The Proton Particle Radiation Therapy-The modern treatment technology in Cancer Treatment

Venkata Narayana Lingampally, Ph.D., DABR
Senior Medical Physicist & Associate Clinical Professor (University of California Irvine)
Department of Radiation Oncology
Long Beach Memorial Medical Center
Long Beach, CA-90801, USA
Email: anjananu@gmail.com

ABSTRACT

The application of ionizing radiations plays a major role in treating the Cancer disease known as Radiotherapy, alone itself or in combination of other treatment modalities such as Surgery and Chemotherapy. The advanced technology in multi-modality imaging increases the knowledge of accurate tumor localization and behavior of the tumor cells in the patients. This leads to selective delivery of radiation to only those tumor cells. The radiation treatment delivered using image guidance is focused to deliver the tumor cells while sparing the normal cells. In conventional Radiation treatment high energy X-rays or electron beams produced by the Medical Linear accelerators are used for the treatment of cancer patients. When a tumor is treated with high energy X-ray beams the normal cells coming across the radiation beam and important organs surrounding the tumor will be irradiated along with cancer cells. This will leads to the damage of normal cells and it will limit the radiation dose to the tumor. Also due to high penetrating nature of the X- ray beams higher integral dose will limit the higher tumor doses in order to reduce the dose to the normal cells. The electron beams will spare the normal cells while delivering a higher doses to the tumor cells. But the limited penetration of Electron beams cannot be used to treat deep seated tumors.

It has been observed that a 10% under tumor radiation dosage results in a significant decrease in cure rate and 10% over dosage results the probability of serious side effects. By the virtue of the Bragg peak property of the protons particles a larger radiation dose will be delivered to the tumor without the dose beyond the tumor by placing the tumor in the narrow Bragg Peak region of Proton beam. This provides a more conformal radiation dose to the tumor and sharp dose fall beyond the tumor. This leads to a higher tumor dose escalation with better cancer control rate with minimal treatment complications due to smaller doses to the normal tissues. The Proton radiation therapy is used to treat all types of cancers and is very useful in treating the base of skull tumors in which surgery is impossible. Proton Therapy is very useful for treating the childhood cancers. Since 70% of childhood cancers are curable, using the conventional radiation treatment for childhood cancer may cause radiation induced cancers during their survival period. The Proton therapy reduces probability of radiation induced cancers in childhood cancers. The cost associated in building the Proton therapy is very high for four room gantry system approximately200 millions of US dollars. The cost of single gantry system will be around 30-40 million US dollars but still more expensive comparable to conventional radiotherapy machines. With more development and more Proton Therapy vendors, building more Proton particle facilities will be affordable in near future.