SHORT COMMUNICATION

Radiation protection management of radioactive corpse given high dose radioiodine-131 therapy: Muslim perspectives

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ABSTRACT

Islam is the next biggest religion after Christianity in the globe. The Muslims are very strict in following the spiritual customs concerning the cadaver of a person. A patient who has received high dose radioiodine-131 therapy may die, while still having considerable radioactivity lingering in his corpse. In such case, a lot of issues begin from transportation of corpse to radiation protection of public. The purpose of the study is to present ideas for radiation protection management of Muslim radioactive cadaver. These ideas propose ways for health examiners, transportation facilitators, relatives of the deceased, ghusl's (washing corpse) persons or facilitators, imam (religious scholar), autopsy, funeral, and burial of Muslim radioactive cadaver.

Keywords: Radiation protection, corpse, radioiodine therapy.

INTRODUCTION

Targeted radionuclide therapies (RNT) with various radiopharmaceuticals are attracting and growing interest in clinical acceptances presumably due to improved specificity of the ligand used and ease in availability of the radioisotopes [1]. Radioiodine-131 (I-131) for the effective management of benign and malignant thyroid disorders has been considered as the most recurrently performed RNT [2,3]. Other I-131 based RNT include I-131 Metaiodobenzylguanidine (MIBG) (for the treatment of some tumors of neuroendocrine origin, such as pheochromocytoma, neuroblastoma, and ^{131}I-tositumomab regimen (Bexxar®) for targeting CD 20 antigen in B-cell non-Hodgkin lymphomas [4]. Newer classes of RNT against more common cancers, such as lung, breast, colorectal, and brain cancers are being investigated at pre-clinical and early clinical phases and have shown clear objective responses with acceptable toxicity levels, these include a variety of radionuclides with alpha, beta, gamma, and mixed emission spectra [4].

Radioiodine-131 ablation therapy is used for the elimination of thyroid remnants after thyroidectomy. However, ablation therapy patients pose radiation risk to radiation workers, hospital staff, and general public. These patients are, therefore, kept in designated isolation rooms with the intention to minimize the radiation risk [3,5]. The isolation of the patients is compulsory by the Nuclear Regulatory Commission (NRC) to persist in the hospital if any one of the community is probable to exceed a radiation dose of 5 mSv from that patient. According to NRC rules and regulation, the patient is permitted to be discharge from the hospital only if her/his survey meter reading is less than 50 µSv/h at 1 m distance [3].

The sudden death of patients within short time after treated with radioiodine-131 ablation therapy is underestimated, because it may not be related to the disease. This death depicts a confounding case from the radiation protection point of views and thereby demands for special protocols.

We are living in religiously, culturally, and ethnically diverse communities all over the globe. Dead body (corpse) handling is different in different religions and cultures. No uniform protocols can be devised in this respect but general guidelines can be charted out

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for diverse religious entities. However, such radiation protection guidelines for management of radioactive corpse are relatively unexplored in the context of religion and culture.

Muslim community is 24.1% of world's population [6]. Only in the United States (U.S), there are 3.3 million Muslims which is 1.1% of the U.S total population and is the third largest religious faith followed in United States [7]. Muslim population in Europe is 4.9% estimated in the year 2017 [8]. The Muslim population is expected to grow double as fast as the overall global population. Understanding of the Muslim religious norms is of immense importance as they are very committed in following their religious rituals, especially after the death of an individual.

In this study, we present the fundamental radiation protection suggestions for the management of radioactive corpse from Islamic perspective. In particular, we present ideas for relatives of the deceased, the religious scholars, organ donors, autopsy, morgue personnel, transportation, and corpse burial. The study provides the most basic form of suggestions which are open for further improvement before implementation in the scientific perspectives [9,10].

GENERAL SUGGESTIONS FOR RADIONUCLIDE THERAPY PATIENTS

Cardiopulmonary resuscitation (CPR)

In CPR procedure, the efforts for recovery of partial flow of oxygenated blood to heart and brain should never include any mouth to mouth breathing while patients receive the dose of RNT. However, assisted respiration may be provided with the help of ambulatory bag; if used, the bag should be immediately checked for any contamination and should be treated accordingly. Furthermore, defibrillator may be used in case of cardiac arrest [11].

Declaration of death

When the death of RNT-patient has been confirmed, the concerned nuclear medicine physician and radiation protection officer (RPO)/ Medical physicist should be immediately informed by the attending medical staff. The RPO is responsible to declare radiation emergency and notify the specific radiation protection precautions. Specifically, the radioactive dead body should be minimally handled to avoid any possible contamination with the body fluids. The RPO should monitor the dose rate of the dead body and excreted fluids, such as urine, feces, and blood and should instruct the radiation workers for handling the body accordingly. Designated plastic bag may be used to restrain leakage of radioactive fluids/ substances from the corpse. The customary procedure of pressing down the abdomen of the corpse must be avoided as it may result in radiation contamination. The body should be clearly labeled with the administered radionuclide form and estimated residual activity. For higher levels of radioactivity in urine and blood, the corpse must be catheterized to remove the urine toward minimizing the activity level inside the corpse [11,12]. The urine from the bag should drain into the toilet of isolation room where the facility of delay tank is always available.

