Research Article

Laparoscopic VS Open Radical Prostatectomy. Comparison of Perioperative and Early Postoperative Outcomes in the Management of Localized Prostate Cancer. A Single-Center Quasi-Experimental Study in Ireland

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Abstract

Background: Laparoscopic radical prostatectomy has emerged as a minimally invasive alternative to open radical prostatectomy for the management of localized prostate cancer. Despite ongoing debates regarding their comparative benefits and drawbacks, comprehensive evaluations of perioperative and early postoperative outcomes are essential.

Objectives: To compare perioperative and early postoperative outcomes between laparoscopic and open radical prostatectomy techniques in the management of localized prostate cancer.

Methods: This single-center quasi-experimental study was initiated after approval in January 2015 from College of Medicine, Nursing, and Health Sciences Research Ethics committee with approval no: NN29. In two years, retrospective analysis of 66 case of laparoscopic group (LG) and 59 cases of open group (OG) of radical prostatectomy cases performed. Predefined criteria guided patient selection, and data were collected prospectively on perioperative factors. Statistical analyses were conducted to compare outcomes between the two surgical approaches. Consent was taken from participants.

Results: Mean ages were LG 57.95±6.68 years and OG 60.13±5.45 years. Preoperative prostate-specific antigen levels were LG 6.68±2.78 ng/mL and OG 8.85±4.32 ng/mL. Distribution of preoperative grades differed between both groups. Mean operating times were LG 195.6 minutes±26.11 and OG 167.5 minutes±30.50. Blood loss averaged LG 406.6 mL±144.64 and OG 1057 mL±620.68. Postoperative stay durations were LG 4.94 days±2.91 and OG 6.46 days±1.93. Histological stages and grades varied postoperatively in both groups.

Conclusion: Laparoscopic radical prostatectomy's advantages over open surgery for localized prostate cancer, citing reduced blood loss, shorter hospital stays, and quicker recovery. Despite longer operating times, laparoscopic cases demonstrate benefits, contributing to the debate on surgical approaches.

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Introduction

Prostate cancer (PC) stands as a formidable global health challenge, ranking as the second leading

cause of death among men.[1] Despite its prevalence, the asymptomatic nature of the disease during its initial stages poses a significant obstacle to early detection and timely intervention.[2] The current screening methods, including PSA testing, digital rectal examination (DRE), and biopsy,[3] play a crucial role in identifying prostate cancer at a treatable stage. However, the optimal surgical approach for localized prostate cancer remains a subject of debate.

The historical evolution of surgical techniques, from the early radical transperineal prostatectomy to the later retropubic approach,[4] provides a backdrop for understanding the development of contemporary approaches — specifically, laparoscopic and open radical prostatectomy,[5] The introduction of laparoscopic radical prostatectomy in the late 1990s has garnered attention for its potential advantages, including reduced operating time, minimized blood loss, and shorter hospital stays.[6,7]

This study emerges from the necessity to address the ongoing debate surrounding the choice between laparoscopic and open radical prostatectomy. The comparative analysis of perioperative and early postoperative outcomes serves as a critical step in providing evidence-based insights into the efficacy of these surgical interventions. By undertaking a single-surgeon, prospective, single-center a quasi-experimental study, we aim to contribute comprehensive data on patient demographics, surgical details, and postoperative recovery.

The immediacy of filling in current information gaps, particularly with relation to the long-term efficacy of laparoscopic radical prostatectomy, is the reason for this study. The results of the research aim to provide useful insights for better patient outcomes and increased healthcare efficiency, which in turn should help guide clinical decisions.

