

Particle Therapy Division

Introduction

Particle therapy at our hospital is focused on two aspects of cancer treatment. The first is to confirm the safety and efficacy of proton beam therapy (PBT) on a clinical basis. The second is to develop treatment techniques that are more precise and easy to apply.

The Clinical Safety and Efficacy of PBT

The preliminary outcome of 37 patients with stage I non-small cell lung cancer treated with PBT was analyzed (122). With a median follow-up period of 24 months, the 2-year local progression-free and overall survival rates were 80% and 84%, respectively. No serious acute toxicity was observed. Late Grades 2 and 3 pulmonary toxicities were observed in 3 patients each.

Ninety-five patients with head and neck cancer, whose tumors were invading or destroying the bony structure of the skull base, were analyzed. The primary lesions were nasal cavity: 28, paranasal sinus: 28, skull base bone: 21, nasopharynx: 10, auditory canal: 4, orbit: 2, and others: 2. Various histological types were present. With a median follow-up period of 19 months, 2-year local control and overall survival rates were 82% and 77%, respectively. There was no statistical difference in local control and survival in relation to histology. No patient suffered from visual weakness or loss.

Multi-institutional phase II clinical trials for localized prostate cancer and hepatocellular carcinoma employing PBT are being conducted, and patient accrual for a prostate cancer trial will soon be complete.

Technological Developments

The proton-irradiated volume can be confirmed by detection, by means of a positron emission tomography (PET) apparatus, of pairs of annihilation gamma rays from positron emitter nuclei generated by the reaction between irradiated protons and nuclei in the irradiation target. In the proton treatment room, a beam On-Line PET system has been set up that enables us to check the irradiated volume and position in real time (123).

The metal oxide semiconductor field-effect transistor (MOSFET) dosimeter is a point dosimeter because of its small size, but it has never before been used for proton dosimetry. Dose reproducibility, linearity, fading effect, beam intensity dependence and the angular dependence of the proton beam were experimentally evaluated. The Bragg curve and spread-out Bragg peak were also measured and the linear-energy transfer (LET) dependence of the MOSFET response was investigated. It was found that the angular dependence and LET dependence of the MOSFET response are of key importance for quantitative proton dose evaluation (124).

An easy operating method for adjusting the position of double scatter has been developed (125), and another simple method for dose measurement has been developed (126).

Organ motion is an important problem in the treatment of the lung or liver tumors. Several new approaches for moving targets have been developed (127-129).

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