RADIATION THERAPY

Surgical Specialty:	Non-OR Anesthesia (NORA)
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Background:

- **General Considerations**
  - Used as primary treatment for certain cancers, or may be required as neo-adjuvant, adjuvant therapy, or palliative treatment in advanced cancers
  - Indicated in pediatric patients for CNS tumors, bone marrow or stem cell transplant, leukemias, Non-Hodgkin's lymphomas, Wilm's tumor, retinoblastoma, soft tissue tumors
  - External beam radiation therapy (EBRT) including electron, proton, or neutron beam therapy is provided in an isolated room/vault with cameras focused on the patient and monitors as providers are outside the treatment area
  - Requires a mapping session for planning prior to commencement of treatments, often called simulation, and may take from 2 hours up to half a day for patients with complicated positioning. Mapping may use CT, MRI, or X-ray.
  - Most therapeutic sessions are on an outpatient basis of 15-30 minutes duration; five days a week over a period of several weeks, to allow normal tissue repair between sessions while tumor burden is decreased / destroyed[1]
    - May take up to 30 sessions to complete therapy
- **Patient Considerations**
  - The patient must remain immobile for the treatment session
  - Younger patients or those with developmental delay may require anesthesia for the treatment session
  - Patient positioning may be prone, supine, or lateral decubitus and can affect respiratory status with monitored anesthesia care
  - Require intravascular access for administration of daily anesthetics (central line or port)
  - In some institutions, ports are accessed on Mondays (possibly after mask induction) and de-accessed on Fridays. The port must be heparinized after each use per institutional guidelines.

- **Associated Comorbidities/Syndromes**
    - Children receiving chemotherapy concomitantly with cytotoxic side effects (eg. vomiting, cardiac, pulmonary toxicity) which can affect hemodynamics, ventilation, and increase the risk of aspiration
    - Patients are immunosuppressed and often have pancytopenia, and leukopenia with high risk for infections, bleeding, etc.
    - Abnormal labs may postpone the therapy session and are reviewed by the radiation oncologist.

  Therapeutic side effects can cause tissue damage, edema, skin changes, esophagitis, worsening nausea, headaches, seizure, and sometimes mental status changes

Anesthetic Planning:

- **Pre-Anesthetic Evaluation**
    - Patients often have extensive oncology workup which should be reviewed to ensure the patient is optimized
    - Verify NPO status
    - Pediatric patients should be planned as the first case of the day to avoid prolonged NPO time
    - Evaluate the patient daily prior to the procedure for changes in mental status or aspiration risk

- **Specific or Unique Room Set-Up Requirements**
    - Location
        - The radiation suite is a secluded, secured room with reinforced walls and doors which are closed during the session
        - The patient is usually positioned on a treatment bed which may include a pre-made ramp, head mask, or other materials to help with exact positioning for each treatment. Stickers/ markings are often left on patients to assist radiation therapy techs in positioning the beams
        - Xray and Proton therapy equipment will rotate around the patient and bed as indicated by mapping and guided therapy
        - The room should have adequate O2 and Air source wall outlets. Oxygen tanks should be available for backup as well
        - The room should have two wall suction outlets, one for suction and the second to attach to the anesthesia machine scavenger system if inhaled agents may be used
        - Anesthesia machine and anesthesia cart are usually placed inside the treatment vault area with monitors, suction, and appropriate length tubing set up
        - During treatment sessions, providers are monitoring the patient from outside the vault through one/two cameras within the treatment area (one for the patient and one for the patient monitors)
    - Staffing
        - Treatment centers often treat both adult and pediatric patients
        - One or two radiation technologists usually present for the positioning and verification of pediatric patient
        - Pediatric Physician Anesthesiologist alone or with another tertiary pediatric trained provider administer the anesthetic

        - Pediatric PACU or PALS certified PACU nurse for recovery is highly recommended[2]
    - Disposition
        - Outpatient treatment, patients usually are discharged home with a parent after recovery
        - If inpatient, usually return to the unit after recovery or directly to PICU
        - If transferred for treatment from another hospital, transportation should be coordinated prior to treatment with EMS services and physicians from the outside hospital

Intraoperative Considerations:

- **Anesthetic Management**
    - Monitored anesthesia care with TIVA is the preferred anesthetic
    - A thoughtful initial anesthetic that goes well may serve as a template for subsequent sessions.
    - Depending on the patient's condition, GETA may be considered particularly if the patient is already intubated
- **Airway**
    - Preferred spontaneous breathing with nasal cannula or face mask with supplemental O2 and ETCO2 monitoring
    - May consider the use of shoulder rolls, oral airway, or supraglottic airway if needed. Shoulder roll may not be allowed if not part of the positioning during simulation planning since the position must be replicated for each treatment.
    - Ensure patent airway prior to leaving vault during radiation therapy
    - Be prepared to emergently intubate if respiratory distress, airway obstruction, apnea
- **Monitors**
    - Standard ASA monitors
    - Ensure the vital sign monitor is within the camera's view
    - Anesthesia machine configuration depending on room layout may have cables or suction stretching across the room
- **Medications/Infusions**
    - Midazolam
        - Consider pre-treatment for anxiety with 0.1 mg/kg IV although may cause longer recovery for outpatients
    - Propofol
        - Boluses usually 1-2 mg/kg until loss of consciousness[4]
        - Maintenance 100-300 mcg/kg/min titrated to effect during prolonged simulation sessions[3]
        - Utilize long TIVA tubing as the patient stretcher often rotated in the middle of treatment to allow for different angles of access
        - Ensure the IV infusion pump is within the camera's view
    - Dexmedetomidine
        - Used less often due to loading time, boluses required, and longer recovery time. Can consider 0.25-0.5 mcg/kg if needed for a history of emergence delirium.
        - Beneficial for longer procedures such as simulation sessions or full body irradiation therapy
    - Ketamine
        - May consider 0.5-1 mg/kg boluses in certain cases; however, there is an increased incidence of complications [3,4]

  - Radiation therapy is often not painful and opioids are not necessarily required for treatment
  - Use of multiple adjuvant anesthetic medications may increase the risk of respiratory complications[3]
- **Positioning**
  - Usually supine; positioning is done by the radiation physicist, who will check portals by turning off all lights in the vault
  - A shoulder head ring can be used for positioning but cannot be moved once final positioning is complete
  - Positioning is dependent on the cancer location and area to be irradiated. If spinal irradiation is performed, the patient may require prone positioning
  - Ensure airway patency especially when radiation masks or frames are used
- **Hemodynamic/Physiologic goals**
  - Maintain hemodynamics and spontaneous ventilation with adequate anesthesia and immobilization
- **Emergence/Disposition**
  - Discontinue TIVA once radiation is complete; transfer patient to PACU stretcher with optional supplemental O2 and transport monitoring

Case-Specific Complications/Pitfalls

- Respiratory depression or obstruction
  - Desaturation and/or apnea due to positioning, airway obstruction or anesthesia
- Laryngospasm
  - Not frequently encountered but should have all medications ready to treat
  - May occur due to light anesthesia, secretions, etc.
- Patient movement
  - The patient should be secured to the treatment table if possible
  - Anesthetic depth should be appropriate prior to leaving the vault and continuously assessed throughout the procedure
  - Prepare to stop treatment and enter the vault if needed
- Hypothermia
  - Careful temperature monitoring since the patient's body is exposed for measurements and cannot use convective body warmer
- Emergency intervention
  - Treatment can be suspended at any time and vault entered

References

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Created: 8/17/22; Last revised: 8/16/23