Methods

To compare the perioperative and early postoperative results of laparoscopic and open radical prostatectomy procedures for the treatment of localised prostate cancer, this study used a quasi-experimental design. Patients who met the inclusion requirements underwent either an open radical prostatectomy or a laparoscopic procedure. These parameters included patient preferences, systemic health, comorbidities, age, and performance level. Individuals who declined surgery, were beyond the age of 70, or had poor performance status from numerous comorbidities or severe systemic disease were all given consideration for alternative treatments, like radiotherapy. Patients with a high body mass index (BMI), high-grade or high-volume malignancy, questionable lymph nodes, or a history of major abdominal or pelvic surgery were excluded. During a two-year period, 66 patients had laparoscopic radical prostatectomy and 59 patients chose open radical prostatectomy. All surgical procedures were performed by a single surgeon, ensuring consistency in technique and minimizing inter-operator variability. After obtaining informed consent, a digital rectal examination (DRE) was performed, followed by the administration of 5ml of local anesthetic on both inferolateral aspects of the prostate gland. Once a diagnosis of prostate cancer (PC) was established and grading details provided, conventional MRI of the pelvis and abdomen was conducted using a Siemens closed-type MRI system. Isotope bone scans were performed only on patients meeting specific criteria, including a PSA>20, Gleason's grade of 4+4, and clinical stage T3, in accordance with the National Comprehensive Cancer Network guidelines. A standardized operating technique was employed for both laparoscopic and open procedures, with adherence to established protocols and guidelines. Data collection commenced following approval from the College of Medicine, Nursing, and Health Sciences Research Ethics committee (approval no: NN29) in January 2015. Informed consent was obtained from all participants prior to surgery. We prospectively collected and recorded patient demographics, preoperative characteristics, intraoperative variables, and early postoperative outcomes to ensure systematic data capture without retrospective bias. Data from both groups were organized based on preoperative assessment, indication, perioperative time, immediate/early post-operative period, and early follow-up variables for analysis. The study's validity and robustness were increased by the grouping methodology, which made it easier to compare preoperative and early postoperative results between patients who had laparoscopic and open radical prostatectomy. Operating time, blood loss, length of hospital stay, complications following surgery, rate of reoperation, pathological stage (pT), pathological grade (G), and positive surgical margins were among the primary outcome variables.

The collected data were summarised using descriptive statistics including means, medians, and percentages. Mann-Whitney U tests, chi-square tests, and two-sample t-tests were used for inferential analysis as necessary, with a p-value of less than 0.05 being considered statistically significant. With the use of the Statistical Package for the Social Sciences (SPSS) programme, data interpretation and analysis were simplified. The relevant institutional review board granted ethical approval, and the study was carried out in compliance with the Declaration of Helsinki. Patient confidentiality and privacy were maintained throughout the study duration. The potential for bias arising from the single-surgeon approach was acknowledged and addressed. The surgeon's experience with both laparoscopic and open techniques, along with standardized protocols, aimed to mitigate bias and ensure the integrity of the study findings. High-grade exclusion criteria were objectively defined to enhance the study's validity and minimize confounding variables.

Results

Patients in the LG were on average 2.2 years younger than patients in the OG (mean age of 57.95 years and 60.13 years respectively, Mean (SD) = 57.95 (6.68) vs. 60.13 (5.45)). A two-sample t-test revealed that there was evidence of a significant difference between the mean ages across the two groups (p-value = 0.05). Mean PSA levels in the LG prior to surgery were significantly lower than mean PSA levels in the OG (p-value < 0.001) with the mean PSA level in the LG equalling 6.69 (SD = 2.779) and the mean PSA level in the OG equalling 8.85 (SD = 4.320). 29 patients (47%) in the LG had ASA levels equal to 1, with the remaining 53% having ASA levels equal to 2. Conversely, 12 patients (19%) in the OG had ASA levels equal to 1, 75% had ASA levels equal to 2 (47 patients), and 6% had ASA levels equal to 3 (4 patients). A chi-square test of association showed that there was evidence of a significant association between ASA levels and group (p-value < 0.001). More patients in the LG had ASA levels equal to 1 than expected, and more patients in the OG had ASA levels equal to 2.

In the T1c level, 7 patients (11%) in the OG had Indication levels T1c, G1 3+3 and T1c, G1 3+4. A further 4 patients (6%) had Indication level T1c, G1 3+4, and a single patient (2%) had Indication level T1c, G1 4+4. In contrast, no patients in the LG had Indication level equal to any of the latter levels. Most patients in the LG (31 patients, 50%) had Indication level T1c, Gleason 3+3, and a further 6 patients (10%) had Indication level in each of T1c, Gleason 3+4 and T1c, Gleason 4+3.

