

RADIOFREQUENCY ABLATION FOR COLORECTAL LIVER METASTASES

- The first use of radio frequency ablation (RFA) occurred in Italy by researchers who placed the thermoablation catheter through the skin into the liver tumors under ultrasound guidance.
- They treated patients with primary liver cancer (hepatocellular carcinoma or hepatoma) who had tumor(s) located centrally within the liver.
- The first use of RFA for liver tumor in the United States occurred in 1996 by Dr. Tanabe at Massachusetts General Hospital.
- RFA can be performed percutaneously, via laparoscopy, or during laparotomy.

Mechanism of Action

- A generator establishes the high frequency power, which is passed through a special needle into the tumor.
- A grounding pad closes the circle.
- The current causes the charged atoms in the tissue to vibrate creating friction, eventually producing heat.
- As tissue temperature rises above 50⁰ C (113⁰ F), the cell membranes melt and fuse, and with continued heating, protein denaturation and irreversible cell death occurs.
- The goal with RFA is to heat the tissues to a temperature above this lethal set point to achieve tumor destruction

- The process generally requires approximately 15 minutes of exposure time per lesion.
- Thermosensors at the tip of the needle measure the temperature during the delivery of energy and after the ablation.
- As tissue is heated, dissolved gasses (primarily nitrogen) are released from cells forming micro-bubbles within the tissue. This is visible on ultrasound as a hyperechoic image allowing visual confirmation of the ablated area.
- After the RFA, tumors are tracked by serial CT scans. A successful ablated lesion shows an increased volume in the first week.
- After 3 months the lesion shrinks in size, sometimes disappearing totally.
- An immunologic reaction and the liquidation of the dead tumor cells through macrophages is the postulated mechanism for lesion shrinkage.

Which patients should be treated by RFA?

- patients who are not candidates for surgical resection
- who have limited hepatic tumor burden and
- who have no evidence extrahepatic tumor.

- Tumor resectability is determined by many factors:
 - size, number, location, overall health of the patients, patient willingness for surgery.
 - Thus, what defines tumors that are surgically resectable oftentimes vary with the training, skill, and confidence of each surgeon.
 - Therefore, the use RFA in lieu of resection is not universally defined.

- *Tumor number*
 - patients with fewer than 5 hepatic tumors, must be visible by US or CT
 - in patients with slow growing tumors (neuroendocrine or gi stromal tumors), or in patients with symptomatic hepatic carcinoid tumors, treatable tumor number may be increased.
- *Tumor size*
 - the size of the tumor that can be effectively treated by RFA is limited by the size of the ablation zone created by the available devices. The best outcome is achieved with tumors that measure <3.5cm.
 - larger tumors can be treated by overlapping ablations, though the chance of missing tumor is markedly increased.
 - the size of the ablation should be larger than the tumor so that an adequate margin is created
- *Tumor location*
 - tumors imbedded in the hepatic parenchyma and remote from large blood vessels
 - tumors located adjacent to major branches of the portal vein are problematic because RFA may cause biliary duct obstruction (stricture and fistula)
 - RFA of tumors adjacent to bowel or diaphragm may lead to thermal injury leading to perforation or significant diaphragmatic injury

Use of RFA for colorectal metastases to the liver

The largest group of patients currently treated by RFA are those with colorectal metastases to the liver who are not candidates for resection and who have failed chemotherapy. Although RFA has been rapidly accepted into surgical practice in the last 5 years, there remains a paucity of long term survival data supporting its use. Recurrence and survival rates for patients from M.D. Anderson Cancer Center (1992-2002) were examined comparing hepatic resection only, RFA + resection or RFA only.

Abdalla, EK, et al. June 2004

Retrospective analysis of patients operated for colorectal metastases confined to the liver. 418 patients treated for colorectal liver mets comparing recurrence and outcomes data following hepatic resection, RFA, and combined resection/ablation. Median age 60 (23-88 years), 61% male, median f/u 21 mos (4-112 months)

Group#1: 348 patients (treatment for cure with hepatic resection, resection/RFA, RFA only

Group#2 “chemotherapy only”: 70 patients found to have disease too extensive for curative therapy based on disease distribution or extent, but no extrahepatic disease

190 (45%) patients underwent resection, 101 (24%) underwent combined treatment, 57 (14%) RFA only (laparotomy)-obtained complete destruction tumor and at least a 1cm margin (when possible), 70 (17%) chemotherapy.

Recurrence of any kind 84% RFA only, 63% RFA/resection, 52% resection

Local recurrence (in previously treated segment or at margin) was most common after RFA only (9% vs. 5% combined treatment vs. 2% resection only)

Overall survival :

@ 5 years highest in resection group: 58%

@4 years: resection-65%, combined treatment-36%, RFA only-22%

@3 years: resection-73%, combined treatment-43%, RFA only-37%

Study concluded that:

- hepatic resection is treatment modality of choice for colorectal liver metastases.
- There was no significant difference in survival rate between RFA+resection and the RFA only groups at 3 and 4 years.
- Data further demonstrate a modest survival benefit of RFA (in unresectable patients) over chemotherapy alone, in patients with colorectal metastases to the liver.

References:

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3. Berber, E., Herceg NL. Laparoscopic radiofrequency ablation of hepatic tumors. *Surg Endosc* 2004;18:390-396

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