COMMENTARY/COMMENTAIRE

The radiological consequences of the Chernobyl accident

The First International Conference of the European Commission, Belarus, Russian Federation, and Ukraine

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Abstract: The human health consequences of the Chernobyl accident in 1986 have been the subject of a great many studies. Many of the findings and opinions were brought together at a major international conference held in Minsk in 1996. The overall findings from this workshop are discussed with particular focus on thyroid cancers and exposures to iodine-131.

Key words: Chernobyl, radiation, human health.

Résumé : Les conséquences sur la santé humaine de l'accident de Chernobyl, survenu en 1986, ont fait l'objet d'un grand nombre d'études. Plusiers constationions et opinions ont été regroupées lors d'une conférence internationale tenue à Minsk, en 1996. L'auteur discute l'ensemble des constatations de cet atelier en accordant une attention particulièreaux cancers de la thyroïde at aux expositions à l'iode-131.

Mots clés : Chernobyl, radiation, santé humaine.
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Introduction

On the 18–22 March 1996, the European Commission and the ministries of the republics of Belarus, Russia, and Ukraine held an international conference in Minsk. Six hundred and fifty scientists from over 200 laboratories working worldwide on the effects of Chernobyl assembled and coordinated their conclusions. Two weeks later in Vienna from 8–12 April, the United Nations Conference "One Decade After Chernobyl: Summing Up the Consequences of the Accident" presented a clear account of the nature and magnitude of the accident's effects and legacy: environmental, medical, social, economic, and political. Over 800 participants officially designated by 74 nations were present, including the Presidents of several and the Ministers of many, plus over 300 media representatives and observers. There was universal acceptance and agreement that 3 persons died immediately in the accident, 28 more within days or weeks, 14 more in subsequent years, and more recently 3 children from thyroid cancer.

Text

Foreseeing worldwide media interest in Chernobyl's "Tenth Anniversary," the European Commission set up an international conference to report on the 16 collaborative Chernobyl research projects organized in 1992 by the Commission and the three republics: Russia, Belarus, and Ukraine. Because of the weather conditions at the time of the accident, Belarus had the most widespread contamination and social consequences, and the conference was, therefore, held in its capital city, Minsk, hosted by the Belarus Government. The 200 laboratories in institutes participating in the projects sent over 600 delegates to summarize and discuss their results to date. The topics focussed on the human health consequences of the accident and necessarily involved environmental radioactivity and its migration, decontamination programmes, and population and individual retrospective dosimetry, as well as direct medical and epidemiological studies.

The Conference was an important milestone in the series of meetings taking place internationally around the anniversary. The conclusions of these scientific presentations and debates were summarized for the world "opinion formers" and "decision makers" at the UN/EC/IAEA/WHO Conference "One Decade After Chernobyl: Summing Up the Consequences of the Accident" on 8–12 April 1996 in Vienna. There, a clear and conclusive understanding of the nature and magnitude of the accident's effects and legacy (environmental, medical, social, economic, and political) was sought.

The primary concern of the media and public since 1986 has been the simple statistics of human health and mortality perceived as a consequence of radiation. This brief note will set out a few figures from the presentations.

Five different human radiation-exposure situations at

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Chernobyl need to be considered: (1) those at the reactor site at the time, and highly exposed; (2) the 800 000 "liquidators" engaged in recovery, cleanup, and research in 1986; (3) the 137 000 people evacuated from Pripyat after 36 h and from the 30-km zone a week later; (4) the large populations, 5 million or more, subject to continuing exposure at a much lower level in the contaminated regions; and (5) those people, especially children, exposed to high levels of radioiodine in the first few weeks after the accident

The statistics for these groups are as follows.

Group 1

Four hundred and forty-four people at the reactor were exposed to intense radiation. Ages ranged from 28 to 60, averaging 35. Three died at once through burns and mechanical injury. Two hundred and thirty-seven were taken to hospitals, of whom 134 were diagnosed as having acute radiation syndrome ("radiation sickness"). Of these, 28 died within days or weeks and 14 more died in the years since. The 14 deaths do not correlate with the severity of radiation exposure, and a car crash and heart attacks have accounted for three or four.

