A PATIENT'S GUIDE TO SELECTIVE INTERNAL RADIATION THERAPY (RADIOEMBOLIZATION)

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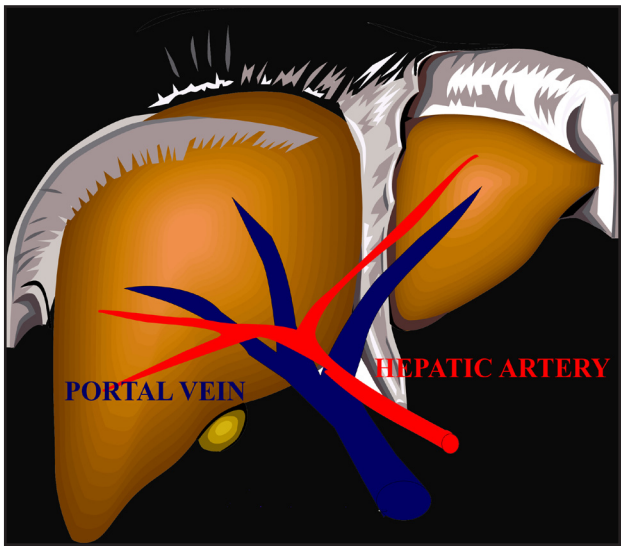
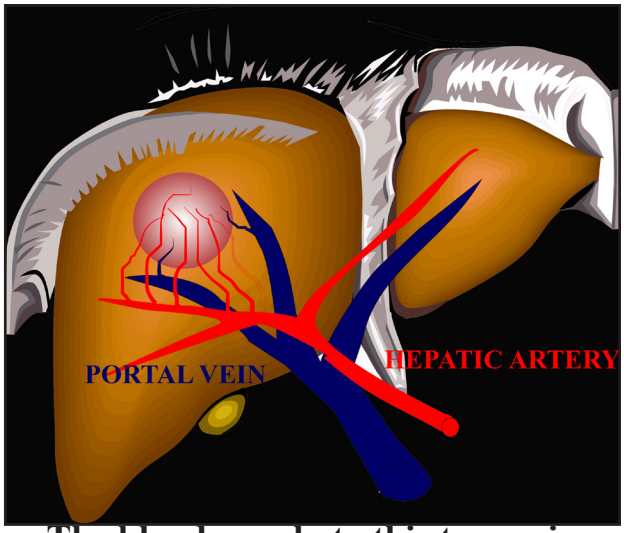
The liver is the site of cancers that originate from both liver cells, (hepatocellular carcinoma) and also from tumors arising from distant sites (most often colon) and traveling (metastasizing) to the liver. The most effective treatment for tumors originating in or metastasizing to the liver is surgery, in which the involved portion of the liver is removed. Unfortunately most patients are not candidates for surgical treatment because of the number or location of the disease, or because their overall health does not permit extensive surgery. Ablative therapy applying heat (radiofrequency ablation), cold (cryoablation) or destructive chemicals (percutaneous alcohol instillation) destroys tumor cells and provide an alternative to surgical resection. These treatments are appropriate primarily for patients with four or fewer tumors with disease limited to the liver. For patients with greater numbers of tumors, or tumors involving multiple organs, chemotherapy provides the most effective form of treatment.

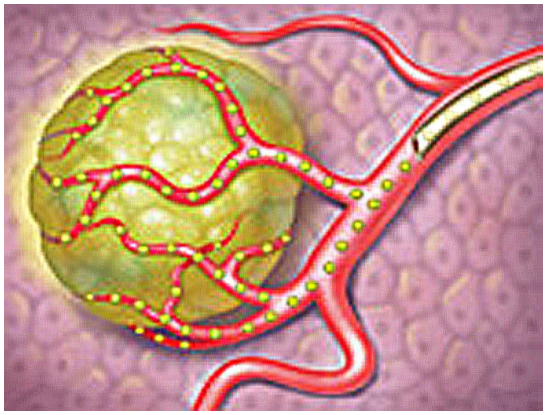


To help understand Selective Internal Radiation Therapy (SIRT), a brief discussion of the principles of treatment is helpful. The liver is a unique organ that has two separate blood supplies. The major artery to the liver, the hepatic artery, provides 20% of the blood supply to the liver while a large vein, the portal vein, supplies the remaining 80% of the blood to the liver. In contrast to the normal liver, cancer involving the liver receives the 80% of its blood supply from the hepatic artery. Selective internal radiation therapy takes advantage of this difference of blood supply between normal liver and cancer involving the liver. Radiation treatment that is delivered through the artery to the liver, the hepatic artery, will preferentially seek the cancer with less radiation dose to the normal liver.

