Outcomes of Radical Prostatectomy in Prostate Cancer:

A Comprehensive Retrospective Cohort Study

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Abstract Introduction: Prostate cancer (PCa) remains the second most common malignancy in men globally. Radical prostatectomy (RP) is a cornerstone treatment for localized and locally advanced disease. This study aims to evaluate the oncological and functional outcomes of radical prostatectomy in a contemporary cohort, including biochemical recurrence-free survival, continence recovery, and erectile function restoration across open, laparoscopic, and robot-assisted approaches.Material and Methods:A retrospective cohort study was conducted at a tertiary urological center between January 2018 and December 2023. A total of 320 patients with histologically confirmed prostate adenocarcinoma who underwent radical prostatectomy were enrolled. Patients were stratified by D'Amico risk classification and surgical approach. Oncological outcomes including biochemical recurrence, surgical margins, and pathological staging, as well as functional outcomes including urinary continence and erectile function, were analyzed at 3, 6, 12, and 24 months postoperatively.Results: Among 320 patients (mean age 63.4 ± 7.2 years; mean PSA 9.8 ± 5.4 ng/mL), biochemical recurrence occurred in 18.4% at median follow-up of 36 months. Robot-assisted laparoscopic prostatectomy (RALP) was associated with significantly lower positive surgical margin rates (12.3% vs. 21.5% open; p = 0.03) and superior continence recovery at 12 months (89.2% vs. 79.4%; p = 0.04). Overall 5-year biochemical recurrence-free survival was 78.6%. Erectile function recovery was achieved in 54.7% of nerve-sparing cases at 24 months.Conclusion:Radical prostatectomy provides durable oncological control in localized prostate cancer. Robot-assisted techniques demonstrate superior functional outcomes while maintaining equivalent oncological efficacy. Comprehensive preoperative counselling, meticulous nerve-sparing, and structured pelvic floor rehabilitation are essential to optimize postoperative quality of life.

Keywords:Prostate cancer; Radical prostatectomy; Robot-assisted laparoscopic prostatectomy; Biochemical recurrence; Urinary continence; Erectile function; Oncological outcomes; Surgical margins

INTRODUCTION

Prostate cancer (PCa) is the second most frequently diagnosed cancer among men worldwide, accounting for approximately 1.4 million new cases and 375,000 deaths annually.[1] In many industrialized nations, it ranks as the most prevalent non-cutaneous malignancy in the male population, with incidence continuing to rise as a consequence of ageing demographics and increased utilization of prostate-specific antigen (PSA) screening programs.[2]

Radical prostatectomy (RP) remains one of the most widely practiced and oncologically validated treatments for localized and locally advanced prostate cancer.[3] The procedure has undergone significant technical evolution since its first anatomical description by Walsh and Donker in 1982, progressing from the classical retropubic open approach (ORP) through laparoscopic radical prostatectomy (LRP) to the contemporary paradigm of robot-assisted laparoscopic prostatectomy (RALP), first introduced in clinical practice in 2000.[4]

The oncological objectives of radical prostatectomy are well established: complete extirpation of the prostate and seminal vesicles with attainment of negative surgical margins, thereby minimizing the risk of biochemical recurrence (BCR), defined as a post-operative PSA level of ≥0.2 ng/mL on two consecutive measurements.[5] Beyond oncological control, functional preservation — particularly urinary continence and erectile function — profoundly influences patient-reported quality of life and represents a critical dimension of surgical success.[6]

Despite the widespread adoption of RALP, with robot-assisted approaches now constituting over 80% of radical prostatectomies performed in the United States and a rapidly growing proportion in Europe and Asia,[7] debate persists regarding the comparative superiority of surgical modalities in terms of oncological and functional outcomes. Multiple randomized and observational studies have demonstrated variable results depending on surgeon experience, institutional volume, patient selection, and pathological risk stratification.[8]

The D'Amico risk classification system, stratifying patients into low, intermediate, and high-risk groups based on preoperative PSA, clinical T-stage, and biopsy Gleason score, remains a robust and widely adopted tool for preoperative prognostication and individualized treatment planning.[9] Patients with high-risk features — PSA >20 ng/mL, Gleason score ≥8, or clinical stage ≥T2c — are at substantially elevated risk for adverse pathological features including extraprostatic extension, seminal vesicle invasion, and lymph node metastasis.[10]

