomes in both groups remain dependent on clinical and pathological parameters. We believe that case selection and optimization of cost-effective treatment is the necessity of the hour.

Declarations

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

FUNDING

This study received no external sources of funding.

ACKNOWLEDGEMENT

Both authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by Jagdeesh Kulkarni. The first draft of the manuscript was written by Neeraja Tillu and both authors commented on previous versions of the manuscript. Both authors read and approved the final manuscript.

References

1. Mathur P, Sathishkumar K, Chaturvedi M, et al (2020) Cancer Statistics, 2020: Report From National Cancer Registry Programme, India. JCO Global Oncology 1063–1075. https://doi.org/10.1200/GO.20.00122
2. Heidenreich A, Bellmunt J, Bolla M, et al (2011) EAU Guidelines on Prostate Cancer. Part 1: Screening, Diagnosis, and Treatment of Clinically Localised Disease. European Urology 59:61–71. https://doi.org/10.1016/j.eururo.2010.10.039
3. Millin T (1945) RETROPUBIC PROSTATECTOMY A NEW EXTRAVESICAL TECHNIQUE. The Lancet 246:693–696. https://doi.org/10.1016/S0140-6736(45)91030-0
4. Eggleston JC, Walsh PC (1985) Radical prostatectomy with preservation of sexual function: pathological findings in the first 100 cases. J Urol 134:1146–8. https://doi.org/10.1016/s0022-5347(17)47661-0
5. Schuessler WW, Schulam PG, Clayman R v., Kavoussi LR (1997) Laparoscopic radical prostatectomy: Initial short-term experience. Urology 50:854–857. https://doi.org/10.1016/S0090-4295(97)00543-8
6. Pasticier G, Rietbergen JBW, Guillonneau B, et al (2001) Robotically Assisted Laparoscopic Radical Prostatectomy: Feasibility Study in Men. European Urology 40:. https://doi.org/10.1159/000049751
7. Kumar R, Gupta N, Saxena V, et al (2012) Perioperative outcome of initial 190 cases of robot-assisted laparoscopic radical prostatectomy - A single-center experience. Indian Journal of Urology 28:. https://doi.org/10.4103/0970-1591.98454
8. Bora GS, Narain TA, Sharma AP, et al Robot-assisted surgery in India: A SWOT analysis. Indian J Urol 36:. https://doi.org/10.4103/iju.IJU_220_19
9. Kulkarni JN, Singh DP, Bansal S, et al (2011) Retropubic radical prostatectomy: Clinicopathological observations and outcome analysis of 428 consecutive patients. Indian J Urol 27:337–44. https://doi.org/10.4103/0970-1591.85437
10. Dindo D, Demartines N, Clavien P-A (2004) Classification of Surgical Complications. Annals of Surgery 240:. https://doi.org/10.1097/01.sla.0000133083.54934.ae
11. Menon M, Tewari A, Peabody JO, et al (2004) Vattikuti Institute prostatectomy, a technique of robotic radical prostatectomy for management of localized carcinoma of the prostate: experience of over 1100 cases. Urologic Clinics of North America 31:. https://doi.org/10.1016/j.ucl.2004.06.011
12. Wolfram M, Brï¿½utigam R, Engl T, et al (2003) Robotic-assisted laparoscopic radical prostatectomy: the Frankfurt technique. World Journal of Urology 21:. https://doi.org/10.1007/s00345-003-0346-z
13. van Velthoven RF, Ahlering TE, Peltier A, et al (2003) Technique for laparoscopic running urethrovesical anastomosis:the single knot method. Urology 61:. https://doi.org/10.1016/S0090-4295(02)02543-8
14. Parsons JK, Bennett JL (2008) Outcomes of Retropubic, Laparoscopic, and Robotic-Assisted Prostatectomy. Urology 72:412–416. https://doi.org/10.1016/j.urology.2007.11.026
15. Rocco B, Matei D-V, Melegari S, et al (2009) Robotic vs open prostatectomy in a laparoscopically naive centre: a matched-pair analysis. BJU International 104:991–995. https://doi.org/10.1111/j.1464-410X.2009.08532.x