Selective internal radiation therapy, a powerful form of radiation therapy, is delivered by combining Yttrium^{90}, a radiation emitting beta particle, to resin (plastic) particles which are delivered directly into the artery to the liver. As previously indicated blood flow from the artery to the liver preferentially goes to the liver cancer. This promotes delivery of high intensity radiation doses to the tumors while limiting side effects of the radiation to normal liver. This high dose of radiation intensity cannot be safely achieved with other forms of radiation therapy. Determination of the best time for SIRT to be included in the treatment of liver cancer is provided by the medical oncologist, the individual with the most knowledge of the patient's treatment options.

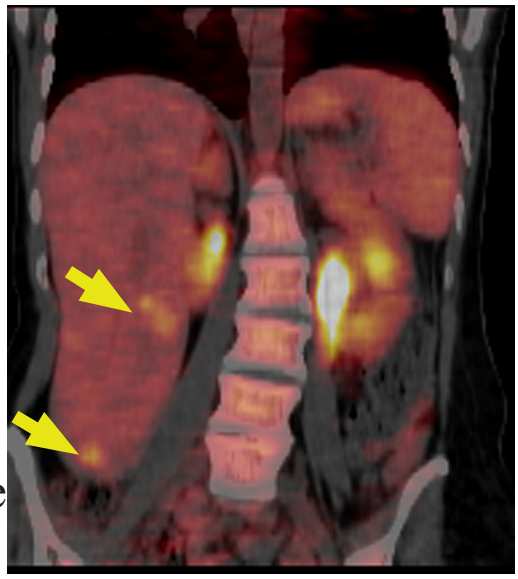


The blood supply to this tumor is predominantly from the hepatic artery.



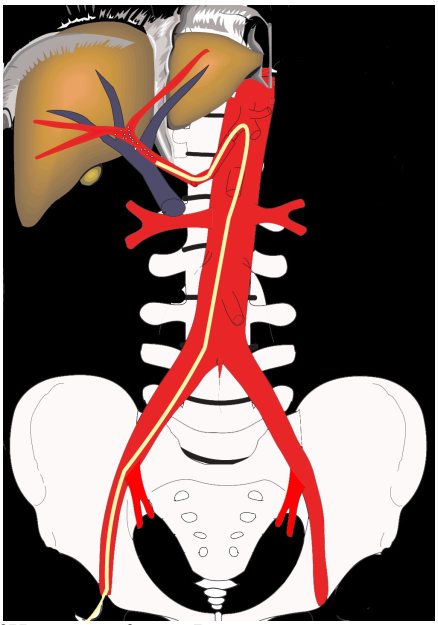
Yttrium radiation is delivered for the most part to the tumor and not to the normal liver .

Prior to undertaking SIRT, several tests are performed to assure that the liver is the primary site of tumor involvement. This is done by performing a special CT scan to determine the extent of cancer involvement. At the same time, a very accurate and different type of cancer imaging, PET scanning, is performed. These two forms of diagnostic testing will determine if SIRT is the appropriate form of treatment. If these two imaging studies conclude that the liver is the primary site of disease, treatment planning for SIRT can begin.



PET scan demonstrating tumors within the liver (yellow arrow).

Each step of the SIRT procedure is performed as an outpatient; that is, the patient is discharged on the day of the procedure and does not have to stay overnight in the hospital. The first step is treatment planning. This involves advancing a tiny tube (catheter) from the artery in your leg to the artery supplying blood to the liver. Prior to starting this procedure the patient is given medication to relax and also given local anesthetic to numb the area of catheter insertion. Once the catheter is advanced into the artery to the liver, an x-ray picture study of the arteries supplying the liver is performed. Using this information , all arteries that go to places other than the liver are blocked so that none of the powerful radiation will damage organs outside of the liver. This part of the treatment is the most time consuming, but also the most important in that it assures that the radiation is delivered only to the liver and not to organs outside of the liver.



This illustration demonstrates a tube (catheter) passing from the artery in the leg to the artery of the liver to deliver the Yttrium particles to the tumor in the liver.

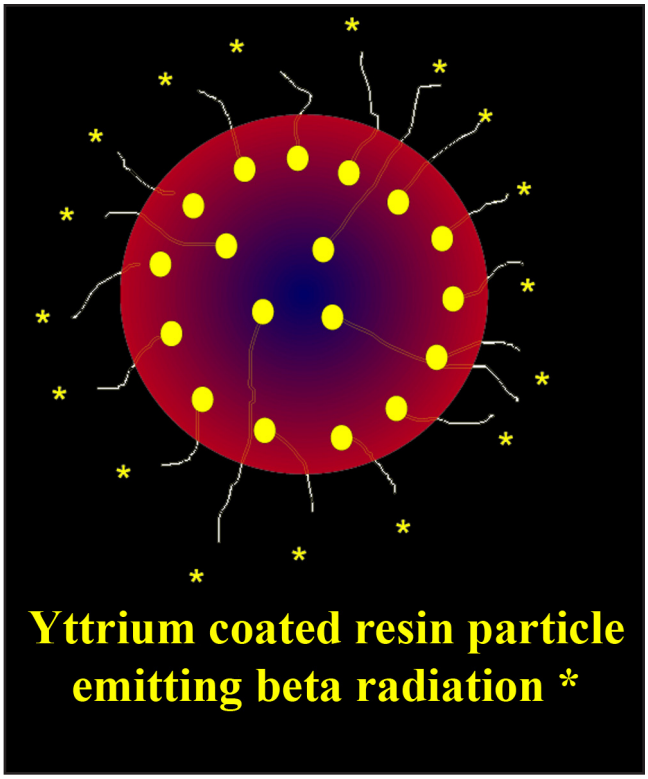
Shortly following the treatment planning procedure, the patient returns for the radiation treatment. This will take place in one or two steps. The number of treatments, one or two, depends on the blood supply to the liver. If the whole liver can be treated in a single session, then the entire treatment takes place with one procedure. Many patients require two treatments because two separate arteries supply the liver, and these treatments are separated by thirty days.

