Long-term Survival After Radiofrequency Ablation of Complex Unresectable Liver Tumors

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Hypothesis: Radiofrequency ablation (RFA) may improve survival of high-risk patients with unresectable and refractory tumors.

Design: Retrospective analysis of a prospective database.

Setting: A tertiary referral cancer center.

Patients and Methods: Between November 1, 1997, and January 31, 2005, we performed 219 RFA procedures to ablate 521 hepatic tumors in 181 patients.

Results: Of the 181 patients, 52% were male and 48% were female, and the mean age was 61.3 years (age range, 27-91 years). Radiofrequency ablation was performed via celiotomy (n=135), via laparoscopy (n=48), or percutaneously (n=36). In 106 patients (79%), RFA was used in combination with surgical resection. The most common tumors included colorectal cancer (40.9%), hepatocellular carcinoma (14.9%), carcinoid tumor (13.8%), melanoma (9.4%), and breast cancer (5.0%). The average number of tumors per patient was 3.3 tumors. The average number of RFA-treated lesions per procedure was 2.38 lesions; the mean lesion size was 3.56 cm (lesion size range, 0.8-9.0 cm). At a mean follow-up of 33.2 months (follow-up range, 12-91 months), overall survival was 48.3 months for carcinoid tumors, 25.2 months for hepatocellular carcinoma, 18.5 months for melanoma, 29.7 months for colorectal cancer, and 30.1 months for breast cancer. Seventy-eight patients (43%) developed recurrences. Of 521 tumors that were treated, 125 (24%) recurred; the incidence of local recurrence was 28% for tumors larger than 3 cm vs 18% for tumors 3 cm or smaller (P=.04). Twenty-nine patients underwent serial ablations. Seventy-one patients (39%) were disease free at last follow-up.

Conclusion: A significant number of patients whose hepatic malignancies are unresectable or refractory to chemotherapy may be considered for RFA as part of a multimodality therapeutic regimen. In these patients, RFA is safe and may prolong survival.

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Over the past two decades, radiofrequency ablation (RFA) of hepatic malignancies has evolved significantly. Although surgical resection is considered the gold standard for curative treatment, many patients have unresectable disease. The development of ablative techniques has revolutionized the management of these patients, who would otherwise have a dismal prognosis. Radiofrequency ablation of unresectable liver malignancies is safer and more effective than cryosurgery, laser hyperthermia, or other techniques for local control of disease. The use of RFA in the treatment of colorectal metastases was initially described in 1996 by Rossi et al,1 who demonstrated decreased local recurrence in 50 patients with large tumors ranging from 1 to 9 cm with the use of multiple probes performed over multiple sessions. Since this initial study, our group and other investigators have been using this technique for bilobar disease or for extensive disease where complete surgical resection results in significantly less functional hepatic parenchyma to support liver function.2,3 Radiofrequency ablation can be combined with liver resection when complete resection of all of the tumors is not feasible.

Recent advances in tumor ablation allow for either an open surgical approach or less invasive surgical techniques such as image-guided laparoscopy and percutaneous ablation, which are better tolerated, more cost effective, and less morbid. In addition, newer RFA devices that deliver higher tumor temperatures in much less time have increased the area of ablation as compared with some of the existing devices.

Although there is evidence to suggest that conventional hepatic resection with 1-cm margins significantly prolongs sur-
vival, only a few studies have evaluated long-term outcomes in patients undergoing RFA alone or in conjunction with liver resection for unresectable primary or metastatic malignancies. In addition, limited data are available on local recurrence after ablation of large complex lesions within different tumor types. Characteristics of these liver metastases, including histological abnormalities, tumor size, number of lesions, and patient demographics, are important to evaluate to assist with patient selection.

We therefore performed a retrospective analysis of a 9-year series of patients whose hepatic malignancies were treated by RFA alone or with resection. Many had extensive disease or had progressed on aggressive chemotherapeutic regimens. Our objective was to determine which clinicopathological variables may be associated with long-term survival and risk of recurrence after RFA. Morbidity and mortality from these procedures were also reviewed.

