Proposed Regulations for Handling Radioactive Cadaver

Mahmoud Hassan Shabon
E.mail: mhshabon@gmail.com

ABSTRACT
Handling a radioactive cadaver may expose handlers to overexposure of ionizing radiation exceed the limits of those handlers.

This review will suggest steps to deal with the cadaver in preparing for washing. As well as how to wash the body of the cadaver. In externally contamination, how to deal with the water of washing. Furthermore, types of burial in Moslem’s religion. Shields if the activity is higher than dose limits.

Regulations to avoid harm of population or environment. Several countries had regulations for these cases while Moslem countries have different religious ceremony and habits.

The aim of this paper is to propose suggestions for regulation for handling Moslem radioactive cadaver.

INTRODUCTION

As patients treated with radioactive materials as therapy or diagnostics may die, so its cadaver will be radioactive. A patient who has been administered with radionuclide may expire while still having substantial residual radioactivity remaining in his body.

In this case handling of this cadaver may face the handlers (nurses, physicians, funeral director, cadaver washer, …) to overexposure of ionizing radiation exceed the limits of those handlers.

Low 7 on 2010 and law 59 on 1960 does not deal with these cases. So regulations for these cases must be organized to protect population and environment. Many countries had regulations for these cases as Australia

KEYWORDS
Moslem Cadaver, Radioactive, Burial, Funeral Ceremony.
and Britain. But as Moslem countries have different religious ceremony and habits. We as Moslems must suspect different modes of handling of these cadavers.

The search will suggest steps to deal with the radioactive patient in death agony and in preparing his cadaver for washing (how to handling, the distance of handling, the time of the person to be stay beside the cadaver, if there is a sort of postmortem autopsy………).

How to wash the body of the radioactive cadaver (protective clothes of the washer, the distance between the washer and the body, the time of washing for every washer, change of the washers, funeral procession “pray” ……….). If there is external contamination with dispersed radioactive material, how to deal with the water of washing.

Burial of the radioactive cadaver and the radioactive activities that may be exempted. Types of burial in Moslem’s religion. Shields if the activity is higher than limits.

DEATH OF NUCLEAR MEDICIN PATIENT

In the case of death of a patient who had been administered radioactive material, there is an important distinction between radioactive material administered for diagnostic studies and patients who have been administered radioactive material for therapeutic purposes.

3-A- DIAGNOSTIC INTAK OF RADIONUCLIDES

1. There are no special precautions beyond standard precautions for the handling of a deceased patient with residual radioactivity from a diagnostic study.

2. Individuals handling the body should protect themselves from exposure to body fluids by wearing disposable gloves and an outer garment such as a laboratory coat or an isolation gown.

3. The body may be released to the family or funeral home without restrictions.

3-B- THERAPEUTIC INTAK OF RADIONUCLIDES

The following procedures should be followed:

1. Immediately notify the Egyptian Nuclear & Radiological Regulatory Authority and the Radiation Safety Officer (RSO) upon death of a therapy patient.

2. If autopsy will be performed it must be only after consultation and permission from the RSO. Radiation safety staff should evaluate the radiation hazard(s), direct personnel in safety and protection, and suggest suitable procedures in order to keep doses (ALARA) during the autopsy.

3. Protective eye wear should be worn by the pathologist and assisting staff for protection from possible splashing of radioactive material. Consider the need for protection against exposure from high-energy beta particles in cases involving therapy with P-32, Y-90 and Sm-153.

4. Remove tissues containing large activities early to help reduce exposure of autopsy personnel. Shield and dispose of contaminated tissues in accord with license conditions. In some cases, exposure reduction may be accomplished by removing tissues for dissection to a location where the exposure rate is lower.

5. If an injury occurs during the autopsy that results in a cut or tear in the glove, monitor the wound and decontaminate as appropriate to the situation; inform radiation safety staff.(1)

PRECAUTIONARY MEASURES IN HANDLING RADIOACTIVE CADAVERS

At the time of death, the body should be clearly labelled with the radionuclide bracelet, form and estimated residual activity. The body should be handled as little as possible, using strict procedures for prevention of contamination with body fluids, until the nuclear medicine physicist has been contacted.
Table (1): Maximum activities (MBq) proposed for autopsy, embalming, burial or cremation of the body of a patient who has died during treatment with unsealed radioactive substances (2).

