Agreement no.: UMO-2018/31/D/NZ7/02217

Title: 99m-Tc internal contaminations among nuclear medicine medical personnel during ventilation-perfusion SPECT lung scan,

Project schedule

Technetium (Tc) is a chemical element belonging to 7th group of the periodic table (transition metal). Primarily, Tc is obtained artificially by fission processes of heavy nuclei, but it is also present in Earth’s crust due to spontaneous fission in uranium and thorium ores. There are 32 radioactive isotopes and 11 metastable isomers of technetium known at this moment.

One of the isotopes of technetium, namely 99mTc, is frequently used in nuclear medicine, especially in diagnostics with Single-Photon Emission Computed Tomography (SPECT) imaging technique. Physicochemical properties such as low gamma-rays energy (140.5 keV, P = 99%), short half-live time equal 6.01 h and rich coordination chemistry contributes to common utilization of 99mTc in wide range of diagnostic tests. It is estimated that in near future almost 80% of examinations in nuclear medicine will be conducted by means of 99mTc.

Ventilation – perfusion lung scan is one of medical imaging methods in which 99mTc is applied. This examination consists of two lung scans. First part, perfusion scan, allows to assess lungs blood supply and requires intravenous injection of technetium macro aggregated albumin containing 150 MBq of 99mTc. In order to examine patency of bronchial tree and lungs, pulmonary ventilation scan is performed. Before scanning, gas containing 400 MBq of 99mTc is inhaled by patient through mouthpiece or mask covering nose and mouth. In medical routine, technetium DTPA or Technegas (ultrafine dispersion of 99mTc labeled carbon) are used as a source of radionuclide. During inhalation of gaseous radioactive technetium, part of 99mTc activity may leak into room air and pose an additional risk of radiation burden for medical staff who perform examinations.

It is very important to provide safe work environment for nuclear medicine staff. Unfortunately, as previous studies have shown, there is a serious problem with uncontrolled internal absorptions of 99mTc by a nuclear medicine medical personnel.

Currently, at Polish nuclear medicine units only the staff exposure to external radiation is monitored. Measurements by thermoluminescent dosimeters, however, will not provide any information on the doses due to radio-iodine incorporated into the body. Therefore, the radiological safety standards applied at present fail to meet the requirements of the so-called conservative assessment rule, where upper dose limits should be estimated. With internal dose estimation for the incorporated technetium entirely ignored, the assessed doses tend to be underestimated, and the doses due to the radionuclides absorbed into the body remain undetermined. Therefore, periodic and
systematic monitoring of the internal contamination should be integrated into radiological protection standards for teams dealing with highly radioactive $^{99m}$Tc. The main goal of the project is to develop new methods of internal dosimetry for medical personnel of nuclear medicine facilities in Poland.