
SIEMENS

The Gateway to Innovative Clinical Pathways

Nuremberg's 310Klinik has installed Germany's first Angio-CT dual-room solution, making space for good ideas.

Text: Andrea Lutz | Photos: Steffen Kirschner

A few hundred meters before you reach the entrance to the 310Klinik in Nuremberg's Nordostpark, you will pass a sign for HighTech Center Nürnberg. Established here in 2002, the 310Klinik exists in the company of innovation-hungry technical service providers, software developers, and materials researchers who have devoted themselves to tackling the big issues of the future. For some time now, the hospital's reputation has extended far beyond the boundaries of the Nuremberg Metropolitan Region. The people behind 310Klinik consistently focus on high-tech medicine, but they also chose the hospital's name to reflect the fact that patient well-being is their top priority: 310 Kelvin corresponds to approximately 37 degrees Celsius, the figure associated with a healthy body temperature. From the outset, interventional radiologist Michael Moche, MD, was impressed by the unique combination of patient proximity and advanced technology. He therefore left the structures of a renowned university hospital and accepted a position at 310Klinik in Nuremberg. Today, Moche is in charge of the hospital's interventional radiology department. "I like dealing with sophisticated technology," he says. Accordingly, he is working side by side with engineers in the context of several EU-funded projects to develop solutions for interventional procedures. However, he also stresses that "we mustn't be tempted to focus only on images – we must always treat the patient as a whole."

From a bare industrial building to a hybrid interventional room in record time

CEO Fabian Hubacek is convinced that image-guided interventions are a crucial part in the spectrum of minimally invasive treatments and therapy: "We are sure that many open surgical procedures will be replaced by this technology". But there are not yet many hospitals in Germany with a dedicated ward staffed by interventional radiologists. Patients treated using interventional techniques are often accommodated on the surgical ward – a perceptual problem that Moche hopes to overcome using his hospital as a model: "Interventional radiology must become a clinical partner for colleagues from other disciplines. In order to do so, we need to specialize even further. We need even more new, committed recruits. Above all, however, we need the opportunity to operate interventional radiology wards and to be integrated into patient preparation and aftercare." In Nuremberg, Moche can put his ideas about interventional radiology into practice in a dedicated ward that he designed and

gave shape according to his wishes. Moche set up the new department in record time: It took him three months of planning plus three months of construction to go from a bare industrial building to the first intervention in an IR environment whose indoor air classification even permits open surgery and where he was able to realize his vision for a dual-room solution. Hubacek: "The efficiency of the collaboration with Siemens Healthineers was impressive. Short communication paths, maximum technical support, and ongoing consultancy are the keys to success. This allowed the project to be implemented in a short time, whereas it usually takes much longer to complete." Today, with the exception of neuroradiology, the 310Klinik can cover the entire spectrum of interventional radiology – from acute care to interventional oncology and from peripheral revascularization to embolization for benign diseases in every organ of the body. However, Moche is especially proud of an organizational aspect: "We are an interventional radiology department with its own beds – an independent clinical location that can count on 310Klinik's entire infrastructure covering surgery, internal medicine, orthopedics, intensive care, and intermediate care."

Dual-room solution allowing independent usage of CT and angiography.

"In 70 % of cases, this system will be used independently so the two-room solution can help to increase the utilization rate and enhance return on investment."

Fabian Hubacek
CEO, Founder and Shareholder
310Klinik, Nuremberg, Germany

Two rooms for greater efficiency and safety

Angiography and computed tomography (CT) are the workhorses of interventional radiology. "We have an especially innovative system with our Angio-CT suite which leverages the strengths of both," says Moche. He is evidently proud that this is the first system in Germany to be set up as a dual-room solution. Moche believes that dual-room solutions provide key advantages: "Even in procedures where both systems are needed, CT is only applied for a relatively short time during the

