Determing the Amount and Safety Effects of RADIOGRAPHIC IMAGING on Pregnant Women

Abstract: Forty pregnant women patients were collected from Al Karama Educational Hospital, Al-Shaheed Dari Al-Fayad Hospital, Baghdad, Iraq, and Al_Hindiya general hospital, Karbala, Iraq. The results showed that most of these patients were exposed to radiation between the second and third weeks of pregnancy. Women exposed to ionizing radiation during pregnancy, where the advice from an official in charge of radiation protection was considered, in addition to the fact that the dose had several limitations, including the type of device used and the procedures used. Therefore, the calculation of the received amount was more accurate if it was calculated for each device correctly individual in some cases. For most cases of radiation exposure, the radiation dose in which the fetus is exposed is less than that to which the mother is exposed, and the stomach of the pregnant mother works in part to protect the fetus from the sources of radiation outside the body. Health problems on the fetus may be from exposure Radiation is dangerous, even at the low radiation doses that may not cause disease to the mother. Health problems may include miscarriage and stunted growth Malformations, brain dysfunction, and cancer. The fetus is most sensitive to radiation at two weeks of age to 18 weeks of pregnancy, and the fetus is less susceptible to radiation during the stage's Subsequent pregnancy.

Keywords: Pregnant, Radiation, IMAGING, MRI.

INTRODUCTION

Despite the increasing use of radiological studies during pregnancy, misconceptions still exist regarding the potential risks of their service to the mother/fetus. This review presents relevant evidence on radiation exposure's possible effects and clinical safety in diagnostic studies during pregnancy (Hart, D., & Wall, B.H. 2002). Iodine contrast agents can have harmful effects on the thyroid gland of a developing fetus. There is limited experience with gadolinium, so its use is not recommended unless the benefit justifies the potential risk (Stewart, A. et al., 1958).

Both ultrasound and MRI are safe for the fetus, so they should be preferred. We recommend excluding pregnancy before carrying out a radio diagnostic study of a woman of childbearing age, with the aim of not exposing fetuses to ionizing radiation unduly (International Commission on Radiological Protection [Internet] ICRP 2002-2015).

In obstetric clinical practice, exposing pregnant women to ionizing radiation is necessary for radiological studies to diagnose associated medical diseases. In these cases, the concern arises about the amount of photon radiation the fetus or fetus receives and the consequences this exposure can have on its development (Parry, R. A. 1999).

Here we present the relevant evidence, primarily collected by the American College of Radiology (ACR), the International Commission on Radiological Protection (ICRP), and the American College of Obstetricians and Gynecologists (American College of Radiology). The potential effects and clinical safety of radiation exposure in diagnostic studies during pregnancy facilitate the work of obstetricians and general practitioners or specialists when deciding to order the appropriate examination of the patient to be cared for (Valentin, J. 2003).

Dose limits do not apply to patients' exposure to radiation, as the decision to use radiation depends on the justification of each case based on the individual patient's condition. Once you have determined that a medical examination or treatment is warranted, it must be improved. This means that the clinical goal must be achieved at the appropriate dose. Safe dose limits have been established for employees, not patients (Wang, P. I. et al., 2012).
The ICRP has postulated the 'ten-day rule' for women of childbearing age. The rule states that 'whenever possible, radiological examination of the lower abdomen and pelvis should be limited to a period of 10 days after the start of menstruation (Wang, P. I. et al., 2006; & Wang, P. I. et al., 2014). " The original suggestion was 14 days, but it has been reduced to 10 days to account for menstrual cycle diversity. There is mounting evidence that, in most cases, strict adherence to the "ten-day rule" can be unnecessarily restrictive. When the number and nature of cells in the embryo are not yet specialized, damage to these cells is likely to result in implantation failure, or undetectable fetal death, which is highly unlikely for abnormalities to be present. Since organogenesis begins between 3 and 5 weeks after conception, it has been estimated that radiation exposure in early pregnancy cannot lead to malformation (Karabulut, N., & Ariyürek, M. 2006; & Goo, H.W. 2012). The most significant risk is miscarriage if exposure results in undetectable fetal death. For this, the dose should exceed 100 milligrams. Accordingly, it has been proposed to remove the "ten-day rule" and replace it with the 28-day rule. This means that if a radiological examination is warranted, it can be performed at any time during the cycle until menopause has occurred. So the focus has shifted to the lack of menstruation and the possibility of pregnancy. In a missed period, the woman is considered pregnant unless proven otherwise (Shin, H. J. et al., 2013; & Crawley, M. T. et al., 2001).

Sometimes a patient may not be aware of her pregnancy when she has an X-ray, and it is normal to be very worried when she finds out that she is pregnant (McCollough, C. H. et al., 2007).

