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Ablation of Renal Cell Carcinoma: An Assessment of Currently Available Techniques

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A B S T R A C T

Image-guided thermal ablation is a minimally invasive treatment option for patients with renal cell carcinoma. The purpose of this review is to describe currently available ablation options for renal cell carcinoma and nursing care.

Introduction

Renal cell carcinoma (RCC) is the most common type of renal malignancy that afflicts approximately 15.6 per 100,000 adult men and women per year (Howlader et al., 2014). It is estimated that approximately 64,000 new cases of RCC will be diagnosed in 2017, leading to approximately 14,000 deaths from the disease (Howlader et al., 2014). For many years, surgical resection by means of radical or partial nephrectomy has been the standard of care for most patients with newly diagnosed or clinically suspected RCC (Campbell et al., 2009; Sun et al., 2012); however, surgical treatment may not be feasible for patients with significant comorbidities that render them high-risk surgical candidates. Since the 1990s, thermal ablation techniques have dramatically changed the landscape of treatment options for patients with RCC. As a result, many patients who would otherwise have no surgical options can now be treated with a variety of thermal ablative techniques. Currently available thermal ablative techniques include radiofrequency ablation (RFA), cryoablation, and microwave ablation (MWA). This review will describe the currently available thermal ablation technologies used to treat RCC.

Patient selection

Most patients who are considered for thermal ablation with RFA, cryoablation, or MWA include those for whom surgery is contraindicated because of significant comorbidities, such as advanced age, cardiac disease, or pulmonary disease, which render them inappropriate or high-risk surgical candidates. Indications for thermal ablation may also include patients with genetic disorders such as tuberous sclerosis and von-Hippel Lindau disease that are prone to develop multiple RCCs over their lifetime (Allasia et al., 2017; Park, Kim, Park, & Shen, 2013). Less common indications for RFA over surgery include patients with a solitary kidney (i.e., prior contralateral nephrectomy or congenital solitary kidney) in whom nephron sparring interventions are preferred to nephrectomy that would obligate the need for hemodialysis (Prins et al., 2017; Raman et al., 2010).

Absolute contraindications for thermal ablation include severe uncorrectable coagulopathies as these may lead to major procedure-related bleeding complications. Relative contraindications include metastatic disease or large tumors with vascular invasion. Anatomic considerations can sometimes limit the ability to perform an ablation, although these limitations can often be overcome by advanced techniques. Centrally located tumors have been successfully treated with RFA and cryoablation after placement of a ureteral stent and perfusion of the ureter during treatment (Dai, Covarrubias, Uppot, & Arellano, 2017; Mauri et al., 2017). Similarly, tumors that abut adjacent structures such as bowel can often be successfully displaced by injection of fluid between the tumor and adjacent bowel (Arellano, Garcia, Gervais, & Mueller, 2009; Patel et al., 2012).

A team of urologists, interventional radiologists, and interventional nursing staff should evaluate all patients who are considered for thermal ablation. A thorough history and physical examination is necessary to properly screen and assess patients for suitability for sedation or anesthesia. Patients must have cross-section imaging that clearly defines the size, location, and extent of tumor involvement. Review of diagnostic imaging also helps to determine whether adjunctive maneuvers such as pyeloperfusion or hydrodissection are necessary for the procedure.

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Nursing care

Pre-, intra-, and postprocedural care is an essential component of any thermal ablation procedure. Nurses comprise part of the multidisciplinary team that cares for patients with RCC. Typically, the multidisciplinary team consists of interventional radiologists, urologists, interventional radiology nurses, nurse practitioners, and anesthesiologists and medical oncologists.

Preprocedural care

Nursing care for thermal ablation is similar to other interventional procedures for which sedation or anesthesia is required. The primary role of nursing is to ensure that patients are appropriately educated about the goals of care, that they provide adequate sedation during the procedure, and that they facilitate patient recovery. Ideally, nursing should be present at the time of the initial consultation during which time the details of the ablation procedure are discussed with patients. At this time, a thorough review of the medical history, allergies, history of prior sedation, and assessment of coagulation is conducted. Patients who are taking anticoagulants are advised to withhold treatment as necessary depending on the type of anticoagulation therapy. In addition, patients are advised not to eat or drink after midnight before the procedure. Patients who take daily morning medications (with the exception of the anticoagulants) are advised to use just enough water to allow passage of oral medications into the stomach but are otherwise restricted to solids and liquids. Nursing provides counseling patients with regard to the use of anesthesia, conscious sedation or deep sedation depending on patient prior history, and comorbidities. Treatment of tumors that are near the collecting system often results in self-limited hematuria that typically resolves within 24 hr. Patients should be prepared for this possibility and that in many cases is a normal expectation and not necessarily a procedure-related complication. If available, patient education materials are indispensable to help alleviate patient anxiety and help the patient better understand the anticipated procedure.

