The Ochsner Journal 15:438–440, 2015

Anesthetic Considerations for Intraoperative Radiation Therapy

Kathryn M. Glynn, MD,[1] Adam I. Riker, MD[2]

[1]Department of Anesthesiology, Advocate Christ Medical Center, Oak Lawn, IL [2]Department of Surgery, Advocate Cancer Institute, Advocate Christ Medical Center, Oak Lawn, IL

Background: Formerly, anesthetized patients who received intraoperative radiation therapy (IORT) had to be transported from the operating room (OR) to the location of the linear accelerator. With the advent of mobile accelerators, therapy is delivered directly to the patient in the OR, presenting specific challenges for the anesthesiologist.

Methods: We review the uses and benefits, operative and anesthetic challenges, and unique issues associated with IORT.

Results: Patient safety and precise delivery of the radiation dose are the primary goals of IORT. The anesthesiologist's role in ensuring the success of these two outcomes includes selecting the optimal anesthetic technique to prevent patient movement and permit sentinel node mapping, monitoring the patient's vital signs throughout the procedure, and ensuring that the sterile field is maintained in the OR.

Conclusion: Although keeping patients in the OR has simplified the process of providing IORT, the anesthesiologist must be aware of potential problems and plan accordingly.

Keywords: *Monitoring–intraoperative, particle accelerators, radiotherapy*

Address correspondence to Kathryn M. Glynn, MD, Department of Anesthesiology, Advocate Christ Medical Center, 4440 W. 95th St., Oak Lawn, IL 60453. Tel: (708) 684-5745. Email: kglynnmd@yahoo.com

INTRODUCTION

The history of delivering radiotherapy intraoperatively (intraoperative radiation therapy or IORT) has its beginnings in the early 20th century. In the United States, IORT was first used in 1976 at Howard University.[1] The study involved delivering a single, high dose of radiation intraoperatively to 7 patients with advanced neoplasms. In spite of the high dose of radiation necessary for this treatment, minimal acute reactions to the radiation were noted.

Formerly, anesthetized patients required transport from the operating room (OR) to the location of the linear accelerator. With the advent of mobile accelerators (units that are transported to the OR to deliver radiation), the therapy is delivered to the patient without the need to travel to another location.

USES AND BENEFITS OF IORT

A common use for IORT is in the context of breast-conserving surgery in the treatment of breast carcinoma.[2] Intraoperative electron radiation therapy delivered through the Mobetron unit (IntraOp Medical) is favored at our institution. The Mobetron is a mobile accelerator that delivers radiation to a tumor bed in the form of electron beams in contrast to the x-ray beams used in conventional radiation therapy.[3] Typically, once the tumor is resected, the surgeon places a cone over the area requiring radiation. The cone restricts the area of radiation therapy to the tumor bed and further serves as a retractor to exclude healthy tissue from the exposed target area.

A benefit of IORT is the ability to solely irradiate tumor margins immediately after surgically removing the tumor while the patient is under general anesthesia, thus eliminating the need for delayed treatment in the adjuvant setting.[2] IORT also offers the advantages of a shortened course of treatment (minutes vs weeks) and the ability to deliver high radiation doses to tumor beds while sparing healthy tissue and skin.

Although IORT often requires additional time in the OR, it has the potential to decrease healthcare costs because only 1 dose of radiation is required instead of a full 6-week course of radiation therapy. IORT also eliminates the possibility of patient noncompliance by delivering the sole dose of radiation intraoperatively. Despite all of its benefits, IORT presents operative and anesthetic challenges that need to be recognized and addressed as this treatment modality gains popularity in the United States and worldwide.

OPERATIVE AND ANESTHETIC CONSIDERATIONS OF IORT

When any general anesthetic is administered, a primary concern is always patient safety. Standard American

Society of Anesthesiologists monitoring should be observed, and all pressure points should be carefully padded and protected. Any extra monitoring (additional intravenous lines and arterial lines) must be addressed prior to positioning the patient under the mobile accelerator that delivers IORT. Avoidance of patient movement is imperative because the slightest movement can alter the direction of the electron beam, thus interfering with the accuracy. Success of the procedure also relies heavily on communication among a diverse group of people within the OR, including surgeons, anesthesiologists, nursing staff, radiation oncologists, and physicists.

