COMMENTARY

Radiation Safety When a Patient Dies After Therapy

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Objective: When a patient dies a short time after radionuclide therapy, several issues arise due to the shifting of responsibility from patient care to protection of the public, while respecting societal values and rites. Such a situation occurred in our institution after administering a large therapeutic dose of ^{131}I for metastatic thyroid cancer. The requirements of safe practice, the shift of accountability, the ethical aspects and forthcoming changes in the regulatory constraints are discussed.

Key Words: thyroid cancer; iodine-131; radiation safety; radioactive cadaver

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Patients treated with radionuclide therapies rarely die soon after treatment because those judged to be moribund are not selected for these therapies. As a result, there are few reported cases relating to the safe handling of a radioactive cadaver (*1–4*). In those rare instances of unexpected death soon after radionuclide treatment, the radiation flux emanating from the corpse as well as the possibility of contamination by body fluids may be significant considerations for pathologists and other hospital workers, funeral home staff and the family. The nuclear medicine staff, especially the radiation safety officer, are likely to be consulted for advice on safe practices during an autopsy and preparation of the body for the funeral, as well as for the safety of the family and public during these rites. The method of disposal of the body may become an issue in some circumstances. The few published cases have concentrated on the dosimetric parameters pertaining to managing the radiation safety situation. This case is presented as the basis for identifying an ethical dilemma between rigorous radiation safety management and sensitivity to the emotional needs of the family and their community.

CASE REPORT

In 1977 a 53-yr-old woman was diagnosed with follicular thyroid cancer. She was treated by hemithyroidectomy and thyroid hormone replacement alone. In 1995 at the age of 71 yr, she presented with a neck mass that was a recurrence of her thyroid cancer. Based on the involvement of structures demonstrated on a CT scan, she was judged not to be a candidate for surgery but no other treatment was offered. About 4 mo later she presented at this institution with a mass that filled the neck from the angle of the jaw to the clavicle and with impending airway obstruction. A CT scan demonstrated that the tumor, which measured 8.5 × 6 cm, had penetrated the thyroid cartilage and had directly involved the vocal cords. Lung metastases were present. The family wished for her to be treated.

Her airway was secured by placing a tracheostomy. The next day she received 5.18 GBq (140 mCi) ^{131}I intravenously to ablate the remaining lobe of the thyroid gland. Administration of ^{131}I was followed 30 min later with monitoring of the radiation dose rate at 1 m from the center of the mass. This was the baseline measurement for monitoring retained dose over time. The intent was to proceed immediately to a course of palliative external beam radiotherapy to her neck as well. Approximately 18 hr after receiving the ^{131}I dose she was found unresponsive in her room. Resuscitative efforts were unavailing and she was pronounced dead after 15 min. Nuclear medicine was notified of the arrest in progress and a technologist was dispatched to the scene with equipment to monitor the cardiac arrest team, the body and the area for contamination. No contamination was detected on the members of the team. The radiation exposure rate emitted by the body was 4.2 mR/hr at 1 m which corresponded to 1.55 GBq (42 mCi) ^{131}I retained. The equipment used in the resuscitative effort was collected into containers for transport to storage. The corpse remained in the room pending development of an action plan.

Several safety-related issues were identified: (a) completing the required protocol for documenting and tagging the body and informing the Canadian Atomic Energy Control Board (AECB); (b) determining the need for an autopsy; (c) discussing with the funeral home their ability to safely handle the body; and (d) determining the family's choice of disposal method. The legal obligations of the hospital were identified and completed in consultation with the AECB. After consultation between the attending physician and the family it was determined that an autopsy would not be done. The corpse was transferred to the hospital morgue for shipment to the funeral

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home. The family consented to a closed-casket funeral home visitation that allowed placing the body without embalming into a hermetically sealed unit designed to fit within the coffin. Outside the midpoint of the casket the radiation exposure rate at 1 m was 3 mR/hr. With the casket in the hearse the radiation exposure rate in the driver's seat area for the projected 90-min drive to the patient's home town was estimated to be 0.6 mR/hr. The funeral director was advised to arrange the visitation room to limit public access to the immediate area of the coffin in an unobtrusive manner.