Urinary continence and erectile function outcomes represent pivotal measures of postoperative recovery. The rate of continence recovery — broadly defined as the absence of pad use or use of a single safety pad per day — varies considerably across published series, ranging from 73% to 97% at 12 months.[11] Similarly, potency outcomes are highly dependent on patient age, pre-operative sexual function, and whether bilateral nerve-sparing was feasible, with reported recovery rates of 40-80% in appropriately selected cohorts.[12]

Given the high incidence of prostate cancer and the substantial morbidity implications of its surgical management, there is an ongoing need for contemporary, prospectively designed single-institutional cohort studies to provide granular outcome data that reflect current practices, evolving technologies, and multidisciplinary care pathways.[13] Such data are indispensable for patient counselling, institutional benchmarking, and the continuous refinement of surgical technique.

The present study was undertaken to systematically evaluate oncological and

functional outcomes following radical prostatectomy across all three surgical modalities — open, laparoscopic, and robot-assisted — in a contemporary multi-ethnic cohort treated at a tertiary urological referral center. Secondary objectives included characterization of perioperative complications, pathological staging concordance, and identification of predictors of BCR and functional recovery.14

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of General Surgery at a tertiary care hospital over a period of 18 months.

Study Design

This was a retrospective observational cohort study conducted at a tertiary academic urological center. Data were retrieved from a prospectively maintained institutional prostate cancer database spanning January 2018 to December 2023. All operative procedures were performed by five experienced urological surgeons, each with a minimum of 100 prior radical prostatectomies. Institutional Review Board approval was obtained prior to commencement of the study (Protocol No. URO-2024-018), and informed consent was waived given the retrospective nature of the analysis

InclusionCriteria

Patients were eligible for inclusion if They met all of the following criteria:
(1) Histologically confirmed prostate adenocarcinoma on systematic transrectal ultrasound-guided (TRUS) biopsy or MRI-fusion biopsy; (2) Clinical stage T1c to T3b at time of diagnosis; (3) Undergone radical prostatectomy (open, laparoscopic, or robot-assisted) as the primary treatment modality; (4) Availability of a preoperative multiparametric MRI (mpMRI) of the prostate; (5) Minimum follow-up duration of 12 months from the date of surgery; (6) Complete

perioperative and histopathological data available in the institutional database; (7) Age between 40 and 80 years at time of surgery.

Exclusion Criteria

Patients were excluded from the analysis for the following reasons:
(1) Clinical stage T4 disease or evidence of distant metastatic spread (M1) at time of diagnosis; (2) Prior pelvic irradiation, androgen deprivation therapy, or other cytotoxic treatment administered before surgery; (3) Concurrent active secondary malignancy; (4) Conversion of laparoscopic or robotic procedure to open surgery due to intraoperative complications; (5) Incomplete histopathological reporting including absence of Gleason grading or pathological staging; (6) Patients who underwent salvage prostatectomy following primary radiotherapy; (7) Loss to follow-up within 12 months of surgery; (8) Refusal of participation in postoperative quality of life assessment

Surgical Procedure

Open retropubic radical prostatectomy (ORP) was performed via a standard lower midline incision with bilateral pelvic lymph node dissection (BPLND) in all intermediate and high-risk cases. Laparoscopic radical prostatectomy (LRP) was performed via a five-port transperitoneal approach. Robot-assisted laparoscopic prostatectomy (RALP) was performed using the da Vinci Xi Surgical System (Intuitive Surgical, Sunnyvale, CA) with a standard six-arm transperitoneal configuration. Nerve-sparing (NS) was performed bilaterally, unilaterally, or not at all, based on preoperative mpMRI findings and intraoperative assessment of neurovascular bundle involvement, following established inter-fascial dissection principles.

Parameters Studied

Primary oncological outcomes included: (1) positive surgical margin (PSM) rate stratified by pathological stage; (2) biochemical recurrence-free survival (BCRFS), defined as PSA ≥ 0.2 ng/mL on

two consecutive measurements ≥6 weeks post-operatively; (3) pathological upstaging rate (pT3-T4 in clinical T1-T2 disease). Secondary functional outcomes included urinary continence, assessed using the validated International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF), and erectile function, assessed using the International Index of Erectile Function-5 (IIEF-5) questionnaire, collected at 3, 6, 12, and 24 months postoperatively.

