Radiation Safety in the Management of Patients Undergoing Radioactive Iodine Ablation Therapy

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High-dose radioiodine therapy for thyroid cancer poses risks to healthcare workers, family members, and the public. Oncology nurses can effectively manage these risks by employing the three key principles of time, distance, and shielding.

At a Glance
• The use of high-dose radioiodine therapy is increasing in tandem with the rising incidence rate of thyroid cancer.
• In inpatient settings, oncology nurses should use the principles of time, distance, and shielding to minimize radiation risks to visitors and staff.
• In outpatient settings, oncology nurses should carefully educate patients about minimizing risks to others at home and in the community.

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This article aims to equip oncology nurses with essential knowledge to safely manage patients with thyroid cancer undergoing therapy with orally administered high-dose radioactive iodine (RAI), also known as I-131. RAI therapy is a long-established and generally effective treatment for differentiated thyroid cancer (Silberstein et al., 2012), but its use carries risks to patients and those who might come into close contact with them, including healthcare workers and family members (Greenlee et al., 2011). Armed with basic principles of radiation safety, oncology nurses can minimize risks to the entire healthcare team, patients, and the public.

The incidence of I-131 administration has been increasing in recent years in tandem with a broad increase in the incidence of thyroid cancer, particularly in women. The National Cancer Institute’s (NCI’s) Surveillance, Epidemiology, and End Results program database indicates that the age-adjusted incidence of thyroid cancer in the United States rose from 8.2 per 100,000 persons in 2001 to 14.2 per 100,000 persons in 2011 (NCI, 2014). The American Cancer Society (2014) described thyroid cancer as the most rapidly increasing cancer in the United States. Some scholars have raised concerns that these recent statistics have been driven partly by overdiagnosis—that is, by the detection of tiny thyroid lesions that are unlikely ever to become life-threatening (Morris, Sikora, Tosteson, & Davies, 2013).

Thyroid cancer treatment generally begins with the surgical removal of all or part of the thyroid gland. Surgery commonly is followed by orally administered RAI, which for more than 60 years has been used to destroy residual cancerous tissue after thyroidectomies (Silberstein et al., 2012). Like all forms of iodine, including ordinary dietary iodine, I-131 is taken up by the thyroid gland, where its radioactive beta particles break down the local tissue (Lehne, 2010). I-131 also emits gamma rays, which travel across a longer range and are the source of potential radiation hazards to the people in close contact with the patient.

The rate of I-131 therapy appears to be increasing in absolute and relative terms. Haymart et al. (2011) found that “between 1990 and 2008, across all tumor sizes, there was a significant rise in the proportion of well-differentiated thyroid cancer patients receiving radioactive iodine” (p. 721). In 2009, the American Thyroid Association (ATA) issued guidelines that discouraged the use of RAI in patients whose primary thyroid tumors were well-differentiated tumors less than 1 cm in diameter (Cooper et al., 2009). Contrary to the guidelines, however, many physicians continue to order RAI, even for these low-risk patients (Haymart et al., 2013).

With the incidence of thyroid cancer and RAI administration increasing, nurses being equipped with knowledge to minimize the risks of radiation exposure is essential. Healthcare workers, family members, and anyone else who might come into contact with the patient during the days immediately after RAI administration run the risk of absorbing low or moderate doses of radiation. Such exposures can generate a long-term risk of developing thyroid cancer,
leukemia, cancer of the salivary gland, and a number of other cancers (International Commission on Radiological Protection, 2007). Exposure to I-131 also can impair fetal development. Pregnant women and breastfeeding mothers must have no contact with a patient receiving I-131 until the patient’s radiation drops to a sufficiently safe level (Sisson et al., 2011). These risk profiles generally are based not on direct evidence from thyroid cancer treatment but from epidemiological studies following atomic bomb explosions and the Chernobyl nuclear disaster, all of which exposed large populations to low and moderate doses of I-131 (Cardis & Hatch, 2011).

Managing I-131 Radiation Risks in Inpatient Settings

If patients require a relatively high dose of I-131, or if they are regarded as unwilling or unable to comply with behavioral requirements to reduce radiation risks to their family members and the public, the treatment is given on an inpatient basis (Harolds, 2011).

The core objective in managing I-131 radiation risk is to keep levels of exposure as low as reasonably achievable (ALARA). The U.S. Nuclear Regulatory Commission (NRC) generally limits each worker’s occupational radiation exposure to no more than 5,000 mrem per year (NRC, 1991a). This cumulative exposure is measured through dosimetry tests of film badges that workers must wear on their torsos. Nuclear licensees, such as hospitals, must limit exposure to members of the public, such as hospital visitors, to no more than 100 mrem per year (NRC, 1991b).

