Researchers produce potential true theranostic agent for cancer

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The therapeutic radioisotope scandium-47 has been produced for the first time in Australia by the Biosciences radioisotope development team, Dr. Paul Pellegrini, Leena Hogan and Attila Stopic, supported by

Mike Izard and Dr. Ivan Greguric.

Scandium-47 has properties similar to lutetium-177, which is already being used in clinical trials, but with some notable advantages.

"Scandium-47 is a beta-emitting radioisotope useful for targeted cancer therapy. However, unlike lutetium-177, scandium has the potential to be a true theranostic agent.

The decay emissions of scandium-47 are amenable to both targeted cancer therapy and higher quality SPECT imaging than can be achieved using lutetium-177. In addition the PET imaging radioisotopes scandium-43 and scandium-44 can be produced using a cyclotron," said Pellegrini.

The term 'theranostic' describes the use of paired radioactive agents, one for diagnosis, and another chemically similar one to provide therapeutic treatment of a tumor or site of infection.

Usually, the theranostic approach involves diagnosis and therapy using the chemically similar radioisotopes gallium-68 and lutetium-177, respectively.

"While gallium and lutetium are similar, the chemical differences between the metals mean we cannot guarantee equivalent behaviour in the body. Using scandium-based radiopharmaceuticals for both diagnosis and therapy achieves this goal; whether you are talking about scandium-44 for PET imaging or scandium-47 for therapy, the agents are chemically identical. This permits clinicians to better estimate a patient's dose and allows them to safely maximise the administration of the radiotherapeutic agent," said Hogan.

"The other great thing about using radio-scandium is the fact that it

works very well with the macrocyclic molecules currently employed for gallium-68 and lutetium-177. In fact, for the commonly used DOTA bifunctional chelator, scandium has demonstrated better binding stability. This means that a higher amount of the radioisotope will stay incorporated in the radiopharmaceutical, leading to better clinical outcomes," added Pellegrini.

Scandium can also be easily substituted into existing molecular targeting agents for neuroendocrine tumors or prostate cancers, where the theranostic method has already shown great success.

"In the first step, a calcium carbonate target is irradiated in the OPAL multipurpose reactor to yield calcium-47 which decays to the desired radioisotope scandium-47. A chemical separation process is then undertaken and the scandium-47 is isolated for radiotracer and radiopharmaceutical research," said Stopic.

"The production of scandium-47 was only achievable with support from multiple groups within ANSTO, leveraging expertise from Nuclear Operations, Health, Work Health and Safety, Radiation Protection Services, System Safety and Reliability, Maintenance and Engineering and Environmental Monitoring. It has been an impressive achievement by the team to coordinate the many moving parts of this project and we are grateful to all those involved for their professional and reliable support," said Dr. John Bennett, Leader, Biosciences.

The team is now shifting its focus to scale up production of scandium-47 and to develop methods for other therapeutic radioisotopes.

"We have several collaborators and clinicians who are keen to access radiotherapeutic tools for their research so we are working hard to push up production levels and expand our capabilities," says Hogan.