2.9: Ionizing Radiation- Fetus and Neonate

The potential effects of ionizing radiation on the fetus are dependent upon the stage of development of the fetus and the radiation dose administered.

Stages of Fetal Development:

– Pre-implantation (day 1 to 10)
– Organogenesis (day 11 to 42)
– Growth stage (day 43 to birth)

The potential for fetal demise is greatest in the pre-implantation and early implantation phase of pregnancy. Harm to the fetus at this stage is considered to be all or nothing i.e. fetal demise or normal development.

The subsequent phase of organogenesis or embryogenesis is critical for the development of organs. Congenital malformations may develop as a result of radiation exposure. The most common abnormality seen related to excessive radiation exposure at this stage is growth retardation.

Nervous system anomalies are the most common manifestation of excessive radiation during the growth phase with fetal deformities such as microcephaly, intellectual impairment, and other central nervous system abnormalities.

Later in fetal development the risk for catastrophic events related to radiation exposure diminishes, but one must remember that the long-term effects of genetic mutation during the life time of the child. Radiation exposure for late gestation feti and neonates should be judicially utilized.

Most radiographic imaging techniques result in low fetal exposures, below 50 mGy, where significant increases in risk to the fetus have not been observed. However, some imaging examinations deliver a substantial radiation dose to the
mother and fetus and should best be avoided. For example, a single abdominal x-ray delivers a dose of 2 – 2.5 mGy to the fetus while a CT of the abdomen will be associated with a fetal dose of 2 – 26 mGy depending upon the parameters used for the CT i.e. slice thickness, kVp and ma settings, and the number of images captured during the examination.

As in all medicine, the risks and benefits of each diagnostic procedure should be assessed on a case-by-case basis. In addition, an understanding of the doses involved in radiological investigations should be evaluated and considered prior to imaging. The American Congress of Obstetricians and Gynecologists (ACOG) states that fetal risk is minimal with doses under 50 mGy, and that doses over 100 mGy may result in malformation of 1% above background incidence. (6)

Organizations such as Image Gently Alliance have recently been established to sensitize healthcare providers and families to the risks and benefits of diagnostic radiation. They began as a sub-committee of the Pediatric Radiology Society and have grown into a multi-organization, world-wide movement with a stated group mission of, "…. providing safe, high quality pediatric imaging worldwide. The primary objective of the Alliance is to raise awareness in the imaging community of the need to adjust radiation dose when imaging children." (7)