An Anesthesiologist's View of Tumor Ablation in the Radiology Suite

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KEYWORDS

• Non-operating room anesthesia (NORA) care • Collaboration • Tumor ablation • Interventional radiology • Anesthesiology

KEY POINTS

- Novel tumor ablation techniques have revolutionized the approach to treating solid organ tumors.
- Various forms of energy (cold, heat, radio wave, and laser) are applied to tumors using different imaging modalities.
- Image-guided tumor ablation procedures have created a new paradigm for treating tumors in patients who otherwise would not tolerate a traditional open procedure.
- Knowledge of these various ablation technologies and procedures by an anesthesiologist is critical to patient safety and optimal outcome.

INTRODUCTION

Tumor ablation is the direct application of chemical-based or energy-based therapies to eradicate or substantially destroy focal tumors.[1] Chemical ablation is a non–energy-based therapy using chemotherapeutic agents (chemoembolization), ethanol, or acetic acid. Energy-based therapies are thermal or nonthermal and include radiofrequency ablation (RFA), cryoablation, and irreversible electroporation (IRE). Tumor ablation is performed for curative, palliative, or debulking purposes. Ablative therapies often require image guidance for precise needle, probe, or catheter placement and use fluoroscopy, CT, MRI, or ultrasound. If anesthesia assistance is requested for ablation procedures, the anesthesiologist must be aware of the specific safety concerns and anesthetic considerations for each type of ablation therapy as well as the

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imaging modality. Thermal therapies require precautions to prevent trauma to surrounding healthy tissue from high temperatures. IRE has numerous anesthetic implications, including monitoring for procedure-related ventricular arrhythmias.

Anesthesiologists must maintain safe practices in the non–operating room anesthesia environment. Ultrasound, used alone, does not require additional safety strategies, but fluoroscopy and CT necessitate strategies to mitigate exposure to ionizing radiation. For MRI procedures, the importance of preventing ferrous materials and equipment from harming patients and staff is paramount. The preanesthesia evaluation should be conducted with these modality-specific concerns in mind.

CHEMICAL ABLATION

During chemical ablation, agents, such as ethanol or acetic acid, induce tumor cell death and coagulation necrosis.[1] The benefits of chemical ablation are low cost and simple technique. Success destroying large solid tumors is limited by poor and nonuniform diffusion, so chemical ablation is typically used as adjuvant therapy.[2] Ethanol ablation treats benign thyroid, thyroglossal, and renal cysts and often yields favorable outcomes after multiple treatment sessions.[3–5] Chemical ablation procedures are typically performed with local anesthesia and do not require an anesthesiologist.

Chemoembolization is currently limited to hepatic tumors, either primary or metastatic. A catheter is inserted into the femoral artery and guided under fluoroscopy into the hepatic artery where contrast material is injected to identify the arterial supply to the tumor. A chemotherapeutic agent (eg, doxorubicin) is then injected and is followed by an embolic agent (eg, iodized poppy seed oil). The latter limits the tumor's blood supply and traps the chemotherapeutic agent in close proximity to the tumor. Combination therapy with cisplatin, doxorubicin, and mitomycin C enhances the tumor-specific toxicity.[6] The procedure is typically performed without an anesthesiologist. If anesthesia is requested, the primary anesthetic concerns are patient comorbidities, coagulopathies, and hepatic insufficiency.

RADIOFREQUENCY ABLATION

RFA is an energy-based thermal therapy that typically targets kidney, lung, breast, bone, and liver tumors. It offers an alternative for patients who may not be candidates for surgical resection because of size, location, poor organ function reserve, or comorbidities. It also may be combined with partial surgical resection for tumors not amenable to complete resection. Because healthy tissue is better able to withstand heat, radiofrequency energy preferentially destroys the tumor and only a small edge of normal tissue around its perimeter. The heat also cauterizes small blood vessels and reduces the risk of bleeding. Ablation can be performed percutaneously or directly within the tumor via laparoscopy or laparotomy with the assistance of CT, ultrasound, or PET.[7,8] Most radiofrequency devices use a single monopolar electrode and disperse the current through 1 or more grounding pads.

The least invasive approach is percutaneous. Complications have been reported and include third-degree burns of the abdominal wall from the tract-ablation portion of the procedure, abscess formation from bile duct injury, postprocedure myocardial infarction, and heat necrosis of the diaphragm resulting in sepsis and death.[8] Because the process produces heat, precautions must be taken when the electrode is adjacent to critical structures. As an example, when RFA was applied to a mediastinal lymph node, a temperature probe was placed at the endotracheal tube cuff to monitor the