16. Patel VR, Palmer KJ, Coughlin G, Samavedi S (2008) Robot-Assisted Laparoscopic Radical Prostatectomy: Perioperative Outcomes of 1500 Cases. Journal of Endourology 22:2299–2306. https://doi.org/10.1089/end.2008.9711
17. Badani KK, Kaul S, Menon M (2007) Evolution of robotic radical prostatectomy. Cancer 110:1951–1958. https://doi.org/10.1002/cncr.23027
18. Trinh Q-D, Sammon J, Sun M, et al (2012) Perioperative Outcomes of Robot-Assisted Radical Prostatectomy Compared With Open Radical Prostatectomy: Results From the Nationwide Inpatient Sample. European Urology 61:679–685. https://doi.org/10.1016/j.eururo.2011.12.027
19. Strother MC, Michel KF, Xia L, et al (2020) Prolonged Length of Stay After Robotic Prostatectomy: Causes and Risk Factors. Annals of Surgical Oncology 27:1560–1567. https://doi.org/10.1245/s10434-020-08266-3
20. Nelson B, Kaufman M, Broughton G, et al (2007) Comparison of Length of Hospital Stay Between Radical Retropubic Prostatectomy and Robotic Assisted Laparoscopic Prostatectomy. Journal of Urology 177:929–931. https://doi.org/10.1016/j.juro.2006.10.070
21. di Pierro GB, Baumeister P, Stucki P, et al (2011) A Prospective Trial Comparing Consecutive Series of Open Retropubic and Robot-Assisted Laparoscopic Radical Prostatectomy in a Centre with a Limited Caseload. European Urology 59:1–6. https://doi.org/10.1016/j.eururo.2010.10.026
22. Ryu J, Kwon T, Kyung YS, et al (2013) Retropubic Versus Robot-Assisted Laparoscopic Prostatectomy for Prostate Cancer: A Comparative Study of Postoperative Complications. Korean Journal of Urology 54:756. https://doi.org/10.4111/kju.2013.54.11.756
23. Tewari A, Srivasatava A, Menon M (2003) A prospective comparison of radical retropubic and robot-assisted prostatectomy: experience in one institution. BJU International 92:205–210. https://doi.org/10.1046/j.1464-410X.2003.04311.x
24. Parsons JK, Bennett JL (2008) Outcomes of Retropubic, Laparoscopic, and Robotic-Assisted Prostatectomy. Urology 72:412–416. https://doi.org/10.1016/j.urology.2007.11.026
25. Son SJ, Lee SC, Jeong CW, et al (2013) Comparison of Continence Recovery Between Robot-Assisted Laparoscopic Prostatectomy and Open Radical Retropubic Prostatectomy: A Single Surgeon Experience. Korean Journal of Urology 54:598. https://doi.org/10.4111/kju.2013.54.9.598
26. Ficarra V, Novara G, Fracalanza S, et al (2009) A prospective, non-randomized trial comparing robot-assisted laparoscopic and retropubic radical prostatectomy in one European institution. BJU International 104:534–539. https://doi.org/10.1111/j.1464-410X.2009.08419.x
27. Rocco F, Gadda F, Acquati P, et al (2001) [Personal research: reconstruction of the urethral striated sphincter]. Archivio italiano di urologia, andrologia: organo ufficiale [di] Societa italiana di ecografia urologica e nefrologica 73:127–37
28. Schlomm T, Heinzer H, Steuber T, et al (2011) Full Functional-Length Urethral Sphincter Preservation During Radical Prostatectomy. European Urology 60:320–329. https://doi.org/10.1016/j.eururo.2011.02.040