The mean operating time was significantly higher for patients in the LG versus the OG (p-value < 0.001), with mean operating time of 195.6 minutes versus 167.5 minutes respectively (Mean (SD) = 195.6 (26.11) vs. 167.5 (30.50)). When comparing blood loss in the two groups, a single patient had an unusually high blood loss of 4200ml. Since the data for blood loss were not Normally distributed due to this unusual observation, the median blood losses are reported for each group. Patients in the LG had lower median blood loss (400 ml) than patients in the OG (900 ml). The variability in amount of blood lost was also much lower for patients in the LG with an IQR (Q3 – Q1) of 186.5 ml versus 507 ml in the OG. A Mann-Whitney-U test revealed that there were significant differences between the distributions of blood loss in the two groups (p-value < 0.001). 98% of patients in the LG did not require a blood transfusion, while 86% of patients in the OG did not require a transfusion. Only 1 patient in the LG required 2 units of blood, 7 patients (11%) in the OG required 2 units and 2 patients (3%) in the OG required 4 units (one of which corresponded to the patient with the greatest blood loss of 4200ml). 54 patients (87%) in the LG and 44 patients (70%) in the OG exhibited no peri-operative complications. Of the remaining 8 patients in the LG, 1(1.6%) had Afib, 3 (4.8%) had an anastomotic leak, 1(1.6%) had an anastomotic leak, laparotomy and repair, 1(1.6%) had a large bowel pseudo-obstruction, 1 (1.6%) had mild pyrexia and 1 (1.6%) had a small bowel obstruction and laparotomy. Of the remaining 19 patients in the OG, 1 (1.6%) had a skin rash, 2 (3.2%) had an anastomotic leak, 2 (3.2%) had urinary retention, 1 (1.6%) had a chest infection, 1 (1.6%) had a DVT, 2 (3.2%) had mild pyrexia, 1 (1.6%) had raised C-reactive protein and 1 (1.6%) had wound infection.

Patients in the LG were able to resume their diet significantly earlier than patients in the OG (p-value < 0.001), with mean days postoperative until resuming diet being 1.65 days versus 3.10 days respectively (Mean (SD) = 1.65 (0.41) vs. 3.10 (1.02)). Patients in the LG were

discharged from the hospital significantly earlier than patients in the OG (p-value < 0.001), with mean days postoperative until discharge being 4.19 days versus 6.56 days respectively (Mean (SD) = 4.19 (1.76) vs. 6.56 (1.86)). Patients in the LG had significantly shorter catheterization durations than patients in the OG (p-value < 0.001), with mean days of catheterization being 7.33 days versus 10.55 days respectively (Mean (SD) = 7.33 (1.45) vs. 10.55 (1.91)). There were no significant differences in the time until oral fluid intake was commenced between the two groups (p-value = 0.123), with mean days postoperative until commencing oral fluids being 1.03 days versus 1.18 days respectively (Mean (SD) = 1.03 (0.18) vs. 1.18 (0.26)).

The mean tumor grade (Gleason score) preoperatively was 7.2 (SD=1.3) in the LG and 7.5 (SD = 1.2) in the OG. A two-sample t-test was conducted to compare the mean tumor grades between the two groups, yielding a p-value of 0.074, suggesting no significant difference in tumor grade between the groups preoperatively.

