Treatment of Liver Cancer with Y-90 Radioembolization

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Nonresectable primary and metastatic liver cancers carried a bleak prognosis with limited treatment options—until recently. Encouraging results of several recent trials suggest radioembolization is achieving the previously elusive goal of destroying hepatic tumor cells while sparing surrounding tissue.

The procedure has been approved in the United States for more than a decade, but the past year has witnessed a surge in utilization. The procedure has been recently introduced in Lebanon and is available in few hospitals, of which is Saint George University Medical Center.

According to American Cancer Society statistics, HCC is the fifth most prevalent primary cancer and the second most frequent metastatic site for all cancers. For colorectal cancer, it may be the only site of metastasis for one in three patients, according to Memorial Sloan-Kettering studies. Chemotherapy and external beam radiation, the current options for treating unresectable liver tumors, are limited in effectiveness and may trade quality of life for a few additional months of life.

Microspheres target liver tumors by taking advantage of their hypervascularity. Metastatic liver tumors larger than 3 mm receive 80% to 100% of their blood supply from the hepatic artery while normal liver tissue is predominantly fed by the portal vein. The microspheres are delivered via a fluoroscopic embolization procedure in which millions of 30-micron beads are infused through a catheter into the hepatic artery. The beads become embedded in the liver, and the therapeutic dose is delivered over a period of about two weeks. The beads are bonded with yttrium-90 (Y-90), a beta-emitting radionuclide that acts locally because its relatively low energy means the beta particles travel at most 11 mm in the liver. This allows the beads to embed in and irradiate the tumor while sparing healthy liver tissue.

"The procedure is typically performed in three sessions," says Abbas Chamsuddin, MD, an interventional radiologist at Saint George Medical Center and Emory University in Atlanta, GA, USA. "The first involves an angiogram of vessels in and around the liver to map regional blood supply. Vessels outside of the liver are sealed off using coil embolization. We then simulate the delivery of the spheres carrying the radiation treatment by injecting spheres of a similar size into the hepatic artery. The destination of those spheres is noted with particular attention to extrahepatic distribution, especially in the lungs. In the second session, we treat one lobe of the liver and the other lobe in a separate session."

The treatment falls under the overall direction of interventional radiologists. Because of the therapy's multifaceted nature, coordination between disciplines is a critical requirement, which may have hindered the development of radioembolization programs at many institutions. At Saint George Medical Center, SIR-Spheres have been increasingly used in recent months, Dr Chamsuddin emphasizes the necessity for close communication "among interventional radiology, radiation physics, medical and surgical oncology, hepatology, and nuclear medicine to evaluate these patients to see what treatment would be best for them."

And there is the need for meticulous attention to technical detail by a team that includes an interventional radiologist, an anesthesiologist, a nuclear physician, a radiation physicist, an interventional technologist, nurses, and radioisotope technologists. Coordination and timing are so crucial that Sirtex provides a representative to oversee the entire procedure to confirm that the entire team is present, the precise dose is on hand, and the sophisticated delivery system is functional. The representative provides in-service training for the staff and supplies printed educational materials for patients, family members, and referring physicians.

Prior to the treatment, a technetium-99m (Tc-99m) macroaggregated albumin (MAA) scan is performed to map the area targeted for treatment.

"Scintigraphic mapping is vital to assure tumor-targeted delivery of treatment," says Dr Chamsuddin. "The interventional radiologist inserts a catheter and directs it and then radioactive particles of Tc-99m MAA are injected via the catheter into the right or left hepatic artery. After the patient leaves the interventional suite, he comes to nuclear medicine and we image the patient's lungs and abdomen, including detailed SPECT views of the liver and abdomen to observe any extrahepatic distribution. In particular, we are interested in lung exposure. We quantify the relative liver-to-lung activity and take note of extrahepatic uptake, especially in the GI [gastrointestinal] tract."

No more than 30 Gy of radiation should be shunted to the liver. A contrast CT scan is also obtained to determine the volume of the liver that will receive treatment.

Once preparation for the procedure is complete, the treatment itself is relatively quick, with only 30 minutes needed for microsphere delivery. Treatment is often performed on an outpatient basis while patients remain conscious.

Chemotherapy is often used before or after therapy with microspheres. Treatment is typically performed in separate sessions for each affected lobe of the liver. "Most patients have bilateral disease, so in the second session we treat one lobe of the liver and in a separate third session, the other," notes Dr Chamsuddin.

Chamsuddin believes that "[Y-90 microsphere therapy] is gaining widespread recognition as one of the most promising techniques currently available in patients whose known malignancy is limited to the liver. Many such patients have failed chemotherapy and are not candidates for external beam radiation. Patient toleration is by and large excellent.

"Immediately after the treatment, most patients are free of complaints," he continues. "Some even feel as though nothing has been done; there is no immediate effect from the treatment. But what will happen over two to three weeks is that patients will have some more fatigue. They'll experience a lack of energy; some of them experience some right upper-quadrant tightness or pain. Many patients develop a fever and others experience a loss of appetite, but these are typically mild and transient."

Patients who received microsphere therapy have shown good response in clinical trials. Right away there is no change, but in our experience, there is a very good outcome. The quality of life improves and the life span also improves, particularly for neuroendocrine tumors.

Dr Chamsuddin believes growing awareness of the procedure among oncologists is the likely explanation for the sharp increase in requests for microsphere therapy compared with a few years ago. "The referring oncologists now know the availability and effectiveness of the treatment, so there is more referral to us," he says.

Still, microspheres remain a relatively new therapy, offering high-dose directed tumor ablation with little toxicity to the surrounding tissues. But if awareness is key, as Dr Chamsuddin suggests, expect further growth in this treatment strategy for nonresectable hepatic tumors.