In such cases, the fetal or fetal radiation dose should be estimated, but this estimation should be made by a medical physicist or radiation safety specialist experienced in dosimetry. This can inform the patient of the potential risks involved. The trouble will be minimal in many cases since irradiation will occur within three weeks of pregnancy. In some instances, the fetus will be more prominent, and the dose involved can be significant. However, it is unlikely that the amount would be high enough to recommend that the patient consider termination of pregnancy (Chaparian, A., & Aghabagheri, M. 2013).

If the radiation dose needs to be calculated for patient counseling, radiographic data should be considered if known. Specific hypotheses can be assumed in dosimetry, but it is better to use actual data from the examination. The date of conception and the last menstrual period (LMP) should also be specified (Kinly III, D. 2006).

Control of Occupationally Exposed Pregnant Women

The primary responsibility for protecting the fetus or fetus lies with the mother herself. She must declare her pregnancy to the management of the company as soon as this is confirmed. Once notified, the employer must consider providing additional protection to the fetus.

From that moment on, working conditions should be such that the additional dose that the fetus or fetus will receive does not exceed 1 mg during the remainder of the pregnancy. This number refers to the fetal quantity and is not directly comparable to doses measured with a personal dosimeter, and the use of a personal dosimeter in the abdominal area is also not helpful (Eskandar, O. et al., 2010).

This limit is comparable to that set for members of the public. In the field of radiation protection, the public is defined as “any member of the population except those exposed to medical or occupational exposure.”

Restricting the dose to the fetus does not mean that it is necessary to completely prevent pregnant women from working with radiation or radioactive materials. However, pregnant workers sometimes request a workplace change to an area with no exposure to radiation, since although they know the risks are low, they are unwilling to accept any increased risks.

Other times, the employer makes this decision to avoid future difficulties if the worker experiences problems in her pregnancy or gives birth to a child with health problems.

These specific decisions are not based on radiation protection principles; It is recommended that they be taken jointly by the operator and management. It is essential not to cause undue discrimination against a pregnant woman. Depending on the region in which they carry out their work, a civil servant can continue to work or move on to another task with minimal exposure.

For example, if her duties relate to radiological diagnosis, the worker can be moved from the fluoroscopy room to the CT room. If work is in nuclear medicine, should reduce the time perform tasks in radiopharmacy or avoid working with iodine solutions. If work in the radiotherapy area, should not work in the manual brachytherapy area (Asgari, M. A. et al., 1999).

Material and Method

Forty pregnant women patients were collected by relying on a cross-sectional study that extends from 4/20/ 2020 to 2, 6, 2021 from Al Karama Educational Hospital, Al-Shaheed Dari Al-Fayad Hospital, Baghdad, Iraq, and from Al_Hindiya general hospital, Karbala, Iraq.
Women exposed to ionizing radiation during pregnancy, where the advice from an official in charge of radiation protection was considered, in addition to the fact that the dose had several limitations, including the type of device used and the procedures used. Therefore, the received amount was more accurate if it was calculated for each device correctly in some cases.

Avoid exposing the fetus to radiation during pregnancy because the first trimester, in particular, may have severe consequences for the future baby.

The effects that a child can have are deformities, mental retardation, etc. Therefore, a series of protocols, measures, and dose limits are put to avoid these consequences.

The woman must report that she is pregnant as soon as possible so that appropriate measures are taken. Then particular ranges of radiation doses are established from the contact of conception to the moment of delivery. From the moment of pregnancy contact, must wear an additional dosimeter always placed on the abdomen. The fetal dose will be the same as the audience, so the fetal equivalent dose will not likely exceed 1 MSV. The fetus must be protected throughout the pregnancy, mainly to evaluate and take the pregnant woman's conditions. For example, they will not work in places with no physical protective barriers, such as interference rays or portable rays.

**Statistical Analysis**

The statistical analysis program SPSS25 soft program analyzed patient outcomes by relying on logistic regression and finding the standard deviation value with the actual value.

**Ethical Construction**

The study was conducted by the Ethical Principles and Good Clinical Practices and approved by an independent local ethics committee at each site.

**RESULTS**

The statistical analysis was done by the SPSS25 soft program, where the average standard deviation and mean arithmetic to age was 31 ±4.9, and the results were shown on the exposure of pregnant women aged 25-29.

![Figure 1](image1.png)

**Figure 1** - Distribution of Patients Depends On Age.

![Figure 2](image2.png)

**Figure 2** - Previous Deliveries (%).
According to various studies, we can say that the loss of IQ is estimated at less than 25 points for each gray received by the fetus. The possibility of a dose-response without a day threshold cannot be ruled out. Less than 100 mGy has been described as unrelated in terms of its effects on the baby. Hence, the baby's risk of developing mental retardation equals or less than if they did not receive radiation during the fetal period.