Before surgery, the mean stage of cancer was 2.8 (SD = 0.6) in the LG and 3.0 (SD = 0.5) in the OG. A two-sample t-test showed no significant difference in the mean cancer stage between the two groups preoperatively, with a p-value of 0.121. In the LG, 4 patients (6.5%) had positive margins, while in the OG, 8 patients (12.9%) had positive margins. The difference in the proportion of positive margins between the groups was not statistically significant (chi-square test, p-value = 0.238). Among the patients with positive margins in the LG, the most common site was the posterolateral margin (n = 2, 50%), followed by the apex (n = 1, 25%) and the bladder neck (n = 1, 25%). In the OG, the most common site of positive margins was the posterolateral margin (n = 4, 50%), followed by the apex (n = 2, 25%) and the bladder neck (n = 2, 25%). The mean specimen weight was 42.6 grams (SD = 12.3) in the LG and 46.8 grams (SD = 13.5) in the OG. A two-sample t-test revealed no significant difference in specimen weight between the groups, with a p-value of 0.156. The mean largest tumor volume was 18.3 cc (SD = 6.7) in the LG and 20.1 cc (SD=7.2) in the OG. There was no statistically significant difference in the largest tumor volume between the two groups (p-value = 0.287, two-sample t-test).

At follow-up, the mean PSA level was 0.89 ng/ml (SD = 0.42) in the LG and 1.12 ng/ml (SD = 0.51) in the OG. A two-sample t-test indicated no significant difference in PSA levels between the groups at follow-up (p-value = 0.091). At the last follow-up, 92% of patients in the LG and 88% in the OG were free of disease (Table no.1). The difference in disease-free status between the groups was not statistically significant (chi-square test, p-value = 0.402).

Table 1: *Comparative Analysis of Clinical Variables between Laparoscopic (LG) and Open (OG) Groups*

Variable	LG	OG	p-value
*Age	57.59(6.68)	60.13(5.45)	0.05
ASA 1	29(47%)	12 (19%)	< 0.001
ASA 2	31 (53%)	47 (75%)	
ASA 3	0	4 (6%)	
Positive margins	6.5%	12.9%	0.238
*PSA level pre-surgery	6.69 (2.779)	8.85 (4.320)	< 0.001
*Tumor grade preoperative	7.2 (1.3)	7.5 (1.2)	0.074
*Cancer stage preoperative	2.8 (0.6)	3.0 (0.5)	0.121
*Specimen weight	42.6 (12.3)	46.8 (13.5)	0.156
*Largest tumor volume	18.3 (6.7) 20.1 (7.2)	20.1 (7.2)	0.287
*Operating time	195.6(26.11)	167.5(30.50)	< 0.001
*Blood loss (ml)	400 (186.5)	900 (507)	< 0.001
*Diet resumption	1.65 (0.41)	3.10 (1.02)	< 0.001
*Tumor volume	18.3 (6.7)	20.1 (7.2)	0.287
*Hospital discharge	4.19 (1.76)	6.56 (1.86)	< 0.001
*Catheter duration	7.33 (1.45)	10.55 (1.91)	< 0.001
*Oral fluid intake	1.03 (0.18)	1.18 (0.26)	0.123
*PSA level post-surgery	0.89 (0.42)	1.12 (0.51)	0.091
Peri-operative Complications			
None	54(87%)	44 (70%)	0.031
Afib	1 (1.6%)	0	
Anastomotic Leak	3 (4.8%)	2 (3.2%)	
Laparotomy and Repair	1 (1.6%)	0	
Large Bowel Pseudo-obstruction	1 (1.6%)	0	
Mild Pyrexia	1 (1.6%)	2 (3.2%)	
Small Bowel Obstruction and Laparotomy	1 (1.6%)	0	
Skin Rash	0	1 (1.6%)	
Urinary Retention	0	2 (3.2%)	
Chest Infection	0	1 (1.6%)	
DVT	0	1 (1.6%)	
Raised C-reactive Protein	0	1 (1.6%)	
Wound Infection	0	1 (1.6%)	

**Variable is Continuous value with Mean (Standard deviation)*

Discussion

Prostate cancer management has witnessed significant advancements in surgical approaches, with open radical prostatectomy (ORP) and laparoscopic radical prostatectomy (LRP) as prominent techniques.[8] This discussion aims to compare the findings of our study with existing literature, providing insights into perioperative and functional outcomes. Parallel to Bhayani et al.'s emphasis on laparoscopic benefits, our research aligns by showcasing diminished blood loss and shorter convalescence. While Bhayani's focus remains on short-term outcomes, our study extends this understanding, delving into longer-term effects like perioperative complications and functional outcomes.[9]

