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Damage Assessment of Rat Lung Tissue After Irradiation at Different Positions of Proton Spread-out Bragg Peak

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Objectives

Compared to photon radiotherapy, proton shows a favorable deep dose distribution, which delivers high dose to the tumor without affecting the surrounding normal tissues. In biology, proton exhibits a 10% higher bioavailability than photon. In clinical practice, a fixed relative biological effectiveness (RBE) of 1.1 is commonly used to develop radiotherapy plans. However, research has found that RBE is not a fixed value, which is affected by linear energy transfer (LET), tissue type, cell radiosensitivity, biological endpoints, etc. Therefore, in this study, we analyze the cellular and tissue changes in lung tissue at different locations of SOBP.

Methods

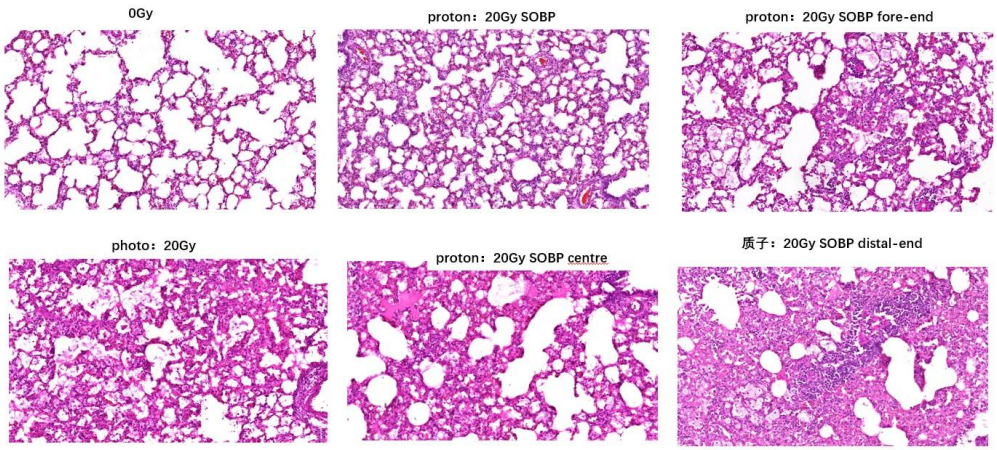
Unfold the Bragg peak at the water-equivalent depth. Firstly, the absolute dose of the irradiation plan was verified with the PPC05 ionization chamber, the flatness and symmetry were verified with films, and the range was verified with the zebra ionization chamber. Secondly, using thermoluminescence dosimeter (TLD) to verify that whether the dose can accurately deposited into the rat lung under this radiotherapy schedule. Finally, rat lungs were irradiated with a single dose at entrance, fore-end, centre, and distal-end areas of the spread-out Bragg peak.The photonic rats were placed in a 5*10 cm field covered with 0.5 cm bolus. The irradiation doses are16 Gy and 20 Gy.All rats are sampled four weeks after irradiation.

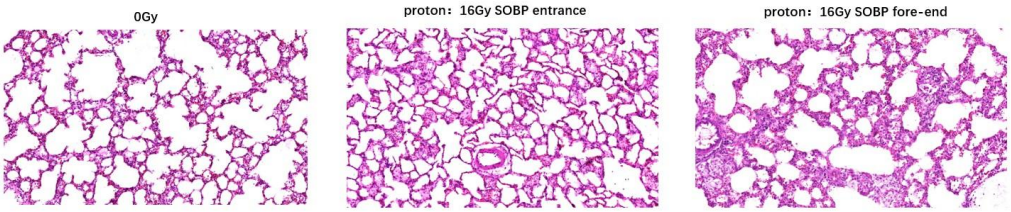
Results

HE staining shows that lung tissue damage is more severe in the distal region of proton SOBP, and in addition, the proportion of mast cells in the distal region of proton SOBP is higher.

Conclusions

This study confirms that compared to the entrance, fore-end, and centre parts of proton SOBP, the distal end of proton SOBP causes the greatest tissue damage. Especially if critical structures are located in this area. Further in vivo studies at lower fractional doses are urgently required.

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proton：16Gy SOBP entrance
proton：16Gy SOBP fore-end

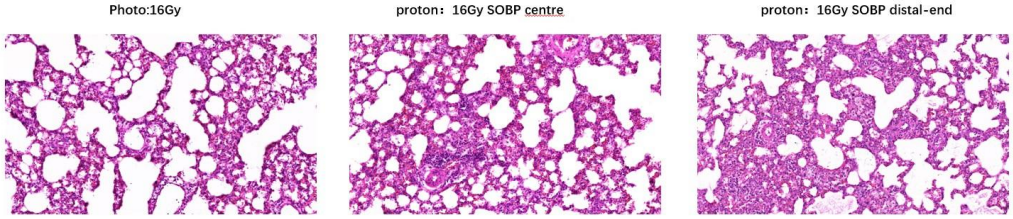
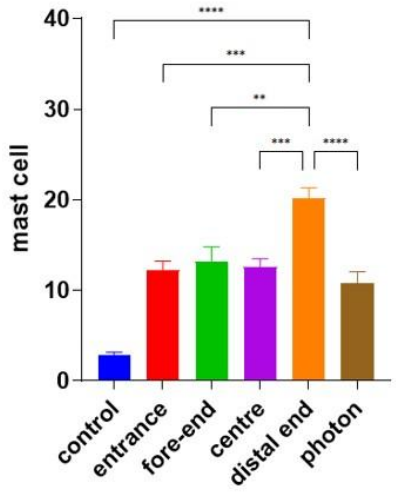


Photo:16Gy
proton：16Gy SOBP centre
proton：16Gy SOBP distal-end

16Gy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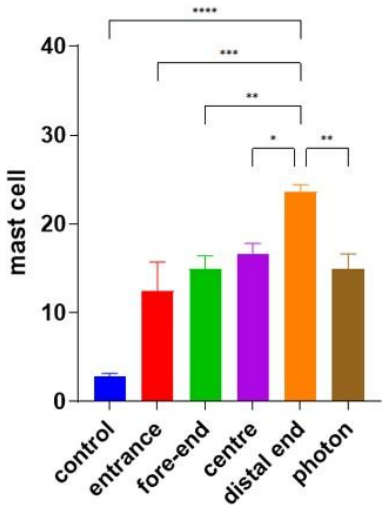
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