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From: on behalf of Hilary Butler
Subject: Cat scan radiation

http://www.abc.net.au/rn/talks/8.30/helthrpt/stories/s929979.htm

Environmental Radiation
25 August 2003

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Professor **Eric Hall** from Columbia University in New York has extensively studied the impact of environmental radiation. He's attended the International Congress of Radiation Research in Brisbane where he presented his findings.

Program Transcript

Norman Swan: Welcome to the program.

This week on The Health Report, putting care in the hands of the person who's got the problem; does it work, and how does it compare to seeing the quack regularly?

The role of death in treating asthma;

And comparing the impact of Hiroshima and Nagasaki to everyday X-rays and the risk of space travel.

Professor Eric Hall from Columbia University in New York has spent much of his career studying the impact of environmental radiation. He's been here in Australia presenting his findings to a conference in Queensland.

Eric Hall: The interest in environmental radiation is to look at the levels to which human beings are exposed from natural background radiation, radiation that comes in out of space, radiation that comes out of the ground, radiation that we have in our food, and contrast this to the sort of radiation levels that astronauts are exposed to when they're in the shuttle and much more so if a visit to Mars comes off where the radiation levels would be very much higher. NASA is one of the major funders of radiation research in the United States now.

Norman Swan: So when you do those calculations, before we get to the medical applications, when you do those sorts of calculations, and maybe even extrapolate it back to what most people go back to, Hiroshima and Nagasaki where you had populations in the sphere of exposure to known radiation, what sort of story evolves in terms of our regular everyday exposure versus space travel, versus what we know from Japanese populations?

Eric Hall: Well the study of the exposed Japanese survivors of the A-bomb attacks is certainly the gold standard, because a huge amount of money was spent on it over a period of more than 50 years, and no other comparable study has ever been done, or is likely to be done. So that's why we keep going back to that. In fact as we often say, people think of that as a high dose study, but in fact most of the people that are now alive 50, 60 years after Hiroshima and Nagasaki, it was quite a low-dose study.

Norman Swan: The high dose people have died?

Eric Hall: No, most of them didn't die from radiation, they died from blast and heat within the first half kilometre. But anyway, the doses are higher than we get from natural background by two orders of magnitude nevertheless, but they are not higher than astronauts will get on a trip to Mars.

Norman Swan: Really?

Eric Hall: They're comparable. And not only that, but the other thing that's quite interesting is that the doses of radiation that one gets in diagnostic radiology in terms of the helical CT scan overlaps with the bottom end of the doses to which the Japanese were exposed and which show an elevation in solid cancer incidence now, 50 years later.

Norman Swan: So you're saying one helical CT scan corresponds to an X-ray dosage similar to peripheral survivors of Hiroshima and Nagasaki?

Eric Hall: Oh yes. In the study we did, which is probably one of the most useful things I've ever done in terms of achieving any result, is we published a paper which calculated the risks involved in a helical CT scan of the abdomen in children. They're very common in the United States.

Norman Swan: And we should just say a helical CT is the modern form of CAT scanning which is much more rapid, where you get a kind of spiral picture where it can be done in a matter of moments, rather than a slow process of repeated slices.

Eric Hall: This is particularly useful and important in children, because it's fast, and therefore you don't need to sedate the child. And so if you do a helical or spiral CT scan of the abdomen of a one-year-old child, it's almost total body irradiation and the dose involved to all the internal organs is of the order of 5-15 rads, and the Japanese data go down to about 5-rads.

Norman Swan: Rad being a measure of radiation exposure.

Eric Hall: Rad being a measure of radiation exposure. So you are able to use these data from the Japanese to make an estimate of the risk from a helical CT scan without using any assumptions about the shape of a model or an extrapolation below the dose range for which data are available, that's the important point.

Norman Swan: And are we talking here about total body exposure, or exposure to bits of the body? Because this does go to the issue of both space travel and medical treatments. When we have radiotherapy it tends to be pretty confined.

Eric Hall: Well when it comes to the induction of cancer by radiation, all of the evidence we have, for example, for the risk of breast cancer, the incidence of the function of dose is much the same.

Norman Swan: Which is why some people who've had Hodgkin's Disease as teenagers, women, who've had radiotherapy to the chest area, are at high risk of breast cancer about 18 to 20 years later?

Eric Hall: That's right. ***Forty times higher or something like that, very high.***

Norman Swan: So just give us a picture, let's go back to this helical CT, and the Hiroshima survivors, just compare what 50 years later the Hiroshima and Nagasaki survivors are getting for the equivalent dose of radiation.

Eric Hall: You mean in terms of cancer incidence?

Norman Swan: Yes.

Eric Hall: The increased incidence is very small. If you look at the ***100,000 people*** that have been studied

very carefully for 50-odd years, something like 12,000 of those have died of cancer naturally over the years.

Norman Swan: So that's the expected number.

