RADIATION DOSE

When X-rays are taken, some of the energy in the X-ray beam is absorbed in the body. This is called the radiation dose, often shortened to 'dose'. It can be expressed in a number of different ways. Here dose will be expressed in Grays. As diagnostic X-ray examinations involve relatively low doses these doses will be stated in milliGrays (mGy), in other words 1 thousandth of a Gray.

BENEFIT VERSUS RISK

X-ray examination are requested and performed on the basis that the benefits of performing a particular examination outweighs the risk of not performing it. The potential dose to the fetus from diagnostic medical procedures using ionising radiation is very low in the majority of procedures.

EFFECTS OF IONISING RADIATION

The exposure of the embryo to ionising radiation can lead to two types of adverse health effects

1. Deterministic Effects

The theoretical effects possible in the developing fetus include malformation, growth retardation and abnormal brain development. These effects occur after a dose threshold of 100mGy to the fetus. **Normal diagnostic medical procedures could never result in a dose this high and so the potential for deterministic effects from diagnostic procedures is practically non-existent.**

2. Stochastic Effects

Stochastic effects as a result of irradiation of the fetus include the possible induction of cancer after birth and hereditary disease in descendants of the unborn child. The risk of these effects is considered to be directly proportional to radiation dose. Dependent on the stage of pregnancy the risk of stochastic effects can be split into two:

2.1. After the first 3 to 4 weeks of pregnancy:

The following risks only take into account the possibility of cancer induction and not the fatality of the cancer. The natural risk of childhood cancer is presently estimated to be about 1 in 500. The additional increase in risk of cancer induction from radiation dose is estimated as 1 in 13,000 per mGy.

For example if a pregnant woman underwent a procedure which resulted in an estimated fetal dose of 0.5 mGy, the additional risk to the fetus of cancer induction from this dose is 1 in 26,000 which is insignificant compared to the natural risks.

In the table 1 the risk of cancer induction has been rounded up to 1 in 10,000 per mGy to minimise any underestimation of risk. The dose from modern diagnostic procedures can range from a few microGray (1 millionth of a Gray) to a few tens of mGy and so the associated childhood cancer risk ranges from less than 1 in a million to about 1 in 200. **The risk associated with high dose procedures is still low in absolute terms and termination of pregnancy based only on radiation risk to the unborn child can never be justified.**

Examination		Typical Fetal dose range (mGy)	Risk of Childhood cancer per examination
X-ray X-ray CT	Skull Breast Head or neck	0.001-0.01	<1 in 1,000,000
X-ray CT ^{99m}Tc	Pulmonary Angiogram Lung Ventilation scan	0.01-0.1	1 in 1,000,000 to 1 in 100,000
X-ray X-ray CT ^{99m}Tc ^{99m}Tc	Abdomen Hip Chest and Liver Thyroid scan White Cell scan	0.1-1.0	1 in 100,000 to 1 in 10,000
X-ray X-ray CT ^{99m}Tc ^{99m}Tc ^{18}F PET	Barium Enema Abdomen Bone scan Myocardial scan Tumour Scan	1.0-10	1 in 10,000 to 1 in 1,000
CT CT ^{18}F PET/CT	Pelvis Pelvis, abdomen and chest Whole body scan	10-50	1 in 1,000 to 1in 200

Table 1: Typical fetal doses and risk of childhood cancer (after first 3-4 weeks of pregnancy) for some common diagnostic medical exposures

2.2. The first 3 to 4 weeks of pregnancy:
In the majority of cases of diagnostic radiation exposures of women in the first three to four weeks post-conception the risks of childhood cancer will be very small and probably much smaller than if the exposure had occurred later in the pregnancy.

2.3. Heritable effects:
Fetal doses from diagnostic radiation should present a negligible risk of appearance of radiation induced hereditary disease in descendants of the unborn child.

FURTHER INFORMATION

We hope you find this information useful. If you would like any additional information or have any concerns, ask to speak to the Superintendent Radiographer.

Alternatively, you may contact the Radiological Protection Centre (details on next page)

Reference:

This leaflet provides a summary of the information contained in the publication: "*Protection of Pregnant Patients during Diagnostic Medical Exposures to Ionising Radiation"* written by the Health Protection Agency in collaboration with the Royal College of Radiologists and the College of Radiographers.

The publication is available in its full form on the HPA website:
http://www.hpa.org.uk

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THE RADIOLOGICAL
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Incorporating The John Perry Laboratory

Diagnostic X-ray Exposures during Pregnancy

Information for Patients and Clinicians