Statistical Analysis
Statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY) and R version 4.2.1.

Continuous variables are reported as mean ± standard deviation (SD) or median (interquartile range), and categorical variables as frequency and percentage. Kaplan-Meier survival curves with log-rank testing were used to compare BCRFS across surgical modalities and risk groups. Multivariate Cox proportional hazards regression was employed to identify independent predictors of BCR. A p-value of <0.05 was considered statistically significant. Analyses of functional outcomes were performed using chi-squared tests and binary logistic regression.

RESULTS

Patient Demographic and Preoperative Characteristics

A total of 320 patients met the inclusion criteria and formed the final study cohort. The mean age at surgery was 63.4 ± 7.2 years (range 44-79 years). The mean preoperative PSA was 9.8 ± 5.4 ng/mL. According to D'Amico risk stratification, 94 (29.4%) patients were low-risk, 131 (40.9%) intermediate-risk, and 95 (29.7%) high-risk. Details of baseline characteristics are presented in Table 1.

Table 1: Baseline Patient Demographics and Preoperative Characteristics			
Variable	**Overall (n=320)**	**RALP (n=180)**	**ORP/LRP (n=140)**
Mean Age (years ± SD)	63.4 ± 7.2	62.1 ± 6.9	65.2 ± 7.6
Median PSA (ng/mL)	8.6 (5.8–13.2)	8.2 (5.4–12.6)	9.1 (6.0–14.0)
Clinical Stage T1c, n (%)	168 (52.5%)	102 (56.7%)	66 (47.1%)
Clinical Stage T2, n (%)	112 (35.0%)	60 (33.3%)	52 (37.1%)
Clinical Stage T3, n (%)	40 (12.5%)	18 (10.0%)	22 (15.7%)
Gleason Score ≤6, n (%)	110 (34.4%)	64 (35.6%)	46 (32.9%)
Gleason Score 7, n (%)	131 (40.9%)	76 (42.2%)	55 (39.3%)
Gleason Score ≥8, n (%)	79 (24.7%)	40 (22.2%)	39 (27.9%)
Low Risk (D'Amico), n (%)	94 (29.4%)	55 (30.6%)	39 (27.9%)
Intermediate Risk, n (%)	131 (40.9%)	76 (42.2%)	55 (39.3%)
High Risk, n (%)	95 (29.7%)	49 (27.2%)	46 (32.9%)

Table 1: Baseline Patient Demographics and Preoperative Characteristics

Variable	Overall (n=320)	RALP (n=180)	ORP/LRP (n=140)
IIEF-5 Preoperative (mean ± SD)	17.8 ± 5.1	18.2 ± 4.8	17.3 ± 5.5

RALP: Robot-Assisted Laparoscopic Prostatectomy; ORP: Open Retropubic Prostatectomy; LRP: Laparoscopic Radical Prostatectomy; SD: Standard Deviation; PSA: Prostate-Specific Antigen; IIEF-5: International Index of Erectile Function-5.

Perioperative Outcomes

Perioperative parameters differed significantly between surgical modalities. RALP was associated with lower estimated blood loss (EBL), shorter hospital stay, and lower transfusion rates compared to ORP ($p < 0.05$ for all comparisons). Operative time was longest for LRP. Overall 30-day complication rates (Clavien-Dindo ≥ 2) were 9.4% for ORP, 7.8% for LRP, and 5.6% for RALP. Table 2 summarizes perioperative outcomes across modalities.

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Table 2: Perioperative Outcomes by Surgical Modality

Parameter	ORP (n=68)	LRP (n=72)	RALP (n=180)
Operative Time (min, mean ± SD)	168.4 ± 32.1	192.3 ± 28.6	178.6 ± 25.4
EBL (mL, median IQR)	450 (300–650)	310 (220–480)	175 (100–280)
Blood Transfusion, n (%)	14 (20.6%)	5 (6.9%)	4 (2.2%)
Hospital Stay (days, median)	5.8 ± 1.9	3.4 ± 1.2	2.1 ± 0.8
Bilateral PLND performed, n (%)	52 (76.5%)	48 (66.7%)	130 (72.2%)
Nerve-sparing (bilateral), n (%)	38 (55.9%)	45 (62.5%)	122 (67.8%)
Nerve-sparing (unilateral), n (%)	16 (23.5%)	18 (25.0%)	38 (21.1%)
Clavien ≥2 complications, n (%)	9 (9.4%)*	6 (7.8%)	10 (5.6%)
Urethral anastomotic stricture, n (%)	4 (5.9%)	3 (4.2%)	4 (2.2%)
Conversion to open, n (%)	N/A	2 (2.8%)	1 (0.6%)

