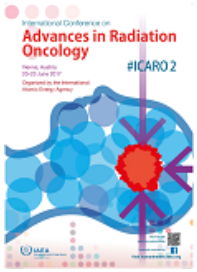

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Specificity of fast neutron therapy. Is it necessary to restore projects in fast neutron irradiation

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Neutrons were first among elementary particles with high linear energy transfer coefficient, which were used to treat tumors.
Neutrons high efficiency was based on high value linear energy transfer, independancy of irradiation effect from mitotic cycle, degree of cell saturation by oxygen, etc.
After neutron irradiation even by small doses damaged cells actually cannot be restored, DNA breaks are not reconstructed.
There was a belief that neutron action against cancer is similar to photons,but it is not.
In incorrect approach complications after neutron irradiation were severe and doctors decided not to risk it and stay on solid grounds of radiotherapy and old standards in radiobiology.
Fast neutron interaction with target have pecularities including the formation of recoil protons, which actually disappear in point of formation, resonance absorption of neutrons by nuclei of elements making up environment,emergence of new particles, for example alpha - particles, which in turn, moving through matter and its structural components not only create a cascade of ions in its path, but also breas in intermolecular bonds. Stage appearance of free radicals is the last factor in cells destroying. Free radicals only complete that was began by neutrons. For instance, after the passage of alpha particles through organic substance only “firewood”remains behind it - scraps of non-renewable structures.
Penetration of neutron into matter launches sequence of interactions that lead to cell death. Each step is marked by specificity of interaction and own lifetime. First it is neutron absorption or excitation of nuclei, neutron energy changes, possible occurrence of alpha particle, disintegration, or the formation of gamma quanta absorbed by electrons, etc. Ionization associated with processes begins at last phase. Protons are formed permanently on the way of neutron trip. They are absorbed in the very place of origin.
Therapeutic results of neutron irradiation were obtained in head and neck tumors, salivary gland recurrences, prostate adenocqarcinomas, sarcomas, slowly progressing tumors. Experiment showed that neutron irradiation effect has small dependance on number of fractions.
Scientists tried to describe neutron action on organic matter in language of conventional radiobiology.
But model cannot go beyond artificial boundaries even after attempt to modify parameters.
In neutron irradiation familiar radiobiological models cannot be applied.
Revived searches in these fields could be of help in understanding and improving existing models in radiobiology.
Threshold dose in irradiation by neutrons exists, below which tumor response to radiation not changes and remains high at low doses without late complications dealing with irradiation.
DNA brakes after neutron irradiation cannot be restored even after small doses..
Physicists should solve complex problems, without which exposure is not possible: stabilization of deuteron beam, measurements of angular distribution of neutron beam, creating of special multileaf collimator, diagnostic imaging transmission to planning system, dosimetry of components in flow - neutrons, protons, gamma photons etc. at different depths. Creating quality assurance system.
For treatment beam typically deuteron beams are used with energy of about 14 MeV, bombarding Be target. Peak of neutron energy amounted 5.6 MeV.
According data obtained in experiments highest radiobiological efficiency corresponds neutron energy 5.6 MeV. Why?

It was shown in our calculations and experiment that basic destroying processes occuring during neutron irradiation are resonant processes in nuclei. Especially for nitrogen, for other elements resonance levels locte in other energy intervals. Times of these processes are small - about 10^(-23) seconds. Time in which atomic nuclei lives, feel and breathe.
Dose value appears in latest orders of time. Absorbed dose is a very common quantity; dose is made up of many previous events with different history and results and what is the most important –with different radiobiological effectiveness.
In Kiev in 80's Project was carried out studying effect of neutron beams on living tissue. Despite the basic findings, the project was not completed.
Aim of report is to convince physicists to restore study of fast neutrons irradiation on living cells. It is necessary to reconsider the linear-quadratic model, restrict its application or create a new one in the case of irradiation by elementary particles. By variation of few parameters shaping accredited model, it is impossible to estimate effect of neutrons. Can occur that value of energy absorbed per unit volume (dose) will be not a crucial parameter leading to cell death or cell survival.

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