



Liver ASSIST V.I. and Virtual Injection

A user experience in liver embolization

Gustave Roussy Cancer Campus

The Gustave Roussy Cancer Campus (GRCC) in Villejuif, France, a leading European cancer center, brings together 2,500 clinicians and other healthcare providers who are dedicated to treating patients with cancer, conducting research to develop new therapies, and sharing their knowledge with the medical and scientific communities in France and worldwide. The interventional radiology unit performs approximately 3,500 oncology procedures per year, including ablations, embolizations, biopsies, and others.

Meet the expert



Pr. Thierry De Baere, MD*

Interventional Radiologist and Chairman of Interventional Imaging Department, Gustave Roussy Cancer Campus

Pr. Thierry de Baere, MD, is the chair of the Interventional Imaging Department at Gustave Roussy Cancer Campus (GRCC). His specialties include tumor ablation; portal vein embolization; intra-arterial therapies; and digestive tract interventions. He has been dedicated to interventional oncology at Institut Gustave Roussy since 1991, focused on minimally invasive therapy for the treatment of liver, lung, and kidney tumors.

“Today information provided by CBCT associated with Liver ASSIST V.I. as injection point simulation solution can help predict spatial delivery of intra-arterial therapy. According to me, this may benefit to the patient through more accurate targeting with potentially less damage to healthy liver.”

Pr. Thierry de Baere

Successfully embolizing liver tumors poses numerous challenges to the interventionalist including: precise identification of tumor-feeding vessels in the liver's complex vasculature; determining the most appropriate injection points in order to treat the all tumor volume with minimal impact on healthy liver tissue.

Thus, such procedures can be especially time consuming, requiring multiple digital subtraction angiogram (DSA) acquisitions and, thus, increased radiation exposure and volume of contrast media.

We asked Pr. Thierry De Baere, MD, an interventional radiology expert who heads the interventional imaging department at Gustave Roussy Cancer Campus, to share his thoughts regarding Liver ASSIST V.I.,¹ GE Healthcare's new image-guided solution for liver care, which introduces Virtual Injection, a dynamic simulation tool to help analyze and plan complex, minimally-invasive liver embolization procedures.

Liver Tumor Embolization at GRCC

What equipment do you use at GRCC for liver tumor embolization procedures?

Dr. Thierry de Baere: "I usually perform liver tumor embolization in the Discovery IGS 740 (GE Healthcare) suite, which I feel is best adapted for embolizations."

How many liver tumors embolization procedures (TACE and TARE) do you perform a year?

Dr. Thierry de Baere: "In 2018, we embolized 260 patients (200 hepatic and 60 non-hepatic), including 80 radioembolizations."

What percent of these patients have multiple tumors?

Dr. Thierry de Baere: "Roughly 60% of patients had multiple liver tumors at the time of intra-arterial therapies, partially because we have a lot of liver metastases from neuroendocrine tumors in our patients. When there are less than 3 or 4 tumors, we treat each individually. Beyond 4 tumors, it is less relevant to be selective. Very few physicians treat more than 4 tumors selectively in the same session."

Identifying and Addressing the Challenges

What are the main challenges you encounter during selective embolization?

Dr. Thierry de Baere: "The first challenge is to locate the tumor during the angiography. In about 15% of cases, we must confirm that what is visible on the angiography corresponds to the diagnosed tumor, which isn't always easy."

The second challenge is identifying the arteries feeding into the tumor, most often arising from the hepatic arteries but sometimes from extrahepatic arteries, so called parasitic feeders.

The third challenge is ensuring that we have treated the entire tumor volume."

How do you select the right injection points for the embolization?

Dr. Thierry de Baere: "The process for selecting embolization points is based on the already acquired 3D CBCT images. We try to maximize the drug injection into the tumors, while ensuring sufficient margin. At the same time, we try to minimize drug injection into the healthy liver tissues."

How do you address these challenges?