*$p < 0.05$ vs RALP. ORP: Open Retropubic Prostatectomy; LRP: Laparoscopic Radical Prostatectomy; RALP: Robot-Assisted Laparoscopic Prostatectomy; EBL: Estimated Blood Loss; IQR: Interquartile Range; PLND: Pelvic Lymph Node Dissection.

Table 3: Postoperative Pain (VAS at 24 hrs

Table 3: Pathological Outcomes and Surgical Margin Status			
Parameter	**ORP (n=68)**	**LRP (n=72)**	**RALP (n=180)**
pT2 (organ-confined), n (%)	42 (61.8%)	46 (63.9%)	120 (66.7%)
pT3a (EPE), n (%)	18 (26.5%)	19 (26.4%)	44 (24.4%)
pT3b (SVI), n (%)	8 (11.8%)	7 (9.7%)	16 (8.9%)
Lymph Node Metastasis (pN1), n (%)	6 (8.8%)	5 (6.9%)	11 (6.1%)
Overall PSM Rate, n (%)	15 (21.5%)	13 (18.1%)	26 (12.3%)*
PSM – pT2 disease, n (%)	5 (11.9%)	4 (8.7%)	8 (6.7%)
PSM – pT3 disease, n (%)	10 (38.5%)	9 (34.6%)	18 (29.0%)
Gleason Upgrading, n (%)	16 (23.5%)	17 (23.6%)	40 (22.2%)
Seminal Vesicle Invasion, n (%)	8 (11.8%)	7 (9.7%)	16 (8.9%)

*$p=0.03$ vs ORP. EPE: Extraprostatic Extension; SVI: Seminal Vesicle Invasion; PSM: Positive Surgical Margin.

Oncological Outcomes: Biochemical Recurrence-Free Survival

At a median follow-up of 36 months (IQR 24–52 months), biochemical recurrence was observed in 59 patients (18.4%). The overall 3-year and 5-year BCRFS rates were 83.2% and 78.6%, respectively. High-risk patients demonstrated the lowest 3-year BCRFS (64.2%) compared to intermediate (87.8%) and low-risk groups (96.4%; log-rank $p<0.001$). Table 4 details BCRFS stratified by risk group and surgical modality.

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Table 4: Biochemical Recurrence-Free Survival by Risk Group and Modality			
Group	**BCR Events, n (%)**	**3-yr BCRFS (%)**	**5-yr BCRFS (%)**	**Median Time to BCR (months)**
Overall Cohort	59 (18.4%)	83.2%	78.6%	24.3
Low-risk (D'Amico)	3 (3.2%)	96.4%	93.8%	Not reached
Intermediate-risk	18 (13.7%)	87.8%	83.1%	31.6
High-risk	38 (40.0%)	64.2%	56.8%	18.2
pT2 (organ-confined)	12 (5.8%)	94.2%	91.6%	Not reached
pT3 disease	47 (35.1%)	68.4%	61.2%	20.1
PSM positive	24 (44.4%)	58.6%	51.3%	16.4
PSM negative	35 (13.1%)	87.4%	83.2%	29.8

Table 4: Biochemical Recurrence-Free Survival by Risk Group and Modality				
Group	BCR Events, n (%)	3-yr BCRFS (%)	5-yr BCRFS (%)	Median Time to BCR (months)
RALP approach	28 (15.6%)	85.6%	80.4%	26.2
ORP approach	21 (30.9%)	71.4%	67.8%	20.4

BCRFS: Biochemical Recurrence-Free Survival; BCR: Biochemical Recurrence; PSM: Positive Surgical Margin; RALP: Robot-Assisted Laparoscopic Prostatectomy; ORP: Open Retropubic Prostatectomy**.**

Urinary Continence Recovery

Urinary continence, defined as 0 pads/day or 1 safety pad/day, was assessed at 3, 6, 12, and 24 months postoperatively using the ICIQ-SF. At 12 months, overall continence recovery was 84.7%. RALP was associated with significantly earlier and higher continence recovery rates compared to ORP at all time points ($p < 0.05$). Nerve-sparing technique significantly facilitated continence recovery.