Following the procedure, patients feel the effect of radiation therapy and the destruction of the tumors in the liver. This includes the possibility of flu-like symptoms. These can consist of low grade temperature, 101 degrees or less, some nausea, and overall fatigue. This will last for several days to one week following the procedure. About one-third of patients will experience short-term abdominal pain requiring pain medication. This pain typically improves in the first few days after the procedure. Patients receive medication to reduce these symptoms. Following the procedure, our team is available at any time to evaluate symptoms or alleviate patient concerns related to any aspect of treatment.

More severe complications are unusual because of careful planning prior to the procedure. These complications may include ulcers from radiation injury to the stomach or bowel. This is minimized by blocking arteries going outside of the liver in the planning procedure. In less than 10% of patients, arteries too small to be seen allow radiation to escape the liver. Radiation injury to the liver or infection in the liver is avoided, but not eliminated by, careful selection of dose based on the CT scan and preprocedure arteriogram. Rarely, radiation injury to the pancreas or lung is reported. Occasionally the blood count is reduced from the radiation but will return to normal in a short period of time.

Most patients are discharged on the day of the radioembolization procedure. For our patients' safety, we suggest that on arriving home they take it easy and limit activity to sitting in a chair or resting in bed until the next morning. Showering is allowed after 24 hours and tub baths after three days. Since the procedure is performed under sedation which may leave the patient tired immediately following the procedure, it is prudent not to make any important personal or business decisions or sign legal documents for 24 hours. For the same reason, a companion is recommended for the first twenty four hours following discharge from the hospital. Limitation of activities for at least one day and refraining from sports, heavy work or lifting for three days is reasonable.

A frequently asked question is whether patients need to be concerned over their or others' safety, due to radiation particles placed in their liver. The answer is NO, but it is advised that following SIRT it is prudent to:



Yttrium coated resin particle emitting beta radiation *

- void often
- wash hands thoroughly
- double flush the toilet for 10 days
- for three days maintain a minimum distance of 3 feet from others
- avoid pregnant women and women considering getting pregnant for ten days
- limit holding infants and children to no more than 30 minutes at a time for 10 days

While the preceding discussion is interesting, two important questions remain. When is SIRT appropriate for patients with cancer primarily involving the liver, and what are the results of the treatment? In general, SIRT is reserved for patients in whom chemotherapy is no longer working or who can no longer tolerate intensive chemotherapy. As experience with this treatment increases, some patients are undergoing SIRT in addition to chemotherapy with the expectation of greater success than either treatment would achieve alone.

Initial experience with SIRT has been promising. Based on size reduction of tumors, about 20 – 30% of tumors improve. Other indicators of cancer response include a 50-70% reduction in markers of tumor activity such as measured in blood, or evidence of tumor function as measured by PET scanning. Survival time has been seen to double in many individuals.

What should a patient look for in the team that treats cancer involving the liver? The most important member of the team is the medical oncologist who knows the patient the best and is best suited to direct the patient's treatment. It is also important that a team of cancer specialists is available to provide the entire spectrum of options. A surgical oncologist is instrumental in determining if the patient is a candidate for potentially curative surgical removal of cancers involving the liver. The interventional radiologist specializing in providing minimally invasive treatment options for cancer in the liver is a critical member of the team. Radiation oncologists, who have a vast knowledge of the principles of radiation therapy, are critical in patient evaluation and treatment planning in complex treatments such as SIRT. Many other members of the team contribute to the success of the treatment program, including radiation physicists who contribute to the safe delivery of radiation to the liver. Nurse program coordinators and physician assistants monitor patients' progress throughout the treatment program. Nuclear radiologists and nuclear radiology technologists contribute to treatment planning and safe delivery of the radiation therapy to the liver. Radiology technologists and interventional radiology nurses are with patients during every step in the treatment process. Each member of this treatment team is dedicated to providing the most state-of-the-art treatment tailored to the individual patient and providing the best opportunity for successful treatment of cancer involving the liver.

For additional information concerning Selective Internal Radiation Therapy or other minimally invasive treatment options for liver cancer, contact:

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