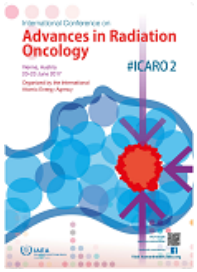

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Comparative study of two techniques for spinalcord irradiation with 3D conformational planning

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Comparative Study of two techniques for Spinalcord irradiation with 3D conformational planning

Introduction of the study

Craniospinal irradiation (CSI) remains technically challenging because clinical target volume coverage is not a simple matter, that includes whole brain and whole length of the spinal axis and covering meninges.

The traditional position of delivering CSI has been with the patient in the prone position, using lateral opposed fields covering the whole brain and upper cervical spine matched to posterior direct fields covering the caudal extent of the spine.

Conventional treatment of adult spine usually exceeds the maximum field size available in standard linear accelerators and requires two matched spinal fields, typically accomplished with a skin gap between them.

However, the gap or overlap between the fields can yield unacceptable dose heterogeneity and potentially be responsible for compromising the optimum tumor control.

At our centre, we compare the conventional CSI technique using gaps and a modified 4-field technique, which employs column fields with table rotation angle and gantry angle in order to eliminate the divergence between them and allow a closer matching.

Methodology

Our CSI patients were planned using computed tomography (CT) simulation, with the patient in the prone position lying on a Styrofoam plate in order to maintain the head position in the same level of whole spine, minimizing the curvature of the cervical spine and eliminating potential skin folds. The arms are placed down to the body side and the head is supported on a standard headrest besides thermoplastic mask immobilization.

CSI treatment planning is performed using Eclipse treatment planning system (Varian, Palo Alto, CA). Two separate treatment plans were generated for each patient, with the aim of comparing the traditional technique and the 4-field modified technique (see Fig.1).

For both techniques, the 2 opposed cranium field isocenter was positioned toward the patient feet as possible, i.e. using asymmetric collimator jaws with cranial superior border in the maximum size available. The inferior border was set limited by shoulder, including in the cranium fields as much as possible of the cervical spine and avoiding irradiating the mandible, oral cavity and larynx by the exit of spinal field.

Efforts were made to spare the lenses using gantry rotation. We also employed couch rotation to eliminate the divergence in the direction of column fields.

In the traditional technique (Fig. 1(a)), cranium field collimator angle is set zero, once the upper part of column is treated by a half-beam blocked field with isocenter localized in the cranium-spinal junction.

Treatment of bottom part of the column is delivered by a direct field and the amount of overlap caused by the divergence of the upper and lower column fields is eliminated by the imposition of a skin gap so that both fields match in treatment depth.

The cranial fields in the modified technique (Fig. 1(b)), in turn, employs also angle collimator in addition to the gantry and table angle. The purpose is to follow the direction of the superior upper column edge field, whose divergence is in the cephalic direction. In this technique, upper column field isocenter is located 20cm shifted longitudinally in relation to the edge of the cranial field, so that the blocked half of the half-beam field eliminates the divergence in the direction of bottom column field. Finally, the bottom column field is treated with 90º couch rotation, eliminating divergence of bottom field and providing a perfect match without gaps in whole column.

Results

We made qualitative dose distribution evaluation in the axial, coronal and sagittal planes for both techniques.

For adult patients, whose extension column exceeds the maximum size available field on the accelerator, the dose distribution in the modified technique was qualitatively higher by the absence of underdose (before normalization depth) and overdose regions (after normalization depth) in the mediastinum of the patient.
DVH evaluation also indicated a better and more homogeneous coverage of clinical target volume.
Quantitative evaluation through indicators such as cold and hot spots, and homogeneity index (following the description of ICRU83) revealed that both techniques are comparable.

Conclusion
In contrast to traditional technique used in spinalcord irradiation, the modified technique previously described has the ability to eliminate the use of undesirable gaps between the fields, so that the whole clinical target can receive more homogeneous dose without compromising tumor control.
The major difference between them is that the modified 4-field technique requires couch rotation to treat column fields, and it is simple to plan and easy to incorporate into the workload of radiotherapy department.

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