

Fetal radiation dose from radiopharmaceuticals administered during pregnancy

Maria Palmer, Margaret Saunders, Alan W. Preece,
United Bristol Healthcare NHS Trust Biophysics

Purpose: Radiopharmaceuticals are widely used throughout the world for diagnostic imaging and therapy. In some instances, such as suspected pulmonary embolism or impaired renal function, they provide the best available diagnostic information. However, there are relatively few data on the placental transfer and consequent fetal radiation dose from commonly used radiopharmaceuticals and physicians are often reluctant to administer them during pregnancy. Thus pregnant women may be unnecessarily denied diagnostic procedures that represent the 'gold standard' for conditions commonly suffered during pregnancy. This study measured the placental transfer of ^{99m}Tc -pertechnetate, and technetium labelled radiopharmaceuticals in the guinea pig and provides estimates of fetal radiation dose in the human following administration of radiopharmaceuticals during pregnancy.

Methods: Pregnant guinea pigs in the late stages of gestation, considered equivalent to the third trimester in humans, received an intracardiac bolus of one of the following radiopharmaceuticals; ^{99m}Tc -pertechnetate, ^{99m}Tc -MAA, ^{99m}Tc -MAG3 and ^{99m}Tc -DTPA. At suitable time intervals up to 6 hours groups of three animals were sacrificed by anaesthetic overdose. The maternal and fetal biodistribution of each radiopharmaceutical was determined by dissection and activity measurement of the major organs and tissues. Fetal radiation dose was estimated using the MIRD 3 and assuming that biodistribution in the human will be similar to that in the guinea pig.

Results: All the radiopharmaceuticals tested crossed the placenta to a small extent. Up to 4.6% of administered ^{99m}Tc -pertechnetate transferred to the fetus with a much lower transfer of the labelled compounds. This level of transfer in pregnant patients would result in fetal radiation doses of 4.4 $\mu\text{Gy}/\text{MBq}$ for ^{99m}Tc -pertechnetate (5.3 $\mu\text{Gy}/\text{MBq}$ in early pregnancy), 1.2 $\mu\text{Gy}/\text{MBq}$ for ^{99m}Tc -MAG3 (5.3 $\mu\text{Gy}/\text{MBq}$ in early pregnancy), 2.8 $\mu\text{Gy}/\text{MBq}$ for ^{99m}Tc -DTPA (5.0 $\mu\text{Gy}/\text{MBq}$ in early pregnancy) and 0.8 $\mu\text{Gy}/\text{MBq}$ for ^{99m}Tc -MAA (1.7 $\mu\text{Gy}/\text{MBq}$ in early pregnancy).

Conclusions: Administration of commonly used radiopharmaceuticals for lung and renal imaging in late pregnancy appears to result in a low fetal radiation dose and poses little risk to the health of the child. Doses are higher in early pregnancy but still well below 1mSv from commonly used clinical doses of radiopharmaceutical.