procedure in many cases. In such cases, CT can be used separately in the second room, e.g., for regular diagnostic scans." Accordingly, it quickly became clear that the dual-room option would be the solution of choice for 310Klinik. Hubacek justifies the decision: "In 70 percent of cases, this system will be used independently so the two-room solution can help to increase the utilization rate and enhance return on investment." Moche describes the clear advantage for his workflow: "Although we use the CT scanner for emergencies or to perform complex interventions in combination from the outset, we can slide it into the adjoining room on rails when it's not in use. This gives us more room to move and allows us to work more efficiently, because the CT is then meanwhile available for diagnostics or smaller interventions in the other room." By means of this flexibility, Moche plans to perform regular diagnostics or shorter minimally invasive procedures, for example biopsies, on about eight to ten patients per day in the CT room. On average, these will be joined by five to eight regular angio or two complex interventions with combined percutaneous and endovascular access – for instance, treating an endoleak – where both modalities are needed.

Treating endoleaks more safely

Endoleak is the most common complication after endovascular stent graft repair of aortic aneurysms (EVAR). "Safe and efficient treatment of type II endoleaks will play a major role in the future," says Moche. Even today, endoleaks are predominantly treated using interventional techniques. Typically, a type II endoleak is punctured using CT guidance, followed by the introduction of a guidewire, and then the patient is moved from the CT unit to the angio suite, which is time-consuming. Moche wants to eliminate the risks known to be associated with this: "When the patient is moved, there is always a risk of dislocating the guidewire. With our new Angio-CT system, we can perform the complete workflow very safely without transferring the patient from CT to the angio suite."

The new nexaris Angio-CT[1]

Seamless integration

- The common coordinate system unifies CT and angiography. With Instant Fusion[1], CT volumes – with intra-arterial injection – are instantly overlaid on live fluoro images, allowing fast and easy access to the relevant visuals.
- Quick Switching[2] with smart collision protection: By simply sliding the table between the two modalities, it will be easier than ever to perform CT-guided ablation and angio-guided embolization in one session and on one table.
- Fully connected, the interventionalists will be able to access angiography, CT and ultrasound sources side-by-side on a single, large display in the exam room and via a single Cockpit[2] in the control room. Common Patient Registration[1] allows automated patient data transfer with only one registration at the start.

Versatile design

- The unique 2-room design of the nexaris Angio-CT allows independent usage of each modality: Different disciplines can work in parallel and potentially raise the utilization rate and return of investment.
- Mounted on rails up to 12 meters in length, the CT gantry slides easily into a dedicated 'garage', while the C-arm swings into the foot-side park position[3], making space for key personnel by moving the major components out of the way.

Pioneering potential

- With instant access to optimal imaging technology on one table, a broad range of clinical pathways can be re-shaped, such as bone metastasis, blunt poly trauma, and acute stroke. Advanced functional imaging may make intraprocedural endpoint-determination more precise.

[1] *The product/feature is pending 510(k) clearance, and is not yet commercially available in the U.S.*

[2] *The product/feature is still under development and not commercially available yet. Its future availability cannot be guaranteed.*

[3] *The product/feature is not commercially available in all countries. Its future availability cannot be guaranteed.*

"Anyone who aims at exploring new clinical pathways in interventional radiology may consider combined CT and angiography."

Michael Moche, MD, PhD
Clinical Director and Head of Diagnostic and Interventional Radiology
310Klinik, Nuremberg, Germany

Maintaining a high quality of life for pancreatic cancer patients

In addition, Moche believes that a new interventional procedure could also benefit from the combined dual-room solution: "Patients with pancreatic cancer often have a poor prognosis – the tumor is rarely resectable and systemic chemotherapy is often ineffective. For these patients, interventional therapies will play an increasingly important role." One increasingly common procedure is known as Irreversible Electroporation (IRE). It uses ultrashort pulses of high-voltage current to damage tumor cells in a relatively selective manner. "Because no heat is generated in the process, vascular structures are preserved – so the procedure is well suited to treat this aggressive cancer, which is often richly surrounded by vital vessels." Until now, treatment was often performed via open surgery using sonographic guidance. Moche wants to make the procedure minimally invasive, safer, and more efficient for the clinician to plan. He therefore favors combined treatment, in which he uses fluoroscopy for angiographic visualization of vessels and CT guidance to precisely navigate the probes around the tumor without injuring the vessels: "Intra-arterial injections leverage the strength of both modalities. The superior soft tissue resolution and the better 3D capability are clear advantages over the treatment planning and image guidance under ultrasound."

