

Future-focused IR imaging for a broad procedure mix

In a day of sessions showcasing the latest advancements in liver-directed therapies, experts focused on new developments in imaging and guidance systems that enhance procedural precision. Hosted at the Cardiovascular and Interventional Radiological Society of Europe (CIRSE) annual congress (14–18 September 2024, Lisbon, Portugal) and at a later private event hosted by Siemens Healthineers, attendees heard case-based experiences demonstrating the ARTIS icono system's breadth of use.

“ULTIMATELY, THIS TECHNOLOGY allows us to have confidence that we are giving patients better overall survival,” said David Madoff (Yale School of Medicine, New Haven, USA), delivering a talk on improving personalised patient care using the ARTIS icono and DynaCT (Siemens Healthineers AG) smart guidance for liver embolization.

Madoff began his presentation by stating that the goal of hepatic transarterial therapy is to maximise treatment to the tumour while limiting non-target intervention. By doing this, successful locoregional therapy can be achieved; however, he noted that sometimes issues can occur through unclear vascular assessment, challenging anatomy, or early stasis or reflux. He explained that these challenges can subsequently cause increased procedural time, radiation exposure, non-target embolization and even aborted treatment.

High-quality intraprocedural imaging is “critical”

In combatting these challenges, Madoff explained that “intraprocedural imaging is critical in optimising tumour targeting and ensuring the success of treatment”, highlighting that cone-beam computed tomography (CBCT) imaging, *syngo* DynaCT has improved survival rates following transarterial chemoembolization (TACE). “*syngo* DynaCT—especially when combined with navigational software—helps to better identify tumour feeders which reduces tumour recurrence rates when compared to digital subtraction angiography [DSA] alone,” said Madoff. He noted that further benefits of advanced technology in this setting include the ability to perform immediate post-procedure non-contrast CBCT (Figure 1). This allows for chemoembolic deposition assessment and quantification within targeted tumours which has been found to be a predictor of local tumour recurrence, Madoff added.

With this background in mind, the speaker described the ARTIS icono system that he and

his team use for intraprocedural imaging. He highlighted a new feature, Case Flows, which stores relevant parameters during procedures such as femoral access. This can help to reduce variations in technique, he said. He detailed that other parameters such as C-arm, table and detector positioning, as well as display layout can each be configured with a

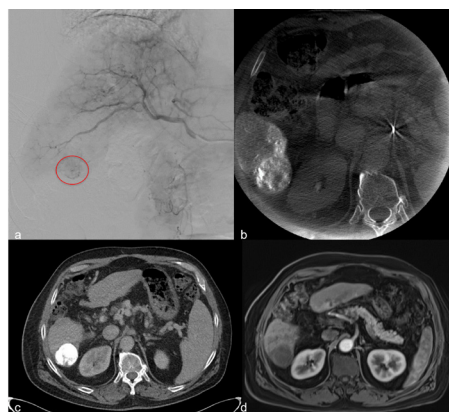


Figure 1a-d. *syngo* DynaCT allows for immediate confirmation of effective tumor treatment. Anteriogram shows residual tumour (a), *syngo* DynaCT immediate after cTACE (b), CT without non-target deposits (c), contrast enhanced MR one month after shows effective treatment of the tumour (d).

single button, which standardises procedural steps. Among other updates to the ARTIS icono system, Madoff detailed the new Omni Spin feature, which allows for faster rotational speeds performed at 90 degrees per second.

“The more vessel detail you see, the more precisely you can place your catheter toward the lesion”

Three-dimensional (3D) image acquisition from head side can be generated within 2.5 seconds.

Optimising tumour and vessel targeting

Madoff emphasised the “full spectrum of tools from imaging, treatment planning, guidance and, ultimately, to treatment assessment” offered in Siemens Healthineers’ range. With the aid of DynaCT’s Embolization Guidance, which supports guidewire navigation to selective therapy positions for tumour targeting, multiple tumour nodules can be treated during a single procedure, Madoff said. Feeding vessels can also be predefined and colour coded, which “facilitates finding the optimal treatment position for each tumour”. He described that the vessel tree can be overlaid on live fluoroscopy images, and that tumour spheres, safety margins and vessel subtrees can be individually switched off and on, as well as faded in and out.