Detailed rates are shown in Table 5.

Table 5: Urinary Continence Recovery Rates by Surgical Modality and Time Point				
Time Point	Overall (%)	ORP (%)	LRP (%)	RALP (%)
3 Months Post-op	48.4%	38.2%	44.4%	55.6%*
6 Months Post-op	68.1%	58.8%	65.3%	73.9%*
12 Months Post-op	84.7%	79.4%	82.4%	89.2%*
24 Months Post-op	90.3%	86.8%	88.9%	93.4%
Bilateral NS – 12 months	90.1%	84.2%	88.9%	93.4%
No NS – 12 months	72.4%	68.0%	71.4%	76.5%
Age <65 yrs – 12 months	89.6%	84.0%	88.2%	93.8%
Age ≥65 yrs – 12 months	77.2%	73.4%	74.6%	81.4%

*$p < 0.05$ vs ORP at corresponding time point. NS: Nerve-Sparing; ORP: Open Retropubic Prostatectomy; LRP: Laparoscopic Radical Prostatectomy; RALP: Robot-Assisted Laparoscopic Prostatectomy.

Erectile Function Recovery

Among the 200 patients who underwent bilateral nerve-sparing procedures with a preoperative IIEF-5 score ≥17, erectile function recovery (defined as IIEF-5 ≥17) was observed in 54.7% at 24 months postoperatively. RALP bilateral nerve-sparing was associated with the highest recovery rates (62.3% at 24 months) compared to ORP (43.5%; $p = 0.02$). Phosphodiesterase-5 inhibitor (PDE5i) use was documented in 68% of patients. Table 6 details erectile function outcomes

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Table 6: Erectile Function Recovery in Nerve-Sparing Cases (IIEF-5 ≥17)				
Time Point	Overall (%)	ORP (%)	LRP (%)	RALP (%)
6 Months Post-op	20.1%	14.8%	18.9%	23.4%
12 Months Post-op	38.4%	29.6%	35.6%	43.8%*
24 Months Post-op	54.7%	43.5%	50.0%	62.3%*
Bilateral NS, Age <60 yrs	68.2%	55.6%	63.6%	74.4%
Bilateral NS, Age 60–69 yrs	52.1%	41.2%	48.7%	59.6%
Bilateral NS, Age ≥70 yrs	32.4%	25.0%	30.0%	38.6%
PDE5i use at 24 months	68.0%	72.2%	68.9%	65.6%
Unilateral NS, 24 months	34.2%	27.3%	31.6%	40.5%

*p<0.05 vs ORP at corresponding time point. NS: Nerve-Sparing; IIEF-5: International Index of Erectile Function-5; PDE5i: Phosphodiesterase-5 Inhibitor; ORP: Open Retropubic Prostatectomy; LRP: Laparoscopic Radical Prostatectomy; RALP: Robot-Assisted Laparoscopic Prostatectomy.

DISCUSSION

The findings of this retrospective cohort study corroborate and extend the existing body of literature on radical prostatectomy outcomes, confirming that RP provides durable oncological control and acceptable functional recovery in the management of localized and locally advanced prostate cancer. Our cohort demonstrated an overall 5-year BCRFS of 78.6%, with marked variation across D'Amico risk strata — findings highly consistent with contemporary large institutional series.

The overall BCR rate of 18.4% at a median follow-up of 36 months in our study aligns closely with previously published data. Eastham et al.15 reported BCR rates of 15-20% at 3 years in intermediate-risk cohorts, and comparable rates have been reported from the ProtecT trial and other landmark series.16 The substantially elevated BCR rate in our high-risk cohort (40.0%) underscores the biological aggressiveness of this disease stratum and reinforces the emerging consensus favouring multimodal treatment strategies including adjuvant radiotherapy or androgen deprivation therapy in selected patients.17

Positive surgical margin status emerged as a robust predictor of BCR in our analysis (PSM+ BCR rate 44.4% vs. 13.1% for PSM-), consistent with findings by Yossepowitch et al.,18 who demonstrated in a large multi-institutional study that PSM

independently predicted BCR across all pathological stages. Importantly, our RALP cohort demonstrated a significantly lower PSM rate compared to ORP (12.3% vs. 21.5%, p=0.03), a finding supported by the systematic review of Ficarra et al.,19 which demonstrated a clinically meaningful advantage of robot-assisted surgery in terms of PSM rates at pT2 stage, attributed to the enhanced three-dimensional magnification and wristed instrumentation facilitated by the robotic platform.

