

The Effects of X-rays (Radiation) on Embryonic and Fetal during Developmental Pregnancy Stages

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Received date: Mar 28, 2015, Accepted date: June 08, 2015, Publication date: June 12, 2015

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Abstract

Preconception irradiation of either parent's gonads has not result in increased cancer or malformation in their children. The radiation dose and gestational ages during X-rays is the yard stick for measuring whether it will have an effect on the embryo or foetus at the time of exposure. During X-rays, high dose of ionizing radiation on embryo or foetus may causes some effects such as miscarriage, restriction of fetal growth, congenital malformation (which include microcephaly), or lead to mental retardation sometimes can cause cancer during childhood.

The experimental observation showed that, radiation-induced of 100mGy equal to 10rads, may usually result to death of the embryo that may kill up to 20% of human embryos or fetuses. The radiation-induced of 5000 mGy equivalent to 500 rads also kill 100% of human embryos or fetuses before 18 weeks gestation. Therefore, it is recommended that during pregnancy or developmental stages X-rays of high dose is not advisable.

Keywords: X-ray; Electromagnetic radiation; Embryo; Foetus; Miscarriage; Congenital malformation; Microcephaly

Introduction

X-rays belong to a group of radiation known as electromagnetic radiation. It propagated in form of waves and made up of electric and magnetic field that are mutually supported each other. It is produced by a charged particles being accelerated and emit electromagnetic radiation and propagated without any medium [1].

X-rays is the powerful invisible rays sending to an examine body that can pass through it to see its inside, such as human body, metals, baggage and created an image where is usually used for medical purposes in human, for identification of fractures in metals and for investigation of hidden items in baggage [2].

X-rays is often in form of electromagnetic radiations that have an extremely short wavelength of less than 100 Å (Angstroms), and have the penetrating power of various thicknesses of all solid. It is used for producing secondary radiations that is impinging on material bodies, and acting on photographic films and plates as light does [3].

The use of X-ray for medical purposes is essential for given healthcare personnel and lifesaving information about numerous medical conditions. X-ray can have risk as well like all other thing in the real world. It has advantages as well as disadvantages, because not all X-rays are the same, some can be dangerous to human health more especially to the pregnant women. When it exposes during examinations on the arms, legs, or chest the beams does not expose to the reproductive organs directly. However, that of torso such as the abdomen, stomach pelvis, lower back and kidney have a greater chance of exposure to the uterus; this can affect the unborn child in the womb [4].

According to the American Academy of Family Physicians; X-rays are generally safe during pregnancy but there is quite bit of controversy surrounding this issue. Studies have been conflicting, and therefore, X-rays should only do when the benefits outweigh the risks [5].

According to American College of Radiation; no single diagnostic x-ray has a radiation dose significant enough to cause adverse effects in developing embryo or foetus [6].

Prenatal Radiation Exposure highlighted that for a 2 weeks gestation an exposure of 100 mGy (10 rads) may lead to death of the embryo. They further explained that, radiation with doses of 5000 mGy can kill embryo or fetus completely. Diagnostic X-ray studies that may involve direct radiation exposure of the developing embryo include (a) X rays of the back (lumbar spine) for evaluating a lower back pain or a nerve route pain, (b) intravenous pyelogram (IVP) to examine kidney function, (c) upper GI series for evaluation of gastrointestinal symptoms, (d) lower GI series (barium enema) to examine the structure and function of the large intestine, (e) X-ray studies of bladder function, (f) X-ray studies of the gallbladder and gallbladder function, (g) X-ray studies of the structure and function of the uterus and tubes with the procedure known as a hysterosalpingogram (HSP), (h) X-ray studies of the pelvis and hips due to hip pain, and (i) standard abdominal X rays [7,8].

Therefore, an attempt is made by this paper to highlight the effects of X-ray during pregnancy period especially to the unborn child.

Materials and Methods

The methods or procedures used to avoid unintentional irradiation of the embryo or foetus are many. However, the technicians may reduce this by asking all the female patients of childbearing age regarding the possibility of being pregnant, and whenever possible the

gonads must be protected during X-ray exposures. Sometimes, the covering of the female abdomen during a chest CT scan or Plain X-ray or the use of lead shielding is more assurance.

Diagnostic and interventional radiological examinations that may causes any exposure of the abdomen or pelvis of a woman who is pregnant or counted as a pregnant must be avoided unless where necessary due to strong clinical reason. If this occur that X-ray is necessary in a woman who is pregnant or likely to be pregnant then the Radiologist, Technicians or any Staff involved must be informed before executing the procedure so that the embryo or foetus may not be exposed to a beam above primary level (1 mGy) [9,10].

Measures taken when performing X-ray to pregnant women or likely to be pregnant are:

Optimized to minimize the dose to the embryo/fetus,

Estimate, when required, the dose received by the embryo/fetus by the medical physics

During X-ray, the patients (pregnant or likely pregnant women) must be strong queried before executing

Informed the patients about the magnitude of the radiation dose to the embryo/fetus and counseled them about any potential risk.

Results

The Table 1 below shows the result of the minimum and maximum doses during several types of X-rays. Therefore, during X-ray processes, the technicians or any person conducting the X-ray will considered the dose send to the patient and must to be within the range of minimum and maximum in order not to have any effect to the patients. The Figures 1 and 2 indicate the types of X-ray which is between 40-50mGy, and is mostly used to identify a hidden items and also may not harm the fetal or embryo of gestational period of 8 to 25 weeks.

