

Radiation and Pregnancy

Shruti Singh¹, Swati Gett²

Author's Affiliation:

^{1,2}Senior Resident, Dept. of Obstetrics and Gynecology, Kasturba Hospital, New Delhi, Delhi 110006, India.

Corresponding Author:

Shruti Singh, Senior Resident, Dept. of Obstetrics and Gynecology, Kasturba Hospital, New Delhi, Delhi 110006, India. E-mail: shrutisingh3120@gmail.com

Received on 02.07.2018,

Accepted on 30.07.2018

Abstract

Radiation is mainly of two types - ionizing and non-ionizing radiation. In pregnancy only non-ionizing radiation is used. Effects are very less in pregnancy than what is actually predicted. According to ACOG, exposure to x-rays during pregnancy is not an indication for therapeutic abortion. Fetal sensitivity to radiation depends upon - radiation dose to fetus and post conceptional period. Health effects are grouped into teratogenesis, carcinogenesis and mutagenesis.

Keywords: Ionizing; Non-Ionizing; Post- Conceptional Period.

Introduction

Nature of radiation and its effect on pregnancy :-

- Ionizing radiation - x-rays, CT scans, Nuclear medicine, radioactive isotopes, etc.
- Non ionizing radiation - ultrasonography, MRI, etc.

Mainly ionizing radiations are used in pregnancy in two conditions :-

- If female is not aware of herself being pregnant.
- When benefits of radiation is more than the risks.

Effects of radiation is very less than what we predict and actually depends on actual fetal age. It is not which we calculate using last menstrual period (LMP), but is 2 weeks lesser than the gestational age and is post conception time.

Fetus develops in three phases:

1. Pre- implantation phase - Blastogenesis (0-14 day) - from conception till implantation.
2. Organogenesis phase (15-55 day) - post conception 3rd to 8th week
3. 9th week till birth - it includes major CNS development phase (9th - 25th week)

Background Radiation [1]

It is always present in our environment and provides us a small radiation dose continuously and we cannot escape it. It is not uniform in all countries, for example it is equivalent to around 50-100 simple chest x-rays for each year to the people residing in Australia.

Radiation exposure causes:-

- unnecessary anxiety, so dosimetry expert should be approached to estimate individual fetal dose.
- Pre-conception radiation exposure :- In either of the parent, pre-conception radiation exposure to their reproductive organs has not been shown to result in increased risk of cancer or abnormalities in their offspring. If a female is trying to become pregnant, she should consider the timing of her menstrual cycle before undergoing any type of radiation exposure [2].
- For pre-implantation duration exposure - there is least chances of survival embryos to be affected.
- For <100 mGy fetal dose - there is no medical reason for termination [3].
- According to ACOG guidelines - exposure to x-rays during pregnancy is not an indication

for therapeutic abortion [4].

- Ionizing radiation's accepted cumulative dose during pregnancy is 5 Rads and no single diagnostic study exceeds this maximum level [5].

X ray studies used for diagnostic purpose which can cause harm to the developing embryo directly includes: [4,6]

- X rays of lumbar spine
- Iv pyelogram (IVP)
- Upper GI - Barium meal
- Lower GI - Barium enema
- X rays - for bladder function, Gallbladder function.
- Hysterosalpingogram
- X rays of hips/ pelvis
- Standard abdominal x rays
- CT Scan
- Fluoroscopy
- Mammography
- General nuclear medicine
- PET- CT
- Therapy (nuclear medicine)

Fetal sensitivity to radiation is dependent upon following factors:-

- Radiation dose to fetus -
 - units of dose, time length of dose
 - external irradiation of mother - depends on - maternal anatomy, uterine position, bladder distension
 - radionucleotide absorbed by mother, or radionucleotide transferred across placenta - depends upon - maternal biokinetics, physical/ chemical/ biological properties of radionucleotides, effect of gestational age on placenta structure and function
 - breastfeeding
- Post - conceptional period - highest effect is seen during organogenesis period and early fetal period (all or none effect) > second trimester > third trimester.

Health effects due to radiation exposure :

It can be broadly grouped into three categories : [7]

1. Teratogenesis (fetal malformation) - CNS

changes - especially mental retardation and microcephaly.

2. Carcinogenesis (induced malignancy) - childhood malignancies - especially leukemia - if background rate of leukemia in children is around 3.6 / 10,000 then exposure to 1 or 2 Rad increases it upto 5 per 10,000 [8].
3. Mutagenesis (germ line genes alteration) - If 10,000 persons were exposed to 1 Rad, then around 10 - 40 new genetic mutations would be induced [9].

Breastfeeding and radiation exposure : [1]

Usually breast feeding has to be suspended for a short time before and after radiation exposure. The length of time period will be dependent upon the amount and type of radiopharmaceutical to be used. Mother will find it beneficial to stop breastfeeding 2- 3 months before receiving therapy with radioiodine because higher doses of radiation will be received by breast tissue that is producing milk than the breast tissue of a female who is not breastfeeding.

References

1. Wallace A, Cain T. Radiation Risk of Medical Imaging for Adults and Children. Royal Australian & New Zealand College of Radiology, Sydney, 2009.
2. Abdullahi MG, Toriman ME. The Effects of X-rays (Radiation) on Embryonic and Fetal during Developmental Pregnancy Stages. J Nucl Med Radiat Ther 2015;6:231. doi:10.4172/2155-9619.1000231.
3. Prenatal radiation exposure. Australian clinical guidelines for radiological emergencies. Sept 2012.
4. <http://www.cdc.gov/radiation/prenatalphysicians.asp> Accessed 7th February 2015.
5. Kevin S. Toppenberg, M.D., D. Ashley Hill, M.D., and David P. Miller, M.S., Florida Hospital Medical Center, Orlando, Florida. Safety of Radiographic Imaging During Pregnancy. Am Fam Physician. 1999 Apr 1;59(7):1813-18.
6. <http://hps.org>.
7. Miller RW. Epidemiological conclusions from radiation toxicity studies. In: Fry RJ, Grahm D, Griem ML, Rust JH, eds. Late effects of radiation. London: Taylor & Francis, 1970.
8. Brent RL. The effect of embryonic and fetal exposure to x-ray, microwaves, and ultrasound: counseling the pregnant and nonpregnant patient about these risks. Semin Oncol. 1989;16:347-68.
9. Committee on Biological Effects of Ionizing Radiation, Board on Radiation Effects Research, Commission on Life Sciences, National Research Council. Health effects of exposure to low levels of ionizing radiation: BEIR V. Washington, D.C.: National Academy Press, 1990.