**METHODS**

We reviewed our prospective database to identify patients who underwent RFA of primary or metastatic liver cancers at the John Wayne Cancer Institute, Santa Monica, Calif, and Century City Hospital, Los Angeles, Calif, between November 1, 1997, and January 31, 2005, and completed follow-up at the John Wayne Cancer Institute. Most patients had progressed on chemotherapeutic regimens. All of the patients had a complete preoperative assessment, which included high-resolution computed tomography of the chest, abdomen, and pelvis. In some cases, magnetic resonance imaging was performed to visualize certain lesions. Positron emission tomography was used to exclude extrahepatic disease.

Patients were characterized by the surgical approach to RFA: resection with RFA, RFA at celiotomy, laparoscopic RFA, or a percutaneous approach. Radiofrequency ablation was the primary modality of treatment only if hepatic lesions were unresectable based on preoperative radiographic imaging or intraoperative assessment. Clinicopathological characteristics of all of the patients, including demographics, tumor histology, number and size of lesions, technique, and follow-up data, were obtained by retrospective review of inpatient and outpatient records. Recurrent disease was defined as disease identified by radiographic imaging or biopsy at the previous site of tumor ablation. Patients were classified as having no evidence of disease, being alive with disease, or being dead of disease.

**SURGICAL TECHNIQUE**

All of the patients were evaluated at a multidisciplinary tumor board conference of surgical oncologists, medical oncologists, interventional radiologists, and pathologists. The surgical approach to RFA was based on evaluation by the surgeons and the interventional radiologists. All of the patients except some with symptomatic neuroendocrine tumors were approached with the intention to cure. Radiofrequency ablation was used alone or with resection. Radiofrequency ablation was considered only if complete resection was not feasible based on lesion size relative to hepatic reserve, number of lesions, or location of the lesions (Figure 1).

All of the patients underwent laparoscopy to exclude extrahepatic disease. Intraoperative ultrasonography was performed to evaluate intrahepatic tumor volume. Patients with multiple large lesions underwent celiotomy, surgical exploration, and RFA with or without resection. If laparoscopic RFA could be performed, a periumbilical incision or a right upper
quadrant incision was used. The parietal and visceral peritoneal surfaces, visceral organs, omentum, and lesser sac were surgically explored. Lymph nodes in the porta hepatis, celiac axis, and inferior vena cava were examined for any suspicious lymphadenopathy.

Radiofrequency ablation was performed as previously described by our group. Prior to 1999, the RITA model 30 probe (RITA Medical Systems, Inc, Mountain View, Calif) was used to ablate lesions by delivering an alternating current of 50 to 200 W at a temperature of 100°C for 10 minutes. This probe effectively ablated lesions smaller than 3 cm, but overlapping ablations were required to destroy larger lesions. After this period, the model 70 probe (RITA Medical Systems, Inc), the StarBurst XL 5-cm needle with a 150-W electrode (RITA Medical Systems, Inc), or the cool-tipped 200-W multiple probe electrode (Radiomics, Burlington, Mass) were used. For all of the lesions, the RFA needle was inserted with ultrasound guidance, and the lesion was ablated for up to 25 minutes depending on the probe used; a margin of up to 1 cm of normal hepatic parenchyma was included in the ablation. A hyperechoic heat lesion observed with real-time ultrasonography confirmed adequate ablation. After completion of the procedure, the tract of the probe was cauterized as the RFA needle was withdrawn from the abdominal cavity.

Postoperatively, patients who underwent RFA either laparoscopically or percutaneously were admitted to the hospital overnight for observation. Patients who underwent resection in combination with RFA were observed for several days in the hospital. All of the patients had liver function tests and a complete blood cell count performed immediately after the procedure and the next morning. All of the patients were followed up with computed tomographic scanning at 1 week, 1 month, and thereafter at 3-month intervals for 2 years, with scans performed every 6 months thereafter. Recurrences were determined by histological or radiographic evidence of tumor at the margin of ablation or within the tumor site. When an area of enhancement was seen on the computed tomographic scan, tumor necrosis was determined to be incomplete and serial RFA procedures were performed until an adequate therapeutic effect was seen on the computed tomographic scan.

