

Utility of total-body PET in monitoring carbon ion therapy: Demonstration in rat

Wednesday, 22 May 2024 10:10 (20 minutes)

Positron emission tomography (PET) has been studied for range verification in particle therapy, in which positron emitters are produced through nuclear fragmentation reactions in body. Due to the physical and biological washout decay, PET imaging during irradiation and/or immediately after irradiation have been thought to be necessary. On the other hand, the new technology of total-body PET may enable PET imaging in a separate room thanks to its high sensitivity. Therefore, we demonstrated the utility of total-body PET in monitoring carbon ion therapy by conducting a small animal irradiation study using our original total-body small-animal PET that can cover the whole body of a rat. The tumor of a rat was irradiated by a ^{12}C ion beam, and PET scan was performed for 30 min starting ~2 min after the irradiation. Magnetic resonance angiography was also performed to determine the tumor vascular conditions. The PET data were divided into ~30 s duration time frames, and image quality was investigated by changing the time frames to a sum. PET images of the late phase were almost the same as those of the whole phase. Also, a heterogeneous distribution in the tumor was observed in the PET image even with the late phase; the high activity intensity region corresponded to the hypoxic region that was observed in MRA images. In conclusion, the utility of total-body PET in monitoring carbon ion therapy was demonstrated in rats not only for range verification but also for tumor diagnosis.

Field

Systems and applications

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Session Classification: Technologies for total body PET imaging

Track Classification: Total body imaging