

Medical Surveillance for Radiation Workers and the Role of the Occupational Physician

Dr. Wong Tze Wai

Department of Community & Family medicine

The Chinese University of Hong Kong

Background

Owing to the widespread use of ionising radiation and radioactive isotopes and their well recognized adverse effects on health, the provision of medical surveillance for radiation workers has become a standard practice in many countries. Ideally this should be incorporated into the occupational health service and performed by an occupational health physician with good knowledge of ionising radiation and its health effects, radiation protection, dosimetry, health physics, the metabolism of radionuclides, first aid and the management of radiation accidents, and the familiarity with the work processes that involve irradiation apparatus and radioisotopes in the workplace. ¹ In Hong Kong, the Radiation (Control of Radioactive Substances) Regulations and the Radiation (Control of Irradiating Apparatus) Regulations of the Radiation Ordinance provides for the medical surveillance of radiation workers as a condition for first employment and continued employment. Persons under 18 years of age are prohibited from radiation work. Medical examinations of radiation workers are currently conducted by the Radiation Board, and include "blood examination and the taking of relevant medical and occupational histories, conducted within 4 months before the first employment and at intervals of not more than 14 months during the continuance of such employment." Medical examination and inquiry in cases of suspected over-exposure to radiation are also covered in the Regulations.²

Medical surveillance programme

According to the Recommendations of the International Commission on Radiological Protection, the medical surveillance of workers exposed to radiation should be based on the general principles of occupational medicine, which aim "to assess the workers' health, to help in ensuring initial and continuing compatibility between the health of the workers and the conditions of their work; and to provide a baseline of information useful in the case of accidental exposure or occupational disease."³ The medical surveillance programme should be related to the job nature and the health conditions required of the worker for the effective performance of the task. As mentioned above, the occupational physician should be familiar with the work process and the job requirement of the radiation worker, and the hazards of the workplace. He/she should be

responsible for scheduling the surveillance programme, organising first aid measures in the event of radiation accidents, and evaluating the safety and hygiene conditions of the workplace.

Pre-placement medical examinations

The pre-placement examination is similar in principle to those engaged in other areas of occupational medicine practice, but should include aspects reflecting the specific health effects involved in radiation work. The findings should serve as a basis for assessing the fitness of the worker for his/her job and a reference point for comparison with subsequent changes.¹ For the occupational history, the physician should review past radiation exposure (both occupational and medical), as well as exposure to carcinogenic substances at work or otherwise. For the past health, haematological illnesses such as anaemia, granulocytopenia and bleeding disorders, skin diseases, eye diseases (cataract, visual impairment), diseases of the lung and gastrointestinal tract, and malignancies should be sought. An assessment of the mental health of the worker should also be made. In the medical examination, the physician should focus on the physical assessment of the worker in relation to the performance of the specific task, and to look for pre-existing conditions which may be related to radiation effects, such as chronic dermatitis, cataracts, haematological diseases, and malignancies of the blood or lymphopoietic system. When examining the skin, the physician should look for signs of chronic radiodermatitis such as skin atrophy, hyperkeratosis and telangiectasia. For jobs which involves handling radioisotopes, frequent wearing of gloves and hand-washing may be a problem for workers with eczema or other skin conditions. The lens should be examined for evidence of cataract with an ophthalmoscope, and if present, documented with a slit-lamp examination. Palpation for peripheral lymph nodes, the liver and spleen should also be performed. The blood examination should include haemoglobin, red cell count, total white cell count, differential count and platelet count. The presence of abnormal or excessive numbers of immature blood cells should be noted. Leukaemia may first manifest as anaemia, neutropenia and thrombocytopenia. It should be noted that wide variations in blood cell counts are possible, either due to physiological variations, minor illnesses or laboratory procedures.⁴

Periodic medical examinations

The frequency of such examinations should be no more than once a year, depending on the age and health of the worker, the job nature and level of exposure to radiation. The periodic examination consists of taking a work history, general medical history and performing a physical and a blood examination. The physician should review the occupational dosimetry, note any record of accidental exposure, and directs the physical examination to the organ / systems as mentioned in the pre-placement examination. Any sickness absence, especially due to

malignancy, should be assessed. ⁴ Discontinuation of radiation work should be considered if there is evidence of blood changes suggestive of pre-leukaemic state. However, for a worker who has developed leukaemia, any reduction of exposure by suspension from radiation work will not materially change the course of the illness. Good communication between the worker and an understanding physician is important. At the termination of radiation work, the health profile of the worker should be reviewed. Because of the long latency of possible health effects, all medical records of radiation workers should be kept for long periods, even after the worker has retired.

Treatment of acute radiation exposure

The Chapter on accident reporting addresses to general principles of accident analysis and prevention. Radiation accidents which may result in inadvertent exposures should be evaluated by the safety officer and physicians are sometimes involved in assessing the health effects. A good account of the incident should be documented. Medical history should be directed to health effects according to the mode of exposure, whether acute, external, whole body or partial exposure, local skin contact (intact or with wound), or internal deposition of radioisotopes. Physical findings are seldom positive, but the worker may experience anxiety. Besides reassuring the worker, the physician should take the opportunity to remind the worker of safe work practice. An assessment of possible health risks should be made in conjunction with environmental measurement of contamination and blood test results (total and differential white cell counts and absolute lymphocyte counts). Serial blood tests are necessary in the case of exposure to high doses. For local radiation burns, sterile dressings should be applied. Deep burns may require surgical treatment and skin graft. For intact skin, decontamination by washing with water and scrubbing with a soft cloth should be performed. To be effective, the process may have to be repeated several times. For internal deposition of radioisotopes, the general principles are to reduce absorption and increase excretion. A knowledge of the physical and chemical properties of the radioisotope, its mode of entry into the body, and its metabolism is necessary. Procedures like nasal, mouth and pharyngeal irritation, removal of gastric contents and laxative use may reduce absorption. Certain medicines are known to decrease the absorption of radioisotopes. Chelating agents bind metals and facilitates their excretion by the kidney. Iodine can be used to prevent the uptake of radioactive iodine by the thyroid gland.

Conclusion

To conclude, the health effects of ionizing radiation and the medical management of exposure are complex. A good occupational health programme for radiation workers should include medical surveillance, personal dosimetric monitoring, accident investigation, and medical intervention where necessary. This requires a coordinated approach by the safety professional, the health

physicist, the occupational physician and other health workers, and the radiation workers themselves.

REFERENCES

- ¹ Polvani C. ILO Encyclopaedia, International Labour Organization, Geneva, 1997:1861-1864.
- ² Laws of Hong Kong, Radiation Ordinance Chapter 303, Government Printers, Hong Kong, 1982.
- ³ Recommendations of the International Commission on Radiological Protection. ICRP publication No. 26. Annals of the ICRP (Oxford), 1977:1-54.
- ⁴ Voelz G. Ionizing radiation. In: Zenz C, Dickerson OB, Horvath EP, eds. Occupational Medicine, 3rd ed. St. Louis: Mosby, 1994: 393-427.