DATA ANALYSIS

All of the data are presented as mean values or numbers. All of the analyses were performed using SAS version 9.1 statistical software (SAS Institute, Inc, Cary, NC). Univariate and multivariate analyses were used to identify variables that might affect survival. Factors significant for survival on univariate analysis were entered into a Cox proportional hazards model. Overall survival was the interval between the time of surgery and death or last follow-up. The log-rank test was used to determine differences in survival between groups, where \( P < 0.05 \) was considered statistically significant.

RESULTS

PATIENT DEMOGRAPHICS

During the study period, 181 patients underwent RFA procedures to ablate 521 unresectable primary or metastatic hepatic tumors (Table 1). Mean and median ages of the patients were 61.3 and 62.1 years, respectively (age range, 27-91 years). Ninety-four patients (52%) were male. Most of the 219 RFA procedures were performed via celiotomy, of which 106 patients underwent RFA as an adjunct to resection (78.5%).

TUMOR CHARACTERISTICS

The average number of tumors per patient was 3.3 tumors; the mean tumor size was 3.56 cm (tumor size range, 0.8-13.5 cm). The average number of lesions ablated per RFA procedure was 2.38 lesions. The most common malignancy was colorectal cancer (CRC) (40.9%), followed by hepatocellular carcinoma (HCC) (14.9%), carcinoid tumor (13.8%), melanoma (9.4%), and breast cancer (5.0%).

The average number of tumors among the different histological types did not significantly differ (\( P = .06 \)); however, patients with carcinoid tumors had the most lesions (mean, 5.93 lesions) whereas patients with breast cancer had the fewest lesions (mean, 1.97 lesions). A significant difference in patients’ ages (\( P = .003 \)) was observed among the different tumor types; patients with HCC were the oldest (mean age, 70.7 years), and patients with melanoma were the youngest (mean age, 48.1 years).

SURVIVAL AND LOCAL RECURRENCE

At a mean follow-up of 33.2 months (follow-up range, 12-91 months), patients with carcinoid tumors had a significantly longer median overall survival than patients with HCC, melanoma, CRC, and breast cancer (48.3 months vs 28.4 [\( P = .04 \)], 25.7 [\( P = .03 \)], 31.5 [\( P = .04 \)], and 39.2 [\( P = .43 \)] months, respectively) (Figure 2). The differences in survival significantly varied between the various tumor types in patients with more than 3 lesions. Patients with carcinoid tumors who had more than 3 liver lesions had a significantly longer overall survival than patients with HCC, melanoma, CRC, and breast cancer (43.1 months vs 23.2 [\( P = .03 \)], 18.5 [\( P < .001 \)], 29.7 [\( P = .03 \)],