Intraprocedural care

Intravenous (IV) access is required for all patients. The goals of intraprocedural care are to maximize patient comfort during the treatment cycle. Patient comfort helps to minimize patient movement during the procedure, which in turn adds to the overall safety of an ablation. Placement of the IV that is easily accessible and not prone to positional variations is ideal. Sedation is usually achieved with a combination of midazolam and fentanyl; therefore, properly functioning equipment for continuous hemodynamic monitoring and readily available oxygen and suctioning are critical. In addition, antiemetics are often helpful to minimize the effects that narcotic analgesics can have on the gastrointestinal tract. Some degree of pain can be anticipated at the time of initial probe placement and during the active treatment cycle, but this is usually ameliorated by the use of 1% to 2% lidocaine at the skin entry site and conscious sedation. Patients who undergo RFA or MWA may experience pain during active treatment cycles that can last from 12 to 25 min. Therefore, sedation should be titrated so as to maintain patient comfort during these periods. Patients who are treated with RFA require placement of grounding pads, typically on the thighs, to complete the electrical circuit. It is critical to ensure that the grounding pads are placed horizontally across the thighs to ensure maximal surface area along the leading edge and that they remain adherent to the skin during the procedure to minimize the risk of skin burns. It is typically not necessary to place cool packs over the grounding pads during RFA procedure. Cryoablation or MWAs do not require grounding pads. Patient positioning is an important component of thermal ablation for RCC. Most ablations are performed with the patient in the lateral decubitus, prone, or supine positions. When ablations are performed using computed tomography (CT) guidance, it is important to position patients so that they enter the scanner feet first. This allows ready access to the patient airway and helps to alleviate anxiety for patients who are claustrophobic.

Postprocedural care

At the conclusion of the procedure, the probe(s) are removed, and postprocedure images (CT or ultrasound [US]) are obtained to assess for any bleeding or immediate procedure-related complication. The most commonly encountered complication is bleeding. Significant bleeding usually occurs at the time of initial probe placement. Fortunately, because most ablations are performed with real-time (US) or near-real-time (CT or magnetic resonance imaging [MRI]) imaging guidance, bleeding complications can be rapidly identified and treated. Most small to moderate size hematomas are managed conservatively by volume resuscitation (assuming normal cardiac function) and pain control. Patients with significant pain may require hospital admission and use of pain-controlled anesthesia. Large hematomas that result in hemodynamic compromise may require emergent angiography or surgery to control bleeding, although this is seldom necessary. After completion of the procedure, patients are transferred to the nursing recovery room, where hemodynamic monitoring continues in the postprocedure recovery period. Once patients return to their baseline level of consciousness and are able to tolerate liquids (usually 2–4 hr), they can be discharged. Most patients who undergo any of the thermal ablation procedure experience post-ablation syndrome, typically manifested as mild myalgia, fatigue, and low-grade temperature. These symptoms typically begin 1 to 2 days after treatment and may persist for up to a week after treatment. Management is usually supportive. As mentioned previously, intermittent hematuria may occur up to 24 hr after renal ablations, and patients must be counseled that this is often anticipated and does not require a visit to the emergency department unless that patient experiences hemodynamic compromise or last longer than 24 hr.

Imaging guidance and procedural overview

Ablations can be performed using US, CT, or MRI guidance (Andersson, Hashimi, Lyrdal, Lundstam, & Hellström, 2015; Kelly & Leveillee, 2016; Kim, Park, Park, & Kim, 2016; Zachos et al., 2016). Currently, only cryoablation can be performed using MRI guidance because of the availability of MRI-compatible equipment that is not susceptible to the strong magnetic fields of MRI machines. There are currently no MWA or RFA devices that are compatible for use in an MRI magnet. US offers the benefit of real-time imaging with visualization of electrode placement. CT offers superior anatomic detail than US and is the most commonly used imaging modality for renal ablations. In general, patients are positioned in a way that allows direct and easy access to the tumor while avoiding vital structures. Positioning options can include supine, prone, or lateral decubitus positions.

A large-bore IV line is necessary for administration of medications. Patients undergo continuous hemodynamic monitoring throughout the procedure and are typically sedated with a combination of IV midazolam and fentanyl citrate. Patients with American Society of Anesthesiologist classification of 3 or higher require general anesthesia for treatment.