In research carried out by Mohamed E Abdelsalam (The University of Texas MD Anderson, Houston, USA) *et al*, the application of superselective embolization has been shown to improve overall survival, Madoff stated. “The more vessel detail you see, the more precisely you can place your catheter toward the lesion,” he said. As was shown in the Abdelsalam *et al* data, Madoff further underlined the “critical” importance of precise imaging patients with a low tumour load.¹

“If you are dealing with a case where there are tumours throughout the liver and you’re performing a whole lobar TACE or Y90, [superselective targeting] is not critical, but when you’re trying to specifically target small tumours or tumours in very different locations in order to maximise effective therapy and reduce treatment to non-target tissue, I find it very important,” said Madoff.

According to Madoff, the addition of DynaCT has improved personalised patient care through smart embolization guidance, allowing his team to cut down procedure time, radiation dosage and potential injury to vasculature. “It has allowed us to be much more confident in our treatments,” he said, “and ultimately, we are able to be surer in our assessment of tumour treatment zones as well as achieving better overall survival for our patients.”

Reference

1 Abdelsalam ME, Appleton-Figueira TM, Ensor J, *et al*. Survival impact of C-Arm cone-beam computed tomography on hepatocellular carcinoma patients undergoing chemoembolization. *Am J Interv Radiol* 2021;5:9.

Cutting-edge approaches in endovascular and percutaneous interventions: liver and beyond

Thereafter, **Maximilian de Bucourt** (Charité-Universitätsmedizin Berlin, Berlin, Germany) detailed three areas of focus for his presentation—embolization, needle guidance, and chemosaturation—to demonstrate his team's hands-on experience with three newly installed ARTIS icono systems. This included two ceiling-mounted systems and one biplane configuration, designed to meet the diverse imaging and interventional needs of their practice. His presentation offered insights into how these advanced Siemens Healthineers systems are enhancing workflows and supporting a wide range of interventional procedures.

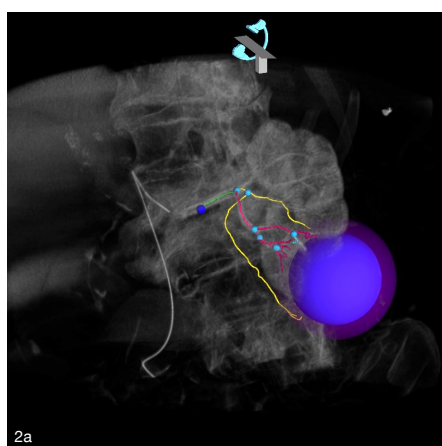
DE BUCOURT BEGAN HIS

presentation by describing the *syngo* Embolization Guidance tool, showcasing its application beyond liver and prostate embolization via two compelling cases involving renal artery embolization. After the tip of the microcatheter is automatically localised, he can then assess the target lesion as well as the safety margin and select or de-select the color-coded feeder arteries prior to embolization. During this workflow, the functionality of super-imposing the feeder arteries generated by *syngo* Embolization Guidance on live fluoro images, enables him to precisely select the vessel branches considered for treatment. According to de Bucourt, the *syngo* Embolization Guidance tool exemplifies the integration of imaging precision and real-time image fusion. A combination, which shows promising feasibility for renal interventions as well, he told CIRSE delegates.

Needle guidance using integrated laser for accurate approximation

Another tool frequently utilized by de Bucourt and his team is the laser cross during needle procedures. Exemplifying a case involving portal vein thrombosis in a severely cirrhotic liver, according to de Bucourt, the unique incorporated laser is convenient as it marks both the skin entry point and the correct needle progression angle, enabling him to approximate the target very easily, with little radiation. For controlled needle compression, the system superimposes the planned needle trajectory onto real-time images from the ARTIS icono system, allowing easy approximation to the target.