Table 1. Clinical and Pathological Features of Patients With Hepatic Malignancies Treated With Radiofrequency Ablation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, No.</td>
<td>181</td>
</tr>
<tr>
<td>Tumors, No.</td>
<td>521</td>
</tr>
<tr>
<td>Age, mean (median), y</td>
<td>61.3 (62.1)</td>
</tr>
<tr>
<td>Female/male, No.</td>
<td>87/94</td>
</tr>
<tr>
<td>Patients with tumor histological abnormality, No. (%)</td>
<td>9 (5.0)</td>
</tr>
<tr>
<td>Breast cancer</td>
<td>25 (13.8)</td>
</tr>
<tr>
<td>Carcinoid tumor</td>
<td>27 (14.9)</td>
</tr>
<tr>
<td>Hepatocellular carcinoma</td>
<td>17 (9.4)</td>
</tr>
<tr>
<td>Melanoma</td>
<td>74 (40.9)</td>
</tr>
<tr>
<td>Colorectal cancer</td>
<td>29 (16.0)</td>
</tr>
<tr>
<td>Other*</td>
<td></td>
</tr>
<tr>
<td>Tumors, No.</td>
<td></td>
</tr>
<tr>
<td>Tumors ≤3 cm</td>
<td>202</td>
</tr>
<tr>
<td>Tumors &gt;3 cm</td>
<td>319</td>
</tr>
<tr>
<td>Tumors per patient, mean, No.</td>
<td>3.3</td>
</tr>
<tr>
<td>RFA procedures, No.</td>
<td></td>
</tr>
<tr>
<td>Open</td>
<td>135</td>
</tr>
<tr>
<td>Percutaneous</td>
<td>48</td>
</tr>
<tr>
<td>Laparoscopic</td>
<td>36</td>
</tr>
<tr>
<td>RFA procedures per patient, mean, No.</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Abbreviation: RFA, radiofrequency ablation. *Other pathological abnormalities included lung and gastric cancer, sarcoma, cholangiocarcinoma, esophageal carcinoma, renal cell cancer, medullary carcinoma of the thyroid, hemangiopericytoma, desmoplastic round cell tumor, and malignant inflammatory fibroblastic tumor.
and 30.1 [P = .04] months, respectively). Similarly, overall survival with treatment of patients with more than 3 lesions was significantly longer in patients who underwent a combination of resection and RFA than in patients treated with RFA alone (P = .004). Differences in overall survival were also seen within the different tumor types when stratified by the number of lesions that were ablated. Patients with more than 3 lesions had a significantly shorter overall survival than patients with 3 or fewer lesions with melanoma metastases (18.5 months vs 28.1 months, respectively; P = .04). These differences were also seen in patients with HCC (25.2 months vs 32.6 months, respectively; P = .06), carcinoid tumor (43.1 months vs 58.3 months, respectively; P = .04), CRC (29.7 months vs 41.3 months, respectively; P = .04), and breast cancer (30.1 months vs 43.3 months, respectively; P = .02).

Significant differences in overall survival were found between patients who underwent an open procedure as compared with patients who had percutaneous RFA (P = .04) (Figure 3). There were no significant differences in survival rates between the open vs laparoscopic groups (P = .45) or the laparoscopic vs percutaneous groups (P = .57).

LOCAL RECURRENCE

Local recurrence was based on the presence or absence of histological evidence of recurrence or on radiographic imaging demonstrating recurrent disease. Because recurrence is associated with decreased survival, an increasing concern has developed regarding long-term outcomes and factors that affect recurrence. Seventy-eight patients (43%) developed recurrences, of which 65 (36%) developed recurrent hepatic disease and the remaining 13 (7%) developed extrahepatic disease. Of 521 tumors that were treated, 125 (24%) recurred; the incidence of local recurrence was 28% for tumors larger than 3 cm vs 18% for tumors 3 cm or smaller (P = .04). Local recurrences for tumors larger than 3 cm were seen in 34% of HCC lesions, 31% of CRC lesions, 29% of melanoma lesions, 25% of breast cancer lesions, and 20% of carcinoid lesions. Disease-free survival analysis also included the risk of recurrence based on tumor histology (Figure 4). Patients with metastases from CRC, HCC, and melanoma had overall higher rates of recurrence than patients with carcinoid tumors or other metastases. Differences in disease-free survival were also seen within tumor types when stratified by the number of lesions (Table 2). At 1 year, no significant differences in disease-free survival were seen within each tumor group for patients with more than 3 lesions ablated compared with those who had 3 or fewer lesions ablated. There were significant differences in 3-year disease-free survival rates in patients with melanoma, breast cancer, HCC, and CRC, with significant differences in 5-year disease-free survival rates seen in all of the tumor types.
Patients’ age, sex, histological abnormalities of the primary tumor, number of lesions, size of lesions, and type of procedure performed were studied for their impact on local recurrence after RFA. By univariate comparison, 4 of the 6 variables significantly affected local recurrence (Table 3). Age and sex were not significant predictors of local recurrence. Of all of the tumors examined, a higher rate of recurrence was seen in patients with metastases from CRC, HCC, and melanoma than in patients with carcinoid, breast, and other cancers combined. The effects of the modality of the RFA procedure that was used were also pronounced. Both the laparoscopic group and the percutaneous group had significantly higher rates of recurrence compared with the group that underwent celiotomy. Moreover, the patients who had undergone surgical exploration and RFA alone also demonstrated a higher rate of recurrence (P = .04) than those treated with a combination of resection and RFA.

