

Physical aspects of nuclear medicine imaging

Dea Dundara Debeljuh

Department for Medical Physics and Radiation Protection, Clinical Hospital Centre Rijeka

Supervisor: Assistant professor Slaven Jurković, PhD

Co-supervisor: Roberta Matheoud, PhD

Abstract

In nuclear medicine radiopharmaceuticals are used for imaging and therapy. The purpose of imaging is diagnosis and staging of particular diseases, and also monitoring the response to the therapy process. Radiopharmaceuticals are various type of pharmaceuticals labelled with short half-life radionuclides. They are administered to patient in order to produce diagnostic and functional information on organs where radioactivity is cumulated. Nuclear medicine is generally based on detection of gamma rays emitted by radionuclides distributed in the body. It can be performed by imaging device known as the gamma or Angers camera. Gamma rays detection in gamma cameras is executed by scintillation counters with high density scintillating crystals coupled to a large number of photomultiplier tubes. In order to create an image of the distribution of the radiopharmaceutical, the measured distribution of locations where gamma rays interacted with the detector must be converted to a 2D image for each detector position. Therefore, it is essential to determine the energy deposited in the crystal and ascertain whether that energy match a prescribed range of desirable energies related to the radionuclides used. Advanced versions of gamma cameras are various Single Photon Emission Computed Tomography devices. Those devices enable 3D images by reconstructing data acquired from measurements for numerous detector positions.

In nuclear medicine the quality of the diagnostic information is directly related to the administered activity, and thus to the absorbed dose delivered to the patient. In order to minimize absorbed dose from radiopharmaceuticals and to achieve optimal image quality there are strict requirements on the measuring performance of the nuclear medicine device and also necessity of the optimization of imaging procedures. Both can be achieved by developing various complex physical procedures to be performed using anthropomorphic phantoms to simulate clinical conditions in the optimization process.

Keywords: nuclear medicine, gamma camera, SPECT, optimization