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### Dealing with the Risks of Medical Imaging



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Advances in radiology are invaluable — and fascinating — but the radiation exposure can be more than trivial.

DON'T GET ME WRONG.

As a family doctor, I think radiology is fascinating. As a medical student and resident, I relished field trips to the radiology department to see elusive diagnoses exposed on film. Now with electronic records and online radiology results, I enjoy toggling through online CT scan images from the convenience of my computer and dragging a “virtual” magnifying glass over suspicious infiltrates on chest films. Patients, of course, enjoy the technology, getting results, and having their problems taken seriously.

### Risks and Benefits

However, I am increasingly called upon to weigh the risks and benefits of medical interventions for my patients — whether it be checking a PSA, prescribing warfarin, or discussing hormone replacement. Two recent studies in the *New England Journal of Medicine* have given me pause about my radiological prescribing habits.<sup>1,2</sup> The following is a review of these studies and suggestions for ways we can decrease radiation exposure for patients.

In their 2007 study, Drs. Brenner and Hail examined epidemiological data from atomic bomb survivors and from 400,000 radiation workers in the nuclear industry to estimate the cancer risks from CT imaging in the United States.<sup>1</sup> The increased usage of CT imaging is striking: from 3 million scans in 1980 to over 62 million scans per year currently. An estimated 6–11 percent of scans are being done in children, often to rule out appendicitis.

The organ radiation dose from an adult abdominal CT is 10 millisieverts (mSv) whereas that from a single chest film is 0.01 mSv. Hence, the radiation is 1,000 times greater. Brenner and Hail conclude that “there is direct evidence from epidemiological studies that the organ doses corresponding to a common CT study (two or three scans, resulting in a dose in the range of 30 to 90 mSv) result in an increased risk of cancer. The evidence is reasonably convincing for adults and very convincing for children.”

Moreover, the authors calculated that up to 1.5 to 2 percent of all cancers in the United States may be attributable to the radiation from CT studies.<sup>1</sup> They cite a reference suggesting that up to 1/3 of CT scans are being done unnecessarily.<sup>3</sup> Among the root causes of over-imaging may be the convenience of scans; their use in quick, defensive medicine; and duplication of work in a fragmented healthcare system with poor communication.

They also cite surveys of emergency department and radiology physicians, a majority of whom answered that they did not believe CT scans increased the lifetime risk of cancer.<sup>4</sup>

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And reading the follow-up letter to the editor from a radiologist, others did not want to believe it either. Still, it was the reputable *New England Journal* I had read. I could not shake the image of someone sitting in a scanner and receiving the equivalent of 1,000 chest x-rays. I get a little anxious when my dentist wants to take films and those are small fry doses! Still, time passed and I continued to enjoy my magnifying glass on my computer.

### **Newer Data**

This year, in a retrospective cohort study, authors Fazel *et al.* examined claims data over a three year period on 952,420 nonelderly adult patients of UnitedHealthcare HMO.<sup>2</sup> “CT and nuclear imaging [mainly myocardial perfusion scanning] accounted for 21.0% of the total number of procedures and 75.4% of the total effective dose” of radiation during this time period. With this large sample size, the authors conclude that approximately 4 million nonelderly adult Americans are subjected to cumulative radiation doses exceeding 20 mSv per year which they consider in the “high” level.

In a table in the article, the highest doses of radiation per single procedure include myocardial perfusion imaging, CT chest angiography, and percutaneous coronary intervention — 15 mSv each, or approximately 700 chest films [these authors assigned a slightly higher dose of radiation to a plain chest film compared to the 2007 study]. One can only imagine the annual radiation doses in the Medicare population; perhaps researchers are mining that data as we speak.

I had to lean back in my chair and take a deep breath after this article. I see so many patients get their annual “Cardiolite” scan for atypical chest pain, or one or more CT scans of the abdomen for vague complaints. I have patients with small spots in their lungs who have serial CT scans ordered by their pulmonologist every several months for 2 years straight. How much is too much?

I am not pointing fingers. Most patients and doctors mean well. They both want a timely diagnosis using the latest medical technology — and let’s face it, we live in an “immediate gratification” society where watchful waiting is becoming less acceptable. Furthermore, we all have stories of a surprise finding on imaging that ended up changing the management of a patient’s condition. Nevertheless, a certain adage from medical school still rings true in my head: 80–90 percent of diagnoses come from the history and physical alone.

Despite many good intentions, there are some unfortunate forces at work that are contributing to the problem. I have seen ample duplication of tests done over the years due to my patients being “diverted” to other hospitals because our emergency department was full. I have had patients come in asking for scans with undertones of, “If you miss something, doc, by not ordering this test, there will be consequences,” along with a story about a family member whose diagnosis was “missed.”