DISCUSSION

Radionuclide therapies are given with the expectation of benefiting the patient. The patient is the primary customer in the treatment transaction. Others, including the family, the community and the involved health professionals, also benefit from the treatment in different ways. The radiation cost, in other words the irreducible nontarget radiation dose, is borne primarily by the patient although others will receive some of the treatment dose through their proximity to the patient or through contamination of the shared environment. If radiation safety is managed well the exposures will not be out of proportion to the expectation of benefit by each party. The management challenge in radionuclide therapy is to maximize the dose to diseased tissue while minimizing nontarget dose to the patient and all others.

Radionuclide therapy is an acceptable practice because it is deemed that the benefit more than offsets the radiation exposure cost. However, benefit and radiation costs are inevitably in different units and the ratio of the two is a noncomputable entity. Thus, the responsibility for the judgement that the treatment is effective must lie with the patient. The process leading to the patient's decision to accept treatment is akin to that of a marketplace where relative values for unlike items are established through bartering in response to need and scarcity for the items in question. In this sense "What will it take for me to feel better? And is it worth the trouble?" are equivalent evaluations to "How many of my locally grown apples can I trade for one of your exotic oranges?" The acceptable nontarget radiation dose is the best price possible in exchange for the anticipated personal benefit.

In contrast to the above, public agencies with responsibility for radiation safety have tended to focus their attention on the dosimetric aspects of safety that have customarily been expressed through regulations requiring admission to a hospital and retention of the patient there until the retained nuclide has been reduced to a specified level through excretion and decay. In the case of ^{131}I the North American standard for hospital discharge has been 1.11 GBq (30 mCi). The new NRC regulation (*5*) is much more patient-focused and will allow earlier patient discharge provided that no other person is likely to receive an exposure greater than 5 mSv from the patient. Liberalization of discharge criteria also is under discussion in Canada. The benefit of this change is in terms of reduced patient isolation and better emotional support from family as well as of reduced health care costs. The irreducible radiation costs are to the patient's closest associates. They are below the level of demonstrable harm and offset by the prospect of improved health for the patient.

If the patient dies soon after therapy, this model of the cost/benefit relationship necessarily collapses and the radiation safety paradigm must shift from support of an anticipated human benefit into one of damage control. However, the possibility should not be overlooked that there are some human needs still to be met even though the patient, the original focus of concern, is deceased. In the absence of the patient, the primary customer for our consideration and radiation safety is the family and its community whose grieving is to be respected with as little intrusion by technology as possible, consistent with the maintenance of a safe environment.

In the North American multicultural environment the practices associated with preparing the body, funeral ceremonies and methods of disposal vary greatly. Some culturally mandated practices, such as embalming or ceremonial preparations of the body, may result in a small radiation exposure to funeral home employees or to family. Delay of the funeral to permit radioactive decay may be culturally unacceptable and emotionally damaging. If cremation is selected as the means of body disposal, there may be concern about the level of radioactive exposure for crematorium personnel or to the family from the residue in the ashes. Clearly there are technological solutions to all of these matters. The concern is that a radiation safety process that is centered on exposure readings, without sensitivity to the benefits of custom, may be inhumane. The cost/benefit relationship must ensure that the radiation safety process does not subvert the needs of the bereaved to the tyranny of radiation measurements in isolation from other, equally real, considerations.

CONCLUSION

Bioethics provides processes for resolving values that are in conflict. There is no uncertainty about the necessity of radiation safety protocols on the one hand or about the autonomy of communities to grieve according to their custom on the other. In some instances the technological perspective afforded by radiation safety regulations must be outweighed by the facilitation of the grieving process through adherence to funeral customs. The objectives of both can be achieved through consideration of the humane objectives of the individual situation.

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