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Radiation and Chest CT Scans

Are There Problems? What Should We Do?

Advanced radiologic imaging, such as the CT scan, has revolutionized medical practice in a quite fundamental and extremely beneficial manner. CT scanning contributes to more effective surgeries, elimination of many exploratory surgeries, earlier and better treatment of cancer, more efficient treatment of trauma, and better management of stroke and cardiac disease. But, like almost all medical practices, radiologic imaging has both benefits and risks, and the challenge is to provide the patient with the best possible benefit/risk balance.[1]

The average radiation dose to which we are exposed in the United States has more than doubled over the past 30 years.[2] The radiation dose from natural background sources has not changed, but that from medical imaging has increased about sevenfold. As Sarma et al[3] point out in their comprehensive review in this issue of *CHEST* (see page 750), by far the biggest contributor to this dramatic increase in population exposure is the CT scan. In 1980, fewer than 3 million CT scans were performed in the United States, but the annual number is now >85 million and increasing by about 6% per year. Because CT scanning effectively involves acquiring many images, CT scanning results in a much larger radiation dose to the patient than, say, a conventional chest radiograph. Although CT scanning is responsible for most of the rapid increase in population exposure from medical imaging, we can also predict with some confidence that newer advanced radiographic imaging modalities, such as PET/CT scan, single-photon emission CT scan, and CT scan screening of asymptomatic patients, will increase the population exposure still further.[1]

Quantifying radiation-induced cancer risks at very low radiation doses is not at all easy,[4] but there is strong evidence at the doses relevant to CT scanning that the risks of radiation carcinogenesis are real, though small for any individual.[4] While there had been much indirect evidence, based on atomic-bomb survivors exposed to low doses, there is now direct evidence of small but statistically significant increased cancer risks, based on studies of 175,000 patients who received CT scans at young ages between 1975 and 2002.[5] The concern arises when an increasingly large population is exposed to small individual risks.[6] Regardless of their actual magnitude, these population risks would undoubtedly be reduced if radiation doses were optimized for each procedure and if medically unnecessary imaging examinations were minimized.

As Sarma et al[3] point out, many aspects of CT scan use have improved considerably over the past decade, in particular technological advances to minimize the radiation dose per scan. Nevertheless, there are three serious issues—quality control, training, and, particularly, overuse—that urgently need addressing.

Quality Control and Assurance

Recent incidents in which several hundred patients received significant radiation overdoses from CT scans[7] suggest that quality control is, at the very least, uneven in US medical imaging facilities. It is striking that radiation doses from identical CT procedures can vary by as much as a factor of 10 from facility to facility and even within facilities.[8] Some recent voluntary initiatives by the US Food and Drug Administration are welcome in this regard,[7] and such initiatives, together with the past legislative experience with mammography, suggest an effective way forward: The Mammography Quality Standards Act (MQSA) of 1992 was designed to require regulatory compliance with what previously were voluntary quality control and accreditation standards. Mammography quality control has significantly improved since the MQSA legislation was enacted,[9] and it, therefore, represents a regulatory paradigm that should be seriously considered in regard to all medical imaging facilities.

Training

In the United States, no training beyond that required for an MD degree is required for any physician to prescribe any diagnostic radiographic examination. Yet the amount of radiologic training in medical school curricula is very limited. Moreover, as new imaging modalities are introduced, there is no mechanism for ensuring that practitioners are trained in their

prescription or use. Again taking a leaf from the mammography legislation, it should be mandatory that all parties associated with the practice of radiologic imaging, from the prescribing physician to the interpreting physician to the physicist to the technologist, should receive continuous education specifically focused on modern imaging techniques.

Overuse

CT scanning is indispensable in many aspects of clinical medicine. Nevertheless, convincing evidence suggests that a significant fraction of the about 85 million CT scans currently performed each year in the United States do not have adequate medical justification.[1,3,6] The quantitative evidence for this comes largely from comparing actual CT scan use with the CT scan use that would be expected if clinical decision guidelines for CT use were followed: As Sarma et al[3] point out, somewhere in the range from 25% to 45% of CT scans could probably be avoided if clinical decision guidelines were followed, and without compromising patient care. Reducing the number of CT scans that are not clinically justified is not easy, because a variety of pressures are pushing in the other direction, including throughput, legal and economic considerations, and patient preference. A key here is use of decision rules, providing broad guidance as to when a CT scan is appropriate.[10] But decision rules are not helpful if they are not used—and a study suggest that physicians use Google five times more often than American College of Radiology appropriateness criteria in making imaging decisions.[11] One successful approach that has increased use of CT scanning decision guidelines has been to incorporate them into the computerized systems used to order CT scans.[12] But unless such computerized decision support is widely implemented, it will not have a major impact.

Conclusions

In summary, there are potential solutions, then, to the main issues in the field of CT scan radiation exposure of quality control, training, and overuse. Are these solutions likely to be widely implemented in the foreseeable future, or, alternatively, should they be incorporated into a regulatory framework,[13] as was done with MQSA? Introducing more legislation into clinical medicine should not be undertaken lightly, but the continuing issues of quality control, lack of training, and overprescribing in medical imaging need to be addressed. Voluntary standards and accreditation have not been ineffective, but the positive experience in transitioning from voluntary mammography standards to the mandatory MQSA[9] suggests that well-crafted legislation applying to advanced radiologic imaging can benefit both patients and providers and, therefore, deserves serious consideration.

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