IMAGING AND DIAGNOSIS

Using Imaging to Fight the World's Biggest Killers

Modern medicine has developed techniques and cures for many of humanity's ailments, treatments that often require early detection or frequent observations. Some of the most revolutionary advances in improving diagnosis and observation of diseases have been through the use of imaging. Radioisotope imaging techniques like SPECT, PET/CT and conventional imaging such as MRI and CT are instrumental in fighting modern diseases like cardiovascular disease and cancer, and the IAEA plays an important role in helping its Member States acquire the skills and resources for implementing these technologies.

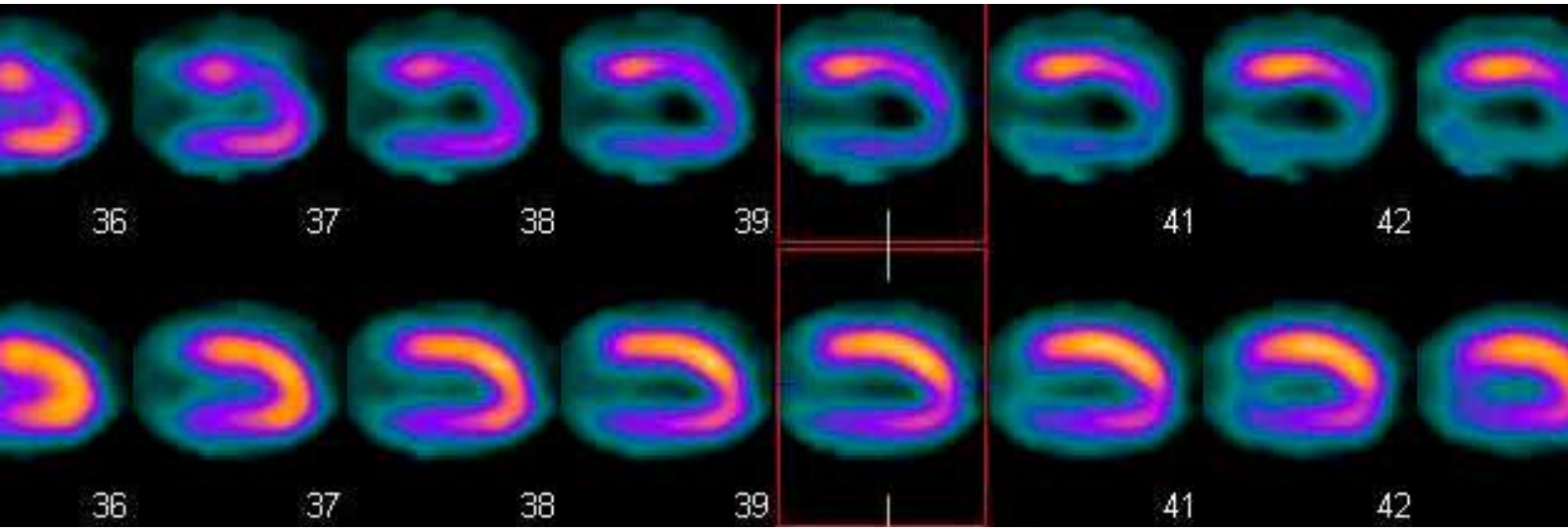
Looking at Hearts

Cardiovascular disease is the single biggest cause of death in the world. The World Health Organization has estimated that as much as 30% of all deaths in the world are due to cardiovascular disease, equating to 17.3 million deaths. Over 80% of these deaths occur in low and middle income countries, with the highest rates being in Africa and Asia. Some of the best and most precise ways of looking at the heart and evaluating its health is with nuclear imaging techniques. The IAEA works with partner organizations to help its member states train medical practitioners and enhance diagnostic capabilities; technical cooperation projects, coordinated research activities, online and on-site training courses all aim at achieving this goal.

Single photon emission computer tomography, or SPECT, is an imaging technique that generates several image 'slices' of an organ (for example, the heart, as in the photo below) by detection of gamma rays emitted by a radioactive substance given to the patient. In the photo below, a patient underwent a myocardial perfusion imaging (MPI) study during treadmill exercise and at resting condition. The upper row of SPECT images demonstrates diminished blood flow to a large area of the heart during exercise, seen as a decrease in colour intensity in comparison with the set of resting SPECT images, seen immediately below. This is a serious condition which can lead to heart infarction due to clogged arteries by fatty substances, such as cholesterol. Lifestyle choices such as high cholesterol diet, smoking, alcohol consumption and lack of physical activity can increase the chance of a heart infarction.

