Introduction

For many years, the only curative treatment of early-stage renal cell carcinoma (RCC) has been surgical resection. Surgical resection, however, is associated with a small risk of mortality and substantial morbidity. Some patients with RCCs are poor surgical candidates because of comorbidities, which until recently essentially excluded them from undergoing curative treatment. There is increasing evidence that percutaneous radiofrequency ablation can be a curative treatment with minimal morbidity for some patients with RCC **(Zagoria *et al.*, 2000).**

The treatment of RCC can be a frustrating problem because of several facts. Fortunately, patients with RCCs that have not spread outside the renal parenchyma have an excellent prognosis for cure if the RCC can be resected **(ZagoriaRJ *et al*., 2000).**

Some patients, however, are not ideal candidates for surgical resection of their renal tumors because of comorbidities, limited functional renal reserve, or other complicating factors. Although observational treatment for the high-risk surgical candidate has been advocated by some authors **(Bosniak *et al*., 1995).**

The natural history of RCCs can be unpredictable and systemic spread may develop during periods of surveillance. Unfortunately, advanced-stage RCC does not respond well to therapy and the prognosis for these patients remains extremely poor **(Zagoria *et al.*, 2000).**

The number of RCCs detected has increased substantially. Most of this increase has occurred because small, localized tumors have been detected incidentally in asymptomatic patients who underwent imaging for other reasons. Tumors in these patients might not progress to clinically significant lesions. For some of these patients, an effective nonsurgical approach to treatment would be appealing **(Rodriguez-Rubio *et al*., 1996).**

Radical nephrectomy has long been considered the standard treatment for even small, localized RCCs. Meanwhile, renal-sparing surgery has grown in popularity, and the techniques have been refined **(Fergany *et al*., 2000).**

Studies in which surgical techniques have been compared have shown that open partial nephrectomy is as effective as radical nephrectomy for curing small, localized RCCs. This success indicates that complete eradication of an RCC can result in cure rates comparable to those obtained with complete removal of a tumor-containing kidney **(Uzzo *et al*., 2001).**

Advances in imaging and thermal ablation techniques, combined with the theory that in situ tumor destruction will yield results comparable to those achieved with tumor resection, have led to increased interest in imaging-guided, minimally invasive percutaneous thermal ablation techniques for treating RCC. There is substantial experience with radiofrequency ablation which causes tumor destruction by heating in the treatment of RCCs **(Gervais *et al*., 2000).**

Although radiofrequency devices can be introduced intraoperatively, during an open procedure, the most experience with and the maximum benefit from this technique have been with percutaneous imaging-guided procedures **(Ogan *et al*., 2002).**

In radiofrequency ablation, a high-frequency, alternating current with a wavelength of 460–500 kHz is emitted through an electrode placed within the targeted tissue. Deposition of radiofrequency energy results in frictional heating from flowing electrons in cells near the site of energy emission **(Lui *et al*., 2003).**

When living human tissues are heated to more than 49°C, cell death occurs within minutes. Temperatures in excess of 60°C cause

immediate cell death . The cell death is induced by the denaturation of proteins, which results in the loss of enzymatic function, melting of cell membranes, and destruction of cytoplasm **(Goldberg *et al*., 2000).**

Alternatively, when temperatures exceed 105°C, cells boil, releasing gas vapor and causing tissue charring . Gas and charred tissue inhibit dispersion of radiofrequency energy, which decreases the effective depth of penetration of lethal energy concentrations **(Lui *et al*., 2003).**

Hence, radiofrequency ablation devices should ideally induce prolonged heating of target tissue with temperatures sustained between 50° and 105°C **(Goldberg *et al*., 2000).**

For percutaneous imaging-guided radiofrequency ablation, the energy is delivered into the target tissue by means of needlelike electrodes. Currently available radiofrequency ablation electrodes range in diameter from 15 to 17 gauge **(Lui *et al*., 2003).**