Letters to the Editor

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Radiation Risk of Body CT: What to Tell Our Patients and Other Questions

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Editor:

The statistical analysis of radiation risk associated with screening computed tomography (CT) by Drs Brenner and Elliston in the September 2004 issue of *Radiology* (1) raises a number of serious questions.

1. The authors argue the risk of dying from a radiation-induced cancer to be 0.08% from a single whole-body screening CT examination, with the majority of the risk coming from lung cancer inductions. They point out that this is greater than the risk of dying in a traffic accident, though they do not compare it with the risk of dying of cancers that might be found in a screening CT examination.

2. While the authors compare the radiation dose of screening CT with that of mammography, a screening study with which it does not compete, they do not compare it with the radiation dose of barium enema, a screening technique that the American College of Radiology supports in the early detection of colon cancer with which CT colonography competes directly. Is a screening whole-body CT examination associated with more or less radiation exposure than a double-contrast barium enema with 3 minutes of fluoroscopy time and acquisition of eight overhead abdominal radiographs? How does the risk of death associated with radiation-induced cancers from screening whole-body CT compare with the risk of death associated with screening colonoscopy (after adjusting for the fact that deaths from colonoscopy-induced bowel perforation or conscious sedation complications occur acutely, not after many years)?

3. At root, radiation risk does not distinguish screening CT from standard CT, which makes up a large component of every radiologist's practice. The studies are instead distinguished by how the patient arranged for the study: Did he or she desire it themselves, or was it ordered by a referring physician? If anything, screening CT may be associated with less radiation risk, because some screening CT protocols, especially for lung cancer, involve lower than standard radiation dose. So if a single screening CT examination of the body causes radiation exposure in the ballpark of that created by standing 1 mile away from the Hiroshima and Nagasaki atomic bomb attacks (as a newspaper summary of the authors' article reports), what should we be telling our patients, by way of informed consent, about the risks of routinely ordered CT?

4. Granted, routinely ordered CT involves a patient with a complaint, but radiologists, more than most medical specialists, are well aware of how flimsy that clinical indication can be: "Vague abdominal pain" gets you abdominopelvic CT; "cough" gets you chest CT. If the risk of even one such CT examination (to say nothing of the not infrequently requested follow-up CT examinations) is associated with a statistically measurable rate of cancer increase, how much additional time should radiologists spend beyond their current practice patterns in preassessing the clinical indications for CT and ensuring that both ordering physician and patient are aware of and comfortable with this radiation risk and that other modalities without ionizing radiation, such as ultrasonography or magnetic resonance imaging, cannot be substituted? I am sure the authors appreciate that, in our litigious times, their article forces us all to reassess that issue.

5. This last point is especially compounded by *(a)* the large percentage of CT examinations reported as having normal findings or only minor abnormalities, and *(b)* the work-up of abnormalities found incidentally. As for the former issue, that must mean either that radiologists as a group miss a lot of abnormalities or (more reasonably) that these studies are "overordered." Overordering a study—that is, ordering a study even if one's pretest probability is very low—may be reasonable if the risk of harm associated with being wrong is high or if the patient is highly risk averse (technically, this assumes the patient actually pays for the study himself, and therefore costs and benefits can be compared directly because they accrue to the same person, an assumption that is largely true of screening CT but not of standard CT). Given the authors' results, however, do they think that this common approach of "let's just see what CT shows to be safe" needs to be radically rethought?

6. As for the incidentally found lesion, if follow-up CT is associated with a significant chance of causing cancer in those who would otherwise not have cancer, perhaps we need to rethink how we follow small incidentally found renal, liver, and adrenal masses. Should we never recommend repeat CT in, for example, 6 months?

7. Finally, what implications does this study have for CT angiography, where a large data set is created, perhaps over as large a volume as from the diaphragm to the ankles, or the aortic arch to the vertex? The anatomic volume scanned for CT aortography and runoff exceeds that of routine body screening CT. Should these studies be abandoned in all patients capable of undergoing MR angiography?

Reference

1. Brenner DJ, Elliston CD. Estimated radiation risks potentially associated with full-body CT screening. Radiology 2004; 232: 735–738.

Drs Brenner and Elliston respond:

Dr Levatter raises a number of interesting and important issues with regard to full-body CT screening, some of which are specific to this examination, and some of which relate to broader questions of CT utilization.