Dr. Thierry de Baere: "For all cases with less than 3 tumors, I almost always proceed to a cone-beam CT (CBCT) to identify tumors due to their arterial enhancement. If it's particularly difficult, mostly due to low arterial enhancement, I may use image fusion with previously obtained CT or MRI.² Because fusion software becomes more and more user friendly, I have the feeling we do not use this enough, by the way."

The image fusion can be particularly important because it enables us to use 3D to locate the regions that require treatment and find difficult-to-see tumors. Even though this only corresponds to 10% of patients, it can be really useful in these cases."

Liver ASSIST V.I.

Where does Liver ASSIST V.I. come in?

Dr. Thierry de Baere: "I use Liver ASSIST V.I. for all tumors to help automatically identify the vessels feeding into the tumor. Once CBCT has been acquired, while I am concentrating on navigating my catheters and micro-catheters, the radiographers launch and manipulate the solution in order to help me for the determination of tumor feeders. It is quite common that radiographers highlight tumor feeders that I did not recognize on CBCT. Recently during a radioembolisation work-up for a segment VIII tumor, Liver ASSIST V.I. depicted a small branch of segment IV crossing the midline that I hadn't seen on CBCT. This helps play an important role in the success of the intervention and complete treatment of the targeted tumor."

I also recently used it for a patient during a complex radioembolization. Based on what I saw, I changed my approach and used 2 embolization points plus coil protection of a large branch. Without the support of Liver ASSIST V.I., I wouldn't have proceeded in the same way.

The solution is also used to simulate the injection points which helps us to select the optimal injection site, which reduces the amount of contrast media injections required to confirm those sites.² Without Liver ASSIST V.I. on this patient, I would probably have needed 3 more angiography series.”

Does Liver ASSIST V.I. save procedural and analysis time?

Dr. Thierry de Baere: “It allows me to do less angiography, which means less contrast and x-rays, which saves time.² It also improves my confidence that I am placing the catheter in the right place to embolize the target.

However, I don't see Liver ASSIST V.I., at least today, eliminating completely the need of DSA.”

Is Liver ASSIST V.I. easy to use?

Dr. Thierry de Baere: “The radiographers are actually the ones who launch Liver ASSIST V.I. and run the solution under our guidance. I've noticed that the ergonomics of Liver ASSIST V.I. are much improved compared to the previous version which did not include the simulation capacity (Liver ASSIST). In particular, the workflow to position the regions of interest and the ability to edit vessels have been significantly improved. The radiographers grope less, making for more fluid, faster workflow. In addition, the multi-target management capacity of Liver ASSIST V.I. allows to plan the entire procedure from the beginning and to break it up for every single catheterization.”

What do you think are the main benefits of Liver ASSIST V.I.?

Dr. Thierry de Baere: “It is definitively even easier to use than the previous versions. The multi-target access is clearly a plus because we don't have to restart the software for each target, which was quite time consuming. In addition, it makes it possible to add a target along the way, something I haven't yet tried, but which is very interesting. These capabilities allow you to focus attention on a specific target.

The virtual injection ability also enables us to get a more precise idea of the injection points because it helps evaluate the portion of liver that will receive treatment.

This complete, global picture makes it possible to anticipate possible complications based on the injection site. So, we can anticipate the amount of healthy liver parenchyma that will be affected by the treatment.

This is one of the big advantages of injection point simulation: to see how many non-target vessels will be impacted. In fact, you choose your injection site based on the potential impact on the healthy liver. This helps you to decide if you are doing a single injection point or 2 more selective injection points to avoid damaging too much hepatic parenchyma. And for radioembolization, it's even more important than for TACE.”

Do you see other benefits brought by Liver ASSIST V.I.?

