Radiofrequency Thermal Ablation as Treatment for Liver Cancer at the John Wayne Cancer Institute

by Thomas F. Wood, M.D., and Anton J. Bilchik, M.D., Ph.D., F.A.C.S.

At the John Wayne Cancer Institute in Santa Monica, Calif., patients with a diagnosis of primary or metastatic liver cancer are treated with a multimodality approach that includes surgery, cryotherapy, radiofrequency thermal ablation (RFA), and/or insertion of a hepatic artery infusion pump for delivery of hepatic-directed chemotherapy.[1,2,3]

More than 150 RFA procedures have been performed at the John Wayne Cancer Institute in patients with inoperable primary and metastatic liver cancers. RFA is performed either operatively via laparoscopy or celiotomy, or percutaneously by ultrasound or computed tomography (CT) scan guidance.

Patients first undergo routine history and physical, laboratory analysis (blood counts, chemistries, liver function tests, serum tumor markers), and imaging studies, including high-quality spiral CT scans. An extensive formal abdominal exploration is performed, and suspicious nodules and lymph nodes are biopsied. Patients who have extrahepatic disease (except those with neuroendocrine tumors) are not eligible for RFA. Patients who have no evidence of extrahepatic disease undergo intraoperative ultrasound of all liver segments; the size and location of each lesion are recorded and compared with preoperative imaging results.

We favor surgery whenever possible. Patients who are not candidates for surgery based on their physiologic status or the location or distribution of liver tumors are considered for RFA either as a primary or adjunct procedure. Patients eligible for RFA have no evidence of extrahepatic disease, a tumor volume less than 40 percent of total liver volume as determined by intraoperative ultrasound, and sufficient liver reserve to undergo ablation. Figure 1 (page 19) shows our algorithm for RFA in patients with inoperable liver malignancies,[1,2,3] and Figure 2 shows the RFA probe itself.

Thomas F. Wood, M.D., is a senior fellow in surgical oncology at the John Wayne Cancer Institute (JWCI). Anton J. Bilchik, M.D., Ph.D., F.A.C.S., is head of the gastrointestinal program at JWCI.
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Address correspondence to: Anton J. Bilchik, M.D., Ph.D., John Wayne Cancer Institute, 2200 Santa Monica Blvd., Santa Monica, CA 90404. Tel: 310-449-5206. Fax: 310-449-5261. E-mail: bilchika@jwci.org

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Percutaneous RFA is performed either on an outpatient or 23-hour-stay basis; following laparoscopic RFA, patients are usually admitted for 23 hours. Patients undergoing RFA via celiotomy require hospital admission. Following RFA, complete blood counts and liver function tests are obtained. Patients are followed postoperatively with spiral CT scanning or other imaging and tumor markers, as appropriate. Scans are obtained at one week as a baseline and then every three months.

Recently, we reported the results of RFA for the treatment of 231 inoperable liver tumors in 84 patients who had no evidence of extrahepatic disease.[4] A total of 91 RFA procedures were performed in these patients; some patients safely underwent multiple procedures for progressive or recurrent liver tumors. In 51 cases, RFA was performed alone. In the remaining 40 procedures, RFA was combined with surgery, cryotherapy, or a hepatic artery infusion pump. Because the available RFA technology during this study was capable of only 2.5- to 3-cm ablations per cycle, we selectively used cryotherapy for larger diameter lesions (those greater than 3 cm) approached at celiotomy. We had previously demonstrated that RFA and cryotherapy may be combined safely and that cryotherapy allows more rapid ablations of larger lesions.[1] In this small group of patients treated with both RFA and cryotherapy, no significant intra- or postoperative complications occurred. Overall, the median diameter of lesions treated by RFA was 3.0 cm (range, 0.3 to 9.0 cm). The median length of hospital stay was five days after RFA via celiotomy, one day after laparoscopic RFA, and zero (0) days after percutaneous RFA.

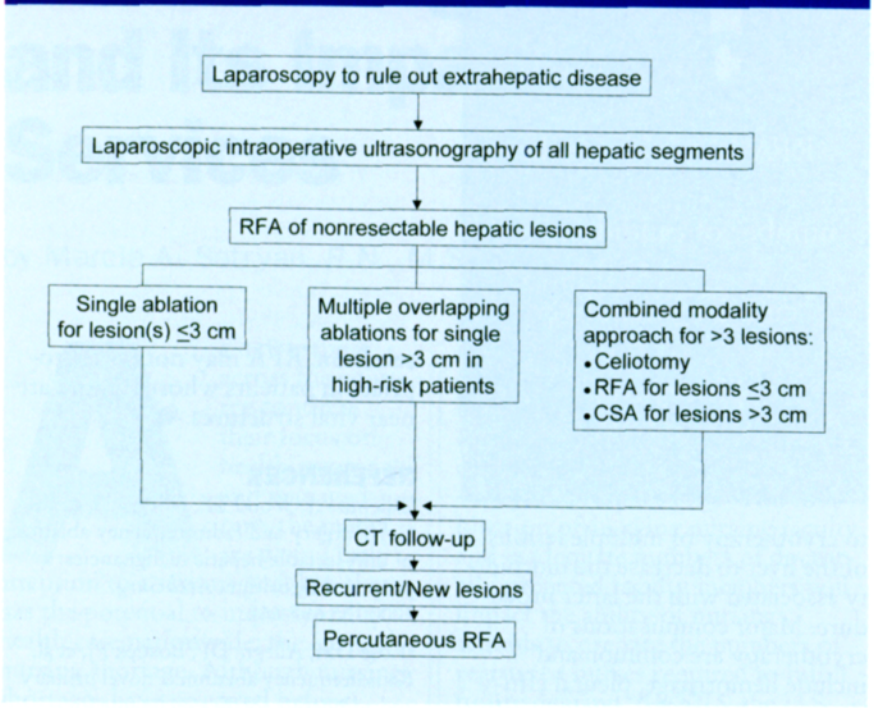
Intraoperative ultrasound identified additional intrahepatic lesions not noted on preoperative spiral CT scans in 25 of 66 patients (38 percent) undergoing operative RFA via celiotomy or laparoscopy. In all these cases, the newly identified lesions required a change in the operative procedure.

