A parameter study to determine the optimal source neutron energy in boron neutron capture therapy of brain tumours

V A Nievaart1,2, R L Moss2, J I Kloosterman1, T H J J van der Hagen1 and H van Dam1

1 Reactor Physics Department, Delft University of Technology, Mekelweg 15, 2629JB Delft, The Netherlands
2 Joint Research Centre of the European Commission, Postbus 2, 1755ZG Petten, The Netherlands

E-mail: victor.nievaart@jrc.nl

Received 3 February 2004
Published 3 September 2004
Online at stacks.iop.org/PMB/49/4277
doi:10.1088/0031-9155/49/18/006

Abstract

The values of the parameters used in boron neutron capture therapy (BNCT) to calculate a given dose to human tissue vary with patients due to different physical, biological and/or medical circumstances. Parameters include the tissue dimensions, the 10B concentration and the relative biological effectiveness (RBE) factors for the different dose components associated with BNCT. Because there is still no worldwide agreement on RBE values, more often than not, average values for these parameters are used. It turns out that the RBE-problem can be circumvented by taking into account all imaginable parameter values. Approaching this quest from another angle: the outcome will also provide the parameters (and values) which influence the optimal source neutron energy. For brain tumours it turns out that the 10B concentration, the RBE factors for 10B as well as fast neutrons, together with the dose limit set for healthy tissue, affect the optimal BNCT source neutron energy. By using source neutrons of a few keV together with neutrons of a few eV, it ensures that, under all imaginable circumstances, a maximum of alpha (and lithium) particles can be delivered in the tumour.

1. Introduction

Boron neutron capture therapy (BNCT) is a promising treatment for various types of cancer. Basically, BNCT treatment consists of two parts: firstly the tumour is loaded with the isotope boron-10 (10B) and secondly the tumour is irradiated with thermal neutrons. When a thermal