

# MOTHERISK UPDATE

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## Ionizing radiation during pregnancy

### ABSTRACT

**QUESTION** One of my patients had a computed tomography scan of her abdomen a week ago and has just found out she is 7 weeks pregnant. What should I tell her about the pregnancy and the risk to her fetus?

**ANSWER** Your patient is not at increased risk of miscarriage or major congenital fetal malformations due to radiation exposure. Her risk is similar to that of the general population (ie, 1% to 3%).

### RÉSUMÉ

**QUESTION** L'une de mes patientes a subi une tomographie assistée par ordinateur de l'abdomen il y a une semaine et vient d'apprendre qu'elle est enceinte de sept semaines. Que devrais-je lui dire à propos de sa grossesse et des risques pour le fœtus?

**RÉPONSE** Votre patiente ne court pas de risque d'avortement spontané ou de malformations fœtales congénitales majeures en raison de l'exposition aux rayonnements. Les risques pour elle sont semblables à ceux de la population en général (c.-à-d. de 1% à 3%).

Ionizing radiation, a form of electromagnetic radiation, penetrates tissues deeply and could alter the components of a living cell. Everyone is exposed to background radiation from cosmic rays, soil, and air. Embryos usually receive less than 100 mrad during 9 months' gestation.<sup>1</sup>

Pregnancy is a major contraindication to radiodiagnostic procedures. Because 50% of pregnancies in North America are unplanned, many women are not aware they are pregnant during routine radiodiagnostic procedures.<sup>2</sup> The term radiation seems to alarm people. They seem to associate it with the known adverse biologic effects of the atomic bombs dropped on Hiroshima and Nagasaki during World War II and

the nuclear accident at Chernobyl in the Ukraine.<sup>1,3,4</sup>

Radiation is a dose-dependent teratogen. Below a certain threshold, radiation levels are similar in exposed populations and control populations who have received only background radiation.<sup>1</sup> A fetus is most vulnerable to radiation-induced central nervous system damage 8 to 15 weeks after conception (Table 1<sup>5</sup>).<sup>1</sup> Radiation from x-ray and CT scans is measured in

rad, rem, gray, and sievert (1 rad = 1 rem = 0.01 Gy = 0.01 Sv). Most diagnostic-imaging centres can specify the amount of radiation used for each patient; the fetal dose is calculated as that of the ovarian or uterine dose.

The United States Centers for Disease Control and Prevention's Radiation Safety Committee recommends that fetuses of laboratory workers not receive more than a cumulative dose of 500 mrad during the entire gestation period.<sup>6</sup> This occupational exposure guideline is one-tenth of the safe dose and should not be confused with the teratogenic-threshold dose.

Pregnant women exposed to <5000 mrad have similar pregnancy outcomes to controls who have received only

**D**o you have questions about the safety of drugs, chemicals, radiation, or infections in women who are pregnant or breastfeeding? We invite you to submit them to the Motherisk Program by fax at (416) 813-7562; they will be addressed in future Motherisk Updates. Published Motherisk Updates are available on the College of Family Physicians of Canada website ([www.cfpc.ca](http://www.cfpc.ca)). Some articles are published in *The Motherisk Newsletter* and on the Motherisk website ([www.motherisk.org](http://www.motherisk.org)) also.

Motherisk questions are prepared by the **Motherisk Team** at the Hospital for Sick Children in Toronto, Ont. **Dr Ratnapalan** and **Ms Bona** are members and **Dr Koren** is Director of the Motherisk Program. **Dr Koren**, a Senior Scientist at the Canadian Institutes for Health Research, is supported by the Research Leadership for Better Pharmacotherapy during Pregnancy and Lactation and, in part, by a grant from the Canadian Institutes for Health Research.

**Table 1. Effects of radiation exposure on prenatal development**

GESTATIONAL STAGE (DAYS AFTER CONCEPTION)	FETAL DOSE (RAD)	OBSERVED EFFECT
Preimplantation (0-14)	5-10	Animal data suggest possibility of prenatal death
Major organogenesis (8-56)	20-25	Animal and NBS data suggest this is the most sensitive stage for intrauterine growth retardation
Major organogenesis (14-105)		NBS data indicate small head size; those exposed at <8 weeks did not display intellectual deficit, even with small head. Most sensitive time for induction of childhood cancer
Rapid neuron development and migration (56-105)	>10	Small head size, seizures, decline in intellect (-25 IQ points/100 rad)
After organogenesis and rapid neuron development (105 to term)		
• Low dose	>10	Increased frequency of childhood cancer
• High dose	>50	Severe mental retardation observed at 16-25 weeks

Data from Parry et al.<sup>5</sup>

IQ—intelligence quotient, NBS—nuclear bombing survivors from Hiroshima and Nagasaki.

background radiation.<sup>1</sup> The United States National Council on Radiation Protection states that the risk of miscarriages, malignancies, or major congenital malformations in embryos or fetuses exposed to doses of 5000 mrad or less is negligible compared with the spontaneous risk in nonexposed fetuses.<sup>3,7</sup> Spontaneous risk includes a 15% chance of spontaneous abortion, a 3% risk of major malformations, and a 4% possibility of intrauterine growth retardation.<sup>3,7</sup>

Most radiodiagnostic examinations expose fetuses to less than 5000 mrad of radiation (**Table 2**). X-ray examination of the abdomen is associated with 250 mrad, and an abdominal CT scan with 3000 mrad.<sup>5</sup> There is no significant increase in major malformations in pregnant women inadvertently exposed to these radiation doses. These women should be reassured and counseled appropriately.<sup>3</sup> ♦

## References

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**Table 2. Estimated fetal radiation doses during some common radiodiagnostic procedures**

EXAMINATION	FETAL DOSE (MRAD)
X-RAY	
Upper gastrointestinal series	100
Cholecystography	100
Lumbar spine radiography	400
Pelvic radiography	200
Hip and femur radiography	300
Retrograde pyelography	600
Abdominal (kidneys, uterus, bladder) radiography	250
Lumbar spine,	
• Anteroposterior	750
• Lateral	91
• Oblique	100
Barium enema	1000
Intravenous pyelogram	480
COMPUTED TOMOGRAPHY	
Head	0
Chest	16
Abdomen	3000

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