Study	View	Minimum (mGy)	Maximum (mGy)
Dental		0.001	
Cerebral angiography			<0.1
Chest	AP	<0.01	<0.01
Chest	PA	<0.01	<0.01
Upper or lower extremity		0.01	
Thoracic Spine	PA	<0.01	0.01
Thoracic Spine	AP	<0.01	0.03
Skull		0.04	
Chest Helical			0.13
Pulmonary perfusion 3mCi (^{99m} Tc) MAA		0.18	
Mammogram	Cc and Lat. (4films)		0.20
Intravenous Pyelogram (IVP)	Lat.		0.37
Pulmonary Ventilation (Xenon) 10mCi (¹³³ Xe) ⁶		0.40	
CT Head (10slices with slices thickness=10 mm)			<0.50
Pulmonary angiography Brachial route			<0.50
Hip	Lat.		0.51
Hepatobiliary 5mCi ^{99m} Tc Sulfur Colloid			0.55
Upper GI Series			0.56
CT Chest (10slices with slices thickness=10 mm)			<1.00
Intravenous Pyelogram (IVP)	PA		1.04
Hip	AP		1.40
Hepatobiliary 5mCi ^{99m} Tc HIDA			1.50
Pulmonary perfusion (Technetium) 5mCi (^{99m} Tc) MAA		1.75	
Intravenous Pyelogram (IVP)	AP		2.64

Abdomen	PA	1.30	3.00
Lumber Spine	Lat.	0.91	3.50
Pulmonary angiography femoral route			3.74
Abdomen	AP	2.90	15.00
Small bowel series with upper GI			21.30
Pelvis	AP	3.40	22.00
CT Abdomen(10slices with slices thickness=10 mm)			26.00
Lumber Spine	AP	7.50	40.00
Barium enema		10.00	130.00
Iodine (¹³¹ I), at fetal thyroid tissue at 20weeks gestation (By the use of radioactive isotopes of Iodine is contraindicated in pregnancy)			5900.00

Table 1: Maximum estimated fetal dose during some common diagnostic imaging studies.

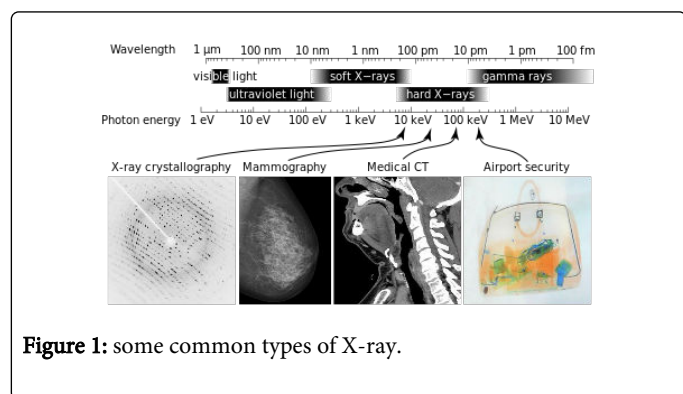


Figure 1: some common types of X-ray.



Figure 2: X-ray during Pregnancy.

Discussions

Radiation-Induced noncancer health effects are not detectable for fetal doses below 40-50 mGy (1mGy=100rads). Radiation greater than or equal to 100 mGy of noncancer health effect may be expected to have the most significant effects between the gestational ages of 8-25 weeks. Ionizing doses of greater than 100 mGy are not commonly reached with fluoroscopic procedures such as barium enema, or with radiotherapy. The table below illustrated an experimental minimum and maximum doses recommended for women during developmental stages in pregnancy.

During X-ray examination, Women should always inform the physician and X-ray technologist if there is any possibility that they are

pregnant. Many imaging tests are not performed during pregnancy so as not to expose the fetus or embryo to radiation. If an X-ray is necessary, precautions will be taken to minimize radiation exposure to the baby.

Conclusion

X-rays is an electromagnetic radiation that exposes into an object for imaging. In human it has an advantages as well as disadvantages. It plays a vital role in medical purposes for given healthcare personnel information about numerous medical conditions and for identification of fractures in metal to the industries also for investigation of hidden objects in airport and other security agencies.

Experimental views showed that 100 mGy radiation exposed on 2 weeks gestation may lead to the death of embryo. However, 5000 mGy can kill almost 100% human embryos or fetuses before 18 weeks' gestation. For fetuses of 8-15 weeks gestation, atomic bomb survivor data illustrated that, it can decline an IQ score of about 25-31 points per 1000 mGy while above can lead to the 40% risk for severe mental retardation.

Also for 16-25 weeks gestation an average of IQ loss is about 13-21 points per 1000 mGy at doses above 700 mGy. For 26 weeks, doses above 1000 mGy may have the risk of neonatal death (death of the Infant 4 weeks after birth) or can cause severe cancer for 0-15 years of ages.

Recommendation

Radiation-Induced noncancer health effects are unlikely at stages of developmental no matter what the radiation dose, where necessary detail explanation has to be made to the patient. For medical workers, a missed period in a regularly menstruating woman should be counted as a pregnant woman, until evidence appear after test, and the pregnant medical radiation workers can work in a radiation environment only if and only if the fetal dose can be kept below 1 mGy during pregnancy.

For dental, plain films of the head, chest including mammograms X-rays for pregnant women has no risk to their fetus of miscarriage, fetal growth restriction, congenital malformation or mental

retardation. However, for Abdomen, there is tendency of all the listed effects above if the doses are equal or greater than 500 mGy.

Acknowledgments

Author is thankful to the Postgraduate school Universiti Sultan Zainal Abidin for the provision of all the required facilities, including transportation for visiting all the hospitals and clinics for further consultations and all other responsible peoples that help in one way or the others such as Prof. Dr. Mohd Ekhwan bin Toriman, Prof. Dr. Muhd Barzani Gasim and ASS. Prof. Dr. Hafizan Juahir.

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