Only in this group in the whole history and extent of the Chernobyl accident has there been any incidence of acute radiation syndrome or early death due to radiation.

Group 2

The estimated doses and health records of the liquidators were recorded from May 1986 onwards. The registers now hold data on 350 000 Ukrainians, 136 000 Belarussians, and 159 000 Russians.

There are reasons to doubt the accuracy of these registers. For one thing, the status of liquidator carries financial compensation and social benefits, and in Ukraine, the authorities estimate that up to 150 000 people may have been registered on false premises.

Of the 200 000 liquidators working in 1986–1987, the estimated individual average dose was 100 mSv. For those working within the 30-km zone at that time, it was 165 mSv. These are estimated external doses; internal doses from ingestion and inhalation should be added, averaging 64 mSv from samples of a few 100 persons. Such doses may eventually show an increase of disease in liquidators, especially in leukaemia, but in these areas of the former Soviet Union, no systematic cancer registry existed before 1992 and any increase may be reflecting the increased surveillance. The overall incidence of disease among liquidators up to 1992 was roughly the same as for the corresponding age group in Russia as a whole. However, there appears to be a shift in the pattern of illness, with an excess of diseases of the blood, circulatory system, and nervous system which have no known relation to radiation and are felt to reflect psychological impact. A section of the Conference was devoted to the increasing growth of neuropsychic disorders, including suicide.

In Ukraine, a small increase in leukaemia in liquidators was reported but not in Russia nor Belarus. The cases on the Ukrainian register appear uncertain, but there is the distinct possibility that excess leukaemia in liquidators will appear in future years, especially in the small cohort (about 300) with very high but not disabling exposure.

The total death rate among liquidators on the Russian register does not exceed that for the corresponding age groups in the entire Russian Federation.

Group 3

It has proved very difficult to trace an adequate statistical proportion of the population evacuated from Pripyat and the 30-km zone, who are, of course, those who received the highest doses in the general population (now estimated to have averaged 10 mSv per individual). This low dose is unlikely to lead to an observable increase in cancer incidence except for childhood thyroid cancer, discussed under Group 5 below.

It would have been especially important to follow those evacuated children prenatally exposed; the number of 1500 has been guessed but not confirmed. These children should have been monitored over a long term not only for leukaemia but for central nervous system damage. There has been a statistically nonsignificant rise suggested in mental retardation among a number of evacuated children exposed in utero, but there is yet no clear confirmation; much searching is now going on in the three Republics for more of these evacuees.

The health of those 2000 or so people, mostly the original inhabitants of the area, who refused to leave the 30-km zone when ordered in 1986 or who walked back later, is much as would be expected of a similar group in a noncontaminated area—better, in fact, as they now have effective medical attention. The majority are elderly and their numbers are insufficient for firm medical statistics, especially as through unemployment or lack of sale for their products, many have lately moved out. The total living within the zone had fallen to around 750 by 1994 and now (March 1996) is about 420.

Group 4

The possible health effects of the continued exposure of the several million people in the contaminated regions remain a central point of concern and disagreement. The population was not told the truth for 3 years after the accident, now refuses to believe all official statements, and attributes all illness and all social and economic misery to radiation. It is of the greatest importance that the populations should be encouraged to have realistic perceptions of risks and consequences, otherwise remedial actions will fail. The health effects of Chernobyl must be clearly dissociated from the effects of the radical social, political, and economic changes after 1987. Russian gross national product has fallen by 50%, industrial production by 60%, and investment by 70%. This economic collapse has had a significant impact on mortality and morbidity. The death rate over the whole of Russia increased from 488 to 741 per 100 000 from 1990 to 1993. Life expectancy for males at birth was 66 years in 1987 but fell to 59 by 1993. Over the whole former Soviet Union, there have been striking increases in diphtheria, measles, tuberculosis, and venereal diseases. It was made clear at the Conference that many of the earlier pseudo-scientific assessments, as well as media reports, used statistics of health decline that were mistakenly attributed to Chernobyl radiation.