De Bucourt further attested to the



versatility of myNeedle Guide with laser through several other cases, including biopsy of an adrenal mass, endoleak treatment, portal vein embolization, percutaneous transhepatic drainage (PTCD), and transjugular intrahepatic portosystemic shunt (TIPS). This wide procedural range highlights the adaptability of the tool across various clinical scenarios, and it is quite easy to use and quick to adapt, concluded by de Bucourt. “The laser cross is a quite feasible tool: it allows approximation to the target so well, and the final steps can be done manually rather easily.”

Material-specific imaging

Lastly in discussing miscellaneous cases, de Bucourt emphasised the critical role of image quality and radiation dose. With such a broad spectrum of interventions comes the challenge of working with numerous devices—guide wires, coils, and stents—crafted from different materials, including iron, iodine, platinum, tantalum, barium,

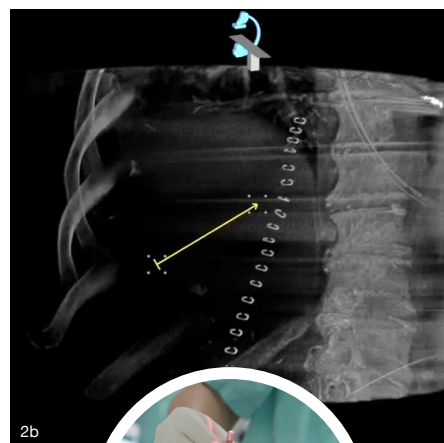


Figure 2a-c. *syngo* Embolization Guidance used in renal artery embolization (a), needle path planning and guidance with integrated laser cross (b), images using CO₂ as contrast agent (c).

“The laser cross is a quite feasible tool: it allows approximation to the target so well, and the final steps can be done manually rather easily”

as well as gases like CO₂. To address this complexity, de Bucourt emphasised the value of Structure Scout, an unique solution for material-specific imaging within the ARTIS icono suite. This feature offers dedicated optimised 2D imaging protocols for diverse materials and devices, providing best contrast to noise ratio with reasonable radiation dose as low as possible.

DynaCT in action: Case presentation

Later that evening, an event hosted by Siemens Healthineers showcased innovation within minimally invasive therapies and had speakers share their daily experience using 3D image guidance technology. **Thomas Albrecht** (Vivantes Klinikum Neukölln, Berlin, Germany) began, sharing two cases from his centre.

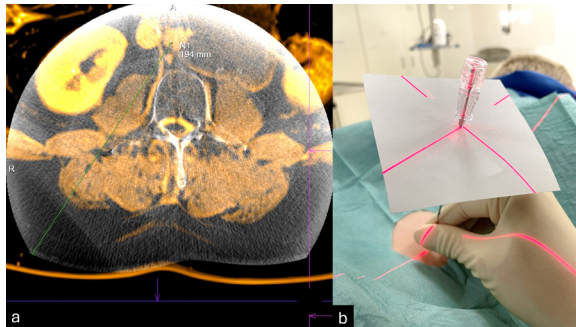


Figure 3a-d. Needle path planning on fused MRI and DynaCT images (a), needle placement guided with laser cross (b), and needle advancement under fluoroscopy control with bullseye view (c) and progression view.

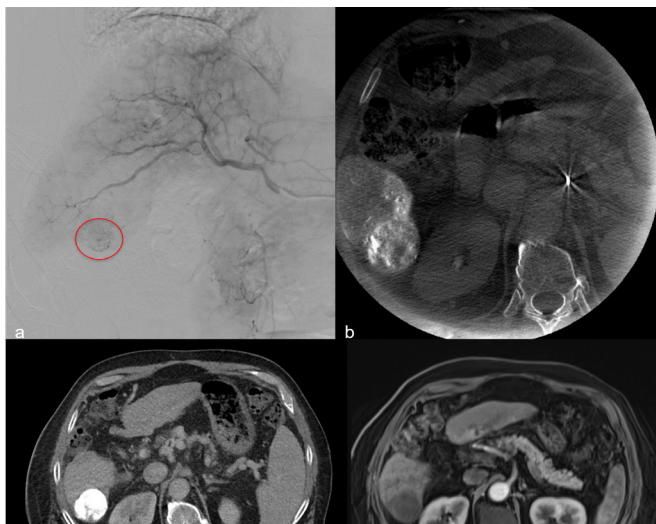


Figure 4a-d. CT images show recurrence in the right liver lobe, with tumour thrombus extending into the inferior vena cava and additional peritoneal carcinosis and lymph node metastases (a-b), syngo DynaCT with injection from the common hepatic artery helped to identify the inferior phrenic artery as the feeding artery (c), DSA of the phrenic artery showing the tumor supply (d).