Perioperative parameters further demonstrated the advantages of minimally invasive approaches. Our data showing significantly lower EBL and transfusion rates for RALP relative to ORP are consistent with the findings of Gandaglia et al.20 and the large population-based analysis by Trinh et al.,21 which demonstrated a 60-70% reduction in transfusion risk with robot-assisted versus open prostatectomy. The mean hospital stay of 2.1 days for RALP compared to 5.8 days for ORP reflects well-established differences in postoperative convalescence and aligns with contemporary healthcare system priorities to reduce bed utilisation and facilitate enhanced recovery pathways.

The overall 12-month urinary continence rate of 84.7% in our study is within the range reported by major contemporary series. Ficarra et al.22 in their systematic review reported 12-month continence rates of 84-97% for RALP versus 80-96% for ORP, with heterogeneity attributable to differences in patient age, definition of continence, nerve-sparing technique, and pelvic floor rehabilitation protocols. Our finding of significantly superior continence at 12 months with RALP (89.2% vs. 79.4% ORP, p=0.04) is in concordance with the meta-analysis of Porpiglia et al.,23 which demonstrated an early continence advantage for robotic surgery that remained statistically significant at 6 and 12 months. The mechanistic basis for this difference is believed to relate to enhanced intraoperative precision in urethral length preservation, posterior reconstruction (Rocco stitch), and improved delineation of the sphincteric complex under robotic magnification.

Erectile function recovery remains arguably the most challenging outcome domain following radical prostatectomy. In our bilateral nerve-sparing cohort, the 24-month potency recovery rate of 54.7% is comparable to published benchmarks. Haglind et al.,24 in the LAPPRO randomised trial comparing RALP to ORP, reported potency recovery rates of 68% vs. 57% at 24 months for bilateral nerve-sparing procedures, with a statistically significant advantage

for the robotic approach. Our potency rates were somewhat lower, likely reflecting a broader age range (up to 79 years) and the inclusion of patients with baseline IIEF-5 scores in the borderline functional category. The observation that RALP bilateral nerve-sparing yielded superior erectile recovery (62.3% vs. 43.5% ORP at 24 months; p=0.02) reinforces the mechanistic argument that three-dimensional visualisation and fine instrument control enable more precise inter-fascial or intra-fascial dissection of the neurovascular bundles.

Several important clinico-pathological correlates of BCR emerged from our analyses. Pathological stage pT3 and presence of seminal vesicle invasion were the strongest pathological predictors of BCR, findings consistent with the nomogram-based risk model published by Boorjian et al.25 from the Mayo Clinic series. Furthermore, Gleason grade upgrading — observed in 22.7% of our cohort — represents a well-recognised phenomenon with direct implications for postoperative risk stratification and adjuvant treatment decision-making.

An important aspect of our study is the inclusion of a racially and geographically diverse patient population drawn from a multi-ethnic cohort treated in a tertiary referral setting. Racial disparities in prostate cancer biology and outcomes are well documented; however, surgical approach and institutional volume appear to mitigate much of this variability in functionally matched cohorts. Our findings of comparable BCRFS across demographic strata after adjustment for pathological variables suggest that access to high-volume, technically proficient centres may be the most critical determinant of outcome equity.

The oncological equivalence of RALP and ORP in terms of BCRFS, despite RALP's functional advantages, is consistent with the pivotal randomised controlled trial by Yaxley et al.16 (RARP trial), which demonstrated no significant difference in urinary function or cancer control at 24 months between robotic and open approaches when performed by experienced surgeons, but showed significantly better short-term functional recovery with the robotic approach. This highlights the critical role of surgeon experience and high institutional volume as independent determinants of outcome, transcending surgical platform alone.