Some epidemiological facts are now certain, however. There has been no observable increase anywhere of childhood leukaemia in the exposed populations of the contaminated areas in the three Republics. Childhood leukaemia is the prime indicator of radiation effects and its absence has wide implications; it makes it very implausible that other increases of illness can be due to radiation. The singular nature of iodine

metabolism and the consequent intensifying of local dose is the exception (see Group 5 below).

One conclusion of the Conference was that the continued exposure of the populations in contaminated areas will have no further observable effect. Levels of environmental contamination are decreasing, not so much by radioactive decay as by geological, ecological, and aquatic processes. The populations have already received the biggest part of their dose, and further evacuation and movement of people will generate far more damaging sociopsychological stresses and resulting illness than leaving them where they are.

Among the general population there is only one health effect that can so far be linked directly to radiation, i.e., thyroid cancer in children.

Group 5

Thyroid cancer is a very rare disease, uniform in its worldwide occurrence in children and adolescents at 0.2–0.4 cases per year for a million children. For example, that is three or four per year in the United Kingdom. The condition is curable and deaths are rare.

In 1991, it was first realized that the annual incidence was increasing in Ukraine and Belarus, from 5 in 1989, 29 in 1990, and 55 in 1991. By 1995, the total number of cases had reached 565 and now (March 1996) it is approaching 900. Three have died, two by faulty or late diagnosis. The cause is radioactive iodine, but what are the circumstances?

In an operating nuclear reactor, iodine is a highly volatile radioactive fission product. Over 9 days, $1.0 \times 10^7 - 1.5 \times 10^7$ Ci (1 Ci = 37 GBq) of the isotope iodine-131 was released as the Chernobyl fuel cans melted. Changing wind directions and rainfall patterns deposited the iodine unevenly over wide areas of southern Belarus, and then northern Ukraine and western Russia. These areas were mostly agricultural grassland, where people spent much of their time outdoors and inhaled the fallout, and cows ate the grass and concentrated the iodine-131 into their milk. Young children in the region, unlike adults, drank a lot of milk, and their growing and active thyroid glands were most vulnerable.

But iodine-131 is very short-lived; with a half-life of only 8 days nothing remained several weeks after the accident. Thus the children now developing the disease are those who in April–May 1986 were between the 12th week of pregnancy (when thyroid growth and activity starts) and several years of age, when milk-drinking falls off. This is confirmed by the present ages of the patients, almost all of whom are between 10 and 18 years. For children younger than 10 years, the incidence has fallen back to the world level.

When the rise was first noted in 1991, a connection with Chernobyl seemed unlikely as only 5 years had elapsed, while Hiroshima and X-ray evidence indicated that more like 10 years was needed for development. But it's now clear that the doses to the thyroid from Chernobyl, which of course cannot now be directly measured, were far higher than first estimated. In Ukraine, the dose for children below 3 years of age seems to have been around 0.1 Gy, for Russia around 0.4 Gy, and for Belarus around 0.7 Gy. But 1% of the children in southern Belarus was estimated to have received a thyroid gland dose of as much as 10 Gy over several days.

A factor that may help to explain the unexpectedly high doses is the geographical position. As in most countries far from the sea, there is a deficiency of iodine in the environment and hence in the diet. Goitre is common; 60% of children in Minsk, for example, show symptoms. This means that humans in these regions rapidly and efficiently take up any iodine which comes along; iodine uptake is proportionally more than in regions where there is a high environmental background of stable iodine. Stocks of potassium iodide tablets were available but poorly distributed far too late after the accident, when the highest doses had already been absorbed.

There will be many more cases of thyroid cancer as the children who were under 1 year of age and near to Chernobyl at the time grow to maturity. Suggestions of an eventual total of 4000 cases were made unofficially. Several compensatory measures, such as bringing dietary iodide levels up to accepted standards, should be introduced, and the European Commission is sponsoring a factory plant for the iodizing of domestic salt. Support from the West is vital in the continuing screening and treatment and in the supply of thyroxin.