


<h2>Safety and Concerns of Diagnostic Imaging Utilisation during Pregnancy</h2>		Healthcare
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Abstract

Pregnancy is special situation where human body of pregnant woman undergoes various physiological changes. These changes are complex and involve in a way all anatomical systems. Medical care during pregnancy is interesting and often challenging as it often engages medical management and diagnostic procedures that can place at risk the fetus and the mother as well. Diagnostic imaging modalities are available for diagnostic use during pregnancy. These include X-ray, ultrasonography, magnetic resonance imaging (MRI), and computed tomography (CT), and other modalities as well. Ultrasonography so far is the most common diagnostic imaging modality used during pregnancy; however, other modalities may be required to be employed. Diagnostic X-ray is the most frequent cause of anxiety for obstetricians and patients as well. To a great extent of this concern is secondary to a general belief that any radiation exposure is harmful and will result in an anomalous fetus. This anxiety could lead to inappropriate therapeutic abortion and lawsuit. Actually, most diagnostic radiologic procedures are associated with little, if any, known significant fetal risks. The concern and anxiety among obstetricians, physicians in general and patients as well is present in almost all of them in Albania, though, concerns of this kind exist even in well organised medical systems in developed countries. Having mentioned that, however, in latter one they are isolated cases as physicians are well informed as medical specialists work in close collaboration with interdisciplinary approach of health care delivery as a team. On the other hand, patient education is a great tool in transmitting proper professional information to interested population in regards of this matter. Conclusions: Since according to the American College of Radiology and American College of Obstetricians and Gynecologists, no single diagnostic X-ray procedure results in radiation exposure to a degree that would threaten the well-being of the developing preembryo, embryo, or fetus, Albanian physician must counsel patients appropriately about the potential risks and measures that can reduce diagnostic X-ray exposure.

Introduction

Pregnancy is special situation where human body of pregnant woman undergoes various physiological changes. These changes are complex and involve in a way all anatomical systems. Medical care during pregnancy is interesting and often challenging as it often engages medical management and diagnostic procedures can put at risk the fetus and the mother as well. Diagnostic imaging modalities are available for diagnostic use during pregnancy. These include X-ray, ultrasonography, magnetic resonance imaging (MRI), and computed tomography (CT). Ultrasonography so far is the most common diagnostic imaging modality used, however other modalities may be used required to be employed. Diagnostic X-ray is the most frequent cause of anxiety for obstetricians and patients as well. To a great extent of this concern is secondary to a general belief that any radiation exposure is harmful and will result in an anomalous fetus. This anxiety could lead to inappropriate therapeutic abortion and lawsuit.

Pregnant woman undergoing a single diagnostic X-ray procedure does not result in radiation exposure adequate amount to threaten the well-being of the developing preembryo, embryo, or fetus and is not an indication for therapeutic abortion.^{1,2} When multiple diagnostic X-rays are anticipated during pregnancy, imaging procedures not associated with ionizing radiation, such as ultrasonography and magnetic resonance imaging, should be considered. In addition, it may be helpful to consult an medical expert in dosimetry calculation to determine estimated fetal dose.^{1,2,4} The use of radioactive isotopes of iodine is contraindicated for therapeutic use during pregnancy.⁴ Other radiopaque and paramagnetic contrast agents have not been studied in humans, but animal studies suggest that these agents are unlikely to cause harm to the developing human fetus.⁴ Although imaging techniques requiring these agents may be diagnostically beneficial, these techniques should be used during pregnancy only if potential benefits justify potential risks to the fetus.^{1,2,3,4}

Discussion

The concern and anxiety among obstetrician, physician in general and patients as well is present in almost all of them in Albania, though, concerns of this kind exist even in well organised medical systems in developed countries. Having mentioned that, however, in latter one, they are isolated cases as physicians and obstetricians are well informed as medical specialists work in close collaboration as interdisciplinary approach of health care delivery as a team. On the other hand, patient education is a great tool in transmitting proper professional information to interested population in regards of this matter.

When a pregnant woman considers any radiation exposure, the most prominent question in her mind is likely to be, “Is this safe for my baby?” To answer this question, the clinician must vigilantly choose words that will help a patient comprehend the real, although very small, risks of exposure. Careful consideration must also be given to the parents' potential emotional confusion at the thought of placing their infant at any increased risk, however small.

In the general population's total risk of spontaneous abortion, major malformations, mental retardation and childhood malignancy according to various studies is approximately 286 per 1,000 deliveries.⁵ Exposing a fetus to 0.50 rad adds only about 0.17 cases per 1,000 deliveries to this baseline rate, or about one additional case in 6,000.^{5, 6} However, if numbers like these are quoted to patients, they are likely to hear only the words; *risk*, *abortion*, and *mental retardation*. This situation emphasizes the challenge that doctors face in ensuring good quality communication during counseling.

