THE HAZARDS OF DIAGNOSTIC X-RAY EXAMINATION


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There is widespread public anxiety at the present time about the long-term effects of the testing of nuclear weapons, and recent reports in the Press indicate that there is increasing opposition to the further testing of such weapons. This, however, is only one aspect of a much greater problem which arises from the expanding use of ionising radiation in various forms. It seems certain that apart from the dangers associated with military use, this new source of power has tremendous possibilities for good if exploited for useful and peaceful purposes. In whatever way ionising radiation may be used, the dangers to health are the same, though there may be a vast difference of degree and intensity. There is an essential risk involved, and it seems profitable to discuss the question and define the risk as far as possible. We have always been exposed to ionising radiations: it is the extent and not the nature of the risk which is new. These risks have to be measured against the established benefits derived from the use of ionising radiation in medicine and industry and in its coming use in the production of power for industry.

Man, throughout his evolution, like all living organisms has been exposed to small but variable amounts of ionising radiations from natural sources. During the past sixty years he has added to these radiations of his own invention. In their biological action there is little difference between the two groups, and all contribute to present hazards from radiation. The radiation from natural sources comes mainly from cosmic radiation reaching us from interstellar space. Most of it, fortunately, is absorbed in the earth's atmosphere. Terrestrial radiation arises from the few natural radio-active elements, of which thorium and uranium are the main primary sources. There is also a small amount of natural radio-active elements in living tissues. It should be stressed that, in contrast to most types of biological response to radiation, the damage to the genetic material cannot be repaired, and the effect of repeated exposures is cumulative. The age distribution is of course important when estimating the consequences to future generations of additional radiation. Doses of radiation which are of no significance to the individual may have genetic consequences. Hence exposure levels must be expressed in terms of the total dosage to the gonads received by the population as a whole during the period of reproductive life. It has been ascertained that the total gonad dose from natural sources of radiation is roughly 0-1 r per annum or 3 r per generation of 30 years.

During this century man has made increasing use of x-rays and radio-active substances in medicine, industry and civil life. The additional gonad doses received from these sources by people in the country should be expressed as percentages of the gonad dose from natural radiation. For some time it has been realised that diagnostic x-rays make much the largest contribution to the radiation of the popula-

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tion as a whole over and above the radiation from natural sources. A recent preliminary survey of the genetically significant dose from the diagnostic use of x-rays in England and Wales has been made (Osborn and Smith, *Lancet*, June, 1956). It has been estimated that in 1955 nearly 18 million x-ray examinations took place. These are subdivided according to the sex and age of the persons examined and the part of the body examined. The average dose to the gonads, male, female, and foetal, was calculated for 24 different parts of the body. These measurements were mostly made at one London teaching hospital where precautions were taken to restrict the gonad irradiation to the lowest level; they are therefore almost certainly minimal figures. The results show that the radiation reaching the reproductive organs of the people of the country from diagnostic radiology is as much as 22 per cent. of that arising from natural sources, and the conclusion is that it may well be several times greater than this figure.

In the table showing the 24 areas of the body x-rayed and the dose received in each case by the gonads, it is clear that by far the largest dosage is produced in five or six areas, i.e., pyelography, hip joints, femora and bladder in the male, salpingography, pyelography, pelvimetry, lumbar spine and sacro-iliac joints in the female, and pyelography and pelvimetry, sacro-iliac joints and bladder in the foetus.

Many common types of examinations (e.g., the extremities, the chest, the skull, the teeth) contribute altogether a very small proportion of the total genetically significant radiation dose. A very few examinations (e.g., hip and pelvis, lumbar spine, pyelography and pelvimetry) amount to only 7 per cent. of the total number of examinations involved, yet they contribute nearly 75 per cent. of the total radiation. It is this group therefore which should receive our immediate attention. The picture, fortunately, is not wholly depressing.

The number of x-ray examinations in hospitals in Britain is increasing annually by about 12 per cent. But great improvement in film and screen speeds in the past 30 years has reduced considerably the average exposure to 20 per cent or less. This has reduced the x-ray dosage necessary to obtain a satisfactory result and has offset, to some extent, the greatly increased number of examinations. Osborn and Smith think that some rather fragmentary evidence now available suggests that the genetically significant radiation dose has not been increasing at a high rate for very long. In fact, they say that the genetically significant radiation dose today is not very different from what it was 30 years ago, within a factor of about 2. Important technical developments, like image intensification, should help further to reduce the dose, thus enabling increasing examinations to be made without increasing the genetically significant dose. Obvious precautions, such as the use of effective diaphragms with all x-ray equipment, the limitation of the field of radiation to the minimum required, the use of faster films and intensifying screens can be of some assistance. And there should be limitation of the examination of what one might call the vulnerable areas in the lower abdomen to cases in which it is essential for such examinations to be made. The possibility of direct protection of the gonads in all branches of medical radiology should be seriously considered.

The question has been posed: "Are diagnostic x-ray examinations safe?". In the present state of our knowledge, we certainly cannot give