Curing Cancer

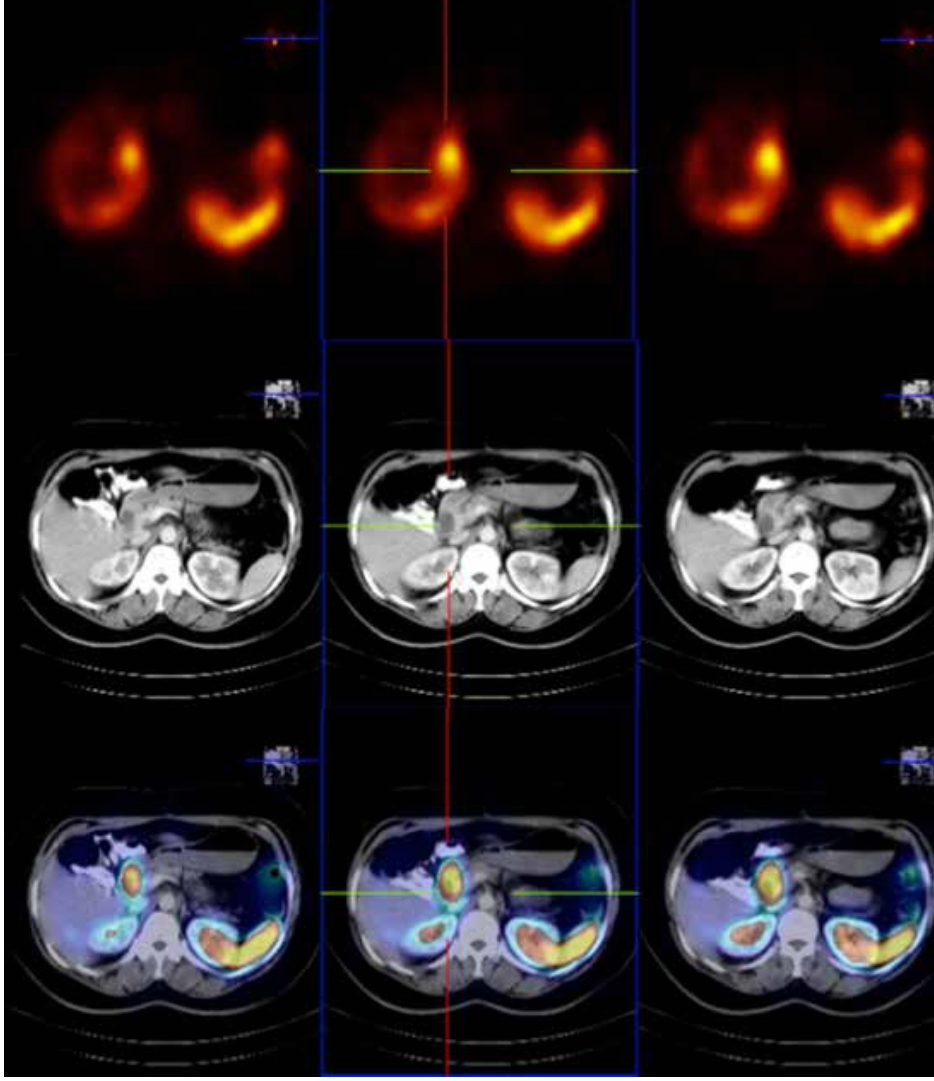
Killing 7.6 million people every year, cancer is a major cause of death worldwide. Cancer has the potential to occur in almost any part of the body and can affect people of all age groups or backgrounds. 70% of cancer deaths occur in low and middle income countries and it is estimated that 30% of cancer deaths could be prevented. The resources and tools the IAEA makes available in helping with cardiovascular diseases also play a key role in the global fight against cancer. IAEA experts help Member



States use nuclear medicine imaging to provide with a comprehensive, safe and complete set of tools and resources to save lives.

Doctors can use software to combine together images from different sources to make a composite image (fusion image) showing what is happening inside a patient. In the figure on the right, the top row of images corresponds to a set of SPECT images, demonstrating a focal area of abnormal increased radiotracer activity close to the midline and deep in the abdomen. However, it is only after obtaining the fusion with a corresponding set of X ray computed tomography (CT) images (middle row), that it is clearly realized the abnormal focal activity in the SPECT images, corresponds to a true lesion immediately adjacent to the small bowel (lower row of images). This additional piece of information not only increases the certainty of the diagnosis but also helps determine the next best course of action. Utilizing multiple imaging techniques medical practitioners are able to better diagnose and cure cancer.

By Michael Madsen, IAEA Division of Public Information



DOSIMETRY* – A SCIENCE THAT HELPS MAKE RADIATION APPLICATIONS SAFE

As the saying goes 'the dose makes the poison' and it is most apt when applied to radiotherapy. The IAEA's dosimetry and medical radiation physics experts work to insure that radiation applied in medicine is safe and effective.

› Radiation is one of medicine's most effective weapons to fight cancer, used in a process called radiotherapy. Doctors use a radiation emitting source to generate a radiation beam that can be precisely targeted to destroy a cancerous growth. Low doses of radiation are ineffective at killing cancer cells, while an overdose damages healthy cells and can cause severe recovery problems for a patient. Precision is essential. Doses that vary outside a strict range pose a risk to a patient's health.

› Dosimetry is the measurement and calculation of radiation dosages.

› The radiation beam is 'calibrated' to make sure that the dosage of radiation delivered through radiotherapy is exact. The IAEA has developed the international Code of Practice for absorbed dose determination, providing control measures that guarantee correct and safe operation of medical radiation treatment machines.

› A variety of instruments are used for absorbed dose measurements, all of which rely on detecting the physical and chemical changes caused by radiation.

› The IAEA's Dosimetry Laboratory is a Secondary Standards Laboratory, whose instruments are directly calibrated with those of the International Bureau of Weights and Measures (BIPM) and Primary Standard Dosimetry Laboratories, and in turn is used to calibrate instruments for its Member States.

› Dosimetry is not only required in radiotherapy cancer treatment, but also in clinical diagnostic radiology, radiation protection of people and the environment, and in industrial applications like food irradiation and sterilization.

By Michael Madsen, IAEA Division of Public Information

*www-naweb.iaea.org/nahu/DMRP/faq/index.html