29. Şimşir A, Kızılay F, Aliyev B, Kalemci S (2020) Comparison of robotic and open radical prostatectomy: Initial experience of a single surgeon. Pakistan Journal of Medical Sciences 37:. https://doi.org/10.12669/pjms.37.1.2719
30. Chen H, Lian B, Dong Z, et al (2020) Experience of one single surgeon with the first 500 robot-assisted laparoscopic prostatectomy cases in mainland China. Asian Journal of Urology 7:. https://doi.org/10.1016/j.ajur.2019.12.004
31. Asimakopoulos AD, Annino F, Mugnier C, et al (2021) Robotic radical prostatectomy: analysis of midterm pathologic and oncologic outcomes: A historical series from a high-volume center. Surgical Endoscopy 35:6731–6745. https://doi.org/10.1007/s00464-020-08177-0

Figures

Image not available with this version

Figure 1

Time taken by patients to achieve continence according to continence

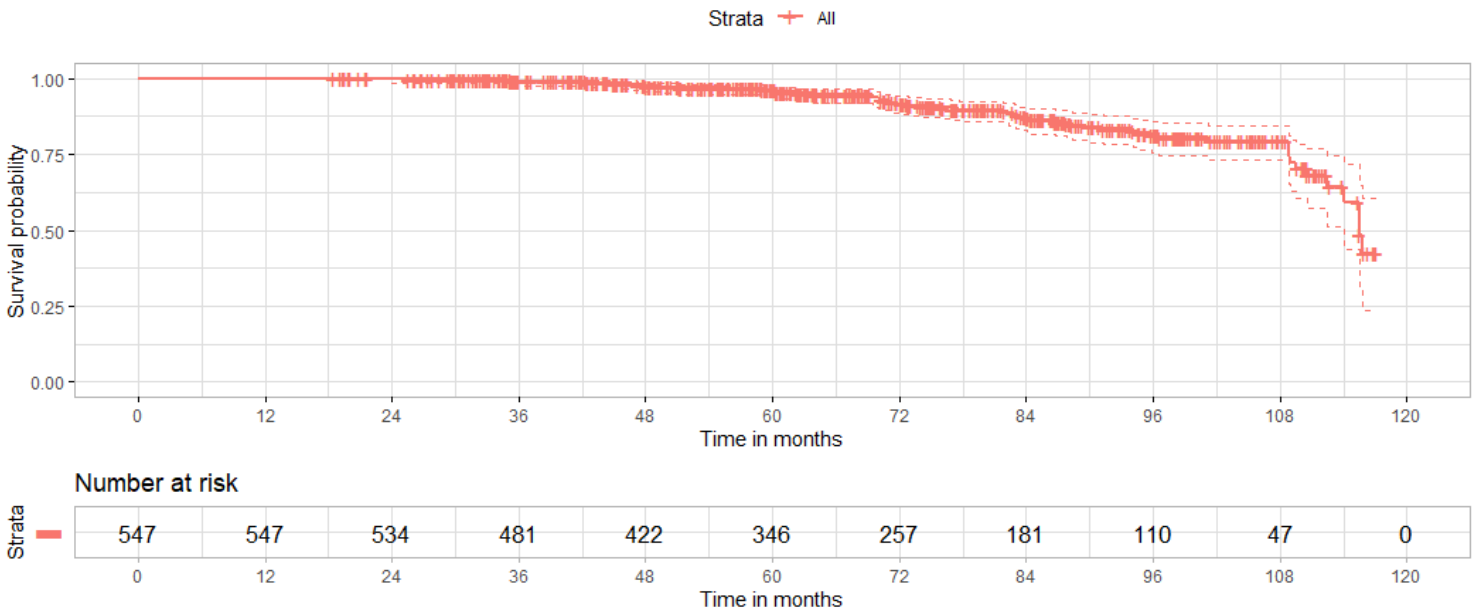

Figure 2

Overall survival of RALP patients at 60, 84 and 108 months.