Tumor size and number of ablated lesions were also significant factors associated with increased risk of recurrence on univariate analysis. Patients with more than 3 ablated lesions had a significantly higher rate of recurrence compared with patients with 2 or 3 ablated lesions. In addition, tumor size was also a predictor of recurrence, with increasing tumor size demonstrating a stepwise increase in recurrence.

Variables found to affect survival (P < .05) univariately or those thought to be relevant were analyzed by Cox multivariate regression analysis. Of the factors considered for recurrence, only tumor size and percutaneous ablation of tumors were found to be statistically significant. The relative risk (hazard ratio) of recurrence with the corresponding 95% confidence interval for each factor is shown in Table 4.

Twenty-nine patients underwent serial ablations for 42 lesions, most of which were from recurrent CRC (48%), HCC (29%), and sarcoma (17%). Analysis of these patients at a mean follow-up of 15 months from the last RFA procedure revealed that 41%, 20%, and 39% had no evidence of disease, were alive with disease, and were dead of disease, respectively.

### COMPLICATIONS

Of the 181 patients in this study, 23 (13%) developed 41 complications related to the RFA procedure. Complications occurred in 4%, 78%, and 18% of the laparoscopic, percutaneous, and open procedures, respectively. The mean tumor size for these patients was 4.43 cm compared with 2.36 cm for the patients who did not develop any complications (P < .001). The number of lesions and total number of RFA procedures were not significantly associated with these complications (P = .43 and .08, respectively). Hepatic abscesses were the most common complication encountered in this group of patients, occurring in 12 (29%) of the 41 complications. Bile duct injuries were the second most common complication, with 8 injuries (20%) noted, most of which were seen in the percutaneously treated group.
Surgical resection provides the greatest potential for cure in patients with liver metastases or primary liver tumors. Unfortunately, many patients either have unresectable disease that is surgically inaccessible or have a large tumor burden or inadequate hepatic reserve. Median survival time of patients receiving chemotherapy for technically unresectable liver metastases from CRC is only 9 to 14 months. Because the benefit of chemotherapy is marginal, RFA is being increasingly utilized and may improve survival further. Resection in combination with RFA in selected patients has been associated with a favorable long-term survival.

The application of RFA has a number of potential advantages in patients with otherwise unresectable liver malignancies. The procedure is relatively safe and well tolerated, and its complication rates in most series have been low. The percutaneous approach can extend survival in patients who may not be good operative candidates or in those with recurrent or progressive disease. Although several investigators have made recommendations for RFA based on the number and size of hepatic lesions, most studies do not have long-term follow-up with data on recurrence-free survival, which could identify predictors of survival. In addition, there are very few large studies on the outcomes of patients with noncolorectal hepatic malignancies. We have used RFA at our institute either as an adjunct to resection or as the primary modality of treatment for patients who were not candidates for curative resection. Our outcome analysis suggests that RFA may confer a survival advantage over chemotherapy alone.

