

Full Length Research Paper

Effect of radiation on pregnancy

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The present study was carried out to evaluate the effect of radiation on pregnancy. 20 experimental animals (rabbits) were exposed to X-ray (10 random exposure to represent patients' dose and 10 continuous to represent radiation workers dose). Each sample was exposed to X-ray and this dose measured with thermo luminous dosimeter (MGP instruments DMC 2000X) in the first, second and third trimester then the dose accumulative was observed and recorded together with its effect on pregnancy during these periods.

Key words: Radiation, pregnancy, Saudi Arabia.

INTRODUCTION

Radiation exposure during pregnancy has been debated for years, but various experiences are continuing to show that there are increasingly negative effects on the growing fetus as well as effects later in life. While the exact effects are unknown due to inability for testing, there are a variety of speculations and proven patterns that suggest that pregnant women should not exceedingly expose themselves to radiation during pregnancy (Charissa, 2006).

Females are at high risk of exposure to ionizing radiation resulting from medical procedures, workplace exposure, and diagnostic or therapeutic interventions before the pregnancy. Such waves are known as electromagnetic waves. In utero exposure to non-ionizing radiation is not associated with significant risks; therefore, ultrasonography is safe to perform during pregnancy. Ionizing radiation includes particles and

electromagnetic radiation (for example x-rays). In utero exposure to ionizing radiation can be teratogenic, carcinogenic or mutagenic. The effects are directly related to the level of exposure and stage of fetal development. The fetus is most susceptible to radiation during organogenesis. Non-cancer health effects have not been detected at any stage of gestation after exposure to ionizing radiation of less than 0.05 Gy (5 rad). Spontaneous abortion, growth restriction may occur at higher exposure levels. The risk of cancer is increased regardless of the dose (Pamela and Stacy, 2010).

Fetal death

Very early exposure to even 10 rad of radiation in the first trimester of pregnancy carries a high risk of fetal death,

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according to perinatology.com. Since the embryo at this stage consists of just a few cells, damage to even one cell can be lethal. Normal x-rays deliver far less radiation than 10 rad; however, treatment for cancer or hyperthyroidism may occur before a woman knows she is pregnant. Since the dose of radiation received in these procedures is very high, in the thousands of rads, according to a Health Physics Society article by Robert Brent, M.D., there is a high chance of fetal damage. Barium studies also deliver more than 10 rad, according to perinatology.com. After 2nd trimester, the fetus is no more susceptible to radiation than a newborn would be, but doses of 100 rad or more leads to an increased risk of still birth.

Fetal deformities

The first trimester of pregnancy is crucial for embryonic growth and development. According to Brent, the average dose of radiation in a typical diagnostic procedure is 5 rad. Studies show that an increased risk of fetal deformity does not occur until radiation exposure reaches 20 rad up to week 8 and 30 rad between weeks 8 to 15. Brent states that fetal deformities do not occur from radiation exposure after week 20, since the fetus is fully formed at that point (International Commission on Radiological Protection, 2003)

Cancer risks later in life

Exposure to radiation before birth in high amounts can increase the chance that a fetus will develop cancer later in life; however, according to the Centers for Disease Control (CDC), the risk for those exposed to equal to 500 chest x-rays or less have only two percent more chance overall of developing cancer than a person without prenatal radiation exposure (according to perinatology.com) this risk is not dependent on the stage of pregnancy when radiation exposure occurred. (Bushong, 2001).

Aim of work

The study aims to observe and detect the effect of radiation on pregnancy.

MATERIALS AND METHODS

A total of 20 animals were collected from September to December, 2012. Samples were collected in healthy condition and transported to the Diagnostic Radiology Department, Faculty of Applied Medical Science, Hail University. Each sample was examined by the following methods.

Advanced x-ray machine

Two groups of samples were exposed to x-rays. The first group was exposed randomly as all population when they need to be exposed to radiation on emergency or medical examination. The second group of samples was exposed to x-rays continuously as radiation workers, they are exposed to radiation or they do not use the protections tools from radiation (www.radiologyinfo.org/en/safety/index.cfm?pg=sfty_xray#part6).

Thermo luminous dosimeter (TLD)

This was employed to measure the accumulative radiation dose (National Council on Radiation Protection and Measurements, 1998).

RESULTS

A total of 20 samples were examined. Out of them, 10 animals (50%) were sensitive for radiation as observed by the different exposure stages in pregnancies. The effects of low-dose, long term irradiation *in utero* can include:

1. Death of fetus, congenital deformity, cancers, impairment of growth and genetic effect. After maturity, radio-sensitivity increases with age. It begins to decrease with age at the end of child bearing age.
2. Within the first two weeks after fertilization the most pronounced effect of a high radiation dose is fetal death which is manifested as a spontaneous abortion.
3. During the 2nd to 10th weeks two effects may occur. Early in this period, skeletal and organ abnormalities can be induced. As organs continue to develop, central nervous system abnormalities may develop. If the abnormalities are severe enough, the effect will be fetal death.
4. After a dose of 200 rad, nearly 100% of the fetuses suffered significant abnormalities. In 80%, it was sufficient to cause death.
5. A dose of 10 rad during organogenesis is expected to induce congenital abnormalities by 1% above natural occurrence.

