Evolution of Radiotherapy for the Prostate Cancer Treatment

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Abstract: Prostate cancer is considered as one of the most frequently diagnosed cancer among men in the USA and world. In the last 10 years, there has been an increasing use of radiotherapy for prostate cancer treatment. This article briefly summarizes latest radiotherapy techniques that are currently used for the prostate cancer treatment.

Keywords: Prostate Cancer, Radiotherapy, Cancer Treatment.

Prostate cancer is considered as one of the most frequently diagnosed cancer among men in the USA and world. Prostate cancer typically occurs in men after 50 years old, and the frequent and affordable PSA testing among men has led to increased number of prostate cancer diagnosis across the globe. Surgery is one of the options to manage the prostate cancer. However, some patients prefer other treatment options such as radiotherapy. In the last 10 years, there has been an increasing use of radiotherapy for cancer treatment. The latest advancement in technology has also further improved the efficiency of radiotherapy treatment.

In the late 1990s, 3-dimensional conformal radiotherapy (3DCRT) was the most common type of modality. In early 2000s, intensity modulated radiation therapy (IMRT) became popular due to superior dose distributions in the case of irregular shaped target volume when compared to 3DCRT. In 2007, volumetric modulated arc therapy (VMAT) has come into the market, and the VMAT is now considered as the most advanced form of the radiotherapy technique in the photon modality. The main difference between the IMRT and VMAT is that VMAT delivers the dose while the machine is rotating around the patient, whereas the IMRT delivers the dose in the form of static beams [1, 2]. Both the IMRT and VMAT are now commonly used to treat the prostate cancer, and the comparison between IMRT and VMAT for the prostate cancer treatment has become topic of studies among may investigators in the last few years [3-9].

The literature review shows that both the IMRT and VMAT are capable of delivering excellent dose distributions to the prostate cancer volume while minimizing dose to the critical structures such as rectum and bladder [3-7]. It is a known fact that the patient anatomy and tumor location may not be same among different patients. Hence, the treatment planning results of one case may not be exactly applicable to another case. Since there are various influencing parameters in the treatment planning of the prostate cancer, it has been noted that the results of one study can be contradictory to the other one. For example, treatment planning system itself varies from one vendor to another, and this can lead to different planning results. The type of dose calculation engine to calculate the prostate plans can give different IMRT and VMAT results [10]. Dosimetric plans also vary depending on the experience of the treatment planning personnel. The experience and skillful planners are able to generate superior treatment plans of the prostate cancer.

Kopp *et al.* [3] found out that VMAT can produce better results than IMRT for prostate cancer patients by achieving lower dose to the critical structures while having the same target coverage. Even with the VMAT, one can have an option of using one arc, two arcs, three arcs, etc. Rana *et al*. [5] and other researchers have demonstrated that single arc technique can produce different results when compared to double arc technique. Again, the partial-single arc technique using avoidance sectors could produce better results by reducing rectal and bladder as demonstrated by Rana *et al*. [5]. Reduction of rectal and bladder can reduce the normal tissue toxicities, thus improving the quality of life of prostate cancer patients. Proton therapy is another advanced radiotherapy technique and the use of protons to treat prostate cancer is very promising. Several investigations have evaluated the proton and photon therapy for prostate cancer, and the results show the superiority of proton therapy over the photon therapy [8, 9]. The idea of using proton therapy for prostate cancer treatment is appealing since proton therapy allows deposition most of the radiation dose in

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the tumor volume when compared to the photon therapy. Hence, proton therapy can improve the prostate cancer treatment by reducing dose to the rectum and bladder, which are two major critical structures next to the prostate volume.

Prostate cancer treatment using radiotherapy, however, is not completely free from the side effects. Common side effects experienced by prostate cancer patients undergone radiotherapy include rectal bleeding, urinary complications, hip fractures, etc. Recent publication by Nguyen *et al*. [11] showed that advanced treatment techniques can produce better biochemical, clinical, and survival outcomes. Shiraishi *et al*. [12] reported reduced acute and late toxicities for prostate cancer patients treated using VMAT than using conventional radiotherapy techniques. Future clinical trials needs to include prostate cancer patients treated using VMAT technique to further analyze the clinical results.

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