Advances in nuclear medicine: Q&A with Satoshi Minoshima on the use of molecular imaging to diagnose dementia

There is no cure for diseases such as Alzheimer's, but accurate diagnosis is important in order to manage patient care. As the 2014 movie Still Alice made clear to a wider public, when accurate assessment of the stage of the disease lags behind, both the patient and caregivers suffer. Enter molecular imaging, which can provide an accurate assessment of the disease even in the presence of other pathologies that are masking symptoms.

To get an idea of the potential and use of molecular imaging in diagnosing brain disorders, Editor Miklos Gaspar sat down with Professor Satoshi Minoshima, Chair of the Department of Radiology and Imaging Sciences at the University of Utah, USA. He is a radiologist specializing in molecular imaging, and has published over 170 peer-reviewed articles.

Minoshima has served as President of the Brain Imaging Council for the Society of Nuclear Medicine and Molecular Imaging (SNMMI) and is currently the SNMMI Vice President and Chair of the Radiological Society of North America (RSNA) Molecular Imaging Committee. He also heads an IAEA coordinated research project on the use of molecular imaging for the diagnosis of dementia, with a focus on the needs of developing countries.

Q: The use of molecular imaging techniques for cardiac diseases, cancer and neurological disorders is well-known. How can these techniques be used when it comes to diagnosing diseases with dementia, such as Alzheimer's?

A: Molecular brain imaging has advanced significantly during the last few decades. Since the 1990s, positron emission tomography (PET) brain imaging with the radiopharmaceutical flurodeoxyglucose (FDG) and brain perfusion single photon emission computed tomography (SPECT) imaging have been critical tools for clinicians to diagnose various brain disorders such as Alzheimer's disease and other forms of dementia. Even though neurodegenerative diseases cannot currently be cured, they often require different and specific approaches for symptomatic treatments, care planning and guidance for caregivers and family members. This means that more accurate differential diagnosis is essential for better patient care.

More recently, amyloid PET imaging has become available in clinical settings in many countries. This technique detects one of the fundamental pathological processes that is associated with Alzheimer's disease.

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It is specific to abnormal protein deposits in Alzheimer's disease and provides a more detailed picture than the more general radiotracers used in the past. Its clinical value is currently being evaluated through multi-centre trials.

Other new PET imaging technologies, such as tau imaging and inflammation imaging, are being evaluated by the research community. All these efforts are not only aimed at helping day-to-day patient care, but also provide critical knowledge of the disease process itself that will help improve therapeutic developments.

Q: Alzheimer's and other dementia have obvious symptoms. What additional benefit can molecular imaging bring in their diagnosis and why is it necessary?

A: Not all patients require the use of molecular imaging for their diagnosis. In fact, 85%-90% of patients display common and typical symptoms, allowing clinicians to diagnose them accurately on that basis. Molecular imaging is helpful in complex cases, or when other conditions are also present and it is not immediately clear to which disease the symptoms can be attributed to. Stroke is a common comorbidity. Stroke can influence the brain function on its own, and some of its symptoms can be similar to those caused by neurodegenerative dementia. Molecular imaging allows doctors to distinguish between them.

Q: Two-thirds of the 44 million people suffering from dementia worldwide are in developing countries. These techniques are expensive. Is it realistic for these patients to get access to these diagnostic tools?

A: Although FDG PET and/or brain perfusion SPECT are quite prevalent in many developing countries, molecular imaging is an expensive technology that cannot be applied to all patients suffering from dementia worldwide. The same cost issue does exist in developed countries as well.

For molecular brain imaging to be used most effectively, several professional societies have produced 'appropriate use criteria' for brain PET imaging. By using such criteria, we should be able to use this technology only when it has the biggest impact on patient care and so save precious resources. Also, less expensive tests are being developed that can be applied more widely without requiring expensive imaging. In the future, the use of such technologies should obviate the routine use of more expensive and complex imaging technologies and hopefully guide more effective use of imaging for specific clinical indications and patients with complex clinical presentations.

Q: Could you tell us about the IAEA research projects that you are heading?

A: Dementia, such as Alzheimer's disease, can occur with co-existing conditions such as vascular disease, diabetes and HIV infection. These comorbidities are frequent in developing countries. In order to aid future diagnostic efforts in patients whose conditions are not yet established, there needs to be more analysis of brain imaging findings of patients known to have these comorbidities. Collecting and analyzing such diagnostic image findings is the goal of the IAEA project.

Q: How can the IAEA — including through this research project — help in increasing access to molecular imaging in this field?

A: There are many things the IAEA can help with. Increasing awareness of the technology and educating physicians and patients about how such technology can help clinical management of dementia are key. The IAEA can help make such technology more widely available in developing countries by assessing resources, providing support, and advocating support in Member States.