Australian Government

ANSTO
Science. Ingenuity. Sustainability.

Preclinical Imaging

Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT) imaging techniques help to discern biological processes at the cellular and molecular levels within an individual over time. PET and SPECT imaging can provide novel insights on fundamental biological principles, disease processes, and monitoring the effects of new therapies by imaging radioisotope distribution within a specimen.

ANSTO Biosciences operates multimodality preclinical imaging systems designed for small animal (rat or mouse) applications: PET/CT systems and a SPECT/CT system. Each of these can be applied on their own or in combination with the other modalities, the most common being PET/CT, SPECT/CT, CT, or PET/SPECT/CT.

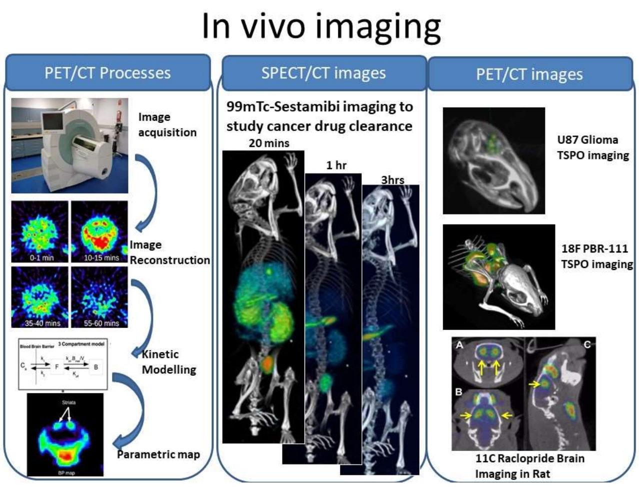

Figure 1: Left - Shows PET/CT study full pipeline right from imaging acquisition, image reconstruction to kinetic modelling to the parametric map. Mid - An example of SPECT/CT image of 99mTc-sestamibi drug clearance study in mouse for 20mins to 3hrs time points. Right - Examples of PET/CT images in various preclinical models.

PET/CT Imaging

Preclinical PET is increasingly used to assess efficacy of therapeutic interventions and to validate the application of both current and novel radiotracers for translation to humans. It is highly sensitive technique and provides true 4D dynamic imaging (space and time). Image acquisition parameters can be tailored to visualize tracer distribution at a specific time point and in variable time frames to capture a particular process. PET imaging is similar to SPECT imaging in that it images radioisotope distribution within a specimen in a minimally invasive way, however it is significantly more sensitive and presents fewer artifacts so less radioactivity is required for an acceptable image. The main strength of PET over SPECT imaging is that it offers quantifiable measures of the fundamental biological process.

SPECT/CT Imaging

SPECT/CT is versatile functional imaging technique with great translational potential in biomedical research and drug development. SPECT cameras image radioisotope distribution in a subject with minimal intervention. SPECT achieves this by rotating one or more detector heads 360º around a subject in order to detect the photon (gamma ray) emission from an injected radioisotope and determine its location in 3D space. The movement of detectors around the subject means there is a minimal rotation time to get a 3D snapshot of the emission profile of the radiotracer. SPECT/CT is able to detect the biological changes in healthy or diseased model longitudinally in same animal cohorts, which eliminates the need for studying large animal groups.

Multimodal PET/SPECT/CT Imaging

The combination of PET/SPECT/CT scanning in the same subject enables the sequential scanning of multiple radiotracers suitable for both modalities. This enables the investigation of multiple physiological and molecular functions within a single subject at a single (or very close) time point and under identical conditions and co-registered in exactly the same orientation regardless of the SPECT or PET technology required to image the radiotracer.

+61 2 9717 3111 enquiries@ansto.gov.au www.ansto.gov.au

Australian Government

ANSTO

Science. Ingenuity. Sustainability.

Preclinical Imaging

Structural Imaging: Micro CT

X-ray Computed Tomography (CT) imaging involves acquiring a number of X-ray scans (projections) at different angles around the subject which can be combined and reconstructed into a high resolution 3D volume. This can then be viewed and manipulated as virtual slices using a variety of image analysis software. Micro CT provides structural information on the subject based on density variations in the subject. This is primarily used for scatter and attenuation correction of SPECT and PET data, however the CT image also helps to generate more accurate regions of interest for the co-registered SPECT and/or PET.

Image Processing and Quantification

A key aspect of the PET capabilities within ANSTO Biosciences is our expertise in advanced image reconstruction methods optimized for dynamic PET. These methods reduce the effect of a number of well-known PET imaging artefacts (such as partial volume effect, spillover and positron range) and enable the extraction of largely noise-free 4D activity distributions in both simulation and experimental studies.

Experimental imaging studies on living organisms can offer only limited repeatability due to the intrinsic variability between individuals. In such cases it may be preferable to perform high quality simulation-based studies as a precursor to an experimental study.

Simulation-based studies can optimize the parameters of the study (such as dosage, parameters of the scanning protocol etc.) and determine the expected range of signal quality. This reduces the uncertainties involved in experiments and minimizes the time and resources required for the successful completion of the experimental study. ANSTO Biosciences' capabilities include expertise in the simulation of dynamic PET studies, conducted on a Monte-Carlo simulation platform developed in-house by ANSTO scientists, with highly realistic and experimentally validated models of PET scanners including the Ecat Exact HR+ human scanner, the R4 and P4 preclinical scanners and for ANSTO Biosciences' preclinical PET scanners.

For further information about

- PET/CT Imaging
- SPECT/CT Imaging
- Multimodal PET/SPECT/CT Imaging

Please contact Arvind Parmar
Phone +61 2 9717 9602
arvind.parmar@ansto.gov.au

For further information about

- Structural Imaging: Micro CT and
- Image Processing and Quantification

Please contact David Zahra
Phone +61 2 9717 9893
david.zahra@ansto.gov.au

When submitting a proposal in the ANSTO Research Portal, additional capabilities must be selected for *in vivo* imaging e.g. radioisotope production, radiotracer production, animal house and holding facilities, imaging quantification etc. To help our expert team facilitate your request, please discuss your requirements with your ANSTO contact before submitting your proposal.

The National Research Cyclotron Facility provides fluorine-18 and carbon-11 for research. This 18 MeV cyclotron is part of the National Imaging Facility (NIF) and is funded via the National Collaborative Research Infrastructure Strategy (NCRIS). If you access these isotopes, then the support of NIF must be acknowledged in all outputs e.g. conference posters, oral presentations, journal articles etc. Please go to https://anif.org.au/news/acknowledging-nif/ for details.

National Imaging Facility

NCRIS National Research Infrastructure for Australia An Australian Government Initiative