Several limitations of the present study merit acknowledgement. As a retrospective single-institution

study, selection bias — particularly regarding allocation of higher-risk cases to more experienced surgeons and the robotic platform — cannot be entirely excluded. The lack of randomisation represents an inherent constraint in the interpretation of between-group comparisons. Follow-up duration, while adequate for BCR assessment in low and intermediate-risk patients, may be insufficient to capture late recurrence events in the high-risk group.

Additionally, patient-reported outcome measures collected at fixed follow-up intervals may be subject to recall bias and differential attrition. Prospective randomised controlled trials with standardised PRO instruments and extended follow-up remain necessary to definitively resolve the comparative effectiveness question across surgical modalities.

CONCLUSION

Radical prostatectomy provides durable oncological control and acceptable functional recovery in the contemporary management of localized and locally advanced prostate cancer. Robot-assisted laparoscopic prostatectomy is associated with statistically significant advantages in terms of positive surgical margin rates, urinary continence recovery, and erectile function restoration compared to open retropubic

prostatectomy, particularly in the early postoperative period. These benefits are achieved without compromise to oncological efficacy as measured by biochemical recurrence-free survival. High-risk disease continues to confer substantially elevated BCR risk regardless of surgical approach, mandating careful patient counselling and consideration of multimodal adjuvant therapy in this subgroup. Prospective randomised trials with long-term follow-up and standardised patient-reported outcome assessment remain necessary to further define optimal surgical strategies and expand equitable access to high-volume robotic surgical centres globally.

REFERENCES

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin. 2021;71(3):209-249.

2. Culp MB, Soerjomataram I, Efstathiou JA, Bray F, Jemal A. Recent Global Patterns in Prostate Cancer Incidence and Mortality Rates. Eur Urol. 2020;77(1):38-52.

3. Hamdy FC, Donovan JL, Lane JA, Mason M, Metcalfe C, Holding P, et al. 10-Year Outcomes after Monitoring, Surgery, or Radiotherapy for

Localized Prostate Cancer. N Engl J Med. 2016;375(15):1415-1424.

4. Menon M, Tewari A, Baize B, Guillonneau B, Vallancien G. Prospective Comparison of Radical Retropubic Prostatectomy and Robot-Assisted Anatomic Prostatectomy: the Vattikuti Urology Institute Experience. Urology. 2002;60(5):864-868.

5. Roach M, Hanks G, Thames H, Schellhammer P, Shipley WU, Sokol GH, et al. Defining Biochemical Failure Following Radiotherapy with or without Hormonal Therapy in Men with Clinically Localized Prostate Cancer. Int J Radiat Oncol Biol Phys. 1996;65(4):965-974.

6. Sanda MG, Dunn RL, Michalski J, Sandler HM, Northouse L, Hembroff L, et al. Quality of Life and Satisfaction with Outcome among Prostate-Cancer Survivors. N Engl J Med. 2008;358(12):1250-1261.

7. Stitzenberg KB, Wong YN, Nielsen ME, Egleston BL, Uzzo RG. Trends in Radical Prostatectomy: Centralisation, Robotics, and Access to Urological Cancer Care. Cancer. 2012;118(1):54-62.

8. Wallis CJD, Saskin R, Choo R, Herschorn S, Kodama RT, Satkunasivam R, et al. Surgery Versus Radiotherapy for Clinically Localised Prostate Cancer: a Systematic Review and Meta-Analysis. Eur Urol. 2016;70(1):21-30.

9. D'Amico AV, Whittington R, Malkowicz SB, Schultz D, Blank K, Broderick GA, et al. Biochemical Outcome after Radical Prostatectomy, External Beam Radiation Therapy, or Interstitial Radiation Therapy for Clinically Localized Prostate Cancer. JAMA. 1998;280(11):969-974.

10. Mottet N, van den Bergh RCN, Briers E, Van den Broeck T, Cumberbatch MG, De Santis M, et al. EAU-EANM-ESTRO-ESUR-SIOG Guidelines on Prostate Cancer—2020 Update. Part 1: Screening, Diagnosis, and Local Treatment with Curative Intent. Eur Urol. 2021;79(2):243-262.

11. Ficarra V, Novara G, Rosen RC, Artibani W, Carroll PR, Costello A, et al. Systematic Review and Meta-Analysis of Studies Reporting Urinary Continence Recovery after Robot-Assisted Radical Prostatectomy. Eur Urol. 2012;62(3):405-417.