Because avoidance of patient movement during the entire procedure is crucial, general endotracheal anesthesia (GETA) is the most logical option for procedures involving IORT. Monitored anesthetic care would not be possible for many of these cases given the amount of surgical intervention typically required for tumor resection. While a laryngeal mask airway (LMA) could be a viable choice for this procedure, most patients with LMAs breathe spontaneously, and sudden large swings in tidal volume or respiratory rate can result in an improperly focused electron beam. GETA with muscle relaxation seems as if it would be an ideal anesthetic approach because the patient would be on ventilator-controlled settings, thus solving the problem of wide swings in tidal volume or respiratory rate. However, muscle relaxants should not be used for cases involving breast conservation therapy because of the sentinel node mapping performed in these types of surgeries. Muscle relaxants impede the surgeon's ability to identify the activity of the nerves in the axilla as the sentinel lymph node biopsy is being performed. A potential solution is to place the patient under GETA so minute ventilation can be manipulated but to avoid the use of muscle relaxants beyond the initial dose required for intubation.

UNIQUE ISSUES ASSOCIATED WITH IORT

Because IORT delivers a high dose of radiation to a focused area of tissue, all personnel must exit the OR prior to the delivery of the dose (stray radiation is extremely low, and extra shielding outside the OR is unnecessary).[4] Consequently, the patient is unattended for several minutes, and a specially outfitted OR with the capacity to monitor patients after all personnel exit the room is required. A simple solution to this problem is to turn the patient monitor toward the hallway or wherever staff is located during IORT delivery. Displaying vital signs on monitors hanging from booms is another option. Some institutions report using mirrors to reflect the patient monitor toward the area where the anesthesiologist is located during IORT.[5]

Another option (the one employed at our institution) is to install a patient monitor in the hallway outside the OR dedicated to IORT. The monitor is turned on when OR personnel exit the room, and the anesthesiologist monitors the patient's vital signs during radiation delivery. IORT can be interrupted if the need for immediate access to the patient arises because the total dose is the imperative, not the duration of delivery.

IORT requires the presence of individuals from other disciplines of medicine who are often not familiar with the OR setting. Monitoring ancillary personnel and maintaining the sterile field in the OR are the responsibilities of all members of the surgical team. The medical technicians responsible for the mobile accelerator are focused on properly aligning the accelerator with the cone demarcating surgical margins and often do not recognize that the metal bars fastened to the OR table to hold cones in place above the tumor bed, patient drapes, and surgical instrument stands are sterile. As a patient advocate, the anesthesiologist must ensure all aspects of patient safety, including maintaining a sterile field.

Figure. Operating room table oriented in reverse position to facilitate movement and accommodate proper positioning under the mobile accelerator.

The accelerator rather than the OR table should be moved when possible. Although the accelerator is heavier, it typically moves with more finesse than the OR table. Moving a table supporting a patient who has an endotracheal tube connected to a ventilator is difficult because the ventilator is connected to the fresh gas supplies delivered through the wall or ceiling from one location in the OR. In addition, even state-of-the-art tables will wiggle when locked or unlocked. This movement can be a problem when proper alignment of the accelerator device and the delivery cone is a question of millimeters. Also, the OR table is in reverse orientation to facilitate movement and its proper positioning under the accelerator (Figure). The slide foot and head buttons can be useful when aligning the patient to the accelerator but are not without complications. When a patient slides completely to the head of the table, the fulcrum of the table is close to the patient's feet and can result in the OR table tipping toward the head. Anticipating this problem is important for patient safety and is another reason for moving the mobile accelerator in lieu of stretching the ability of the OR table to its limits.

CONCLUSION

IORT is an established treatment for many types of cancer, especially breast cancer. Mobile accelerators have eliminated the need for OR personnel and an anesthetized patient to leave the OR for this therapy. Although keeping patients in the OR has simplified the process of providing IORT, the anesthesiologist must be aware of potential problems and plan accordingly.

ACKNOWLEDGMENTS

The authors have no financial or proprietary interest in the subject matter of this article.

REFERENCES

1. Goldson AL. Preliminary clinical experience with intraoperative radiotherapy. *J Natl Med Assoc*. 1978 Jul;70(7):493-495.
2. Vaidya JS, Joseph DJ, Tobias JS, et al. Targeted intraoperative radiotherapy versus whole breast radiotherapy for breast cancer (TARGIT-A trial): an international, prospective, randomised, non-inferiority phase 3 trial. *Lancet*. 2010 Jul 10;376(9735):91-102. doi: 10.1016/S0140-6736(10)60837-9.
3. Meurk ML, Goer DA, Spalek G, Cook T. The Mobetron: a new concept for IORT. *Front Radiat Ther Oncol*. 1997;31:65-70.
4. Daves JL, Mills MD. Shielding assessment of a mobile electron accelerator for intraoperative radiotherapy. *J Appl Clin Med Phys*. 2001 Summer;2(3):165-173.
5. Djalali AG, Pearson JK. Mirror mirror on the wall, is the patient breathing after all? A novel use for the prone pillow mirror. *Anesthesiology News*. 2011 Oct;37(10):106-107.

This article meets the Accreditation Council for Graduate Medical Education and the American Board of Medical Specialties Maintenance of Certification competencies for Patient Care and Medical Knowledge.