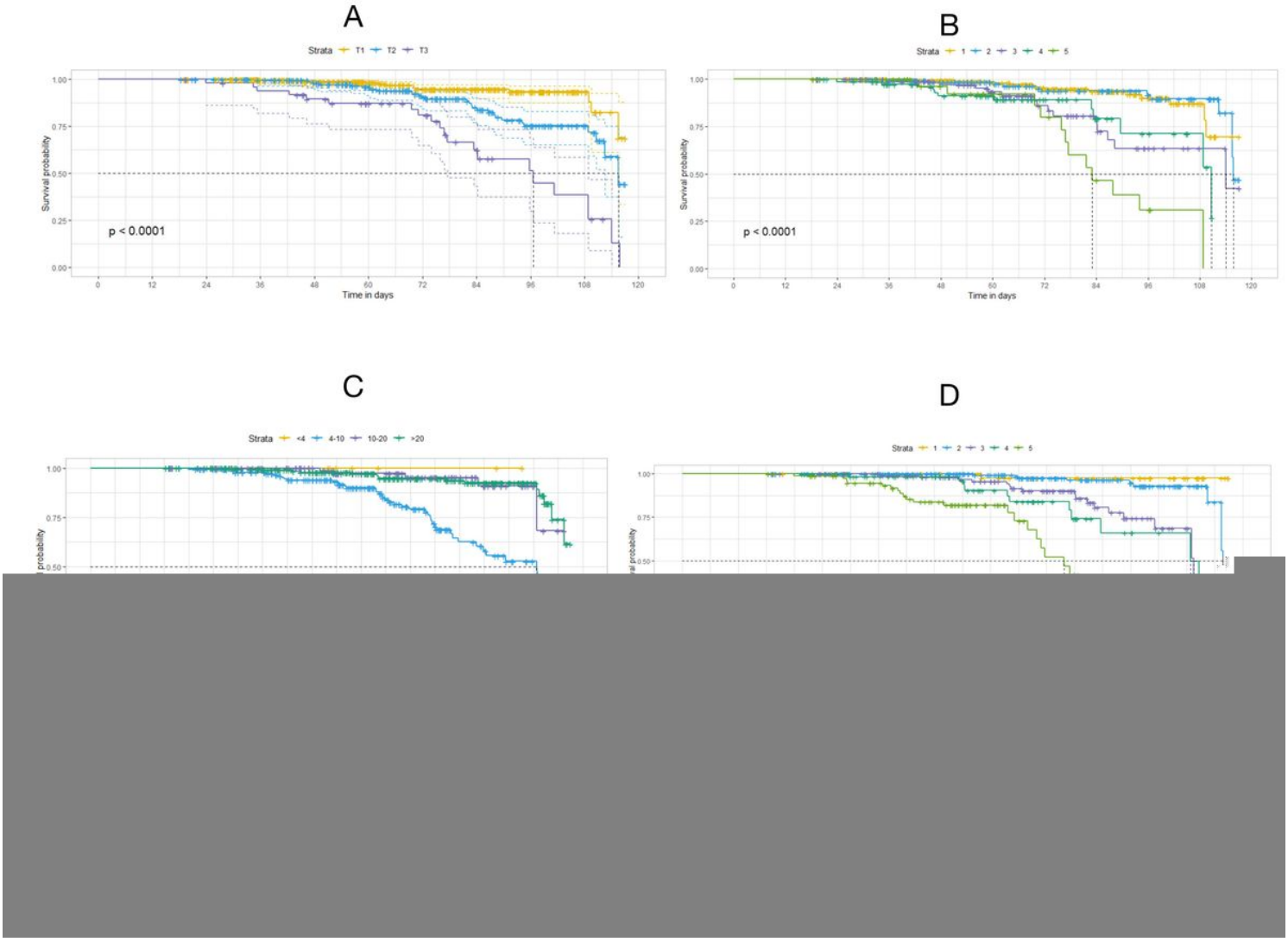

Figure 3

Log rank analysis of all variables (clinical T stage, biopsy Gleason grade group, PSA groups and pathology specimen Gleason grade groups) had impact on overall survival.