Our findings converge with Slabaugh's study, underscoring the efficiency of minimally invasive approaches through shorter operative times in mini-lap RRP. This reinforces the practicality and economic advantages of such techniques in prostate cancer surgery.[10,11] Our study echoes Hu JC et al.'s observations, affirming the rise of minimally invasive techniques. Consistent with their findings, our laparoscopic approach demonstrated advantages such as reduced blood transfusions, shorter hospital stays, and lower respiratory complications. However, disparities in complications and functional outcomes suggest nuanced implications tied to surgical methodologies.[12]

The LG had significantly lower median blood loss than the Open group. Literature suggests that blood loss is significantly lower in LRP, approximately 500cc, than in ORP around 1000cc.[13] Unclear reporting makes analysis and interpretation of peri-operative complication difficult.[14] Similar major and minor complications were reported[15]. In European hospitals the average stay in hospital after LRP is 6-10 days.[16] In our study patients in the LG had significantly shorter lengths of stay in hospital with 77% of patients being in hospital for 4 days or less versus 80% of patients in the OG being in hospital for 6 days or more. The duration of urethral catheterisation is shorter in LRP cases than with ORP 17 approximately 7 days after LRP and 14 days after ORP. In our study Laparoscopic patients had a significantly lower length of catheterisation, with 77% of patients having a catheter for 10 days or less, while 46% of patients in the OG had a catheter for 11 days or more. Our results harmonize with Kongcharoensombat's emphasis on the benefits of extraperitoneal laparoscopic radical prostatectomy, exemplifying reduced blood loss and shorter hospital stays. This signifies the robustness of minimally invasive techniques across diverse patient populations and clinical settings.[18]

Strengths include the use of an observational prospective design in the study, which enables the collecting of data over a specified time in a real-world environment. This design can give important insights into the real results of a single surgeon's laparoscopic and open radical prostatectomy. Because just one surgeon is involved in the study, variability arising from differences in surgical expertise is mitigated as homogeneity in surgical technique is ensured. By limiting outside influences and guaranteeing uniformity in patient care, follow-up procedures, and data gathering techniques, the study's singular site emphasis improves internal validity. It addresses relevant therapeutic issues while comparing laparoscopic and open radical prostatectomy. Its clinical value is shown by stressing perioperative and early postoperative results. Restrictions on generalizability, possible bias, and a lack of long-term data are some of the limits, though. Even with consistent procedure, bias can still be introduced by the expertise and personal preferences of surgeons. It is advisable for readers to carefully consider these advantages and disadvantages.

Conclusion

Our study highlights the superior perioperative and early postoperative outcomes of laparoscopic radical prostatectomy in comparison to open procedures. Even with lengthier operating durations, laparoscopy results in less blood loss, shorter hospital stays, shorter catheterization periods, and quicker recovery after surgery. These findings support laparoscopic treatments and add to the current debate about the best surgical techniques for prostate cancer that is localised. To confirm these results and guide evidence-based clinical practice, longer-term, multicenter investigations are necessary.

Ethical Approval: College of Medicine, Nursing and Health Sciences Research Ethical Committee of University of Galway approved the study vide Ref Nn29.

Conflict of Interest: The authors declare no conflict of interest.

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Author's Contribution

NBN: Conception and design, drafting the article or revising it critically for important intellectual content. Final approval of the version to be published.
NZ: conception and design, drafting the article or revising it critically for important intellectual content. Final approval of the version to be published
SM: conception and design, drafting the article or revising it critically for important intellectual content. Final approval of the version to be published.
AR: conception and design, drafting the article or revising it critically for important intellectual content. Final approval of the version to be published.
KW: conception and design, or acquisition of data, Drafting the article or revising it critically for important intellectual content. Final approval of the version to be published.
GD: conception and design, drafting the article or revising it critically for important intellectual content. Final approval of the version to be published.
SI: Drafting the article or revising it critically for important intellectual content. Final approval of the version to be published. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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