and 5 prior CT abdomen studies will have the same theoretical radiation risk of developing cancer due to his 6th CT study as another 35-year-old male undergoing a CT abdomen for the first time for suspected pancreatitis. It is important to stop factoring prior CTs into the decision-making process, and educate our medical colleagues about the same.

Pediatric patients have been purported to be at a higher lifetime risk of developing radiation-associated cancer as they are assumed to be more radiosensitive (besides having a longer lifespan), leading to a special focus on them.[10] A few large epidemiological studies have famously observed a correlation between pediatric CTs and subsequent development of cancer.[12,13] However, these results have been questioned even by the NCRP chairman, and the association is likely due to reverse causation (patients who developed cancers were more likely to have had a CT scan due to the presence of predisposing syndromes such as myelodysplasia).[14] More recent studies in the pediatric patient population which adjusted for such factors, in fact, did not demonstrate any significant excess cancer risk.[15,16] A similar study in patients (both pediatric and adult population) who had undergone a CT head did not find an increased risk in the development of a meningioma in them, after excluding patients who already had a meningioma at the time of the first CT and those who had received radiation therapy.[17] Thus, it would be more prudent to again focus on radiation optimization rather than radiation reduction in pediatric patients.

A new theory published recently is about the increased risk of radiation caused by the iodinated contrast media itself within vessels and tissues when it interacts with the X-rays,[18] a theory that has been successfully challenged and debunked in the same issue of the journal.[19]

Conclusion

In conclusion, based on the current literature, the radiation risks for carcinogenesis are certainly no cause for concern, and are most likely non-existent. In fact, certain data suggests

- In patients with eGFR <30 ml/min/1.73 m^2, discontinue metformin at the time of scan and restart after 48 hours after a renal function test has been performed.
- Metformin can be continued in patients receiving gadolinium.

Dialysis

- Hemodialysis has no proven role in preventing post-contrast AKI. While contrast administration should be avoided if reasonable alternatives exist, contrast should not be withheld if there is a genuine clinical need for it.
- In patients on routine dialysis, correlation of contrast administration with the timing of hemodialysis is not necessary.
- In particular, do not hesitate in giving contrast in anuric CKD patients on dialysis, as there is no substantial remaining renal function present in them anyway to harm.
- Continuous ambulatory peritoneal dialysis patients do not need a hemodialysis session after IV iodinated contrast.

B. GADOLINIUM-BASED CONTRAST MEDIA

- Based on their chemical structure, gadolinium-based contrast agents are classified as either linear agents or macrocyclic agents. Linear agents are further classified as ionic or non-ionic agents (Table 2.2).
- With regards to stability, macrocyclic agents are more stable than linear ionic agents, which in turn are more stable than linear non-ionic agents.

Table 2.2: Linear ionic and non-ionic agents

Linear non-ionic	*Linear ionic*	*Macrocyclic*
Optimark	Magnevist	Dotarem
Omniscan	Multihance	Gadavist
Eovist	Prohance	

- Confirm the pregnancy status and weeks of gestation. If unsure, a pregnancy test must be performed prior to the examination.
- If the patient is pregnant, the indication and the specific examination for the indication must be justified. Discuss each case with the referring physician and assess the risk–benefit ratio. Check whether USG or non-contrast MRI will provide the required information. Be factual while explaining to the patient regarding the need for the study, the available options if any, and the risk–benefit ratio.
- Providing lead shielding to wrap the pelvis of the pregnant patient during a non-pelvic CT may help the emotional well-being of the patient, but the dose to the uterus (primarily from internal scatter radiation) is not materially altered by this shielding.

RISKS RELATED TO RADIATION EXPOSURE

- Fetal radiation risks can be stochastic or deterministic. The ACR and International Committee on Radiological Protection (ICRP) have published a table of *in utero* radiation-induced deterministic effects in the fetus depending on the gestational age and the degree of radiation exposure (Table 3.1).[2]
  a. Fetal radiation doses below 50 mGy is not known to cause fetal toxicity.
  b. Radiation exposure up to 100 mGy should not be considered a reason for terminating a pregnancy as per ACR and ICRP.
  c. Radiation doses above 100 mGy may result in a 1% combined increased risk of organ malformation and the development of childhood cancer.
- **Radiation exposure per procedure is usually much lower than 50 mGy for even major diagnostic studies like PET/CT; so performing CT should be safe in pregnancy when indicated.** Please refer to Table 1.1 in Chapter 1 for the estimated radiation doses to adults from common imaging examinations.

2. American College of Radiology. Radiation Dose to Adults from Common Imaging Examinations. https://www.acr.org/~/media/ACR/Documents/PDF/QualitySafety/Radiation-Safety/Dose-Reference-Card.pdf. Accessed on 28.6.17
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