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Original Research Article

A Study on Biochemical response and toxicity profile in very low, and intermediate risk prostate cancer individuals after stereotactic body radiotherapy

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Abstract

Introduction: Prostate cancer (PC) is the second most common cancer globally, with significant incidence in India. Various treatment options exist, but Stereotactic Body Radiotherapy (SBRT) is emerging as a precise method for managing very low, low, and intermediate-risk PC. This study aims to assess the efficacy and toxicity profile of SBRT in these patients.

Methods: This prospective observational study at Omega Hospital, Hyderabad, involved 30 patients with localized prostate cancer treated with Stereotactic Body Radiotherapy (SBRT). Inclusion criteria included men over 18 years with a WHO performance status of 0-2. The study assessed PSA levels and toxicity profiles during and after treatment, following ethical approvals.

Results: In this study, 40% of participants were under 65, 20% were over 76, and the rest were aged 66–75. Mean baseline PSA dropped significantly from 11.86 ng/dl to 0.71 ng/dl over 12 months post-SBRT. Most experienced grade 1 acute gastrointestinal and genitourinary toxicity, with no toxicity above grade 1 by three months.

Conclusion: This study underscores SBRT's effectiveness and safety in localized prostate cancer, showing significant PSA reduction and durable biochemical control. With mostly grade 1 acute gastrointestinal and genitourinary toxicity, SBRT proves to be a viable treatment option, offering effective cancer control and minimal impact on quality of life.

Keywords: Prostate Cancer, SBRT (Stereotactic Body Radiotherapy), Biochemical Control, Toxicity Profile, Quality of Life

Introduction

Worldwide, prostate cancer (PC) is the second most common cancer and the sixth leading cause of cancer deaths and by 2030, the expected burden of new cases will be nearly 1.7 million and 499 000 new deaths. [1] Indian subcontinent also contribute significant number and annual PC incidence range is 5 – 9.1 per 1,00,0000 population. [2, 3] Higher age group, slow progression and availability of prostate specific antigen (PSA) marker at an early stage to detect the prognosis are the characteristic features.

Different treatment options are available such as active surveillance, radical prostatectomy (RP), external beam radiation therapy, brachytherapy, chemotherapy, androgen deprivation therapy (ADT). There is impact on quality of life due to treatment related toxicity and side effects. Stereotactic body radiotherapy (SBRT) is promising therapeutic option for PC due to its precision in delivering high radiation doses to the tumour. This approach is widely adopted for very low, low, and intermediate-risk PC. SBRT achieves excellent biochemical control, decreases PSA levels.

Limited literature is available regarding the treatment response and interrelationship between PSA response in PC individuals treated with SBRT. With this a study was conducted to assess efficacy and toxicity profile of SBRT in very low, low, and intermediate risk PC patients.

Methods

This was a prospective observational study conducted in the department of Radiation Oncology, Omega hospital, Hyderabad. Study was conducted between June 2018 to 2019. Study

protocol was approved by the institutional ethics committee. An informed consent was taken from the study members.

The sample size was considered to be 30 by taking mean PSA score as per et al. study. [6] Individuals >18 years, histologically, locally confined PC patients, classified very low, low, or intermediate risk groups, WHO performance status of 0–2, international Prostate Symptom Score (IPSS) of ≤12 were included in this research. Exclusion criteria, such as prior pelvic radiotherapy and contraindications to fiducial marker implantation, ensure patient safety and data reliability. Participants undergo a pre-treatment workup including baseline assessments for PSA levels, CT scan, and MRI of the prostate for precise tumour localization. Fiducial gold markers are implanted transrectally for target localization. SBRT was delivered over five sessions, using image-guided radiation therapy (IGRT) for precise dose delivery to the prostate while minimizing radiation exposure to adjacent organs like the bladder and rectum. Follow - up occurs at regular intervals post-treatment to monitor biochemical response (PSA levels) and assess toxicity profiles. Toxicity is graded based on the Common Terminology Criteria for Adverse Events (CTCAE), focusing on gastrointestinal toxicity (GT) and genitourinary toxicity (GiT). Acute toxicity is assessed during and shortly after SBRT, while late toxicity is evaluated at six months, one year, and two years post-treatment.

Statistical analysis

Statistical analysis compares biochemical control and toxicity outcomes across the very low, low, and intermediate-risk groups, using PSA response as the primary endpoint and toxicity profiles as secondary endpoints. Data analysis is conducted using appropriate statistical software, with significance levels set to determine meaningful differences among risk groups, enhancing the study's insights into SBRT efficacy and safety for localized prostate cancer.