When the corpse is identified as radioactive potential hazard, the key attendant should be given a small card (pictures of sample card) with details of the proper handling of the corpse. The card should contain with proper precautions regarding radiation protection and contact details for RPO associated with the department where therapy was instituted [11–13].

Access to the designated isolation room occupied by the deceased should be controlled until the room has been decontaminated and surveyed. Keeping the Islamic religious aspects, concerns arise with respect to embalming, burial of the corpse, and the conduct of autopsy examinations [9–12].

Organ donation

According to Fatwa given by famous Islamic scholars from other countries and Pakistan, Islam gives permission of organ donation for life-saving purpose of human beings [14,15]. In such circumstances, RPO should estimate radiation doses for all personnel involved in the surgical procedure toward harvesting and transplanting the donated organ. RPO should determine the necessary radiation protection precautions accordingly. Special attention should be paid to any temporary radioactivity near the donated organ, e.g., organ bags, cold saline, organ box, etc. [11–13]. Contamination from body fluids should be checked by RPO if it is suspected.

It is dubious that the uptake/ accumulation of activity in the donated organ will be sufficient to cause significant radiation damage to the organ itself or impose sufficient radiation risk to the recipients as to nullify the procedure. Moreover, for the organ recipient, the organ donation is most likely life-saving procedure; thereby the radiation dose to the recipient alone should not be considered a limiting factor to the procedure. Nevertheless, RPO should strictly implement the As Low As Reasonably Achievable (ALARA) principle throughout the procedure.

Precautions during autopsy

Post-mortem examinations must not be achieved without the advice of RPO [11]. Autopsy is permitted in Islam only in special circumstances such as the corpse is involved in the investigation of a murder to ascertain the unexpected death's cause [16]. The radiation exposure risk, and thereby the adopted precautions will depend on the time span between the death and the autopsy procedure. For instance, the autopsy procedure within a few days after radiopharmaceutical administration [17] will demand for well supervised procedure. Alternate techniques, such as CT scan, MRI, or their combination to autopsy, should be preferred [18].

The radiopharmaceuticals used in RNT's are usually preferentially accumulated in a target organ and excision of the organ at initial stage of autopsy will significantly reduce the risk of radiation exposure. For instance,

I-131-based RNT specifically target thyroid gland thereby removal of thyroid in the start of autopsy will result in less exposure. The medical staff dose in case of such excision can be reduced either by adopting delay and decay strategy for autopsy or implementing special radiation safety precaution [17].

Biochemical samples required for pathological assessment should be evaluated for residual activity by RPO prior to releasing the samples to the pathology laboratory. The samples with suspected higher amount of activity include urine, blood, thyroid tissue, metastatic sites of the disease, etc. In such cases, the samples should be held until the activity has significantly decayed, if this delay is not affecting the test results [19]. Moreover, goggles typically used in pathology lab for protecting against blood-borne pathogen exposure should be worn to prevent an accidental splash into the eyes [20]. Separate table for tissue processing (fixing, staining, sectioning, etc.) should be preferred. Finally, all the equipment used in excision or pathology assessment should be decontaminated by thorough rinsing in a detergent solution followed by washing in running water [21].

Corpse storage in morgue

Islamic ruling emphasizes on the earliest possible burial (i.e., to put the corpse in the ground) [10,16]; however, the body can be kept in morgue for reasonable time toward the safety and protection of general public. To this end, the RPO should educate and convince the relatives of the deceased to allow the corpse storage in morgue so that the radiation exposure falls within or near the permissible limits and radiation protection issues for general public should be minimized. Once agreed, the morgue should be adequately notified by RPO. Furthermore, radiation safety precautions should be discussed with the morgue personnel.

A triage station should be declared outside the collecting area, which should consist of table for necessary containers, body bags, and a technician with gloves, lead apron, face mask, and survey meter. The formation of the triage on the basis of radiation survey is the responsibility of the technician/medical physicist. If the reading of the survey meter is greater than 1 mSv/h at 1 inch away from the corpse, then the body should be moved at least 30 feet away from the working area [18].

Transportation

The RPO/Medical Physicist should make the administrative limits for the workers, so that their doses not exceed the dose limit. The RPO/Medical Physicist should advice the workers to minimize the radiation doses by moving away from the work area when doing nothing [18].

