Breakthrough gives hope for new imaging isotope source

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A University of Alberta team has made an important breakthrough in the race to find a viable replacement for supply of technetium-99m, an important isotope produced by Canada's Chalk River reactor.

Their research has proven that this important medical isotope, used in nuclear medicine imaging for about 250,000 Alberta patients each year, can be created in a device known as a cyclotron—and is as safe to use and provides as reliable an image as reactor-based isotopes. Their results are a promising first step in responding to an impending global need for an alternative supply.

Sandy McEwan, a researcher with the University of Alberta and medical director with Alberta Health Services' Cross Cancer Institute in Edmonton, says that the team has produced viable quantities of high-quality technetium-99m using a 19-mega-electron-volt cyclotron, a circular particle accelerator that propels charged particles using a constant magnetic field. McEwan recently presented results from the first human clinical trials at the annual conference of the Society for Nuclear Medicine in Miami.

McEwan notes that the clinical trials were performed to Good Clinical Practice (GCP) standards, a set of international quality standards set by the International Conference on Harmonization. The GCP standards serve to protect the human rights of subjects in clinical trials, and ensure the safety and efficacy of the newly developed compounds. He says this is the first time that this type of study has ever been performed to GCP.

"We have taken the technetium made on the cyclotron and shown that it behaves exactly the same as the technetium we get from the reactor," he said. "We've shown that the quality of the technetium and the quality of the images is the exactly the same."

This process is a significant step in the search for a viable non-reactor-based solution to replacing the medical isotope stream currently produced by the aging Chalk River facility, where 40 per cent of the world's medical radioisotope supply is generated. The balance of the world's supply of these imaging isotopes comes from aging reactors in South Africa, France, Belgium and the Netherlands, installations that will soon need extensive upgrading or replacement. The U of A researchers believe that this is the first time that technetium has been successfully created in commercially viable quantities using a cyclotron.

"The reactor supply chain is complex, and these complexities contributed to the difficulties associated with the shutdown of Chalk River. We hope that the local supply model of the cyclotron will avoid these problems of the future."

Currently, technetium-99m is used in 85 per cent of all nuclear medicine procedures globally every year. In the United States, roughly 20 million imaging procedures are performed each year. The procedure is used to diagnose patients with cancer, cardiac illness, neurological diseases and other diseases. It can be critical in identifying the presence or absence of disease, determining best treatment options and identifying recurrence or progression of the disease.

"Two million scans are performed in Canada every year with technetium-99m. We believe that we now have the potential to continue supplying patients with the tests they need without constructing new nuclear reactors," said McEwan. "This means there is now a potentially valid alternative to reactor-produced medical isotopes."

There is also an important financial aspect to this research. McEwan notes that under the current method, production costs would climb because of costly retrofitting or replacement of the reactors around the world. He also cautions that, although this discovery is an important step in replacing the supply chain of medical imaging isotopes through a non-reactor-based process, further testing is still needed to determine the supply cost of technetium. Further testing is also required to confirm that suitable quantities can be produced via cyclotron to serve the population. However, given the results of the clinical trials, he is optimistic that the team's research is an important first step.

"I think that if it's an 800-metre race, we've hit the 300-metre point," said McEwan. "We've established a very clear plan. Following that plan, we have achieved the first two or three goals in that process. We're confident that the next two goals will be easy."

Provided by University of Alberta

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