Training will change dramatically

Moche is aware that technical progress has revolutionized his discipline in particular over the last few years: "Imaging has made incredible leaps forward. Today, we work with multimodal image guidance, and use PET and CT in combination to visualize functional changes in tumors. In addition, we can merge image data and provide the clinician with additional image information via augmented reality. In the near future, we will further increase the integration of robotic systems, delivering even greater precision and more radiation protection for clinicians." However, to be able to optimally use all of these capabilities, changes will be needed to train radiologists. "I'm convinced that we'll need to carry out even more training on simulators in the future in order to make the learning curve steeper. We'll also need to use simulation software to validate our methods and to plan interventions even more effectively." Moche is in no doubt that "anyone who aims at exploring new clinical pathways in interventional radiology may consider combined CT and angiography." However, he adds that those who want to benefit from a system like the Angio-CT suite must also be prepared to explore the capabilities of such a system, and to make consistent use of its advantages. In his opinion, these advantages by no means only apply to complex interventions: "With Angio-CT, we are improving safety in many cases with additional image information, by optimizing the workflow, reducing the time of the intervention, and by completely eliminating the potential risks involved in transferring the patient between the modalities." ●

The statements by Siemens' customers described herein are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption) there can be no guarantee that other customers will achieve the same results.

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Combined Embolization and Ablation in an Angio-CT Interventional Suite

Courtesy: Bruno C. Odisio, MD, Department of Interventional Radiology,
The University of Texas MD Anderson Cancer Center, Houston, Texas, USA

Patient history

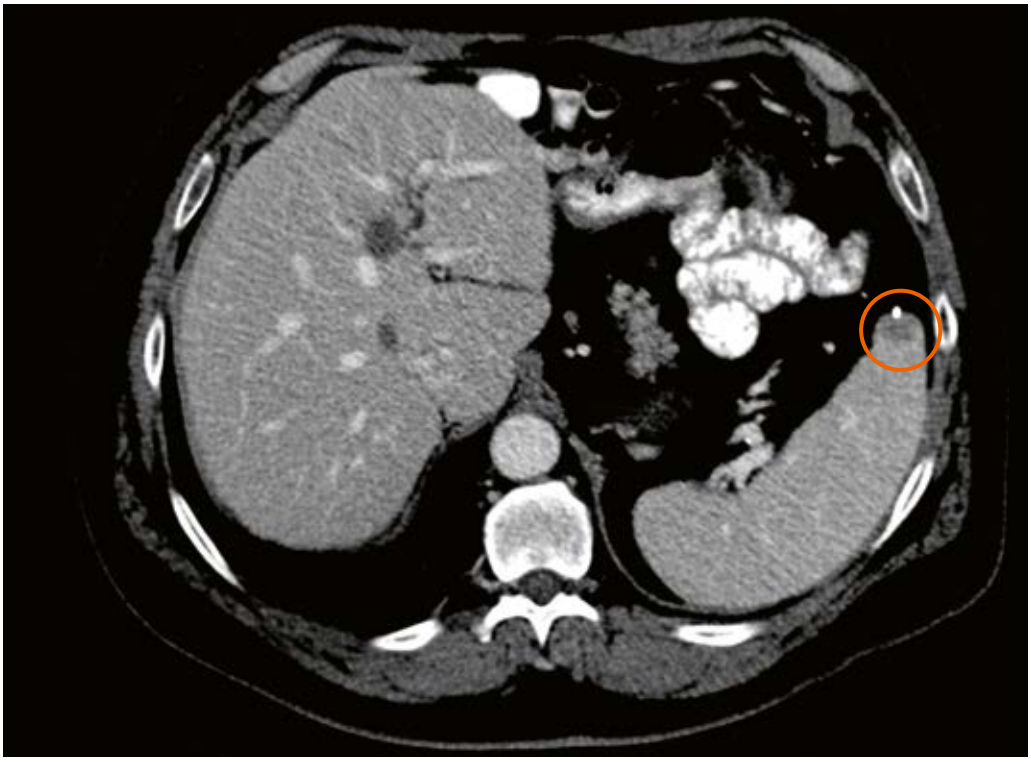
A 59-year-old male with metastatic colorectal cancer to spleen