Dr. Thierry de Baere: I think Liver ASSIST V.I. may help in determining the volume of embolic agent to be injected in each vessel selected. For instance, take the example of a tumor fed by 3 vessels. We usually select 2 injection points. When you inject Tc99, one part of the syringe is injected at a first injection point and the other part at the second injection point. But how much volume is injected at each point? Is it half and half? Or one-third and two-thirds? We do not really know how to spread the dose of radioembolization. It remains pretty subjective or intuitive.”

Do you think that radioembolization will gradually take precedence over TACE?

Dr. Thierry de Baere: I think the next step will be to merge the CBCT volumes with the SPEC-CT images, which would be great. Of the physicians who do radioembolization, the majority use multiple injection sites. This is a real point to develop. We have been trying to calculate how much doxorubicin is being used in chemoembolization for years, but it is even more important to do this with radioembolization. However, this remains a big challenge.”

In what percentage of radioembolizations or TACE would you recommend using Liver ASSIST V.I.?

Dr. Thierry de Baere: “For neuroendocrine tumors, about 15%-20%. These are usually lobar treatments due to widespread disease to the liver, so there is no need to be selective. The tumors are extended. If I don't embolize the whole tumor, I'll come back next time to do the rest.

For hepatocellular carcinomas, on the other hand, I would say 70% to 80% of TACE procedures. In radioembolization, it's a little less because the targeted tumors today are quite large, but I would use Liver ASSIST V.I. in probably 50% to 60% of the procedures. So, it's very different depending on the disease and the type of treatment. In fact, the more selective we are, the more precise we need to be. This is where we need the support of Liver ASSIST V.I..”

Do you have any recommendations for the use of Liver ASSIST V.I.?

Dr. Thierry de Baere: “The most important thing is training the radiographers to use the solution. The physician isn't going to do it. Given the time pressure for these procedures, Liver ASSIST V.I. should work almost automatically while the physician is working. So, the tech launches Liver ASSIST V.I. and builds the structure while you prepare the microcatheter. Then the only thing you have to control is where the Region Of Interest are located and then to select the optimal points of injection with the support provided by the solution.

And the second most important point is to have a Discovery IGS 740 wide bore. With the wide bore, CBCT acquisition is very easy with excellent image quality even with a large patient with the arms along the body. The wide bore provides another dimension for the acquisition of CBCT as a base to launch Liver ASSIST V.I..”

Selective Radioembolization with Liver ASSIST V.I.

Courtesy of Pr. Thierry de Baere, Gustave Roussy Cancer Campus

Patient History:

A 70+/-year-old male patient with an history of alcohol induced cirrhosis and presenting a 45 mm large HCC nodule on Segment VIII (Fig. 1) (Please note that the tumor is abutting segment IV on the left, and segment VII on the right). the patient was referred to our department for a radioembolization. In order to save the healthy liver and to be very aggressive a selective Y90 radioembolization treatment strategy also called radiation segmentectomy was planned.

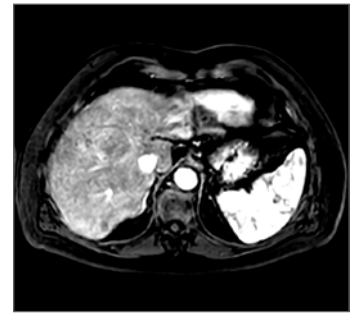


Fig. 1 - MR of the segment VIII HCC showing moderate arterial enhancement.

Clinical Challenge:

A detailed vascular assessment is required to localize targeted vessels, eventually determine which part of the liver has to be protected, anticipate the amount of off-target embolization. The end goal is to determine the optimal embolization points for the treatment.

Procedure:

The patient is positioned with the arms down and a 5 second 3D CTHD is acquired on Discovery IGS 740. Liver ASSIST V.I. is used to help identify the tumor feeding vessels and test various embolization points. Segment VII branches is identified as a tumor feeder despite low arterialization of the tumor. Segment VII branch give some tumor feeding artery but it is decided to coil a major hepatic branch to segment VII (Fig. 2) in order to minimize the quantity of Y90 on off-target location.