remission evident on CT at six months.

Nine months later, recurrence was detected in the right liver lobe, with tumour thrombus extending into the inferior vena cava and additional peritoneal carcinosis and lymph node metastases (Figure 4a-b). Given her positive response to TACE, another session was performed.

Following the baseline angiogram from the common hepatic artery, a syngo DynaCT scan was performed from the same catheter position, which helped to identify the right inferior phrenic artery as the feeding artery (Figure 4c-d). This then allowed the super-selective embolization for a precise therapy.

Two weeks later,

Endoleak embolization with needle guidance

In 2017, a 61-year-old male experienced a ruptured infrarenal abdominal aortic aneurysm (AAA), treated with endovascular aneurysm repair (EVAR) followed by endoleaks several times which were treated accordingly. Between 2022 and 2023, the aneurysm sac expanded, and MRI detected a new type II endoleak.

Given the sac's growth, a direct puncture approach was chosen for embolization, with guidance from pre-intervention MR image fused with syngo DynaCT (Figure 3a). The patient was 160kg at prone position for dorsal access. Needle guidance software was used to plan an accurate path, presenting a laser cross which marks the entry point on the skin and the angulation of the needle (Figure 3b). Fluoroscopy allowed for real-time monitoring of the needle's progress (Figure 3c-d). After advancing the needle and confirming the correct location, a microcatheter was advanced for precise embolization. A follow-

up CT scan confirmed complete resolution of the endoleak.

Albrecht concluded that the laser helps him to get the needle exactly to where he wants the needle to be. He can control the needle progress by fluoroscopy and assess the position by syngo DynaCT. This allows him to do needle procedures extremely precisely and efficiently, which also frees time of his CT scanner.

TACE for multifocal HCC guided by syngo DynaCT

A 64-year-old female was confirmed multifocal hepatocellular carcinoma (HCC) and additional local peritoneal carcinosis, staged at Barcelona Clinic Liver Cancer stage C in 2022.

The tumour board recommended transarterial chemoembolization (TACE) with doxorubicin. Three TACE sessions were performed via a bi-lobar approach. Post-procedural MRI showed the disappearance of hypervascular tumours, with complete

follow-up imaging revealed complete devascularisation of the liver tumours and thrombus. Additionally, immunotherapy appeared effective in reducing peritoneal carcinosis and lymph node involvement. Currently, the patient is doing well, with significant tumour reduction over the past year.

Albrecht was one of the first syngo DynaCT users 20 years ago. He commented that “with the latest ARTIS icono ceiling, syngo DynaCT has become so fast: the acquisition is now as fast as 2.5 seconds, and the processing time is nearly zero such that we could get the images almost instantaneously”. Therefore, they are using syngo DynaCT in almost every interventional oncological intervention, more or less everyday.¹

Reference

- 1 CIRSE Society (2024). CIRSE 2024 Technology Snapshot SIEMENS Healthineers: Image guidance with ARTIS icono ceiling. [online] YouTube. Available at: <https://www.youtube.com/watch?v=PR9nrRxxJ-Jk>

State-of-the-art imaging in PAE

Following Albrecht's case presentation, **Aaron Fischman** (Icahn School of Medicine at Mount Sinai, New York, USA) took attendees through a 'day-in-the-life' case, exemplifying his centre's standard prostate artery embolization (PAE) workflow.