Diagnosis

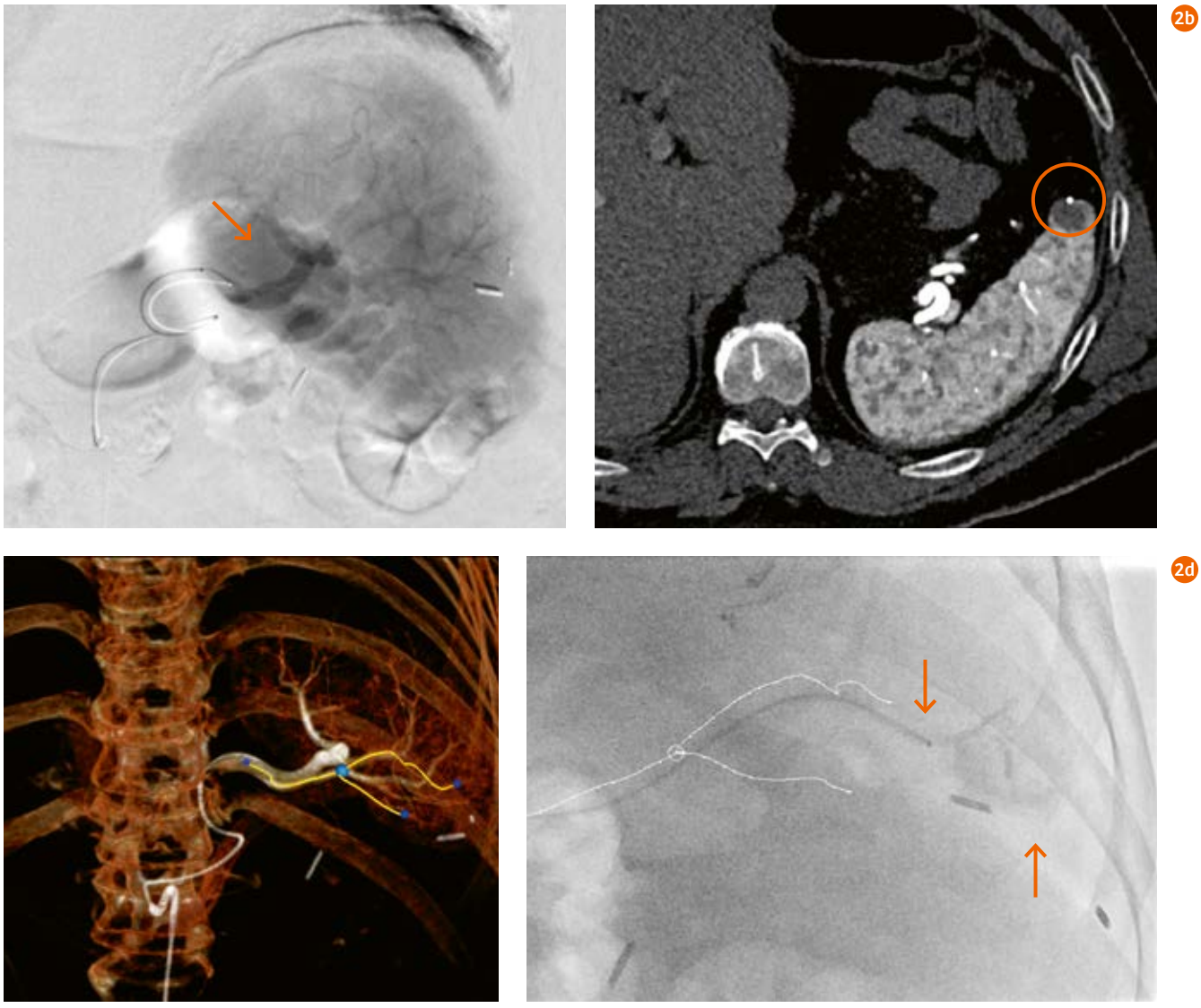
The patient was previously diagnosed with metastatic colorectal cancer to the liver and successfully treated using CT-guided liver ablation.
A new metastasis measuring 1.9 cm was found in the superior aspect of the spleen (Fig. 1). This was treated with percutaneous CT-guided microwave ablation and with a preablation superselective embolization of the feeder vessels to the tumor in order to reduce the risk of bleeding.