Direct consumer marketing of coronary calcium scoring and whole body scans is big business with no proven benefit over traditional risk assessment.<sup>5</sup> Not only can they cause unnecessary worry with incidental findings, but they carry radiation risks.

Lastly, well-meaning radiologists — who work in a field high in liability risk — often dictate “cannot rule out

disease X, consider further imaging with study Y if clinically indicated.” As imaging has gotten precise down to the millimeter, we struggle to interpret the relevance of small and borderline findings.

## Tips to Minimize Radiation

As physicians, we took an oath to “first do no harm.” And while many may not agree on the magnitude of the harm of medical imaging and whether it outweighs the benefits, I think every physician would want to minimize radiation for themselves or their loved ones whenever possible.

Here are some practical tips I have to inform patients of the risks of medical imaging and to order tests more responsibly.

1. Know the radiation doses associated with common procedures. Radiology centers often inform patients of this, but by then, patients have pretty much committed to having the test done. I have a macro on our electronic records that translates the radiation dose per procedure into “# of chest x-rays” and gives a baseline of how much background radiation a person gets from just living in the United States (3 mSv/year) or taking a coast-to-coast airplane flight (0.03 mSv/roundtrip).<sup>6</sup> My patients are often surprised by the amount of radiation involved and sometimes think twice about getting a test. These discussions enhance patient education and promote shared decision-making.
2. Take a good history and do a thorough physical. Writing a quick order for an imaging test can save time in our busy lives, but it may be doing a disservice to a patient when we could have taken the extra time to get that key history or to discover a surgical scar on exam that precluded the need to do imaging.
3. If the patient’s complaint is not urgent, try to obtain the old records or outside records. It is sad to think studies are duplicated because we cannot get our hands on records or because patients do not remember the details of previous studies.
4. Do not forget to use ultrasound/Doppler modalities and, when appropriate, more expensive magnetic resonance imaging (MRI), which have no harmful radiation. A stress echocardiogram rivals myocardial perfusion imaging in terms of predicting future cardiovascular events, and has the bonus of giving information on the heart valves.<sup>7</sup>

A renal Doppler for a nonobese patient is an excellent option for evaluating for renal artery stenosis. An abdominal ultrasound is good for evaluating many organs and should be considered as an initial imaging option to rule out appendicitis in children.

5. Use the d-dimer test more — even for patients you are sure need CT scanning. A recent article estimates that 25 percent of CT scans could have been prevented had a d-dimer been checked prior.<sup>8</sup> In this study, the d-dimer had a negative predictive value of 100 percent, so it is incredibly valuable at ruling out thromboembolic disease when the test is negative. However, given the poor specificity of the test, for some very low risk patients, a falsely positive d-dimer can influence the provider to order the subsequent CT scan. Again, rely on the history and physical first and foremost.
6. Do not reflexively order a follow up study suggested in the radiologist’s dictation. It is your patient, and you know the clinical picture better than anyone! Call the radiologist and discuss the situation.

They are often happy to get some contact with the outside world, and they should be used as true consultants like any other specialist. If you do decide to do the suggested study, discuss the radiation doses with the patient that those studies would entail.

7. Do not forget plain films. They are quick, often do not need approval from insurance, have 1–2 orders of magnitude less radiation than CT scans, and can give useful information. A simple KUB can tell you if a patient's suspected urinary stone will be too large to pass spontaneously. A KUB can also confirm constipation in children with periumbilical pain who were on their way to the CT scanner to rule out appendicitis. Good initial PA and lateral plain films of the chest can often reveal a diagnosis for chest pain/respiratory problems.
8. Be especially mindful of the radiation risks in children and reproductive age women. Even seemingly innocuous lumbar plain films expose the ovaries to the radiation equivalent of getting a chest film *daily* for an entire year.<sup>9</sup> I can count on the fingers of one hand how often plain films on a young person with atraumatic back pain has revealed anything that would have changed my management, and current guidelines do not support this practice.<sup>9</sup>

I hope the above points serve as constructive and helpful guidelines. I love looking at medical imaging, and I respect my radiology colleagues who so adeptly navigate through the images and explain the findings. Yet, we need to be mindful of the risks of reflexively ordering tests. We should not order tests just because we can, or out of pure convenience, or because of patient pressure.

Think of it this way: the Women's Health Initiative data on hormone replacement decimated the market for HRT. This paradigm shift was based on a small excess risk of composite endpoints (19 out of 10,000 women over a 5 year period or 0.19 percent).<sup>10</sup> Should not a theoretical 1.5–2 percent cancer prevalence from modern day imaging promote a little more discussion and restraint? I would hope so.

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