CT Scans, Children, and Cancer

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I would like to use this opportunity to introduce myself as the new chair of the Judicial Family Institute, a position I previously held about ten years ago. I have been actively involved with the program for longer than that and have helped recruit the past two chairs, Pat Hannah and Isabel Picó, who have presided over the JFI programs superbly. I only hope that I can do as well. Unlike them I am not an attorney. I have been a professor of genetics and zoology at the University of Wisconsin until my retirement. My professional specialty has been the health effects of high-energy radiations, X-rays, gamma rays, and neutrons, primarily.

Most of what follows is my attempt to raise what I think is a potential health problem that should be of concern to you as parents and grandparents. My credentials, so that you know that I am not some quack, are as follows: I have been a U.S. scientific advisor to the United Nations, the National Academy of Sciences, and most national and international commissions on radiation protection, until my retirement. In addition I have served for most of seven years in Japan as a director and chief of research of the Radiation Effects Research Foundation, a joint U.S.-Japan program, which studies the health effects of the atomic bomb on survivors in both Hiroshima and Nagasaki.

These studies began in 1947 and started immediately following the children born to survivors at least nine months after the bombings. The studies have been ongoing, and some 80,000 children are in the program. It took almost a decade to establish a full-scale study of 120,000 survivors with respect to their radiation-induced health effects. This has primarily involved cancer mortality, cancer incidence, and non-cancer effects, as well. To date the most significant (but not the only) result has been the increase in cancers, including leukemia, thyroid, lung, breast, stomach, and liver, to name just some, found in both males and females, in all age groups. After nearly 60 years of follow-up the program has found that the increase in cancer frequency is directly associated with the radiation dose received by each survivor.

To put it a different way, if one group receives twice as much radiation as another group, then they will be at twice the risk of developing cancer; a four-time-larger dose results in a four-times-larger risk. That is a very important point. The lowest-dose range in these studies where a significant increase in overall cancer risk has so far been found was between 10 to 15 rem (rem is defined as a dose term, roentgen equivalent man).

We use different terms to describe dose, and I will use the term rem. The a-bomb population received instantaneous doses from 0.05 rem to over 200 rem. The average dose to the whole population was 20 rem. To add to your confusion, the new standard dose representation is the Sievert (Sv), and 1 Sv is 100 times larger than 1 rem. I will be speaking of doses in the range of 1/10 of a rem to 10 rem.

The U.S. population receives about 0.3 rem a year from natural background radiations, including cosmic radiation, and about 20 or so years ago, 0.05 rem of medical radiation, primarily diagnostic X-radiation. By 2006 medical exposure had increased to 0.3 rem, a sixfold increase, primarily as a result of CT (or CAT) scans. Of that increase, 54% of the scans were to those older than 50 years. However, 26% of the scans were to those under the age of 35. Such scans produce 100 times as much x-radiation as the usual x-ray procedures; for example, a typical chest x-ray delivers about 0.008 rem of exposure.

All of the above information serves as background to my most immediate concern: CT scans for children.

A paper published by Pearce, Salotti, and Little in the journal *Lancet* (June 2012) studied 178,000 children in Britain who had received CT scans from the 1980s until 2002, covering at most 20

years post-exposure. This was the first study to demonstrate that two to three head CT scans, up to the age of 15, could triple the risk of developing a brain tumor, and five to ten scans could triple the risk of developing leukemia. In the a-bomb study, leukemia was the first cancer to appear in the survivors and is still appearing among those who were young at the time of the bombing; some 10 years later, thyroid cancer was the next cancer to show a significant increase. It is obvious, as with the studies in Japan, that long-term follow-up will be needed. Such a large epidemiological study was possible in Britain because its national health care program readily allows for this kind of surveillance.

A second study, which has relevance to CT scans, was reported by Smith-Brindman and collaborators in 2009 in which over 1,000 patients were studied retrospectively at four major hospitals in the San Francisco Bay area. One of the most important results in this study that for the same procedure, for example, head, abdomen, and pelvic regions, there was as much as a 13-fold variation from the lowest to the highest "effective" dose for each type of study. This, as the authors state, highlights "the need for greater standardization across institutions." Without such standardization and frequent instrument calibration, this issue is far from resolved. This matter should involve all hospital administrations. The authors caution that experts suggest that for every 1,000 to 2,000 CT scans there is the increased probability of one additional cancer in adults. Based on the Japan a-bomb studies, children are two to three times more sensitive to radiation-induced cancers than adults.

A recent report from the National Cancer Institute (2012) describes that between 5 million to 9 million CT exams are performed on children annually. This leads me to conclude that *there can be between 10 thousand to 18 thousand additional cancers during the lifespan of these children.* The report goes on to discuss the many benefits in the use of CT scans for diagnosing illness and injury in children and procedures that are being taken to reduce or minimize risk to children. Each of us has to rely on our physician's medical judgment in suggesting this procedure However, *you should ask if other procedures, such as ultrasound or MRI, which do not have radiation exposure, could be used instead.*

I also suggest that you keep track of the number and type of scans used so that such information can be provided to different medical personnel when the case arises, particularly since they may not be aware of previous CT scans.

Finally, I suggest for those who are interested that there are many other articles concerning CT scans and children on Google.