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Editorial

Using Stereotactic Body Radiation Therapy (SBRT) to Irradiate and Re-Irradiate Prostate Cancer

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Background

Prostate cancer is the leading cause of invasive cancer of men in the U.S according to 2010 Surveillance, Epidemiology and End Results (SEER) data [1] compiled by Center for Disease Control and Prevention (CDC). The annual rate of prostate cancer diagnosis was 126.1 per 100,000 men in 2010 [1]. Prostate Specific Antigen (PSA) and digital rectal examination screening have attributed to improved detection and treatment outcome of prostate cancer [2,3]. The freedom from biochemical or clinical relapse is about 22 % at 8.7 years with 78 Gy radiation treatment alone [4]. There is still room for improvement in treatment outcome [5]. Androgen deprivation with radiation treatment has improved prostate cancer treatment outcome [6] but is associated with significant toxicities [7]. Radiation dose escalation has been hampered by the possibility of increased treatment toxicities. This paper discusses the use of stereotactic radiotherapy as a means of increasing the dose of prostate radiotherapy while minimizing treatment toxicities. This is a part of a series describes utilizing advanced radiation treatment systems in challenging clinical scenarios [8].

Stereotactic radiation treatment of prostate cancer

With prostate cancer α/β ratio is estimated to be between 1.5 – 3 [9,10], hypofractionated stereotactic body radiation treatment (SBRT) delivers more biologic effective dose (BED) [11] to the prostate cancer. Some investigators have argued using high dose rate (HDR) may be better than SBRT in tumor coverage and organ sparing [12]. But SBRT may be a more convenient radiation treatment.

Radiation dose escalation has produced improved prostate cancer radiation treatment outcome [4,13]. But attention to rectal [14] and bladder [15] doses is needed to prevent increased treatment toxicities. Prostate interfraction [16,17] and intrafraction [18] organ motion have limited decreasing the treatment margin to further spare critical organs at risk including rectum, bladder and penile base. On MRI, the levitorani is concave at the prostatic apex, and convex below the apex [19]. This may help to contour the penile bulb to spare the penile base [20]. With full bladder, empty rectum, 3 mm margin may be enough [21] to treat the prostate alone. With fiducials tracking, stereotactic radiation systems could achieve a safe posterior margin of about 2 mm and 5 mm in other directions to spare normal tissues [22]. Prostate cancer patients treated with SBRT have been found to have good quality of life after radiation treatment [22-25]. Alpha-agonist use could rise 40% 18 months after SBRT, but grade 3 urinary toxicity is low, about 1-2% [26]. Sexual potency is comparable to conventional radiation modalities [27].

SBRT of prostate cancer with CyberKnife produces good dose fall off as Intensity Modulated Radiation Treatment (IMRT) using a large number of beams [28]. However, SBRT may be more cost effective than IMRT [29]. With fiducials placement CyberKnife can track organ motion. SBRT of prostate cancer could be done with linac based machines for example Varian Trilogy with on-board imaging and IMRT capacities [30], and other advance stereotactic radiation systems [31].

SBRT of prostate cancer is an effective radiation treatment for organ confined prostate cancer [32]. However, competing technologies SBRT, hypofractionation, proton therapy [33] and HDR [34] should be studied for cost effectiveness [35,36]. Furthermore, novel systemic treatment may be combined with radiation treatment in the future to improve treatment outcome [37]. However, this should proceed cautiously when large fraction size of SBRT is considered [38].

Re-irradiation of prostate cancer

Radio-resistant recurrent prostate cancer has been treated with external beam [39] and with brachytherapy [40]. SBRT has also been used in treating recurrent prostate cancer [41], lymphadenopathy and bone metastasis [42]. In one study, six recurrent prostate cancer patients after external beam radiotherapy were treated to 30 Gy in 5 fractions [41]. No prostatic progression was found, and no major rectal or urinary toxicity were found with a median follow up of 11.2 months [41]. In another study, CyberKnife was used in re-irradiating recurrent lateral pelvic malignancies [43]. With a dose of 36 Gyin six fractions over 3 weeks, the median dose of prior treatment was 45 Gy (Biologic Equivalent Dose at 2 Gy (EQD2) [44] range: 20 – 96 Gy [43]). The median size of the tumor target was 34.5 mm [43]. Median disease free interval from initial treatment to recurrence was 27 months (range 4 - 148 months). Actuarial local control rate was 51.4% at one year. There were no major toxicities [43].

Conclusion

SBRT may be a safe and effective in irradiating and re-irradiating prostate cancer with advanced radiation therapy systems [45-47].

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