1. Benefits versus risks: Dr Levatter is quite right that, while we attempted to estimate the radiation-related risks of full-body CT (1), we did not provide a quantification of the potential benefits of this screening procedure. We would love to have discussed the benefits of full-body CT screening, but the fact is that there are no clinical studies, small or large, randomized or nonrandomized, that address this issue, to our knowledge. We very much hope that the current publicity on full-body CT screening might stimulate such studies.

2. Comparison with barium enema screening: A typical effective dose from a double-contrast barium enema procedure is around 7 mSv (2), about half that from a typical full-body CT examination (1). However, the radiation-related cancer risks from a double-contrast barium enema procedure are probably much lower than from full-body CT. This is in part because of the lower doses, but much more because the lung, which is the organ most sensitive to radiogenic cancer in the mature adult, is exposed to a low dose from a double-contrast barium enema (3) when compared with that in a full-body CT examination (1).

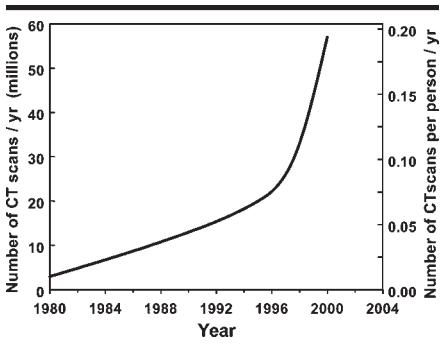
3. Diagnostic versus screening CT: Generally, though not always, the overall risk will be lower for diagnostic CT versus full-body screening CT, simply because fewer organs are exposed. The other dosimetric issue is, of course, that screening CT must involve regular examinations, with an inherent increase in dose purely due to the number of examinations performed during an individual's lifetime. In contrast, diagnostic CT typically involves one or just a few examinations (4).

The essential issue here is the benefit-to-risk ratio. For most diagnostic CT examinations, the benefits are clear—accurate diagnosis—so the benefit-to-risk ratio should always be very large. By contrast, the benefit-to-risk ratio for full-body screening is unknown: We know that full-body CT examinations are associated with cancer-induction risks (1), and we also know that there are potential downsides in terms of false-positive findings (5), but we know virtually nothing about the potential benefits of full-body CT screening.

4.–6. Diagnostic CT utilization: Despite the fact that most diagnostic CT examinations are associated with a large benefit-to-risk ratio, *we* agree with Dr Levatter that there is a strong case to be made that too many CT examinations are currently being performed in the United States. As illustrated in the Figure, the number of CT examinations in the US is increasing at an extraordinary rate, such that probably well over 60 million CT examinations will be performed in the United States this year. The rate of increase of CT examinations is probably even higher in children, who are more sensitive to radiation-induced cancer (6).

Could or should this rapid increase in diagnostic CT utilization be slowed or reversed? A recent straw poll of pediatric radiologists suggested that perhaps 30% of pediatric CT examinations could be replaced by alternate approaches (7). A case in point is the ongoing debate regarding the use of CT as a primary diagnostic tool for acute pediatric appendicitis (8–10).

Part of the issue, we would argue, is that physicians often do not view CT examinations in a different light from other radiologic procedures, despite the fact that CT-related doses



Graph shows the increase in the estimated number of CT examinations performed in the United States between 1980 and 2000 (based on data in references 15–18).

are typically much higher—high enough that there is direct evidence of increased cancer risks at these doses in survivors of the atomic bomb (11). In this light, the short pamphlet on "Radiation and Pediatric Computed Tomography: A Guide for Health Care Providers" (12), which was circulated recently among the medical community by the National Cancer Institute and the Society for Pediatric Radiology, is most welcome.

7. CT angiography and easy availability of CT: The use of CT angiography is increasing rapidly, as it generally produces lower doses than those with conventional digital subtraction angiography (13). Coupled with the fact that CT angiography is quicker, less invasive, and probably more cost-effective than conventional angiography (14), this seems an admirable development.

The point of concern, however, which applies more generally to all diagnostic CT, is encapsulated by a comment in a recent editorial on CT angiography (13): "Due to its easier availability, CT of the pulmonary arteries may, however, be used more liberally in patients with low clinical suspicion." This trend toward a somewhat less selective use of diagnostic CT, for better or worse, has clearly occurred in many different applications of CT and is in considerable part responsible for the dramatic increase in CT utilization shown in the Figure.

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