Fig. 2 - Coiling protection (A before), (B after).

2 Points of injections have been determined and 99m Tc-MAA is has been injected to evaluate lung shunt fraction (<7%) as well as drug distribution in the liver.

2 weeks later, the patient has referred for the treatment phase which started with a non-selective 3D CTHD to assess potential evolution of the vascular anatomy. Liver ASSIST V.I. is used again to verify the 2 points of injections. The Virtual Injection simulation is matching very well for the confirmation DSA, prior injection of the Y90 drug (Fig. 3).

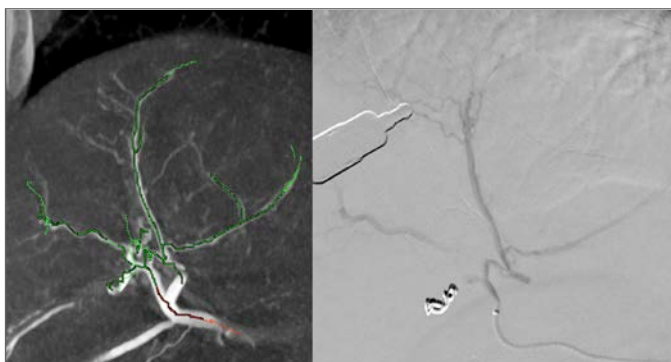


Fig. 3 - Liver ASSIST V.I. Virtual Injection (left), showing on a Coronal 10 mm view the anticipated distality from the 2nd injection point. The Posterior-Anterior DSA (right) presenting a similar pattern of distality.

The post-operative Y90 PET data are showing a dose distribution which is consistent with the Virtual Injection applied on the 2 injection sites (Fig. 4a & 4b).

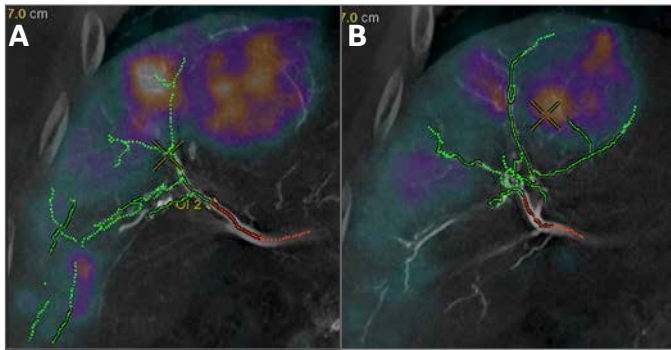


Fig. 4 - Fusion between post Y90 PET and Virtual Injection applied on the first (4a) and second (4b) injection points.

The 1-month post radioembolization MRI (Fig. 5) clearly shows the very accurate targeting of the tumor with wedge margin representing a radiation segmentectomy. Alpha-fetoprotein (AFP) decreased from 1200 ng/ml before treatment to 64 ng/ml 4 weeks after treatment.

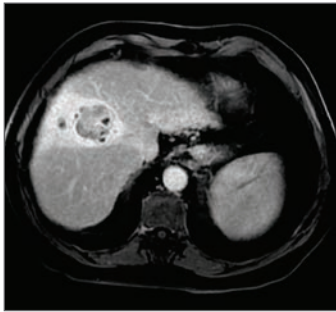


Fig. 5 - Post radioembolization MRI.

1. Liver ASSIST V.I. solution includes Hepatic VCAR and FlightPlan For Liver that can be used independently. It also requires an AW workstation with Volume Viewer and Volume Viewer Innova. These applications are sold separately. May not be available for sales in all markets.
2. The Statements described here are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist i.e. hospital size, case mix, there can be no guarantee that other customers or patients will achieve the same results.

* The statements described here are Dr. de Baere's professional opinion. Dr. de Baere is a paid consultant of GE Healthcare



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