Children and Radiation

Think twice before ordering that CT scan

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The popular media is full of articles about the risk of cancer from medical imaging radiation exposure—but is this a real risk? Or is it just hype?

CT scanning, introduced in the 1970s, represented a great advance in medical imaging. The ability to see detail and three-dimensional images provides great benefits both diagnostically and therapeutically. But CT scans require ionizing radiation in doses ranging from a few millisieverts (mSv) to more than 50 mSv for each study. Because this has been perceived as a relatively small amount of radiation exposure per study, little attention was paid to its potential negative effects until recently.

The new focus on the potential biological effects of ionizing radiation comes from the dramatic rise of the use of CTs and other high-radiation dose studies such nuclear cardiology studies and angiography. From the introduction of CT scans until around 1996, the number of these procedures increased dramatically to an estimated 62 million per year with many people having multiple studies. Of the 62 million studies performed in 1996, an estimated 4 million were performed on children.[1] Between 1996 and 2005, the numbers of CT scans doubled in children less than 5 years old and tripled in children between 5 and 14.[2] Though total scans began to decline in mid-decade, in 2011 of the 85 million CT scans done, it is estimated that between 4.5 million and 9.3 million were done in children.[3]

There are several reasons to be concerned about ionizing radiation exposure, particularly in children in whom several studies have identified a measureable projected and observed increased risk of both solid cancers and leukemias.[4-6] Younger patients and female patients of all ages are at highest risk. The most common CT scans in children are head, abdomen/pelvis, chest and spine. A recent Australian study that followed, for a mean of 9.5 years, 680,211 children who had CT scans and compared them to more than 10 million non-scanned children in the same age cohort and found a 24 percent higher risk of cancer in the CT scanned children (after accounting for age, sex, and year of birth). Of the 608 excess cancers in this group, 147 were brain, 356 were other solid tumors, 48 were leukemia or myelodysplasia and 47 were other lymphoid.[5]

A U.S. study performed across seven U.S. healthcare systems identified CT scans in children younger than 16, calculated the radiation doses delivered, and projected lifetime attributable cancer risk using the model proposed in the 2006 Biological Effects of Ionizing Radiation VII (BEIR VII) report.[7] This model projects that for girls, one solid-organ cancer will result from: every 300 – 390 abdomen/pelvis scans and from every 330 to 480 chest scans and from every 270 to 800 spine scans. Brain CTs were projected to result in 1.9 leukemias/10,000 scans. Overall, a year's worth of pediatric CT scans (using a figure of 4 million scans per year) will ultimately result in 4,870 future cancers.[2]

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Children generally should be scanned with lower doses of ionizing radiation because of their small body sizes following the As Low As is Reasonably Achievable (ALARA) concepts as defined in the U.S Nuclear Regulatory Commission, Title 10, Section 20.1003, of the *Code of Federal Regulations*.[8] Reducing dosages likely could result in almost a 50 percent reduction in the cancer risk.[2] Cancer risk from ionizing radiation is cumulative; multiple scans throughout one's life add to risk, no matter how many years intervene between scans. So children, who may have multiple additional scans throughout life, are already fighting an uphill battle. It is critical to always assess potential of alternative studies not using ionizing radiation that will provide the diagnostic or therapeutic information needed. An ultrasound, for example, can identify many intra-abdominal issues including appendicitis, one of the most common reasons for ordering abdomen/pelvis CTs. Brain MRI, which has only a few contraindications, has in nearly all cases at least the same diagnostic value as a Brain CT.

Before you order a CT scan, ask yourself:

- Is there an alternative study that may provide the same information as a CT scan?
- Is there a clear indication for any study? *(For example, American Board of Internal Medicine Foundation's Choosing Wisely lists[9] suggest there is no proven benefit to brain studies for simple febrile seizures, syncope, mild head injuries, or stable migraine headaches)*
- How will the results of this study impact management of this patient?

To find out what the radiation dose a specific study is likely to deliver to your patient, check out the radiation calculator available at www.RadiationCalculator.com as well as an App on both Android and Apple devices. Just enter the patient's age, gender, test and body part and the dose will auto calculate. The site also has a wealth of information about radiation exposure. NIA also launched RadZoneKids.com, an inventive web tool that provides an interactive way for parents and their children to learn how to best prepare for various radiology tests, including CT scans, MRI scans and X-rays.

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3. *IMV Medial Information Division. IMV CT Market Outlook Report. IMV Medical Information Division; Des Plaines, IL: 2012. 2012.*
4. *Pearce MS, Salotti JA, Little MP, et al. Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: a retrospective cohort study. Lancet 2012; 380(9840): 499-505.*
5. *Mathews JD, Forsythe AV, Brady Z, et al. Cancer risk in 680,000 people exposed to computed tomography scans in childhood or adolescence: data linkage study of 11 million Australians. BMJ 2013: 346:f2360.*
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7. *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2. The National Academies Press; Washington, D.C.: 2006. Committee to Assess Health Risks from Exposure to Low Levels of Ionizing Radiation and National Research Council.*
8. *http://www.nrc.gov/reading-rm/basic-ref/glossary/alara.html Accessed March 23, 2015.*
9. *http://www.choosingwisely.org/ Accessed March 23, 2015.*

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