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>Half life (days)</th>
<th>Indicative maximum activity administered</th>
<th>Autopsy/Embalming</th>
<th>Burial</th>
<th>Cremation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{32}\text{P}$</td>
<td>14.3</td>
<td>200</td>
<td>100</td>
<td>2000</td>
<td>30</td>
</tr>
<tr>
<td>$^{89}\text{Sr}$</td>
<td>50.7</td>
<td>200</td>
<td>50</td>
<td>2000</td>
<td>20</td>
</tr>
<tr>
<td>$^{90}\text{Y}$</td>
<td>2.7</td>
<td>2000</td>
<td>200</td>
<td>2000</td>
<td>70</td>
</tr>
<tr>
<td>$^{131}\text{I}$</td>
<td>8.0</td>
<td>10 000</td>
<td>10</td>
<td>400</td>
<td>400</td>
</tr>
</tbody>
</table>

Note: Samarium-153, an alternative to strontium-89 for the palliation of malignant bone disease, is not included in Table 10 as the short half life of 1.95 days allows significant reduction in residual activity after a few days delay.

All corpses released for autopsy, embalming, cremation or burial above these limits should have a label attached, identifying the radionuclide and its activity at the time of release, together with a release statement signed by the qualified expert or a nuclear medicine physicist.

Precautions for handling the corpse are given below. In addition the requirements of the Transport Code will need to be taken into account if a body is to be transported, such as repatriation to another country. 5

**AUTOPSY**

If an autopsy is required, consideration should be given as to whether a CT examination would be sufficient.

Five guidance on radiation safety procedures following the death of a patient with a sealed form of radioactive material in situ, such as iridium-192 or iodine-125, is given in the Safety Guide for Radiation Protection in Radiotherapy. (3)

When a corpse contains less radioactive material than the activities shown in Table 1, procedures for personal protection normally observed during an autopsy will provide adequate protection against external radiation exposure or contamination with radioactive material.

If a corpse contains activity in excess of the levels shown in Table 1 and autopsy cannot be postponed for a suitable period for radioactive decay, the pathologist should be informed of the radiation levels likely to be encountered and of the hazards involved. The methods employed and the precautions adopted should be chosen accordingly in consultation with a nuclear medicine physicist.

If it is known that the radioactive material used for treatment will have been selectively absorbed in a particular organ, e.g. iodine-131 in the thyroid, the organ should be excised and removed from the work area before the autopsy examination proceeds. It may later be disposed of with the body.

If it is known that radioactive material will be distributed in particular body fluids, e.g. iodine-131 or strontium-89 in the bladder, these should be drained off, using suitable equipment, before the examination proceeds. In general, these fluids may be safely disposed of via the sewerage system. The equipment should later be decontaminated by thorough rinsing in a detergent solution followed by washing in running water.(4)

The precautions to be taken in handling radioactive cadavers depend on the nature and quantity of the radionuclide present and on the type of handling intended (e.g. autopsy or embalming prior to burial).

Autopsy is inadvisable if the amount of radioactivity in the cadaver is greater than 15 mCi of I-131. The autopsy of highly radioactive cadavers should be invariably restricted to the absolute minimum.
It is essential that the staff should wear disposable gloves, and supplementary measures for radiation protection and decontamination should be provided in consultation with the RHSO.

**STORAGE**

Storage of the cadaver in an adequately refrigerated compartment is necessary until the exposure dose rate at one meter from it is less than 25 µSv/hr. The storage area must be labeled restricted area.

**POST-MORTEM EXAMINATIONS**

When post-mortem examinations are performed at places other than treatment centers, no special precautions are necessary provided that the activities remaining in the cadaver do not exceed 15 mCi of I-131. Where the pathologist needs to carry out the post-mortem procedures before the activity has decayed to below the above values, the Radiological Health & Safety Officer (RHSO) should be consulted so that the radiation levels likely to be encountered are identified and the hazards involved are assessed. Every effort shall be made to adopt procedures which minimize contamination, and any contamination should be removed immediately after the post-mortem examination has been completed.

