GUIDELINE FOR RADIATION SAFETY

The Guideline for Radiation Safety has been approved by the AORN Guidelines Advisory Board. It was presented as a proposed guideline for comments by members and others. The guideline is effective June 15, 2015. The recommendations in the guideline are intended to be achievable and represent what is believed to be an optimal level of practice. Policies and procedures will reflect variations in practice settings and/or clinical situations that determine the degree to which the guideline can be implemented. AORN recognizes the many diverse settings in which perioperative nurses practice; therefore, this guideline is adaptable to all areas where operative or other invasive procedures may be performed.

Purpose

This document provides guidance for preventing patient and health care worker injury from ionizing radiation exposure during therapeutic, diagnostic, or interventional procedures performed in the perioperative environment. Guidance for low-dose-rate and high-dose-rate brachytherapy using ionizing radiation is included. This guidance applies to patients, perioperative team members, and the caregivers of patients who receive brachytherapy or other radioactive therapeutic implants.

A review of the literature provided evidence that perioperative team members and patients are exposed to radiation in nearly all perioperative specialties (eg, general surgery, urology, neurosurgery, peripheral vascular surgery, cardiac surgery, endoscopy, orthopedics).[1,2] These procedures are performed in various settings (eg, operating rooms [ORs], ambulatory surgery centers, inpatient and outpatient endoscopy suites, physician offices). In some situations, such as when a patient has brachytherapy implants, radiation safety practices extend beyond the clinical setting into the community.[3]

Studies have demonstrated that ionizing radiation can have adverse effects on the human body; therefore, patients and personnel should be protected from unsafe levels of ionizing radiation.[4-8] The adverse effects of radiation are classified as *deterministic* or *stochastic*. The deterministic effects of radiation (eg, skin erythema, hair loss, cataract formation, infertility, circulatory disease) appear at various times after the exposure.[9-13] There have been reports of deterministic effects appearing as soon as 24 to 48 hours after the exposure and as long as three to four years after the exposure.[14,15] The deterministic effects frequently appear at the radiation entrance site (eg, back, neck, buttocks, anterior of the chest).[1,4,6] The stochastic effects (eg, cancer, genetic effects) can appear at any time after the exposure, but usually appear after several years.[13,15-17] The stochastic effects occur when radiation causes a mutation within the cell or cell death. For both the deterministic and stochastic classifications, the severity and type of damage are related to the dose received (ie, the greater the dose, the greater the damage). Several factors affect the radiation dose delivered to the patient and personnel, including

- patient positioning,
- image magnification,
- fluoroscopy duration,
- maintenance of a single beam angle,
- use of high-intensity mode,
- dose monitoring,
- x-ray beam angulation, and
- mechanical defects in the radiation source.

When these factors are controlled by the perioperative team, the dose of radiation received by the patient and the team members will be decreased.[4,18]

The potential for some stochastic effects in patients may be low. Based on a 2009 literature review on ovarian radiation sensitivity and the genetic hazards of ionizing radiation in female mammals including humans, Adriaens et al[19] concluded that much of the literature involved irradiated animals and that the probability of genetic effects in humans resulting from exposure to radiotherapy or radiological examinations and accidental exposure is lower than the risk of genetic effects resulting from spontaneous risks (eg, exposure to the sun). The authors reviewed international articles from the 1970s, articles published between 1990 and 2008 identified in a MEDLINE® search, and additional articles acquired from citations in the literature.

The amount of radiation received by perioperative team members is affected by the direction of the beam, the beam quality, the field size, the position of the operator according to the position of the beam originator, and the dose required to produce a clear image.[20] The radiation dose required varies among procedures, among operators, and among patients undergoing the same procedure.[4,6]

Radiation may be generated by various modalities (eg, C-arm [eg, standard, mini], O-arm, computed tomography [CT], mobile or fixed fluoroscopy, portable x-ray machine)[16,21] or by direct delivery methods (eg, brachytherapy using seeds or balloons, intraoperative radiation therapy).[1] The modality or method chosen for delivery of radiation depends on the procedure being performed.

Perioperative team members are exposed to radiation from three different sources, including

- primary radiation, which is emitted directly from the source;
- leakage radiation, which emanates from the x-ray machine housing; and