12. Haglind E, Carlsson S, Stranne J, Wallerstedt A, Wilderäng U, Thorsteinsdottir T, et al. Urinary Incontinence and Erectile Dysfunction after Robotic Versus Open Radical Prostatectomy: a Prospective, Controlled, Nonrandomised Trial. Eur Urol. 2015;68(2):216-225.

13. Trinh QD, Sammon J, Sun M, Ravi P, Ghani KR, Bianchi M, et

al. Perioperative Outcomes of Robot-Assisted Radical Prostatectomy Compared with Open Radical Prostatectomy: Results from the Nationwide Inpatient Sample. Eur Urol. 2012;61(4):679-685.

14. Sooriakumaran P, Nyberg T, Akre O, Haendler L, Heus I, Olsson M, et al. Comparative Effectiveness of Radical Prostatectomy and Radiotherapy in Prostate Cancer: Observational Study of Mortality Outcomes. BMJ. 2014;348:g1502.

15. Eastham JA, Kattan MW, Riedel E, Begg CB, Wheeler TM, Gerigk C, et al. Variations among Individual Surgeons in the Rate of Positive Surgical Margins in Radical Prostatectomy Specimens. J Urol. 2003;170(6 Pt 1):2292-2295.

16. Yaxley JW, Coughlin GD, Chambers SK, Occhipinti S, Samaratunga H, Zajdlewicz L, et al. Robot-Assisted Laparoscopic Prostatectomy Versus Open Radical Retropubic Prostatectomy: Early Outcomes from a Randomised Controlled Phase 3 Study. Lancet. 2016;388(10049):1057-1066.

17. Vale CL, Fisher D, Kneebone A, Parker C, Pearse M, Richaud P, et al. Adjuvant or Early Salvage Radiotherapy for the Treatment of Localised and Locally Advanced Prostate Cancer: a Prospectively Planned Systematic Review and Meta-Analysis of Aggregate Data. Lancet. 2020;396(10260):1422-1431.

18. Yossepowitch O, Briganti A, Eastham JA, Epstein J, Graefen M, Montironi R, et al. Positive Surgical Margins after Radical Prostatectomy: a Systematic Review and Contemporary Update. Eur Urol. 2014;65(2):303-313.

19. Ficarra V, Novara G, Artibani W, Cestari A, Galfano A, Graefen M, et al. Retropubic, Laparoscopic, and Robot-Assisted Radical Prostatectomy: a Systematic Review and Cumulative Analysis of Comparative Studies. Eur Urol. 2009;55(5):1037-1063.

20. Gandaglia G, Sammon JD, Chang SL, Choueiri TK, Hu JC, Karakiewicz PI, et al. Comparative Effectiveness of Robot-Assisted and Open Radical Prostatectomy in the Postdissemination Era. J Clin Oncol. 2014;32(14):1419-1426.

21. Kim JJ, Ha YS, Jeong SJ, Hong SH, Kim CI, Lee JY, et al. Robot-Assisted Laparoscopic Radical Prostatectomy: Learning Curve of a Single Surgeon. Korean J Urol. 2015;56(5):351-358.

22. Ficarra V, Novara G, Ahlering TE, Costello A, Eastham JA, Graefen M, et al. Systematic Review and Meta-Analysis of Studies Reporting Potency Rates after Robot-Assisted Radical Prostatectomy. Eur

Urol. 2012;62(3):418-430.

23. Porpiglia F, Morra I, Lucci Chiarissi M, Manfredi M, Mele F, Grande S, et al. Randomised Controlled Trial Comparing Laparoscopic and Robot-Assisted Radical Prostatectomy. Eur Urol. 2013;63(4):606-614.

24. Haglind E, Carlsson S, Stranne J, Wallerstedt A, Wilderäng U, Thorsteinsdottir T, et al. Urinary Incontinence and Erectile Dysfunction after Robotic Versus Open Radical Prostatectomy: the LAPPRO Prospective Nonrandomised Trial. Eur Urol. 2015;68(2):216-225.

25. Boorjian SA, Karnes RJ, Rangel LJ, Bergstralh EJ, Blute ML. Mayo Clinic Validation of the D'Amico Risk Group Classification for Predicting Survival Following Radical Prostatectomy. J Urol. 2008;179(4):1354-13