Trans arterial chemoembolization (TACE) is recommended for patients with advanced hepatocellular cancer (HCC), no extra-hepatic metastases, and adequate liver function. Selective internal radiation therapy (SIRT) is recommended for patients with liver metastases from colorectal cancer, no extra hepatic metastases, and adequate liver function.

Interventional radiology offers palliative treatments that diminish or destroy tumors in patients, which can prolong survival and improve patients’ quality of life. These treatments are generally used for patients with primary liver cancer or isolated metastases in the liver secondary to colorectal cancer or neuroendocrine tumors, who are not candidates for surgical resection or radiofrequency ablation of the tumors. Unfortunately, the majority of patients with these conditions are not candidates for surgery, either because of the extent of disease or because of co-morbid conditions.

Treatments for oncological palliation include transcatheter arterial chemoembolization (TACE), and selective internal radiation therapy (SIRT). TACE is a treatment that is offered to patients with advanced hepatocellular cancer (HCC) whose tumors are too large to be treated by thermal ablation or surgical therapy. TACE may also be used for colorectal or neuroendocrine metastases to the liver. SIRT is recommended for patients advanced liver metastases due to colorectal cancer or neuroendocrine tumors and no extrahepatic disease. It may also be used to treat patients with large or multifocal HCC tumors.

**Trans Arterial Chemoembolization (TACE)**

TACE (Figure 1) is recommended for treatment of advanced HCC, with tumors that are too large or too numerous for thermal ablation or surgical resection. TACE has level I support for the treatment of unresectable HCC with evidence for significantly higher rates of survival after TACE at one (82% versus 63%) and two years (63% versus 27%) compared to those receiving supportive care (P = .009). The Society of Interventional Radiology position statement reports that TACE is a safe, proven, and effective technique for the treatment of a number of liver malignancies including HCC. It may be used as a bridge to liver transplantation and may be used prior to thermal ablation.

**Figure 1.** A. MRI of liver shows a 6 cm HCC tumor. B. Angiographic image shows tumor vasculature. C. MRI, one month after TACE, shows complete necrosis of the tumor. Click on image to enlarge.
ablation as reduction of tumor vascular supply by embolization that enhances the effectiveness of tumor ablation. TACE is also considered to have a palliative role for patients with colorectal liver metastases and neuroendocrine tumor metastases without evidence of significant extrahepatic disease.

The treatment is delivered via a catheter into the hepatic artery, under imaging guidance, which selectively delivers the chemoembolization agents to tumors in the liver because they have an arterial blood supply, whereas the liver parenchyma is primarily supplied by the portal circulation. The traditional TACE cocktail includes lipiodol, a compound that is selectively taken up and retained by HCC cells and some hepatic metastases and which effectively increases the concentration and retention of chemotherapeutic agents. More recent formulations, such as those used at Mass General Imaging, use drug-eluting microspheres instead of lipiodol. Cancer cell death occurs by a combination of ischemia and response to chemotherapy.

Current therapy guidelines limit TACE to patients with adequate liver function and no vascular invasion or extrahepatic spread. Patients do not tolerate TACE if more than 50% of the liver is replaced with tumor, serum total bilirubin is greater than 2 mg/dL, lactate dehydrogenase is greater than 425 mg/dL, and aspartate aminotransferase is more than 100 IU/L. Survival rates of 57-82% and 31-63% at one and two years, respectively, have been reported for patients treated with TACE, compared to 31-63% and 11-27%, respectively for those who received supportive care.

**Selective Internal Radiation Therapy (SIRT)**

SIRT (Figure 2) is an effective palliative therapeutic option for patients with large or multifocal hepatic metastases from colorectal cancer, neuroendocrine tumors, or HCC. In SIRT, resin microspheres loaded with yttrium-90, Sir-Spheres®, are injected into the proper hepatic artery. One treatment consists of 40 to 80 million microspheres, ranging in size from 20 to 60 microns and carrying 50 Bq of Yttrium-90, which has a half-life of 64.1 hours and an average energy of 0.94 MeV (corresponding to a maximum range of 1.1 cm within tissue and a mean path of 2.5 mm). The treatment results in tumor embolization and delivers a high dose of targeted radiation (a type of brachytherapy) to tumors while minimizing radiation damage to normal surrounding hepatic parenchyma and adjacent tissues.

Two phase III prospective randomized trials have compared SIRT plus hepatic arterial chemotherapy with hepatic artery chemotherapy alone in patients with chemotherapeutic resistant colorectal metastases. The first of these indicated that SIRT resulted in a significant effect as measured by tumor response (50% versus 20%; P=.03).

Figure 2. (A) PET-CT scan shows a hypermetabolic focus in the right lobe of the liver due to a metastasis from colorectal cancer. (B) Corresponding PET image. (C) PET-CT at 8 weeks after SIRT procedure shows near complete resolution of the hypermetabolic metastasis in the liver. (D) Corresponding PET image. Click on image to enlarge.
Both reported that treatment with SIRT plus chemotherapy increased progression free survival (16 months versus 10 months; \(P=.02\) and 4.5 versus 2.1 months; \(P=0.03\), respectively) Neither of these phase III trials demonstrated statistically significant differences in survival. However, in a phase II randomized trial of systemic therapy (fluorouracil and leucovorin) with or without SIRT, the addition of a single SIRT treatment increased tumor response \((P<.001)\), time to disease progression (19 months versus 4 months; \(P<.0005\), and median survival (29 months versus 13 months; \(P=.02\)).

Patients who are candidates for SIRT must have metastatic disease largely confined to the liver, adequate liver function (bilirubin <2 mg/dl), good performance status (Eastern Cooperative Oncology Group status <2), good portal vein patency, and adequate renal function (eGFR >30 ml/min/m²). It is also imperative that the patient be assessed to prevent radioactivity-induced damage to the lungs or the stomach. Perfusion scintigraphy is performed using \(^{99m}\)Tc-macro aggregated albumin (MAA), infused into the proper hepatic artery. MAA particles are similar in size to SIR-Spheres® and provide information about blood flow from the hepatic artery, in particular to the lungs and abdominal organs. SIRT is contraindicated if >20% of the radioactivity reaches the lungs (via hepato-pulmonary shunting) because of the risk of developing radiation pneumonitis. If 10-20% reaches the lungs, it is possible to perform SIRT with a reduced dose. Prior to SIRT, the gastroduodenal artery and right gastric arteries are generally coil-embolized to prevent reflux of the resin microspheres.

The procedures are usually performed as same-day procedures, without the need for hospitalization. After treatment, approximately 30% of patients experience acute abdominal/epigastric pain and/or nausea. Low-grade fever, loss of appetite, lethargy, and fatigue are common for up to 6 weeks post-procedure. Radiation-induced gastric ulcers, which do not heal well, have been reported in 3-5% of patients. Radiation-induced liver disease or pancreatitis is very rare.

PET-CT imaging, together with laboratory tests for tumor markers, is used to assess response 6 weeks after initial treatment and at subsequent 3-month intervals for the first year and every 6 months thereafter to detect recurrence or spread of disease. If liver tumors recur but there are no metastases elsewhere, it is possible to retreat with SIRT.

**Scheduling**

Appointments for SIRT and TACE can be scheduled by calling **617-726-8315** (Vascular Radiology). Interventional radiology procedures are performed at the main campus only.

**Further Information**

For more information about palliative interventional radiology, please contact **Avinash Kambadakone, MD**, Abdominal Imaging and Intervention, Department of Radiology, Mass General Hospital, at **617-643-6315**.

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References


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