Editorial

Putting Health Risks from Radiation Exposure into Context: Lessons from Past Accidents

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The response of the international media to the possible health effects of the radiation leaks that occurred at Fukushima, Japan, following the massive earthquake and Tsunami have shown that we have still not learned sufficiently from the Chernobyl accident. There is still a public perception that any amount of radiation is likely to cause cancer in a substantial fraction of the population. Annual doses from natural radiation vary widely around the world. To have evolved as a successful species, we must be superbly adapted to protecting ourselves from the effects of natural radiation. The problem that we have as scientists is that we rarely expose large populations to increased levels of radiation, so have little evidence to determine risk from exposure above the norm. How much have we learned in terms of risk to human health from the 2 largest exposures of populations to man-made radiation – the atomic bombs in Hiroshima and Nagasaki in 1945 and the Chernobyl Nuclear Power Plant accident in 1986?

Health Effects of Radiation Exposure

Hiroshima and Nagasaki

Contrary to popular belief, the majority of those who died following the atomic bombs in Hiroshima and Nagasaki died from flash burns or other injuries. Only around 15% to 20% of the population died as a result of acute radiation sickness.[1] In terms of long-term health consequences, studies of the lifespan cohorts have stated that of the 9335 cancer deaths in the 86,572 member cohort between 1950 and 1997, only 440 (5%) of the solid cancers[2] and 103 of the 310 cases of leukaemias in the population between 1950 and 2000 were attributed to radiation exposure.[3] A very small proportion (0.8%) of non-cancer related deaths can so far be attributed to radiation exposure.[2] In addition, there are no observable inherited effects in the subsequent generation. [4] The estimates for the overall effect in terms of decreased life expectancy are 2.6 years for those who received the highest doses and 21 days for those who received the lowest doses. The majority of those who received high doses of radiation died as a result of blast or burn injuries sustained during the explosion itself, so the surviving population is weighted more towards those who received lower doses of radiation and the average loss of life expectancy for those who received non-zero doses is estimated to be 4 months.[5]

Chernobyl

The radiation exposure following the atomic bombs was a short-lived, but intense, exposure to relatively high doses of penetrating radiation. The radiation exposure following the Chernobyl accident was a more prolonged exposure and, at least in terms of the population exposure, was almost exclusively isotopic radiation in the fallout. Exposure was therefore due to ingestion and inhalation of radioiostopes, the 2 most abundant being iodine 131 (I-131) and caesium 137 (Cs-137). The initial assumption was that there would be an increase in leukaemia, but in actual fact the only proven radiobiological effect has been an increase in thyroid cancer in those who were young at the time of the accident.[6,7] The increase was rapid, being first reported in 1992.[8,9] The increase is still apparent today, although in those who were born after the radioiodine had decayed in the environment (1 January 1987), the frequency of thyroid cancer has decreased to the levels seen before the accident.[10] There appears to be little difference in the pathology[11,12] or the clinical outcome of radiation induced thyroid cancer[13] when compared with age-matched controls. Thyroid cancer is very amenable to treatment, especially in childhood, and it is predicted that although 30% of patients may suffer a relapse, only 1% will eventually die of their disease.[13] Of 6000 diagnosed cases since 1986, only 15 have so far proved fatal.[6] It is likely that many of these cases would have been prevented if administration of stable iodine had been provided at the appropriate time. Twenty-five years after the accident, there is still no evidence for increases in other diseases in the exposed population at large, and the thriving natural environment around the reactor accident, now that the human population has been reduced due to the establishment of the exclusion zone, suggests that the presence of higher than background levels of Cs-137 in the environment poses little risk to human or animal health. However, it will only be possible to determine further

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minor deleterious radiobiological effects of this accident on human health if life-span studies conducted similar to those instigated in Japan are put in place. Without such studies, it will be impossible to put the risks of a nuclear power plant accident into proper context of overall disease burden from causes other than radiation exposure.

If we are to ask what have we learnt from the Chernobyl accident, the answer is that cancer risk associated with isotopic radiation exposure is determined by the age at exposure and whether the radioactivity concentrates in particular tissues (iodine concentrates in the thyroid, but caesium does not appear to concentrate in one tissue type). We have also learnt that low doses of radiation, even when this involves relatively sustained exposure over a long period of time, are perhaps not as deleterious to health as we would have predicted. The one thing we appear not to have learnt is how to deliver information about radiation risk to an exposed population. There have been considerable psychological consequences, unrelated to the actual risks on human health, from the Chernobyl accident which have been poorly researched.[14] The recent frenzy following the damage to the Fukushima plant in Japan suggests that the media are keen to feed our nuclear fears, by focusing on an event that is extremely unlikely to result in a single death, even when a natural catastrophe has killed at least 20,000 people and displaced more than 100,000 in the same region.

As scientists, we are always keen to say we need more research before we can be sure of our facts, but taken together the information on the risks to human health of exposure to radiation may not be what we have been led to expect. Maybe it is now time to dispel some of the public's preconceived ideas of the risk of radiation. Rightly or wrongly, it is human nature to assume that anything that is man-made or that we have no control over is more dangerous that some of the cancer-associated risks that we willingly expose ourselves to, e.g. tobacco smoke or obesity. One recent article tries to put radiation risk into context and concludes that radiation exposures experienced by the most exposed group of atomic bomb survivors led to an average loss of life expectancy significantly lower than that caused by severe obesity or active smoking.[15] We can only have a rational debate about the risks and benefits of nuclear power if we can put the risks into a balanced perspective. Unfortunately it still seems that when radiation knocks at the door, science and rational thinking go out of the window.

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