DEVELOPMENT, TESTING AND CLINICAL IMPLEMENTATION OF A TREATMENT PLANNING SYSTEM FOR NEUTRON CAPTURE THERAPY

A. Rezaei[1]

[1]Department of Nuclear Physics, Royal Institute of Technology, Stockholm, Sweden

ABSTRACT

A new application will be developed for neutron capture therapy (NCT) which can be used for a combination of radiation treatments such as gadolinium NCT, boron NCT, and other modalities with the aim of optimization of treatment planning parameters such as speed and accuracy both in calculation and identification of the clinical target with help of image sets obtained by various techniques.

The system will be installed and used for routine patient treatment in Studsvik after been benchmarked by comparison with current treatment plans and verified with standard phantom measurements.

Introduction

New applications of NCT such as gadolinium NCT, a possible combination of boron neutron capture therapy (BNCT) with other radiation treatment modalities, and the routine use of several imaging techniques for identifying the clinical target volume (CTV) will require a radiation treatment planning system more general than those developed for BNCT alone (Nigg 2003). The imaging module of such a system should be able to combine images obtained by various techniques and facilitate creation of a three-dimensional model of patient anatomy. It should also allow displaying on the images the distribution of various dose components from different treatment modalities separately or combined. The computational module should produce those dose distributions in a reasonably short time, i.e. less than 15 min.

Methods and Materials

The treatment planning system will consist of four modules:

- Image module will allow export images from different imaging and their combination to facilitate the definition of the patient anatomy and the CTV as well as representation of dose distributions.
- Calculation module will calculate and combine radiation doses from different treatment modalities. The standard Monte Carlo calculation software MCNP (ref) will be used as the main calculation engine.
- Treatment plan report module will create a report containing: data regarding patient positioning, dose distributions including dose volume histograms, and final treatment data.
- An interface between aforementioned modules will create a three-dimensional model of patient anatomy and transfer data the data adjusting their format accordingly.

The system will be benchmarked by comparison of the obtained results with those obtained with the current BNCT treatment planning software SERA (Nigg et al. 1997). Further verification will be done by comparison of the calculated and measured dose and neutron flux distributions in a standard phantom. Measurement will be carried out using ionization chambers and foil activation techniques (Munck af Roseschöld et al. 2003).

Final, tested and verified version of the software will be installed on the treatment planning computers at the Studsvik NCT facility to be used for routine patient treatment.

References

Munck of Rosenschöld PM, Giusti V, Ceberg CP, Capala J, Sköld K, Persson BRR *Reference dosimetry at the neutron capture facility at Studsvik.* Med. Phys. 2003 in press.

Nigg DW, Wheeler FJ, Wessol DE, Capala J, Chadha Computational dosimetry and treatment planning for boron neutron capture therapy of Glioblastoma multiforme. J. Neuro-Oncol. 33:93-104, 1997.

Nigg DW Computational Dosimetry and treatment planning considerations for neutron capture therapy. J. Neuro.Oncol. 62:75-86, 2003.