**EMBALMING**

The embalming of radioactive cadavers constitutes an undesirable hazard and should be done with strict precautions. If the body is not autopsied, the contamination risk to the embalmer is small. All embalmers should wear disposable gloves, protective clothing and face protectors. Embalmers should be supervised by the RHSO to observe proper radiation protection measures. Embalming should not normally be carried out if the residual activity in the cadaver exceeds 15 mCi of I-131, but if there are special reasons for doing so, the embalmer should be advised by the RHSO of the hospital as to what precautions should be taken. All cadavers in this category shall have a label attached, identifying the radionuclide and its activity at the time of death.

**BURIAL**

The amount of incorporated radioactivity allowed at the time of burial depends on the regional and environmental conditions such as climate, distance to cemetery, type of transport, and availability of low-temperature refrigerators.

Precautions to be taken may be classified according to three levels of activity remaining at the time of burial.

1. **Residual activity up to 555 MBq (15 mCi) of Iodine-131:**

   There is no need for personal dose control either of the staff or of the relatives of the deceased and no need for supervision by the RHSO. It is unnecessary to mark the cadaver, the coffin, or the clothes or to undertake a contamination test.

2. **Residual activity of 555 – 1110 MBq (15-30 mCi) of Iodine-131:**

   There is no need for personal dose control of the staff or of the relatives of the deceased. Preparations for burial and any contact between relatives and the cadaver should be controlled by the RHSO. The body should be marked with the radiation symbol but no need to label the coffin. All objects, clothes, etc. that might have been in contact with the deceased must be tested for contamination.

3. **Residual activity of 1110 – 11100 MBq (30-300 mCi) of Iodine-131:**

   Relatives must be prevented from coming into contact with the body, and people must not be allowed to linger in the presence of the coffin. The hospital staff, the coroner, the persons washing and preparing the corpse for burial, the staff of the undertaker, and the transportation and cemetery staff must be instructed by the RHSO and monitored for their personal dose rate by means of pocket dosimeters. While there is no need to mark the coffin, all objects, clothes, etc. must be tested for contamination. It is expedient to wrap the cadaver in plastic foil immediately after death has occurred, and it should never
be handled unless with disposable protective gloves. (5) & (6)

EMERGENCY PROCEDURES IN CASE PATIENT DIES

1- The nurse or hospital staff on duty must immediately notify the attending physician and RHSO of the death of a radioactive patient.

2- If the Physician finds that there is still significant residual activity in the cadaver, he must attach a tag with a label indicating that the body contains radioactivity and the estimated activity.

3- The attending physician must ensure that appropriate instructions and information are given to the relatives of the dead patient.

4- The RHSO shall only allow post-mortem examination or any related activities on the cadaver if the measured exposure dose rate at one meter from the body is less than 25 μSv/hr (2.5 mR/hr).

5- The RHSO must set the working time limits and provide the proper radiation protection accessories if it is necessary to attend to the body immediately.

6- If the body is stored and it is necessary for the workers to be near the storage area, then the RHSO must set the working time limits and the distance from the area.

INFORMATION THAT SHOULD BE IMMEDIATELY AVAILABLE

1- Date and time the patient died.

2- Radioactive substance remaining in the body of the cadaver (type of radionuclide and activity).

3- Amount of the radionuclide that was initially administered to determine the residual activity at the time of death.

- Radiation measurements at different distances from the cadaver.
- If a patient who has received a therapeutic dose of any radionuclide dies in the hospital within a three week period after administration, the physician must:
  o Notify the Radiation Safety Office, night or day. The Radiation Safety Office will give suitable instructions to the pathologist and funeral director.
  4- Notify the pathologist, if an autopsy is to be performed, that the cadaver contains radioactive material and that the Radiation Safety Office will provide necessary monitoring during autopsy. (7)

BURIAL IN ISLAMIC SUNNA

As the grave go in the ground depth of 1.5 meter and length of about 2 meter. In the bottom go to a side as L shape. Put the cadaver in the short arm of L and covered with stones or wood then heel the soil in the grave. This method is the most suitable for making shield and protect visitors.

REFERENCES

(1) Commonwealth of Virginia Radiation Protection Regulatory Guide, September 2011

(2) IAEA 2007

(3) (ARPANSA 200Z)

(4) Radiation Protection Series No. 14.2

(5) Health South Eastern Sydney Local Health Network, 2014

(6) NRLSD Bulletin 97-01

(7) National Health and Medical Research Council, Australia; 1986