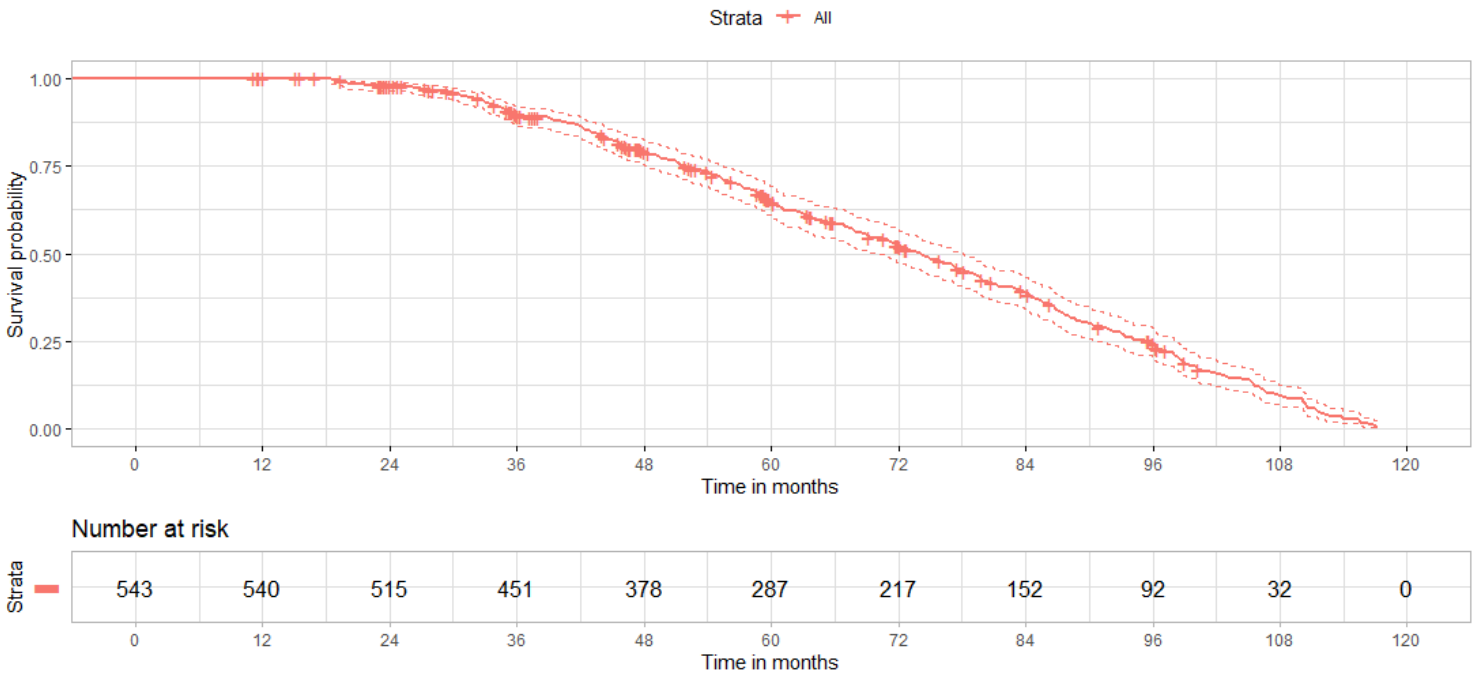

Figure 4

Recurrence- free survival of RALP patients at 60, 84 and 108 months respectively.