**DISCUSSION**

The risks of radiation exposure during pregnancy (in the womb) depend on the gestational age at the time.

From imaging and absorbed dose. The risks are most significant at the time of organogenesis. Early in the fetus, under the influence of X-rays, cell division can stop or be disrupted. The consequences of such changes can be unfortunate, ranging from genetic mutations to carcinomas. With a radiation dose of more than one cubic meter, a woman is likely to experience spontaneous rejection of the fetus, or the baby will be born in a hazardous condition. In addition, often, after x-ray irradiation, children may have severe disturbances in the work of the nervous system, the most dangerous of which are x-rays taken at the beginning of pregnancy. Any radiation should be avoided in the first trimester of pregnancy, i.e., in the first two months, as the likelihood of developing fetal abnormalities after exposure to X-rays after the 16th week of pregnancy is less likely.

In general, an x-ray examination can be conditionally divided into three categories, depending on the degree of danger to a pregnant woman:

X-rays with the most severe consequences. The most harmful are x-rays of the organs of the spine, abdomen, and pelvis since, in this case, the x-rays pass directly through the fetus.

Medium-risk X-ray. This type includes an X-ray of the chest, head, extremities, and lungs as well. The rays do not reach the fetus directly, but the dose received is large enough and spreads over a large area of the body, so such beams should be treated with caution.

X-rays with minimal consequences. The safest types of examinations include X-rays of the nose and teeth. In this case, the diagnosis is carried out using a device that affects the body’s lower area of ​ the .

According to established sanitary standards, the dose of radiation received by the unborn child should not exceed one mSv. For some types of radiography, they are:

- chest x-ray - 0.3 mSv;
- X-ray of the extremities - 0.01 mSv;
- X-ray of the nose - 0.6 mSv;
- Dental X-ray - 0.02 mSv.

When examining modern devices, you will receive a minimum radiation dose. In addition, the doctor must be informed of alternative research methods if this is
possible in a particular case. For example, ultrasound or MRI can successfully replace X-rays of pregnant women in many cases.

The first two weeks of pregnancy have good resistance to the fetus and are more sensitive to lethal effects with doses of 50 mSv, while between the third to ninth week with amounts less than 200 mSv, the fetus does not undergo abnormalities, abortion, or growth.

The effect of ionizing radiation on fetal development is assessed by extrapolating experimental data obtained from animal irradiation, primarily from observations of victims of the atomic bombing in Japan and cases of unintended medical exposure. Risks include prenatal and neonatal mortality, congenital malformations, severe mental retardation, and temporary or permanent dwarfism. The risk of radiation-induced genetic diseases has been reported as 1% per gray. Most authors believe that with proper shielding of the abdominal cavity, the fetal dose can, in most cases, be reduced by 50% or more, and mantle field RT can be safely administered to a pregnant patient after the first trimester.

Based on the results of their patients' observations and a review of the literature, they publish recommendations for treatment, which have changed since the 1970s. Now because of the accumulation of more experience and sophistication in treatment. Indeed, initially, RT radiotherapy was an essential part of treatment, primarily for the in-situ stages of the disease. The standard for CT was the MOPP regimen known for its embryotoxicity. At present, chemotherapy is recommended for most early stages of HL, allowing the onset of RT to be delayed until the second trimester, delivery, or postpartum period. They are pretty similar. In the first trimester of pregnancy, if a delay in treatment is unacceptable, an abortion may be offered. In cases of a severe lesion, or rapid progression of the disease, treatment should be provided, but the choice of the drug remains very difficult if the continuity is regular.

CONCLUSION

The consequences depend on the stage of pregnancy at which the study was conducted and what the radiation dose was. During the first two weeks after conception, radiation acts on the fetus according to the “all or nothing” principle: either a miscarriage occurs, or there is no effect, and the pregnancy proceeds without consequences.

After the first 14 days during the first trimester of pregnancy, exposure to radiation carries a risk of congenital disabilities or mental retardation. For doses up to 250 milligrams, the risk is ≤0.1% per milligram.

After the first trimester, radiation increases the risk of childhood cancer, ranging from 0.07 - 0.88% depending on the dose and gestational age.

The fetus receives the lowest radiation dose if the mother undergoes a CT scan of her head. The closer the examined organ is to the fetus, the higher the radiation dose to the unborn child. Even if the mother's pelvis area is covered with a special covering, it will only protect from CT radiation, but not from radiation that spreads through the body.

REFERENCES
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