Transport code should be followed while shifting the corpse from hospital to home. Specifically, corpse transportation from hospital to home should be carried through an unaccompanied ambulance with special lead shielding at the back of driver seat. As most of patients in our country belonging to far flung areas, so in case of long transportation route, two or more drivers may provide their services on rotation basis, as per recommendations from RPO. The body bag must be retained in safe custody for proper waste disposal.

Visitation ceremony

As per Muslim customs, the corpse is staged in open with the motive that people can look at the deceased for the last time. The RPO must ensure minimum time for lookout for each visitor. Furthermore, the corpse must be watched from a reasonable distance as suggested by RPO. Moreover, children and pregnant women should not be allowed near the corpse for extended time.

Preparation for burial

Retaining the corpse in morgue facilitates radiation protection during later stages of the burial. However, immediate burial without any morgue will significantly complicate the radiation protection for the relatives of the decease and general public. The RPO should monitor the exposure level at different sites of interest and all activities must be performed under his/her strict surveillance. Relatives and people engaged in burial activities must be directed to keep maximum possible distance from the corpse. In addition, the time spent near the corpse should be minimized [17].

Bathing and shrouding of the corpse (Ghusl)

It is obligatory to wash the whole body of the corpse with water as per Islamic ruling [9,16]. In case, the corpse had received RNT, the bathing must be performed quickly to reduce the radiation risks. The bathing must be carried out swiftly with various tasks distributed among many individuals. The RPO must direct the persons involved in bathing to wear disposable surgical gloves. The corpse is typically placed on elevated wooden floorboard and bathed on mud ground so the water get absorb in mud. However, in case of Radioactive iodine (RAI) corpse, the dead body must be washed on cemented ground. The body should be washed by using dilute and disperse principle of radioactive materials (i.e., large quantity of water should be used to reduce the activity level). Prior to the corpse is wrapped in shroud and placed in coffin, the corpse body must be covered in plastic bag to avoid leakage and contamination. The cloths and towel used in cleaning and drying during the corpse bathing must be disposed as radioactive waste. All the persons involved in the bathing and shrouding process must be advised to take bath afterward.

It is also permitted to substitute water bathing of the corpse with dry wash called Tayammum as per Islamic ruling [9]. Tayammum should be preferably followed so that radiation exposure to general public can be minimized.

Carrying of radioactive corpse to graveyard

Corpse from which the radiation dose rate value is less than 1 mSv/h at 1 inch should be directed to funeral place and graveyard [18]. Transport code should be followed while shifting

the corpse from home to graveyard. The corpse is shifted on shoulders by a crowed of relatives and public as per Islamic customs. In this case, the persons carrying the corpse on shoulders must be changed frequently. Furthermore, the accompanying crowd should also keep a reasonable distance from the corpse. Although this scheme of corpse transportation pose significantly higher radiation exposure risks to larger part of the crowd, t may be difficult for the RPO to convince the relatives for adopting the ambulance scheme for corpse transportation.

Funereal Prayers (Salaatul Janaazah)

As per Islamic sharia, the corpse is placed in the front of the Imaam/ religious scholar (prayer leader) and congregation for the final prayer called Salaatul Janaazah, [9] which typically takes 10 to 15 minutes. The RPO must educate the Imaam/ religious scholar about the risk of radiation hazards and convince him to keep distance from the corpse while offering the funeral prayers. After the Janazah salaah is performed, the corpse should be buried as soon as possible; this is also in agreement with the Islamic ruling [9,16].

It is also noteworthy to carefully communicate the radiation protection protocols to the Imaam/religious scholar and relatives so that adequate controls are implemented without compromising the corpse dignity and feeling. In addition, the RPO must be careful while dealing and explaining the radiation risks so that the corpse relatives may not consider the RNT as the death cause. Furthermore, it is essential that the Imaam/religious scholar should not overreact to the risks associated with the radioactive corpse.

Burial

The grave excavated for the corpse should be deep enough to overcome radiation protection issues. Moreover, the post-funeral activities performed at grave must be arranged at such a distance to minimize exposure to general public. In case of higher dose rate in the grave proximity, the RPO should advise the relatives and congregation not to perform the post-funeral Islamic duties around the grave.

CONCLUSION

Muslims as a religious faith constitute a large portion of the world's population. They follow religious codes strictly when comes to dealing with death of an individual. Issues of conflict are solved with bioethics. There is no doubt that there are issues because we have to follow religion and customs on one side, and follow radiation safety procedures on the other side. However, the radiation protection protocols must also be valued in following customs of dealing with radioactive corpse. The understanding of these safety protocols is of immense importance in death of radioactive corpse. In general, the customs and rituals of short duration between the death and burial, short visitation time, short funeral prayers are favorable in terms of radiation protection.

List of Abbreviations

MIBG	Metaiodobenzylguanidine
NRC	Nuclear Regulatory Commission
RAI	Radioactive iodine
RNT	Radionuclide therapy
RPO	Radiation protection officer

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