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Neutrons in Medicine

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Neutrons were applied in the study of medicine very quickly. A mere six years after discovery, neutrons were first used for cancer therapy. Interest in neutron radiotherapy waxed and waned over the following decades. The last use of neutron-only therapy, treating cancer of the salivary glands, ceased several years ago.
There is, however, still interest in boron neutron capture therapy (BNCT) for certain brain tumours that have no good current treatment options. Boron neutron capture synovectomy (BNCS) for horribly disabling arthritis has also been explored. The idea behind BNCT is that if tumours can be loaded with boron, then reactions of that boron with neutrons result in heavy charged particles recoiling in the cell. This would be highly effective in killing cells. Ideally, there can be a large difference in the radiation dose delivered to healthy tissue and tumour because only the tumour would contain boron. Healthy tissue would be spared. However, the chemistry to be able to load enough boron into the tumour to make the treatment successful has been a challenge.
Of course, neutron activation has created a variety of radioisotopes that are used for both imaging and treatment of disease. 99mTc is still commonly used in imaging, and for decades was produced in Chalk River, Canada. 125I is used to treat prostate cancers and at any point in time a large percentage of the world's supply of this agent is produced at McMaster University in Hamilton, Ontario.
Finally, in vivo neutron activation analysis (IVNAA) has been used since the 1960s to study levels of both essential and toxic elements in the body. IVNAA helped physicians understand the challenges of parental neutron therapy for cancer patients and was the first technique to show bone loss in anorexia nervosa patients. IVNAA studies also led to legislative changes in air levels of toxins such as cadmium. Canada is still at the forefront of this area of research: studies measuring people have taken place over the last decade at McMaster. The first in vivo studies of fluorine exposure showed that exposure in Ontario is low, and that the single biggest factor in exposure is tea drinking. Recent studies have been made of aluminum levels in Northern Ontario miners exposed to McIntyre power. Early data shows inhaling powder resulted in uptake of aluminum into the body and the aluminum has persisted in the bones of miners for years or decades.

Primary author: MCNEILL, Fiona (McMaster University)

Presenter: MCNEILL, Fiona (McMaster University)

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