Results

In this study, 40% (12) belonged to ≤65 years, 20% (6) were ≥ 76 years and the rest between 66 – 75 years. According to performance status, 19 belonged to ECOG PS I. T staging showed 14 members belonged to T1CN0M0, 9 to T2aN0M0 and rest T2bN0M0. Gleason grade showed that 50% to group 1, 26.67% (8) to group 2 and rest group 3. Group staging showed that 7, 8, 8 and 7 members belonged to stage I, IIA, IIB and IICS, respectively. The mean baseline serum PSA was 11.86 ng/dl, dropped to 1.15ng/dl by the end of three months after SBRT. Whereas it was 0.85ng/dl and 0.71 ng/dl at 6 months and 12 months respectively; statistically there was significant difference. Acute lower GT showed that throughout SBRT, 29 members experienced grade 1 toxicity, and rest grade 2. By the three-month follow-up, no patients reported toxicity greater than grade 1. Acute GiT during SBRT showed that 25 members had grade 1 and 5 had grade 2 toxicity. At three months, no patient reported toxicity above grade 1.

Discussion

In this study, age distribution among patients with localized prostate cancer revealed that 40% (12 patients) were younger than 65 years, 20% (6 patients) were over 76 years, and the remaining patients were between 66–75 years. Age significantly influences PC progression and treatment outcomes. Younger patients tend to present with more aggressive disease but may also benefit from intensive treatment options like SBRT, while older patients often have comorbidities influencing treatment tolerance and outcomes. Tailoring PC treatment based on age and health status may optimize therapeutic efficacy and minimize adverse effects. [6, 7] The study showed a significant reduction in mean serum PSA levels in prostate cancer patients following SBRT. Initially, the mean PSA was 11.86 ng/dL, dropping to 1.15 ng/dL within three months post-SBRT. This decline continued, reaching 0.85 ng/dL at six months and 0.71 ng/dL by twelve months, indicating effective biochemical control of localized PC. The sustained PSA decrease can be attributed to the high radiation doses targeting the tumour, reducing cancer cell activity and PSA production. A sharp PSA decline after radiation therapy is associated with improved outcomes, as it reflects effective tumour targeting and lower recurrence risk. [8. 9] PSA nadir levels serve as strong prognostic markers, with lower nadirs correlating with longer progression-free survival. Monitoring PSA levels post-SBRT is crucial for evaluating treatment response and detecting potential biochemical recurrence. Previous studies have reported similar PSA decline patterns, demonstrating SBRT's efficacy in maintaining low PSA levels and achieving favourable toxicity profiles, aided by the radiobiological benefits of hypofractionation in PC treatment. [10, 11]

Acute lower GT during SBRT was assessed in the study, revealing that 29 patients experienced grade 1 toxicity, while the remaining reported grade 2 toxicity. Remarkably, by the three-month follow-up, no patients experienced toxicity greater than grade 1. This finding is consistent with previous studies, which indicate that SBRT has a favourable safety profile with minimal gastrointestinal side effects. Research shows that the acute toxicity associated with SBRT is generally manageable and transient, with a low incidence of significant long-term gastrointestinal complications. [12, 13]

Moreover, the focused nature of SBRT allows for precise delivery of radiation to the tumour while sparing surrounding healthy tissue, contributing to lower toxicity rates. These results underscore SBRT as a viable treatment option for localized prostate cancer, effectively balancing efficacy with safety. [14]

During SBRT, acute GiT was evaluated, revealing that 25 patients experienced grade 1 toxicity, while 5 reported grade 2 toxicity. Notably, by the three-month follow-up, no patients reported toxicity greater than grade 1. These findings align with previous research demonstrating that SBRT typically results in low levels of genitourinary toxicity, making it a favourable treatment option for localized PC. [15, 16] The focused nature of SBRT allows for precise radiation delivery, minimizing damage to adjacent healthy tissues and reducing the likelihood of significant adverse effects. Studies indicate that most patients tolerate SBRT well, with acute side effects being manageable and transient. Overall, the low incidence of significant GiT supports SBRT's role as an effective and safe treatment modality for PC.

In conclusion, the study highlights the efficacy and safety of SBRT in managing localized PC. The significant reduction in serum PSA levels demonstrates durable biochemical control, while the low rates of acute gastrointestinal and genitourinary toxicity reinforce SBRT’s favorable safety profile. With manageable side effects primarily limited to grade 1 toxicity, SBRT emerges as a viable treatment option, offering patients effective cancer control with minimal impact on quality of life. These findings support the continued use of SBRT as an innovative approach in the treatment of PC.

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