Three key concepts to achieve ALARA exposure rates are time, distance, and shielding. Time spent exposed to the patient receiving radiation generally is minimized to 30 minutes per person per shift. The nurse should bundle care for maximum efficiency, transferring care to other members of the healthcare team when time limits are reached. An individual nurse should be assigned to no more than one patient receiving radiation per shift (Yarbro, Wujcik, & Gobel, 2011). Patient safety risks, side effects, and needs may be assessed frequently via intercom between nursing visits.

Distance from the patient should be maximized, as distance and exposure are inversely related (see Figure 1). To illustrate, at bedside immediately after dosing, radiation exposure at 1 meter from the chest is typically 100 mrem per hour. When the distance is doubled to 2 meters, the radiation exposure is reduced to 25 mrem per hour. To employ this principle, the nurse hands items through the door rather than entering the room, unless necessary.

Shielding, such as lead or concrete, blocks radiation emissions. Some hospitals have rooms designed with shielding in place. Where shielding is not available, a corner, private hospital room not next to a stairwell or open area is optimal. The head of the bed should be positioned against the outside brick wall. Additional protection can be achieved by placing a shield between the door and the patient.

Before a patient is dosed, the room is prepared. Signage indicating a radiation hazard and “no housekeeping services” should be placed on the door. Linen and trash hampers are placed inside the room, as are vital designated sign equipment. All surfaces the patient may frequently touch, such as the toilet, faucet handles, phone, and bedrails, should be wrapped in plastic wrap (Al-Shakhrah, 2008). Materials used in the care of the patient are left in the room for the entire hospital stay.

As much as possible, healthcare workers and visitors should minimize their contact with the patient’s body fluids because these will be radioactive for a period of time after RAI administration (Ibis et al., 1992). To minimize fluid exposure, managing nausea and preventing emesis, which are common side effects of I-131 therapy, are important (Silberstein et al., 2012). Hospitals may ask patients receiving I-131 to handle their own urine collection and measurement, so that staff members need not have close contact with the fluid (Duke University Medical Center, 2014). Male patients should be instructed to sit while voiding, and all patients should be instructed to flush the toilet twice, with the lid closed, to reduce the risk of aerosolization. Vigorous hydration is highly encouraged because it hastens biologic elimination. Sweat is a source of contamination; subsequently, as many showers as tolerated are recommended for the first two weeks.

In the event of cardiac arrest or other medical emergencies, the nurse should follow the facility’s specific protocols. When a patient receiving I-131 is at immediate risk of death or severe harm, many facilities relax their radiation restrictions and allow the patient to be moved away from the shielded room. Stanford Hospital’s (2012) occupational safety handbook, for example, declares that in emergencies, “treatment shall take precedence over radiation safety measures designed to prevent infractions of State or Federal law” (p. 30). When administering cardiopulmonary resuscitation to a radioactive patient, staff members should be extremely cautious about using appropriate barriers.

Visitor safety is promoted by prohibiting pregnant visitors and visitors aged younger than 18 years. State regulations and hospital policies vary, but visits

![FIGURE 1. Relationship Between Radiation and Distance](http://bit.ly/1CwafgP)

Note. See the American Thyroid Association’s guidelines for comprehensive discharge recommendations (http://bit.ly/1CwafgP).
typically are limited to 30 minutes and require that visitors maintain a distance of at least 6 feet from the patient (Al-Shakhrah, 2008).

The patient and room should be surveyed with dosimeters at prescribed points at least daily. Surveys include points where care is provided, such as 1 meter from the patient’s chest, each side of the bed, the foot of the bed, and the doorway. In addition, the visitor chair, the inside and outside of the door, and the adjacent patient wall should be surveyed. When survey readings at 1 meter from the patient’s chest are 7 mrem per hour or less, the patient is considered safe for discharge (Silberstein et al., 2012). However, the discharge criteria may vary from state to state and from facility to facility.

Managing I-131 Radiation Risks in Outpatient Settings

Since 1997, when the NRC relaxed certain restrictions, a large majority of patients receiving I-131 have received their treatment on an outpatient basis. The NRC requires licensees to guarantee that no member of the public will receive a total effective dose equivalent of more than 500 mrem from a discharged patient, with tighter restrictions for pregnant women and young children (Harolds, 2011).

To fulfill their obligation to minimize exposure to family members and the public, nurses must extensively educate patients receiving I-131 before discharge. The ATA guidelines include maintaining a personal distance of greater than 6 feet, not sharing personal hygiene items or eating utensils, maintaining maximum hydration, showering at least the first two days, and wiping toilets with flushable wipes after each use (Sisson et al., 2011).

As the incidence of iodine administration and thyroid cancer continue to rise, knowledge of radiation safety principles becomes essential for a growing number of nurses. The three key principles of time, distance, and shielding are vital to employ when caring for the patient undergoing radiation. Knowledge of these principles equips nurses to safely manage patients undergoing RAI, minimize occupational risk, and protect the public. Nurses are in a unique position to educate the healthcare team, patients, and families on the essential concepts of radiation safety, protecting them from unnecessary risk.

References