In utero irradiation has been associated with childhood malignancy. Fetal death when the abnormalities are severe enough.

DISCUSSION

Everyone is exposed to radiation every day. People are continuously exposed to low-level radiation found in food, soils, building materials, and the air and from outer space. All of this radiation originates from naturally

occurring sources. For example, bananas contain naturally occurring radioactive potassium-40 and air contains radon, a radioactive gas. The average natural background radiation dose is about 3.0 mSv (300 mrem) each year, in comparison with the study of Kevin et al. (1999).

Maternal illness during pregnancy is not uncommon and sometimes requires radiographic imaging for proper diagnosis and treatment. The patient and her physician may be concerned about potential harm to the fetus from radiation exposure. In reality, however, the risks to the developing fetus are quite small. The accepted cumulative dose of ionizing radiation during pregnancy is 5 rad, and no single diagnostic study exceeds this maximum. For example, the amount of exposure to the fetus from a two-view chest x-ray of the mother is only 0.00007 rad. The most sensitive time period for central nervous system teratogenesis is between 10 and 17 weeks of gestation. Non-urgent radiologic testing should be avoided during this time. Rare consequences of prenatal radiation exposure include a slight increase in the incidence of childhood leukemia and, possibly, a very small change in the frequency of genetic mutations. Such exposure is not an indication for pregnancy termination. Appropriate counseling of patients before radiologic studies are performed is critical. Observed in atomic bomb survivors has been an increase in mental retardation. This involved very high exposure rates. It is known that radiation does retard growth. Irradiation particularly during organogenesis has been associated with microcephaly (small head) and retardation. Human data from atom bomb survivors and residents of the Marshall Islands exposed to fall out from atom bomb tests demonstrated impaired growth in children. In addition to natural background radiation, the Pt may be exposed to radiation from medical x-rays and medical radiation tests or treatments, if the Pt think, or there is a possibility, that the female may be pregnant and need a medical x-ray or radiation procedure.

Radiation effects vary depending on the fetal stage of development and the magnitude of the doses that indicates that there is a threshold below which negative effects are not observed. According to the American College of Radiology (2010), routine x-rays of a mother's abdomen, back, hips, and pelvis are not likely to pose a serious risk to the child. However, certain procedures (such as a computerized tomography [CT scan]) or a lower GI fluoroscope exam) to the mother's stomach or hips may give higher doses. Most standard radiological tests and treatments produce radiation doses below 50 mSv (5,000 millirem). The National Council on Radiation Protection and Measurements (1998) and the American College of Obstetricians and Gynecologists (2013, 2014) both agree that the potential health risks to the fetus are not increased from most standard medical tests with a

radiation dose below 50 mSv. Potential health risks, however, may increase for a few medical tests or combinations of tests that result in radiation doses that exceed 50 mSv, depending on the dose and on the stage of pregnancy.

The sensitivity of a developing fetus to radiation can vary with the stage of development, the magnitude of the dose, and the length of time of the total exposure (minutes, hours, days, or weeks). The most radio sensitive period appears to be between 8 and 15 weeks after conception.

CONCLUSION

The effects of low-dose, long term irradiation *in utero* can include: death of fetus, congenital deformity, cancers, impairment of growth and genetic effect. These abnormalities are based upon exposure of greater than 10 rad in animal experiments (rabbits). There is no evidence that diagnostic levels of radiation exposure currently experienced occupationally or medically are responsible for any such effects on fetal growth or development. Ultrasonography is safe to perform during pregnancy.

RECOMMENDATIONS

1. Keep the time of exposure to radiation as short as possible.
2. Maintain a large distance as possible between the source of radiation and the exposed object.
3. Insert shielding material between the radiation source and the exposed person.
4. ALARA stands for "As low as reasonably achievable" and is the corner stone of radiation safety policies and procedures.
5. During pregnancy we should be considering having an abdominal/pelvic x-ray or medical test.
6. Determine if the procedures can be delayed until after birth or whether another medical procedure, such as an ultra-sound or MRI, could be used instead.
7. When pregnancy and abdominal x-rays are scheduled without consultation with doctor, we should inform the person performing the exam of our pregnant state. As a precaution, you should inform a person performing any type of x-ray or radiation procedure that you are pregnant. Ultrasonography is safe to perform during pregnancy.

Conflict of interest

Authors have none to declare.

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