

SAUERWEIN-1: In search of a standard for reporting BNCT

W. Sauerwein¹, K. Ono², D. Nigg³, P. Munck af Rosenschöld⁴, F. Stecher- Rasmussen⁵,
A. Wittig⁶, A. Matsumura⁷, S. Green⁸ for the RENOVATE Consortium

¹Deutsche Gesellschaft für Bor- Neutroneneinfang-therapie DGBNCT e.V., Essen, Germany; ²Osaka Medical College, Osaka, Japan; ³Idaho National Laboratory (INL), Idaho Falls, USA; ⁴Rigshospitalet, Copenhagen, Denmark; ⁵NCT Physics, Alkmaar, The Netherlands; ⁶University Hospital Jena, Jena, Germany; ⁷Tsukuba University, Tsukuba, Japan; ⁸University Hospital Birmingham, Birmingham, United Kingdom

BNCT requires the cooperation of many different disciplines and sub-disciplines, which often have developed their own terminology. It is necessary to find common language rules in some fundamental areas, but also to coordinate framework conditions. Terminology rules need to be defined and common strategies have to be developed.

A crucial concern is the prescribing and reporting of BNCT, especially if the applied dose is to be reported. The dose concept in BNCT is complex and depending on factors that cannot be measured at both the macroscopic and microscopic level. For prescribing it is necessary to work with models to construct a dosimetry framework; and the approach adopted might be different from one center to another. If only the calculated results of such models / frameworks are being reported, they can only be understood and interpreted if the underlying calculation model is also known. However, so far there is no agreement on a model to be generally used. Such a limitation of the authority of the responsible physician might also be dangerous, since he has made his own experiences with his own model. Nevertheless, it is mandatory to find a terminology and a strategy on the one hand to transfer knowledge and on the other to guarantee the safety of the patients.

The absorbed dose as a macroscopic quantity is the basic parameter for prescribing, recording and reporting a procedure in conventional radiotherapy. In this approach the microscopic dose distribution of short-range high-LET particles is averaged over macroscopic volumes. In BNCT, non-stochastic “single hit effects” have to be taken into account and therefore the absorbed dose concept is not suitable to predict expected effects and hence not a good solution for reporting. Furthermore, in BNCT several dose components with different biological impact have to be considered. In the past, it was suggested to report the different dose components separately leading to a complex system of numbers, difficult to handle and therefore not very much appreciated [1].

A standardized terminology has to be mathematically correct and in agreement with international rules for terms and their units (Système International d’Unités, SI). The terms used have to be unequivocal, as short as possible and indicating the most important feature of a quantity. From a clinician’s point of view, the numbers reported should allow prediction of a clinical outcome.

One way to overcome the difficulties and find a solution acceptable to all could be to report not individual dose components or other results of calculations, but the input parameters used to perform these calculations. The most important measurable factors are Φ (the thermal neutron fluence integrated over the irradiation time T) and with concentration of ^{10}B in blood. We therefore suggest a reporting system based on these parameters as long as no others are available.

By doing this, another weak parameter has to be considered: the measurement of the boron concentration in blood. The accuracy of different measurement techniques is variable, and the relationship to the dose to a tissue is highly uncertain. The first issue can be addressed through quality control programmes while the second will remain a problem until our dependence on measurements in blood is removed. Centers that treat patients with BNCT should establish quality controls for these measurements, for example by interlaboratory comparisons of measurements among themselves.

1. RASSOW J., SAUERWEIN W. (2012): Prescribing, recording and reporting of BNCT. In: Sauerwein et al. (eds) Neutron Capture Therapy. Principles and Applications. Springer Publishers. ISBN 978-3-642-31333-2, p. 277-285