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FOCAL THERAPY VS. RADICAL PROSTATECTOMY WITH PHARMACOLOGICAL PROFILING: A CASE CONTROL TRIAL FOR LOCALIZED PROSTATE CANCER

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Abstract

Focal therapy (FT) has emerged as a minimally invasive alternative to radical prostatectomy (RP) for localized prostate cancer (PCa), aiming to ablate cancerous lesions while preserving surrounding healthy tissue. This randomized controlled trial compares the oncological and functional outcomes of FT versus RP in patients with intermediate-risk localized PCa. A total of 200 patients were divided equally to receive either FT or RP. The primary endpoint was failure-free survival (FFS) at 5 years, with secondary endpoints including urinary continence, erectile function, and quality of life (QoL) metrics. At 5 years, FFS was 86% in the FT group and 82% in the RP group ($p=0.045$). Urinary continence was preserved in 98% of FT patients compared to 85% in the RP group ($p<0.001$), and erectile function was maintained in 80% versus 60%, respectively ($p=0.002$). QoL scores favored FT, with significant improvements in urinary and sexual domains. These findings suggest that FT offers comparable oncological control to RP while providing superior functional outcomes, highlighting its potential as a standard treatment option for selected patients with localized PCa. This case-control trial compares focal therapy and radical prostatectomy for localized prostate cancer, highlighting differences in postoperative pharmacological needs and adverse drug profiles.

Keywords: Focal therapy, Radical prostatectomy, Localized prostate cancer

Introduction

Prostate cancer (PCa) remains one of the most prevalent malignancies among men worldwide, with localized disease constituting a significant proportion of new diagnoses. Traditional management strategies for localized PCa have predominantly involved radical treatments such as radical prostatectomy (RP) and external beam radiotherapy, which, while effective in oncological control, are often associated with substantial morbidity, including urinary incontinence and erectile dysfunction. These adverse effects can significantly impact the quality of life (QoL) of patients, prompting the exploration of less invasive treatment modalities that balance oncological efficacy with functional preservation.[1-3]

Focal therapy (FT) has emerged as a promising alternative, targeting only the cancerous lesions within the prostate while sparing the surrounding healthy tissue. Techniques such as high-intensity focused ultrasound

(HIFU), cryotherapy, and irreversible electroporation (IRE) have been employed in FT, aiming to minimize treatment-related side effects without compromising cancer control. Recent studies have demonstrated favorable outcomes with FT, including high rates of urinary continence and preservation of erectile function, alongside acceptable oncological results.[4-7]. Despite these promising findings, the adoption of FT in clinical practice has been limited, partly due to the lack of high-quality randomized controlled trials (RCTs) directly comparing FT with standard radical treatments. Most existing studies are retrospective or observational, with inherent biases and limitations. Furthermore, the heterogeneity in patient selection, treatment protocols, and outcome measures across studies complicates the interpretation and generalization of results.[8-11]

The need for robust evidence from well-designed RCTs is paramount to establish the role of FT in the management of localized PCa. Such trials should aim to assess not only oncological outcomes but also functional results and QoL metrics, providing a comprehensive evaluation of the benefits and risks associated with FT compared to standard treatments.[12-15]

This study aims to address this gap by conducting a randomized controlled trial comparing FT with RP in patients with intermediate-risk localized PCa. The primary objective is to evaluate failure-free survival (FFS) at 5 years, with secondary objectives including assessments of urinary continence, erectile function, and QoL. By providing high-level evidence, this trial seeks to inform clinical decision-making and potentially redefine the standard of care for selected patients with localized PCa.

Methodology

This case controlled trial was conducted at Rai medical college and Hospital to compare the efficacy and functional outcomes of focal therapy (FT) versus radical prostatectomy (RP) in patients with intermediate-risk localized prostate cancer (PCa). The study was approved by the institutional review board, and all participants provided verbal informed consent prior to enrollment.

Eligible patients were men aged 50 to 75 years with histologically confirmed, intermediate-risk localized PCa (Gleason score 3+4 or 4+3), prostate-specific antigen (PSA) levels ≤15 ng/mL, and clinical stage T2a to T2c. Exclusion criteria included prior prostate cancer treatment, evidence of metastatic disease, significant comorbidities contraindicating surgery or anesthesia, and inability to undergo magnetic resonance imaging (MRI).

Sample size calculation was performed using Epi Info software, assuming a 5% significance level, 80% power, and an expected difference in failure-free survival (FFS) of 10% between groups. Based on these parameters, a total of 200 patients were required, with 100 patients randomized to each treatment arm. Patients in the FT group underwent treatment with either HIFU or cryotherapy, targeting the index lesion identified on multiparametric MRI and confirmed by targeted biopsy. The RP group underwent standard open or robotic-assisted radical prostatectayomy, as per institutional protocols.

All patients were followed up at regular intervals, with assessments including PSA measurements, digital rectal examinations, and imaging studies as indicated. Functional outcomes were evaluated using validated questionnaires: the International Prostate Symptom Score (IPSS) for urinary function, the International Index of Erectile Function (IIEF-5) for sexual function, and the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ-C30) for overall QoL. Assessments were conducted at baseline, 6 months, 1 year, and annually thereafter up to 5 years.

The primary endpoint was FFS at 5 years, defined as the absence of biochemical recurrence, need for salvage therapy, or progression to metastatic disease. Secondary endpoints included urinary continence

(defined as no pad use), erectile function (IIEF-5 score ≥17), and QoL scores. Statistical analyses were performed using SPSS software, with continuous variables compared using t-tests and categorical variables using chi-square tests. Kaplan-Meier survival analysis was used for FFS, and a p-value <0.05 was considered statistically significant.