Safety is not an absolute term when it comes to medical sciences, but one that physicians and medical specialists should not be afraid to use. When a radiographic study is needed for appropriate management of a pregnant patient, the American College of Radiology and American College of Obstetricians and Gynecologists recommend that; health care professionals should inform patients that x-rays are safe and provide patients with a clear explanation of the benefits of x-ray examinations.^{1, 2}

One tool that physicians may consider using to reassure patients is *Figure 1*, which graphically compares the dosage of radiation provided by various common diagnostic studies or environmental sources with the accepted limit of 5 rad. A patient's particular study could be also plotted on this graph, showing the clear margin of safety that exists for all single diagnostic studies.

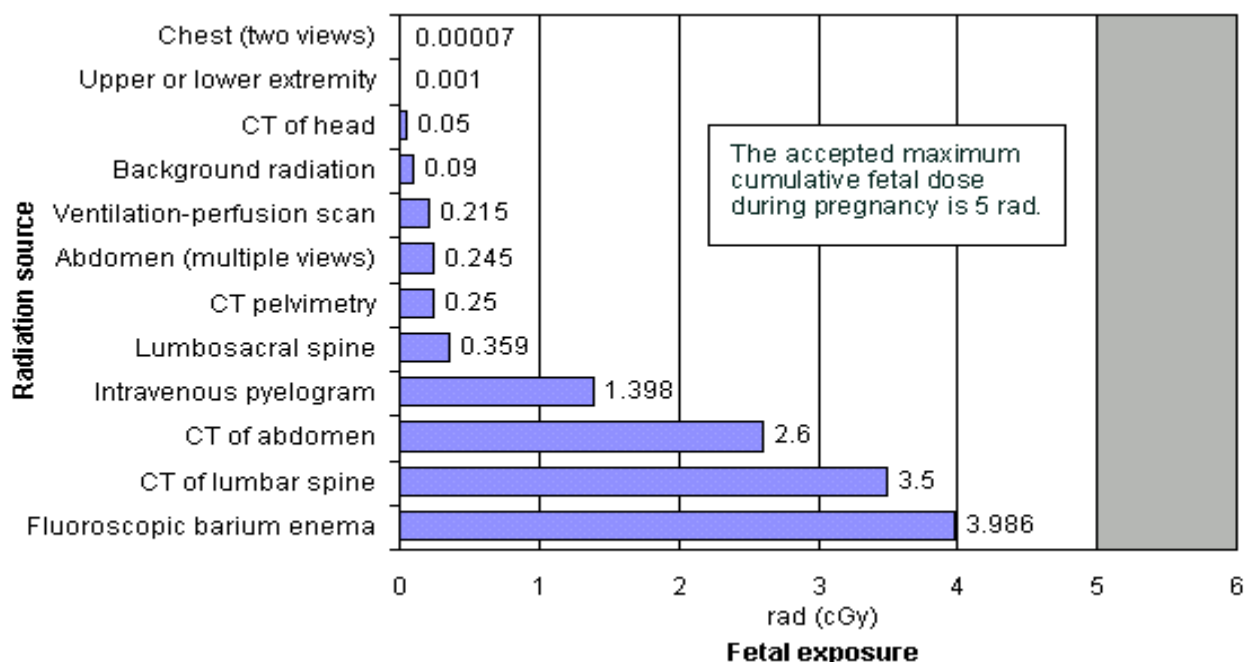


Figure 1. Graphic comparison of common radiographic studies with the accepted 5-rad cumulative fetal exposure limit. (CT = computed tomographic; Gy = gray). The American College of Radiology and American College of Obstetricians and Gynecologists.

As part of patient medical information and counseling, physicians should help patients understand that birth anomalies frequently occur spontaneously, with no identifiable cause. Statistics show that among the general population, in 4 to 6 percent of all deliveries, some spontaneous malformation is present.² For this reason, it is important never to promise parents a perfect baby. Radiation from diagnostic x-rays is exceedingly unlikely to cause harm to a fetus.^{1, 2} So far, if after any exposure an anomaly is found, a parent's natural inclination may be to blame radiation, and it will then be difficult to help them understand baseline malformation rates. For example, one author reported on a case of a woman who nearly instituted legal action because of mild syndactyly of her infant's fourth and fifth fingers after third-trimester dental radiographs (exposure 0.0001 rad or less).² This case of syndactyly was almost certainly coincidental, and yet it appeared that the mother had difficulty understanding or accepting this explanation.