COMPLICATIONS AND RECURRENCE

In the study just described, seven patients (8 percent) suffered complications from RFA. Four

continued on page 19

Figure 1. Algorithm for operative or percutaneous RFA at JWCI



An operative approach is undertaken whenever possible and resectable lesions are resected. Size recommendations are for first-generation RFA probes and generators. New generation probes and generators may be capable of effectively ablating larger lesions. Adapted from Wood and colleagues.[4]

Figure 2. RFA probes

Technology of RFA probes and generators is improving. Illustrated are the first-, second- and latest generation probes from RITA Medical Systems (Mountain View, Calif.). The upper probe, capable of 2.5- to 3-cm ablations, was used for most patients in our recent study.[4] The newest generation probe is larger and capable of 4- to 5-cm ablations with a single ablation cycle. Reprinted with permission from Wood and colleagues.[4]

cases (one third-degree skin and abdominal wall burn, two hepatic abscesses, one postoperative hemorrhage) were not severe. The remaining three complications were severe and eventually fatal (4 percent). However, only one of these fatal complications was directly attributable to RFA. This patient sustained a heat-necrosis injury to his diaphragm and then developed a hepatic abscess. In retrospect, the percutaneous approach should not have been used in this patient; an operative approach would have been safer. Since that study, we have performed more than 60 additional procedures.

In the same report,[4] at a median follow-up of 9 months, 18 percent of our patients had developed recurrence; the local recurrence rate was 6.5 percent per lesion. Most of these patients had undergone RFA of large lesions, and in all cases RFA had been performed using the early generation probes and generators.

Our experience indicates that the rates of recurrence and complications following RFA are not negligible but can be minimized. Patients with liver malignancies, except those with neuroendocrine tumors, should be approached with curative intent and the goal of extending survival. Intraoperative ultrasound during celiotomy or laparoscopy can demonstrate intrahepatic disease not evident on spiral CT scans. Approximately 12 percent of patients undergoing laparoscopy prior to RFA will have extrahepatic disease and therefore will not be candidates for potentially curative procedures.[1] We preferentially use operative ablative procedures when possible. Operative approaches allow detection of extrahepatic disease missed by preprocedure imaging. A laparoscopic approach

provides a minimally invasive technique of ablating smaller numbers of smaller lesions. The celiotomy approach, on the other hand, is the most invasive but most versatile approach. During open procedures, large and multiple tumors may be safely treated, allowing concurrent procedures and combinations of therapies (surgery, cryotherapy, or insertion of a hepatic artery infusion pump). We, therefore, recommend celiotomy or laparoscopy approaches in patients who are operative candidates and a percutaneous approach only for patients who would not tolerate operation or who have recurrent or progressive disease. To avoid injury to adjacent structures, lesions approached percutaneously must not be located peripherally in the liver.

DISCUSSION

We do not advocate RFA as an alternative to liver surgery, which has a well-documented record of safety and clinical efficacy,[5] and our multimodality treatment program favors surgery whenever possible. In our recent study,[4] RFA was used as an adjunct to surgery, cryotherapy, and/or hepatic artery infusion pump insertion in 40 of the 91 RFA procedures. RFA was the primary procedure in patients who were poor operative candidates because of poor liver reserve, bilobar disease, and/or tumor close to major vessels. Elias and colleagues[6] have also reported the use of RFA in conjunction with other modalities. In their study, several patients underwent concomitant surgery and RFA to treat deep, centrally located lesions within the liver. This combined approach increased the rate of curative liver resection. Their findings and our data show that intraoperative RFA may increase the number of candidates for curative intent liver procedures.

We have used RFA as an adjunct to cryotherapy of multiple lesions of the liver to decrease the morbidity associated with the latter procedure. Major complications of cryotherapy are common and include hemorrhage, pleural effusions, and liver failure, among others.[7,8] These complications occur with an incidence of 15 to 20 percent, and their frequency is related to the total volume of liver that is frozen. We have found that concomitant use of RFA to treat smaller lesions minimizes the incidence and severity of complications during cryotherapy, and we have successfully combined the two techniques in multiple procedures.

In summary, RFA can be safely applied via operative approaches (laparoscopy or celiotomy) or percutaneously for inoperable liver malignancies. Operative approaches allow intraoperative ultrasound, concomitant surgery, cryotherapy, or hepatic artery infusion pump placement, and isolation of the liver from adjacent organs. Percutaneous RFA should be reserved for patients who are not operative candidates or those with recurrent or progressive disease. Given current technology, we believe that RFA should be cautiously used for lesions greater than 5 cm in diameter. Because of the relatively high rate of disease progression at intrahepatic sites other than RFA sites as well as extrahepatic sites, consideration of hepatic-directed and systemic chemotherapy is reasonable in these patients.[9,10] Severe complications and even death after RFA are rare but warrant careful patient selection. RFA may not be appropriate in patients whose tumors are near vital structures.

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