EDITORIAL

Reduction in Childhood Cancer Following Nuclear Plant Shutdown

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Cancer is a chronic disease whose treatment requires significant sacrifice of time and money; the results of which can be felt on both personal and social levels though financial losses, reduced quality of life and altered allocation of resources.\(^1\) Cancer accounts for around 13% of all deaths worldwide (7.6 million deaths in 2008).\(^2\) In 2001, it was noted that 35% of cancer deaths (2.43 million) were attributable to nine potentially modifiable risk factors; 0.76 million deaths of this figure were in high-income nations while 1.67 million were in low and middle-income countries. The leading risk factors for cancer worldwide and in low and middle-income countries were smoking, alcohol, low fruit and vegetable intake and human papillomavirus (which causes cervical cancer in women). In high-income countries, obesity, smoking and alcohol consumption were significant risk factors for cancer.\(^3\)

Another significant risk factor is radiation. Over the past 50 years, epidemiology has tremendously increased the knowledge pertaining to the carcinogenic effects of various ionizing and nonionizing radiations, commonly originating from radioactive substances, ultraviolet sources and pulsed electro-magnetic fields.\(^4\) According to Anand and colleagues,\(^5\) radiation exposure accounts for up to 10% of total cancer cases, especially leukemia and tumors of the thyroid and skin. Elaine Ron (a past senior investigator at the National Cancer Institute’s Division of Cancer Epidemiology and Genetics) also confirmed that data collected from numerous studies link leukemia, thyroid, breast and lung cancers with radiation exposure.\(^6\)

Along with type of exposure, amount of exposure also plays a role. For instance, it is known that high doses of ionizing radiation clearly produce deleterious consequences in human; however, the effect of low doses is not yet clear.\(^7\) Two studies have attempted to gain more insight about the effect of low dose radiation: the first one used seven cohorts from three countries (U.S., UK and Canada) in a trial to assess the carcinogenic effects of low level of low linear energy transfer (LET) radiation (exposure to this type of radiation may occur, albeit not exclusively, within such facilities as nuclear reactors, plutonium weaponry and reactor fast-fuel fabrication technologies).\(^8\) The second study looked at the risk of developing cancer among workers within the nuclear power production facilities.\(^9\) Both studies showed increased risk of cancer even at low doses, specifically, a significant rise in the risk of leukemia was found in the LET study. In addition, factors such as tobacco and chemotherapeutic agents act synergistically with radiation resulting in exacerbation of its devastating effects.\(^6\)
So, how do people get exposed to radiation? Elaine Ron spoke of such exposures as atomic bomb explosions, medical procedures utilizing radiation or environmental exposures in the form of nearby nuclear facilities. In Connecticut, data from the National Cancer Institute stated that leukemia incidence in children up to 4 years of age increased by 121% during atomic bomb testing; however, a decline of 53% occurred five years after testing termination.

Between 1987 and 1997, eight nuclear plants in the United States were shutdown. The national infant mortality rate two years before the plant closures were compared with rates two years after the closures; the data showed a decline from 17.4% to 6.4%. These results raise the question of, did these plants negatively affect the health of the nearby populations?

In an attempt to address the correlation between radiation and risk of cancer, Mangano and Sherman studied the decline in cancer risk after the cessation of a nuclear plant activity. Children were chosen for the study as they are more sensitive to radiation exposure; for example, children aged two and under are ten times more sensitive to radiation than adults. The study of Mangano and Sherman is interesting. One specific reactor, “Rancho Seco,” permanently closed on June 6, 1989 in Sacramento, CA, was chosen for the study by authors for several reasons:

1. Its location within a relatively populated area (1,418,799 inhabitants) provided strong statistical power.
2. The next closest reactor was over 200 miles away, so the main source of radiation on the area was confined to the Rancho Seco reactor, allowing more unbiased assessment of its effect.
3. Its closure of over 23 years permitted observation and assessment of long-term health effects.
4. The fact that Sacramento County uses renewable sources for generating most of its electricity accentuated the potential health improvements associated with the closure of the reactor by eliminating other pollution sources.

When compared to the results from 1988-1989, the study detected a decline in all invasive cancer cases from the period 1990-2009 combined. Declines in the standard incidence ratio (SIR) were noticed for both males and females, but the change was four times greater in females. It was also noticed in the study that four types of cancer were significantly decreased following nuclear plant shutdown: melanoma of the skin, female breast cancer in situ, thyroid cancer and oral cavity and pharynx cancer. Among the children, the cancer rate in Sacramento County dropped 11.7% from the period 1988-1989 to 1990-1994, while the state rate remained unchanged.

In this context, future studies should fully address such issues as the estimated risk of low dose exposure and differences in cancer risk according to the type of radiation, exposure rate and genetic-based radio sensitivity. The study conducted by Mangano and Sherman yielded many interesting results, although they have acknowledged the need for more investigations in order to determine direct causation between low-dose radiation exposure and increased cancer risk. Some of their suggestions for improvement of future investigations include expansion of the Rancho Seco analysis, addressing changes in populations other than children, repeating the study near other closed reactors and assessing whether short-term data can be a useful baseline for future analyses. The gravity
and controversy of this topic, most importantly with regard to its effects on human well-being, will be sure to initiate many future debates within scientific, political and social media.

REFERENCES