According various studies and American College of Radiology and American College of Obstetricians and Gynecologists recommendaions, diagnostic x-rays during pregnancy are considered safe, yet physicians should use reasonable caution while remaining sensitive to patients' fears and concerns. As with all patient care, good communication promotes a trusting relationship. Unexpected outcomes often lead to anger and legal action. Thus, a based on fact discussion of the nature of the planned

examination and its potential outcomes, and documenting consent are appropriate steps before ordering a study. Asking non pregnant women with child-bearing potential about the possibility of pregnancy is also an important approach to avoid unpleasant surprises.

Women exposed to radiation exceeding a cumulative dose of 5 rad and those with particular concerns about their infant's health may require further evaluation or referral. A radiation physicist can calculate the estimated dose of radiation to the fetus to assist in patient counseling.

These days where technology application is important part of our day to day life, it is impossible to avoid the radiation exposure in general. This comes from common appliances and communication equipment, such as microwave ovens, radios, televisions, radar, high-voltage power lines, certain burglar alarms, long-distance telephone and telegraph transmissions, electric blankets, heated water beds, taxi dispatch lines, satellite communications towers, video display terminals, automatic garage door openers, and electric toys. There's just no way to avoid most of this.

In Albania, we do lack in patient education programs and we are far way of well organised medical system where appropriate and professional patient information is delivered in properly institutionalized way.

Ultrasonography involves the use of sound waves and is not a form of ionizing radiation. There have been no reports of documented adverse fetal effects for diagnostic ultrasound procedures, including duplex Doppler imaging. Energy exposure from ultrasonography has been arbitrarily limited to 94 mW/cm² by the U.S. Food and Drug Administration. There are no contraindications to ultrasound procedures during pregnancy, and this modality has largely replaced X-ray as the primary method of fetal imaging during pregnancy.^{1, 2,8,9} Magnetic Resonance Imaging - MRI, magnets that alter the energy state of hydrogen protons are used instead of ionizing radiation. This technique could prove especially useful for diagnosis and evaluation of fetal central nervous system anomalies and placental abnormalities (eg, accreta, previa).^{1,2,8,9} A plain X-ray generally exposes the fetus to very small amounts of radiation. Commonly during pregnancy, the uterus is shielded for nonpelvic procedures. With the exception of barium enema or small bowel series, most fluoroscopic examinations result in fetal exposure of millirads. Radiation exposure from computed tomography (CT) varies depending on the number and spacing of adjacent image sections. Although CT pelvimetry can result in fetal exposures as high as 1.5 rad, exposure can be reduced to approximately 250 mrad (including fetal gonad exposure) by using a low-exposure technique.^{1,2,8,9}

Conclusions

Diagnostic Imaging examinations in areas of the body other than the abdomen and pelvis deliver minimal radiation doses to the fetus. Women who undertake dental x-rays, plain films of the head, extremities, and chest (including mammograms), or computed tomography (CT) of the head or chest may be counseled that there is no increased risk to their fetus of miscarriage, fetal growth restriction, congenital malformation (e.g. microcephaly), or mental retardation. A pregnant woman who is ill and requires radiographic imaging faces potential risks from her disease to her own health as well as that of her developing infant's. These risks almost always outweigh the minor hazards posed by low-dose radiation exposure. Physicians should not hesitate to order a study if an appropriate work-up of the mother requires a specific test to guide diagnosis and treatment.

References

1. Gray JE. Safety (risk) of diagnostic radiology exposures. In: American College of Radiology. Radiation risk: a primer. Reston, Va.: American College of Radiology, 1996.
2. American College of Obstetricians and Gynecologists, Committee on Obstetric Practice. Guidelines for diagnostic imaging during pregnancy. ACOG Committee opinion no. 158. Washington, D.C.: ACOG, 1995.
3. Hall EJ. Scientific view of low-level radiation risks. *Radiographics*. 1991;11:509–18.
4. Bentur Y, Horlatsch N, Koren G. Exposure to ionizing radiation during pregnancy: perception of teratogenic risk and outcome. *Teratology*. 1991;43:109–12.
5. Valentin J, Editor, Annals of the ICRP, Publication 84: Pregnancy and Medical Radiation, International Commission on Radiological Protection, Volume 30, No. 1. Tarrytown, New York: Pergamon, Elsevier Science, Inc., 2000.
6. Wagner LK, Lester RG, Saldana LR. Exposure of the Pregnant Patient to Diagnostic Radiations: A Guide to Medical Management, 2nd ed. Madison, Wisconsin: Medical Physics Publishing; 1997.
7. 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.
8. William's Obstetrics Twenty-Second Ed. *Cunningham, F. Gary, et al, Ch. 41*.
9. International Commission on Radiological Protection. Pregnancy and medical radiation. *Ann ICRP* 2000; 30: 1–43