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# Proton Beam Radiation Targeted Nucleotides with Negligible Effect on Interferon

**Zainab W Abdul Lateef** *BSc*, *MSc*

Dept. of Physiology & Medical Physics, College of Medicine, Al-Mustansiriya University.

## Abstract

**Background** There is increasing evidence that localized irradiation of the tumor may also modify the tumor microenvironment and generate inflammatory cytokines.

**Objective** This study is aimed to clarify the effect of proton beam radiation on the interferon (IFN-α**,** IFN-β, IFN-γ) and nucleotide.

**Methods** The Microsoft "The Stopping and Range of Ions in Matter (TRIM-SRIM)" version 1998, and 2003 was used. A model of targeting certain interferon (IFN-α, IFN-β, IFN-γ) as well as the nucleotide pair was created. Each target was subjected to proton radiation of hydrogen [H], helium [He], or carbon [C] at different range of energy seeking for the Bragg's peak**.**

**Result** The results showed that the cross sections IFN-α, IFN-β, IFN-γ and nucleotide targeted by proton therapy were 0.9776, 0.8317, 0.8297 and 0.7305 [keV/(μg/cm$^2$)] for hydrogen ion, and 2.3354, 2.3414, 2.3377, 2.0842[keV/(μg/cm$^2$)] for helium ion, and 8.3032, 8.3198, 8.3109, 7.5394 [keV/(μg/cm$^2$)] for carbon ion respectively.

**Conclusions** It concludes that targeting of well precise located tumor with proton beam radiation therapy resulted in nucleotide damage of cancer cell without affecting the immune system in term of interferon surveillance.

**Key words** Proton, Nucleotide, Interferon

## Introduction

Interferons (INFs) are glycoprotein belong to cytokines that released in response to the presence of virus, bacteria, parasites or tumor cells. They activate natural killer cells and macrophages and they increase recognition of infective or tumor cell to T lymphocytes. IFN- γ has pleiotropic effects in the tumor microenvironment, including the inhibition of cell proliferation and angiogenesis [(1)]. They reversed the signal defect in T lymphocytes in patients with melanoma and the synthetic INF-$\alpha_{2b}$ is useful as an adjuvant therapy for high risk melanoma [(1)]. Because abnormally low levels of INF-γ are produced by tumor cells and local T lymphocyte in the glioma, it is a promising adjunct to other immunotherapeutic modalities in the treatment of brain tumors [(2)]. Radiation is an important treatment for the local control of cancer based on its ability to directly kill tumor cells.

However, there is increasing evidence that localized irradiation of the tumor may also modify the tumor microenvironment and generate inflammatory cytokines, which can increase the robustness of the immune response [(4,7)]. Radiotherapy has been demonstrated to cause inflammation, a potentially beneficial state in which IFN-γ is undoubtedly involved as well as it created a tumor microenvironment conducive for T cell infiltration and tumor cell target recognition [(6)]. Interferon-α potentiated the cytotoxicity of X-ray radiation [(8)]. *In vitro* model the production of INF-γ by cells is suppressed by ultraviolet A1 radiation and thereby the immune system is suppressed [(3)]. Recently proton radiation gets