Dose effects induced by a localized transverse magnetic field of 0.5 T in inhomogeneous medium for MV photon beams

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Purpose:
This purpose of this study is to present a potential technique of using a low-strength localized magnetic field to increase the dose to tumor and to decrease the dose of normal tissue in radiotherapy therapy of lung cancer.

Materials and Methods:
A simple water-air-water phantom was utilized to investigate the dose effect induced by the magnetic field applied to air region. Two permanent magnets with dimensions of 5 × 5 × 5 cm^3 were positioned vertically to incident photon beams. The Gafchromic EBT3 self-developing film was used to measure the dose distributions for 6 and 10 MV photon beams with the field sizes of 1.5 × 1.5 and 3 × 3 cm^2.

Results:
A noticeable distinction of dose enhancement and dose reduction regions between the proximal and distal interfaces was outstandingly observed. The dose on the proximal air region significantly increases with the field sizes due to a large number of scattered electrons prior to entrance in the air region. For the field size of 3 × 3 cm^2, the magnitudes of the maximum and average dose enhancement were 13.9% and 8.5% for 6 MV and 14.6% and 9.4% for 10 MV, respectively. In air region in front of distal interface, the magnitudes of the maximum and average dose reduction were 9.0% and 5.0% for 6 MV and 11.7% and 6.1% for 10 MV, respectively. This is due to the disequilibrium of transient charge particle at the distal end of the magnetic field.

Conclusions:
The low-strength transverse magnetic field within the air region is capable of producing dose enhancement and dose reduction regions along the central axis of the photon beams. This magnetic field induced dose effect could be adjusted by the field size and the energy of photon beam. This magnet technology could be further developed to provide higher dose to the tumor and lower dose to the normal tissue in radiotherapy of lung cancer.

Keywords:
transverse magnetic field, photon beams, inhomogeneous medium, EBT3 film