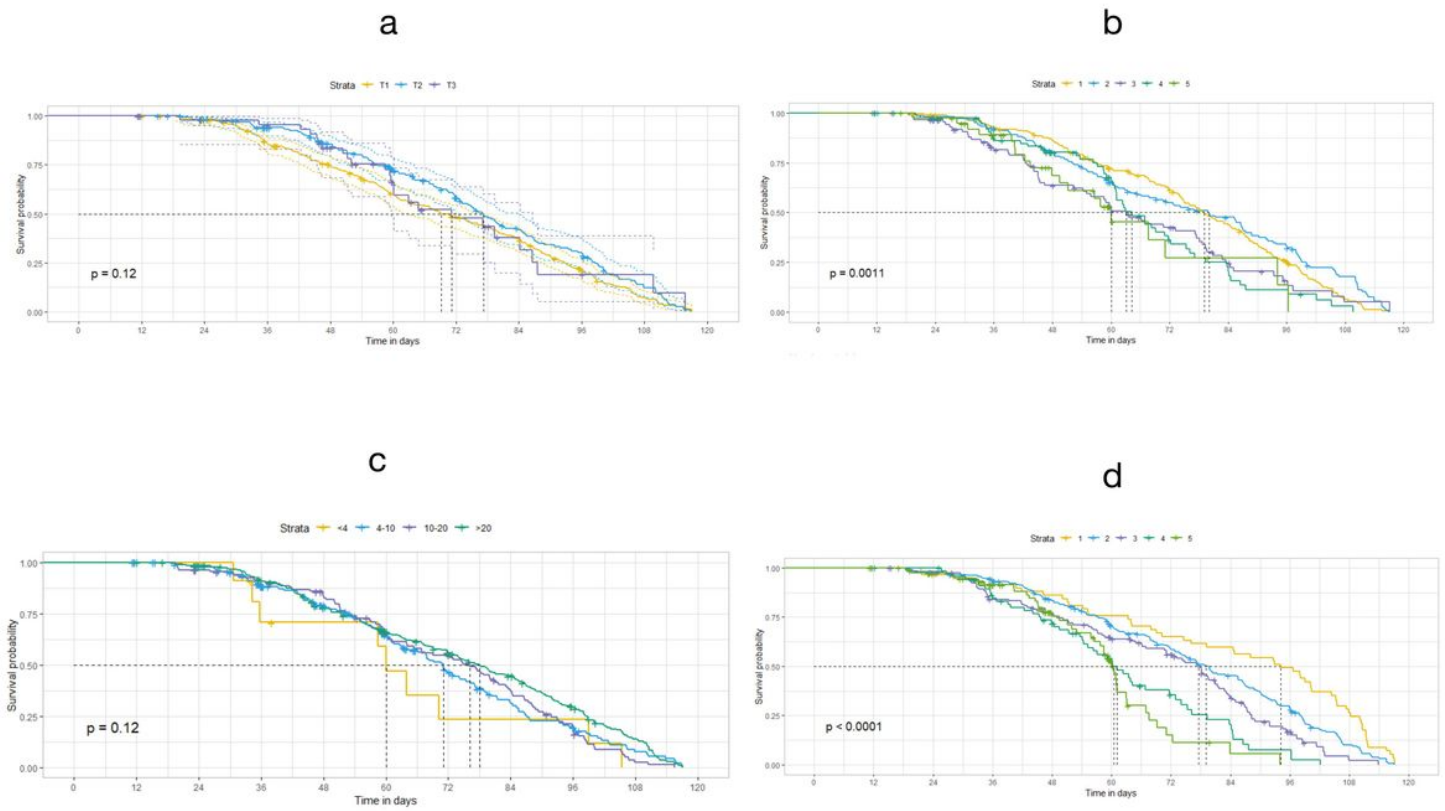

Figure 5

Log-rank analysis of variables (clinical T stage, biopsy Gleason grade group, PSA groups and pathology specimen Gleason grade groups) which had an impact on recurrence-free survival.