"THE MOST DIFFICULT ASPECT OF PAE is not the procedure but taking care of these patients. With the ARTIS icono system—which we have been using for eight months—we've been able to make the procedure the easiest part, when caring for benign prostatic hyperplasia (BPH) patients," Fischman said.

Initially, imaging is carried out prior to treatment using *syngo* DynaCT for vessel identification, he stated. "You can place a catheter in the top of the aortic bifurcation and go bilaterally or unilaterally. Some

arteries. "Here, our focus was not solely on prostate perfusion; rather, we sought out collateral connections, specifically to the pudendal artery," Fischman described. "Image quality is essential when identifying these arteries," he said. To treat, Fischman's preferred technique involves using a combination of nitroglycerin and verapamil to manage flow. Then, using an embolic combined with iodised oil, his team can differentiate between the catheter tip and the embolic, which is "extremely important" when performing PAE, he stated.

sometimes referred to as the recurrent artery," he said. Showing the two images—one using an oil mixture and one using contrast—Fischman noted the clear difference between the two as seen in the vessel, a distinction of crucial importance to him and his team.

Concerning their contralateral angiogram, despite operating at low doses, Fischman's team were able to provide sufficient clarity to identify vessel branches on the opposite side of the internal iliac artery. "The roadmap function available with DynaCT operates at a much higher level than other systems we've used and offers an added advantage here, allowing dose conservation while enhancing contrast and image detail," Fischman said.

Fischman remarked that PAE has recently faced criticism regarding both recurrence rates and radiation exposure. Notably, prominent urologists have raised concerns, including those at institutions such as Mount Sinai, suggesting that repeated radiation exposure could lead to increased cancer risk. According to Fischman, the case presented shows a balanced approach: while complex



Figure 5a-b. Ipsilateral oblique view of right internal iliac artery used as overlay reference image.

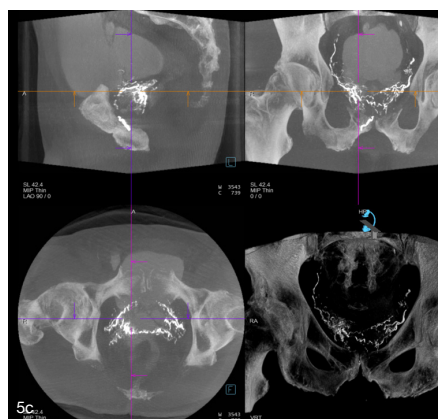


Figure 5c. DynaCT showing targeting of entire prostate circulation

do both prior to the procedure—with this technology, identifying difficult-to-see vessels is straightforward," Fischman said.

He described a case which exemplifies a typical PAE treatment to illustrate what can be seen when using low-dose imaging protocols paired with overlay visualisation. Regarding his first image, which was taken upon entering the internal iliac artery, he described how ultra-low-dose imaging can maintain quality while reducing radiation exposure. "Working with ARTIS icono system, we achieved an extremely low dose, down to levels previously considered unusable." This extra-low-dose protocol delivers a clear angiographic view of the prostate artery while the image overlay of the catheter can be dialled up and down to check its position, he added.

This standard PAE case involved using small microcatheters to cannulate target

Working with ARTIS icono system, we achieved an extremely low dose, down to levels previously considered unusable"

Following embolization, Fischman highlighted that a repeat angiogram confirmed successful occlusion of prostate-feeding vessels. "On this angiogram, we looked for collateralised flow and supply from the pudendal artery to the prostate,

and time-intensive (with a fluoroscopy time reaching 30 minutes in this instance), radiation exposure was kept to a minimum. In another patient case, a nine-minute fluoroscopy time resulted in less than half a milligray (mGy) dosage, underscoring the efficiency of the ultra-low-dose protocol, even for patients with higher body mass index.

"DynaCT and simple roadmapping are important for PAE, and ARTIS icono can do that for us very easily," he summarised. "We use DynaCT for vessel mapping and identification, for excluding non-target vessels and to confirm correct catheter position. And I can't emphasise more about the radiation dose." One of his overarching goals when performing PAE is to keep the dose as low as possible, Fischman said, which has been achievable and "seamless" with the ARTIS icono system.