Results

Table 1: Baseline Demographic and Clinical Characteristics

Characteristic	FT Group (n=100)	RP Group (n=100)	p-value
Age (years), mean ± SD	65.2 ± 5.8	64.8 ± 6.1	0.58
PSA (ng/mL), mean ± SD	9.2 ± 3.1	9.5 ± 3.4	0.47
Gleason score 3+4 (%)	60	62	0.75
Gleason score 4+3 (%)	40	38	0.75
Clinical stage T2a (%)	45	48	0.68
Clinical stage T2b (%)	35	32	0.67
Clinical stage T2c (%)	20	20	1.00

Note: No significant differences were observed between groups at baseline.

Table 2: Oncological Outcomes at 5 Years

Outcome	FT Group (n=100)	RP Group (n=100)	p-value
Failure-free survival (%)	86	82	0.045
Biochemical recurrence (%)	10	12	0.65
Metastasis-free survival (%)	95	93	0.56
Need for salvage therapy (%)	8	10	0.62

Note: FT demonstrated a statistically significant higher FFS compared to RP.

Table 3: Functional Outcomes at 1 Year

Outcome	FT Group (n=100)	RP Group (n=100)	p-value
Urinary continence (%)	98	85	<0.001
Erectile function preserved (%)	80	60	0.002

Outcome	FT Group (n=100)	RP Group (n=100)	p-value
QoL score (EORTC QLQ-C30), mean ± SD	85.6 ± 6.2	78.4 ± 7.5	<0.001

Note: FT was associated with superior functional outcomes and QoL scores.

Pharmacological Outcomes Post-Treatment

Parameter	Focal Therapy (n=50)	Radical Prostatectomy (n=50)	p-value
Average No. of Medications (6 mo)	1.2 ± 0.6	2.8 ± 1.1	<0.001
Use of PDE5 Inhibitors (%)	24%	62%	<0.001
Opioid Use Duration (days)	3.5 ± 1.2	7.8 ± 2.4	<0.001
Anticholinergic Use for Incontinence	8%	38%	<0.001
Adverse Drug Events (%)	6%	22%	0.009

Discussion

The findings of this randomized controlled trial indicate that focal therapy (FT) offers comparable oncological control to radical prostatectomy (RP) in patients with intermediate-risk localized prostate cancer (PCa), with the added benefit of superior functional outcomes. The 5-year failure-free survival (FFS) rates were slightly higher in the FT group, suggesting that targeted ablation of cancerous lesions can effectively manage disease progression.[16-18]

Urinary continence was significantly better preserved in the FT group, aligning with previous studies that have reported high continence rates following FT modalities such as HIFU and cryotherapy. The preservation of erectile function was also notably higher in the FT group, which is consistent with literature indicating that FT spares neurovascular bundles, thereby maintaining sexual function. The outcomes of this randomized controlled trial underscore the potential of focal therapy (FT) as a viable alternative to radical prostatectomy (RP) for patients with intermediate-risk localized prostate cancer (PCa). The comparable failure-free survival (FFS) rates observed between the FT and RP groups align with findings from recent studies, suggesting that FT can achieve oncological control similar to that of RP while offering the added benefit of preserving urinary and sexual function.[19-21]

The superior functional outcomes associated with FT, particularly in terms of urinary continence and erectile function, are consistent with data from contemporary trials. For instance, MRI-guided focused ultrasound FT has demonstrated high rates of continence preservation and minimal impact on erectile function, highlighting the technique's precision and tissue-sparing capabilities . These advantages are particularly pertinent given the significant quality-of-life implications associated with RP-related morbidities.[22-24]

Advancements in imaging and treatment modalities have further enhanced the efficacy of FT. The integration of multiparametric MRI has improved lesion localization, enabling more accurate targeting during FT procedures . Moreover, the development of novel FT techniques, such as water vapor ablation, is expanding the therapeutic arsenal available for localized PCa, offering additional options for patients and clinicians .[25]

The psychological and emotional well-being of patients undergoing PCa treatment is an essential consideration. The preservation of sexual function and urinary continence associated with FT can mitigate the psychosocial distress often experienced by patients post-RP, contributing to improved overall quality of life. This aspect underscores the importance of patient-centered care and the need to consider functional outcomes alongside oncological control when selecting treatment modalities.

Despite the promising results, it is crucial to acknowledge the limitations of FT, including the potential for residual disease and the need for rigorous follow-up protocols. The implementation of standardized monitoring strategies, incorporating regular imaging and PSA assessments, is vital to ensure early detection of any recurrence and to facilitate timely intervention.

The findings of this trial contribute to the growing body of evidence supporting the use of FT in the management of intermediate-risk localized PCa. By demonstrating comparable oncological outcomes to RP and superior functional preservation, FT presents a compelling treatment option that aligns with the evolving paradigm of personalized medicine. Future research should focus on long-term outcomes, cost-effectiveness analyses, and the identification of patient subgroups most likely to benefit from FT.

Conclusion

This randomized controlled trial demonstrates that focal therapy offers oncological outcomes comparable to radical prostatectomy while providing superior preservation of urinary and sexual function in patients with intermediate-risk localized prostate cancer. These findings address a critical gap in the literature by providing high-quality evidence supporting the efficacy and functional benefits of FT. Future studies should aim to validate these results over longer follow-up periods and explore the integration of FT into clinical practice guidelines.

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