Internal radiation dosimetry of orally administered radiotracers for the assessment of gastrointestinal motility

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HIGHLIGHTS
Internal radiation dose estimates for radionuclide GI transit were calculated.
The ICRP 30 GI tract model, MIRDOS 3.1 & OLINDA/EXM 1.0 software applications were used.
The calculated equivalent dose and effective dose for organs were reported.
The radiation doses among 153Sm, 111In and 99mTc formulations were compared.
The calculated doses were in good agreement with the ARSAC published values.

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ABSTRACT
Radionuclide imaging using 111In, 99mTc and 153Sm is commonly undertaken for the clinical investigation of gastric emptying, intestinal motility and whole gut transit. However the documented evidence concerning internal radiation dosimetry for such studies is not readily available. This communication documents the internal radiation dosimetry for whole gastrointestinal transit studies using 111In, 99mTc and 153Sm labeled formulations. The findings were compared to the diagnostic reference levels recommended by the United Kingdom Administration of Radioactive Substances Advisory Committee, for gastrointestinal transit studies.

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1. Introduction

It is essential that any medical radiation exposure is justified and optimized before use. With increased public awareness of ionizing radiation effects, all imaging studies involving radiation must have commensurate risk and benefit assessments. It is therefore important to estimate the radiation dose received by a patient administered with any amount of a radiopharmaceutical.

Nuclear medicine investigations are regarded as the gold standard for the assessment of gastric emptying and gastrointestinal (GI) motility. A number of potential radionuclides can be used for this purpose, each with advantages and disadvantages of photon energy, physical half-life and radiation dosimetry. The main radionuclides that have been employed are Indium-111 (111In) and Technetium-99m (99mTc) which are incorporated into non-absorbable forms for oral administration. An alternative radionuclide, Samarium-153 (153Sm) in the form of resin-based formulation, has recently been developed and tested to assess whole gut motility in constipated patients (Yeong, et al., 2011, 2012). The advantages of 153Sm include minimal radiation exposure to radiopharmacy staff, improved manufacturing and radioactive transportation, workflow and potentially...