Bestrahlung von primären Gewebezellen mit Neutronen für das Europäische Forschungsprojekt ANDANTE

Bei der Strahlentherapie mit Protonen oder Schwerionen, aber auch bei Bestrahlungen mit Gammastrahlung hoher Energie, kann es im gesunden Gewebe außerhalb vom Tumorvolumen zu zusätzlicher Strahlendosis durch Neutronen kommen. Das im 7. Rahmenprogramm der EU geförderte Forschungsprojekt ANDANTE untersucht das Krebsrisiko nach Exposition mit niedrigen Dosen von Neutronen. Die Bestrahlungen von primären Gewebezellen mit Neutronen mit verschiedenen Energien werden an der PTB Ion Accelerator Facility (PIAF) durchgeführt.

For the irradiation of tumours, proton and light ion beams offer a higher effectiveness and better dose distribution compared to conventional photon radiation therapy. This results in sparing of the surrounding healthy tissues and sensitive organs. However, the interactions of the particles with the irradiation system (mainly in the case of passive modulation systems) and the body tissue can lead to the production of neutrons and additional small doses to healthy tissue. The risk of second cancers many years after proton therapy and intensity-modulated radiation therapy (IMRT) has been discussed for example by E.J. Hall 2006 [1]. This risk is of greatest concern for the treatment of children. The risk of cancer from exposure to neutrons is not well known, and may be strongly dependent on the neutron energy [2]. By determining the quantity *relative biological effectiveness* (RBE) of neutrons compared to the risk from photons, it is possible to estimate the risk from neutrons from the better-known risk from photons.

The goal of the European research project ANDANTE is the "*Multidisciplinary evaluation of the cancer risk from neutrons relative to photons using stem cells and the analysis of second malignant neoplasms following paediatric radiation therapy".*

The project brings together research groups from the universities of Pavia(I), Goteburg(Se), Groningen(Nl), Rostock(D) and Loma Linda(USA) , as well as ESTRO(EU), PSI(Ch) and the BfS(D).

http://www.andanteproject.eu/

The major task is a better determination of the RBE of neutrons compared to the risk from photons at energies and dose-rates relevant to proton therapy. One of the novel and challenging approaches are measurements of relevant radiation effects in stem cells from thyroid, salvary gland and breast tissue. In order to achieve better risk estimates, these RBE values will be combined with epidemiological studies of relative incidence rates of second cancers of the thyroid, salivary gland, and breast following paediatric radiotherapy.

For the irradiation of cells in neutron fields of various energies and intensities, the PTB Ion Accelerator Facility (PIAF) was chosen. Its unique combination of a 3.75 MeV Van de Graaff accelerator and an energy-variable, compact cyclotron provides well characterised (ISO 8592) mono-energetic neutron fields with energies between 24 keV to 19 MeV. In addition, a collimated high-intensity neutron beam with a broad energy distribution is provided for cell irradiation at low and high dose rates of 3 mGy per minute and 100 mGy per minute, respectively. The mean neutron energy is these cases is about 5 MeV. The experiments will continue in 2015 and results are expected towards the end of the ANDANTE project in December 2015.

References

[1] E.J. Hall, Intensity-modulated radiation therapy, protons, and the risk of second cancers. Int J Radiat Oncol Biol Phys 65 (2006) 1–7

[2] International Commission on Radiological Protection: 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Ann. ICRP 37 (2-4) (Oxford Pergamon Press) (2007)

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