Biological effects of neutron mixed-beam irradiation for boron neutron capture therapy on cell survival and DNA double-strand breaks in cultured colon cancer cells

Kamila Maliszewska-Olejniczak
National Centre for Nuclear Research, Poland
Email: kamila.maliszewska-olejniczak@ncbj.gov.pl

Agnieszka Dróżdż
National Centre for Nuclear Research, Poland

Martyna Waluś
National Centre for Nuclear Research, Poland

Michał Dorosz
National Centre for Nuclear Research, Poland

Maciej Wiliński
National Centre for Nuclear Research, Poland

Szymon Domański
National Centre for Nuclear Research, Poland

Łukasz Bartosik
National Centre for Nuclear Research, Poland

Michał Gryziński
National Centre for Nuclear Research, Poland

The main aim of our research is evaluation of biological effects after boron neutron capture therapy (BNCT) on cellular processes and DNA damage in human cancer cell lines at the MARIA research reactor in Poland. The project will involve description of DNA damage and repair pathways after induction by boron neutron capture therapy in aggressive tumours with no effective treatment using in vitro model. Mechanisms of DNA repair and damage activated by BNCT have not been fully determined. Currently, the therapy is experiencing a renaissance, as it has occurred that BNCT therapy is dedicated to the treatment of aggressive tumours that do not respond to conventional therapies and have a fatal result in short time after diagnosis such as lung and skin cancers, malignant gliomas and recurrent head and neck cancers. Evaluation of the biological effects of neutron mixed-beam used for BNCT is crucial in order to obtain the reduction of side effects and effectiveness of the therapy.

The purpose of our research is to broaden the knowledge of radiobiological mechanisms involved in repair mechanisms activated as a tumour response to the mixed beam in BNCT. In our study, we examine cell viability and DNA double-strand breaks (DNA-DSBs) in human colon cancer cells (HCT 116) and healthy colon epithelial cells following neutron mixed-beam irradiation for BNCT. Firstly, we divided our research in four groups: 1) no radiation; 2) the gamma-ray irradiation group (control) 3) the neutron radiation group and 4) the neutron mixed-beam group. Next step will be analysis of cell viability after three types of irradiation. We plan to broaden our research on immunofluorescent analysis of repair mechanisms using a double-strand marker γH2AX for analysis of foci number and of 53BP1 foci, also indicator of DNA-DSBs. In future, we will analyze on molecular level expression of genes encoding proteins activated during damage and repair mechanisms.

Our planned in vitro experiments will contribute to a better understanding of mechanisms of DNA repair and damage after BNCT therapy convincing for more effective treatment.