Eric Hall: That's the expected number, and the number from the control group, and about ***500 excess cancers*** involving all dose groups. It's about 500 extra, so it's not a very big increase considering the whole population was exposed to a nuclear weapon.

Norman Swan: Take me on that line to the use of regular radiology, you know X-ray imaging.

Eric Hall: We calculated that a ***one-year-old child having an abdominal helical scan had about a one in a thousand chance of developing cancer, and since there are 2.6-million children scanned every year in the United States, that would suggest that you are quite possibly producing a public health problem for the future.***

Norman Swan: What about adults getting helical CTs?

Eric Hall: Well adults are bigger than one-year-old children, so that the proportion of their total body irradiated for a given sized scan is much less, and secondly, a mature adult say 50, 60 years old, is about 15 times less sensitive to radiation-induced cancer than a one-year-old child.

Norman Swan: So for adults, it's less of an issue ?

Eric Hall: I would say for any situation where the medical problem urgently needs a CT scan, it shouldn't be an issue, but it argues against using helical CT scans in sort of a screening mode, which in many ways they are used in the United States.

Norman Swan: ***So in other words, these people who are going for a whole body scan which has been a very popular marketing ploy here, although recently banned in at least one State, is not a sensible thing to have done, because you might as well have stood on the edge of Nagasaki in 1945.***

Eric Hall: Not a very sensible idea I would say.

Norman Swan: What about space travel? Does this make it impractical to do a manned trip to Mars?

Eric Hall: It's borderline. Whether humans beings can have the journey to Mars, spend some time on Mars, and come back without getting a dose of radiation that is lethal, is marginal at the moment.

Norman Swan: Lethal? So it's that much?

Eric Hall: Yes.

Norman Swan: So it's equivalent to the high dose in a nuclear bomb going off?

Eric Hall: Yes. NASA is spending a lot of money trying to look for protectors and of course trying to devise ways to shield and protect astronauts, but at the moment it's being talked about, but whether it will ever happen I'm not sure.

Norman Swan: What about radiotherapy? How does this apply to radiotherapy, which it's argued, at least in the Australian context, is actually under-used in people with cancer, and probably about 20% or 30% more people need to have radiotherapy according to the evidence, than are having it at the moment; what are the risks there?

Eric Hall: Well in most instances it's very difficult to get an assessment of the possible induction of

malignancy in cancer patients because you don't have a good appropriate control group. Now the two big exceptions for that are carcinoma of the cervix in women and prostate cancer in men. In particular we've taken a very careful look at prostate cancer and there you do have a good control group because –

Norman Swan: Some may choose not to be treated.

Eric Hall: Some may choose to have surgery. So we came up with 50,000 patients treated with radiotherapy, and 70,000 patients that had a prostotectomy –

Norman Swan: With no radiotherapy.

Eric Hall: No radiotherapy, and where they were matched for other factors. And to cut a long story short, we found that there was about a 1 in 70 chance of developing a radiation-induced second malignancy after about ten years. The incidence goes up with time, after radiation, by five years it's barely detectable, but by ten years it's about 1 in 70, and involves the bladder, it involves part of the GI tract, and even as far away as the lung, you get a very small increase in second malignancies. So again, in instances where radiotherapy is the best way to treat, it's a small downside to an otherwise very effective treatment.

Norman Swan: ***But it's important so that you can make an informed decision?***

Eric Hall: That's right, and the other part is we've taken a look at the new developments that are potentially very exciting, the use of IMRT, or Intensity Modulated Radio Therapy. The idea here is to concentrate the radiation dose more accurately in the tumour and reduce the high dose to the normal tissue surrounding the tumour, and the idea is that this should improve cure rates.

Norman Swan: It's almost like applying a magnifying glass to the sun, it's really getting it highly focused on a tiny bit of tissue.

Eric Hall: That's a very good analogy, yes indeed. The downside from our point of view is that in order to do this procedure it means that a much bigger volume of normal tissue is treated. Instead of using typically four beams coming in from four directions, you may use eight, nine or ten beams.

Norman Swan: These are like the entry tracks for the beams before they concentrate on the hot spot in the middle?

Eric Hall: That's right. So you end up irradiating a much bigger volume of normal tissue in these techniques.

Norman Swan: But with a lower dose?

Eric Hall: But with a lower dose. And there is good reason to believe that that significantly increases the risk of an induced malignancy in those normal tissues.

Norman Swan: So what do we do with all this information? Well first of all, I'm not going to Mars, you've convinced me. I'll hand back my ticket, that's the first thing you've done. And I'll certainly not have a whole body scan with helical CT. But with radiotherapy?

Eric Hall: Well again, we're talking about going to these new techniques, and I think it's important that the people that advocate going to these new techniques have got to prove that the benefit of the new techniques outweighs any potential downside. I think it's important that we have all of the information available before big decisions are taken.

Norman Swan: Eric Hall is Professor of Radiation Biophysics and Director of the Center for Radiological Research at Columbia University in New York.

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