This retrospective study reflects our experience of aggressive cytoreduction in patients who had been carefully selected to undergo RFA. Our study is one of only a few studies with a large number of patients and long-term follow-up that demonstrate low local recurrence rates that may translate into prolonged survival in this group of patients. This local recurrence rate of 36% is clearly higher than the recurrence rate of 11% seen in patients after resection alone in a study by Abdalla et al. Risk factors identified by other groups include tumor size, number of lesions, histology of the primary tumor, and the modality used for ablation. Similar findings were found in our series of patients, as patients with more than 3 lesions had a lower overall survival and a lower disease-free survival than patients with no more than 3 lesions; large lesions (>3 cm), metastases from HCC, CRC, and melanoma, and a percutaneous approach to tumor ablation also significantly increased risk for recurrence. Although there were no significant differences in tumor size within groups, the differences in overall survival within each tumor type based on the number of lesions likely reflect differences in tumor biology and hence should be interpreted cautiously. However, the differences in local recurrences could be related to differences in conduction of heat within certain tumors or even the ability of certain probes to penetrate specific tumor types due to tumor density or vascularity. Not surprisingly, patients who underwent resection and RFA with curative intent had statistically better overall survival than those who underwent celiotomy and RFA alone. For now, the open approach allows for a more accurate assessment of the extent of disease because of intraoperative ultrasound, and it may protect adjacent visceral organs from thermal injury. Percutaneous RFA should therefore be considered for patients who are at high risk and for those with recurrent disease who may benefit from serial ablations.

This retrospective study identified a select group of patients who survived for 25 to 48 months after diagnosis of hepatic malignancies. It is also important to note that most of these patients had more than 3 lesions as well as lesions larger than 3 cm, rendering a poor prognosis. In addition, the patients were treated with probes that had a maximum ablation diameter of 3 cm, requiring multiple, overlapping ablations to achieve successful ablation. Recent advances in probe technology, particularly in microwave ablation, now allow for larger tumor ablations for lesions as large as 7 cm with a single ablation using higher temperatures and faster ablation times. This new technology will reduce limitations of tumor size, thus reducing local recurrence rates.

Radiofrequency ablation offers a promising future in the treatment of hepatic malignancies. This technique has improved management of these patients and has been invaluable for individualizing treatment protocols. Presently, there are no studies to our knowledge that advocate the use of RFA over resection, and large multicenter trials comparing RFA alone with resection for hepatic metastases are unlikely. For now, resection remains the first choice for patients with disease confined to the liver, and this is supported by our data of higher local recurrence rates after RFA than after resection. Radiofrequency ablation may be offered as an alternative for those patients unable to undergo resection due to extensive disease and limited hepatic reserve, bilobar disease, or medical conditions that would preclude surgery. For these patients, RFA can be very successful and its results may be durable. It also increases the number of patients who may be candidates for surgery. Since RFA is only a form of local therapy, systemic chemotherapy should be considered to treat microscopic disease. Prospective trials are needed to evaluate the potential role of RFA in improving survival.

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Finally, you mentioned that chemotherapy is frequently ineffective and nowadays I believe that it is frequently effective, especially for metastatic colorectal cancer, which is now quite responsive to oxaliplatin and avastin. How many patients in this group were treated with chemotherapy also?

In summary, I think the procedure works very well sometimes. It increases the number of patients that are able to be operatively managed. But, sometimes it does not work well. I do think this paper helps us decide when it is best applied.

Dr Bilchik: Each patient in the study was approached with an intent to cure except for the symptomatic patients with multiple neuroendocrine tumors. Hepatectomy is still the gold standard, with the lowest recurrence rates and the highest survival. Most patients underwent laparotomy and hepatectomy, and RFA was used as an adjunct to resection to treat a tumor in the opposite lobe or in an unresectable location, unresectable being defined as bilobar lesions, patients with limited hepatic reserve, or proximity to major vasculature.

We applied the same principles to RFA that we applied to resection. In each case, a 1-cm margin of normal hepatic parenchyma was ablated surrounding the lesion. Both laparotomy and laparoscopy facilitate the use of intraoperative ultrasound, which is the most sensitive modality to detect and assist with the treatment of hepatic tumors, possibly leading to lower local recurrence rates compared with percutaneous treatment.

