Safe Handling of Tissue Containing Radioactive Substances*

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ABSTRACT

Patients recently treated with radioactive isotopes may present problems or even hazards during physical examination, operation or autopsy, especially following the use of iodine isotopes and $^{198}$Au. $^{32}$P is rarely a significant hazard. Contamination of victims of radiation accidents may be a problem initially, but they are usually promptly decontaminated. Guidance of the hospital's radiation safety officer is helpful, particularly with regard to handling of contaminated persons or materials. Long-lived isotopes, such as radium or thorotrast, are usually present in too low concentration to be dangerous. Projected use of artificial hearts powered by plutonium should not be hazardous because of adequate shielding of the source.

Radiation is one of the best known of toxic agents. Conventional modalities, such as x-rays and gamma rays, can be readily confined and controlled, and their use can be expected to be hazard-free. Radioactive isotopes in patients or cadavers may, however, be difficult to handle in that they may be widely diffused in the body or concentrated in certain organs or tissues and may be present in excreta. Thus, they may present problems at physical examination, operation or autopsy. The isotopes used for diagnosis are effective for testing in such low concentrations that they are harmless as regards radioactivity, thanks to the high sensitivity of the instrumentation now available. Also, the containers in which diagnostic isotopes, including generators, are shipped and stored in bulk are adequately shielded. However, the isotopes commonly used in therapy, $^{131}$I and its related isotopes and $^{198}$Au, may be present in the body in quantities potentially dangerous to those in close contact with the patients. $^{32}$P with its relatively soft beta radiation is not a significant hazard.

Tissue that has been irradiated by conventional external sources, such as x-rays, has no residual radioactivity. In the rare event of recent exposure to a neutron beam, activated elements such as $^{23}$Na may be a hazard for a brief period, hours or less.

Victims of radiation accidents with external contamination by radioactive sub-
stances are usually decontaminated before or when admitted to the hospital, so they rarely constitute a hazard subsequently.

As a rule of thumb, if a patient or a cadaver contains more than five millicuries of radioactive material, there is potential danger. Patients receiving large doses of radioactive isotopes should be hospitalized for adequate control until their isotope content has dropped with time to 30 millicuries. In the event of death of such a patient soon after treatment, the pathologist may be exposed in the course of an autopsy to the radiation from more than 30 millicuries. An autopsy should not be begun without the guidance of the hospital's radiation safety officer unless the level of radioactivity has dropped below five millicuries.

The intensity of radiation from $^{198}$Au is reduced by 25 percent per day, that of $^{131}$I by 9 percent per day. Details regarding these and other isotopes are available in Handbook 56 of the National Council on Radiation Protection and Measurements.4

In performance of an operation or autopsy on a body containing beta-emitting isotopes such as $^{32}$P, the use of a double pair of heavy rubber gloves will reduce the beta radiation received by the hands to about one fifth of the ambient level. Such shielding, of course, would not protect against gamma rays. In the early course of the autopsy, as much blood and fluid containing radioactive material should be removed as possible, preferably by suction. Contaminated materials or instruments should be given to the radiation safety officer for decontamination.

If the level of radioactivity is high and delay not feasible, several pathologists might work advantageously in relays. In removal or dissection of particularly radioactive organs (the thyroid in case of $^{131}$I, for example), long-handled forceps and scissors should be used. After the body leaves the hospital, the embalmer or funeral director should not receive a potentially dangerous dose because of radioactive decay with time since treatment.

Internally deposited long-lived radioactive substances, such as radium or thorotrast, rarely are encountered in sufficient concentration to be dangerous. Radium is eventually largely deposited in bone.2 Thorotrast that has been present for some years is chiefly found in soft tissues. This material has about a 1:3 ratio of radium to thorium. Thorotrast does not appear to be incorporated into mineral bone.3 Plutonium may be an extreme hazard as a carcinogenic agent in even minute amounts if it gains access to the body. Tissue containing it should be handled only with guidance of an experienced health physicist.

In the future, artificial hearts powered by plutonium may have to be considered as a possible source of radioactive exposure. However, containment in shielding is planned to so protect the prospective user that any person in contact with that user, including a pathologist at autopsy, would receive low doses of less than tenths of a millirad per hour.1

Contaminated tissues after examination are best disposed of by cremation.

References