We defined local recurrence using predominantly radiographic findings on CT [computed tomographic] scan, typically an ill-defined margin with an area of enhancement. We have also found that PET [positron emission tomographic] imaging within 3 months of RFA is accurate in determining recurrences.

The local recurrence rates have clearly decreased with advances in probe technology and improvements in intraoperative ultrasound. Most studies that report local recurrence do so using first-generation probes that have a maximum diameter of ablation of 3 cm. With some of the newer technologies, in particular microwave ablation, which allow larger tumor ablations, we see fewer local recurrences. I am concerned, however, that we may see more complications in the future because of rapid large ablations at higher temperatures.

The complication rate was also higher in patients treated percutaneously, possibly because these patients were higher-risk surgical candidates, and the diaphragm and adjacent visceral organs are more susceptible to thermal injury. Although hepatic abscesses are the most common complications seen, this was mostly related to large areas of necrotic liver from tumor ablations rather than other interventions. We do not have any data at this time on the number of patients who had a previous papillotomy and the effect on outcome and complication rates.

The higher rates of recurrence seen within certain tumor types are likely a reflection of tumor biology, with certain tumor types being more receptive to ablation than others. In our series, higher rates of recurrence were seen in colorectal cancer and hepatoma vs carcinoid. These differences may be related to characteristics such as tumor density, vascularity, differences in the parenchymal milieu, and heat conduction within tumor types.

In our study, overall survival was not calculated from the date of diagnosis but rather the interval between the date of the procedure and death or last follow-up. Most of the metastatic colorectal cancer patients in this study did receive systemic therapy but had progressive disease on chemotherapy prior to being considered for ablation. I agree that systemic agents are more sensitive today and should be considered in all patients undergoing RFA.

William E. Haun, MD, Denver, Colo: Do you routinely use inflow occlusion (ie, Pringle maneuver) for larger tumors of the liver during open procedures for improved tumor kill? Any suggestions, words of wisdom, warnings, or recommendations for RFA of hepatic tumors adjacent to the IVC [inferior vena cava]?

Dr Bilchik: We selectively use hepatic artery inflow occlusion, particularly for larger tumors. With some of the newer-generation probes, inflow occlusion may be unnecessary because of the ability to perform large ablations very rapidly.

Clearly, the recurrence rate for tumors in close proximity to the IVC is higher. I am reluctant, however, to perform inflow occlusion on all these patients because I believe that the heat-sink effect can be protective, reducing the chance of vascular injury.

Robert P. Sticca, MD, Grand Forks, ND: The problem that I have with all of the studies on outcomes with radiofrequency ablation is that in most cases, these patients were excluded from surgery because they were considered unresectable either due to advanced disease or anatomic reasons, which implies a worse prognosis. In many cases, these studies are comparing apples and oranges. Therefore, it is very difficult to compare the results of ablation with direct surgical excision of hepatic metastases.

I have tried in several of the cooperative groups to propose a study comparing ablation with resection for resectable metastatic colorectal tumors. Unfortunately, that has not been received very well. I just wonder, in your institution with the volumes that you have, have you ever considered randomizing patients to either ablation or resection for tumors that are resectable, such as isolated solitary metastases or 1 or 2 unilateral metastases?

Dr Bilchik: There has never been a randomized trial evaluating hepatectomy for resectable colorectal cancer lesions. I think it will be difficult to perform a trial comparing radiofrequency to hepatectomy in the United States. The results with hepatectomy are mature, and the mortality is low. Many studies are now reporting 5-year survival rates of over 50% for resection of metastatic colorectal cancer.

There is 1 multicenter prospective randomized trial in Europe called the CLOCC [Chemotherapy Plus Local Ablation vs Chemotherapy] trial, which compares systemic oxaliplatin plus radiofrequency ablation with or without resection to systemic chemotherapy alone. The study requires 390 patients to be enrolled, of which only 90 have been accrued to date.