Treatment

Digital subtraction angiography (DSA) imaging of the splenic vasculature was acquired with femoral access using a 5F catheter into the celiac artery, followed by a 2.8F micro catheter into the splenic artery (Fig. 2a). An intra-arterial CT scan with contrast administration was



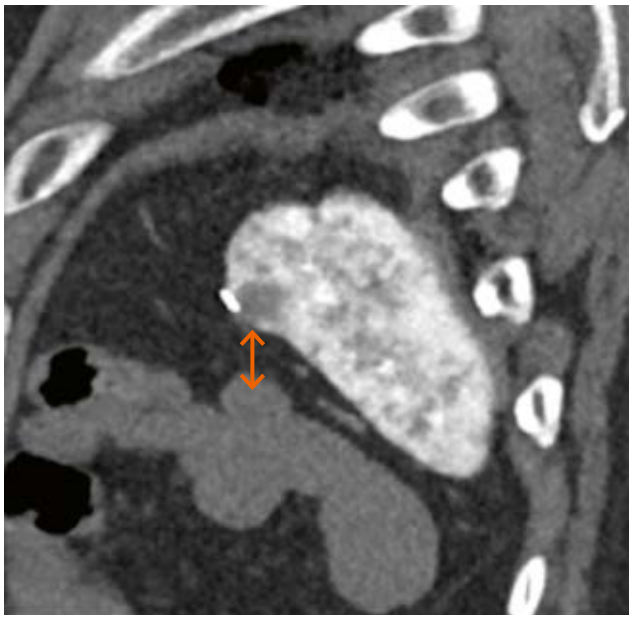
1 Diagnostic CT imaging showing metastasis to spleen. Note the previously treated liver metastasis.

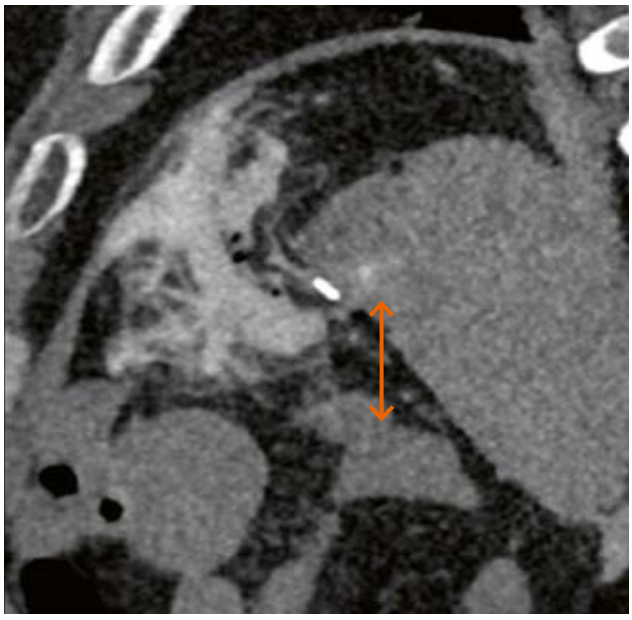


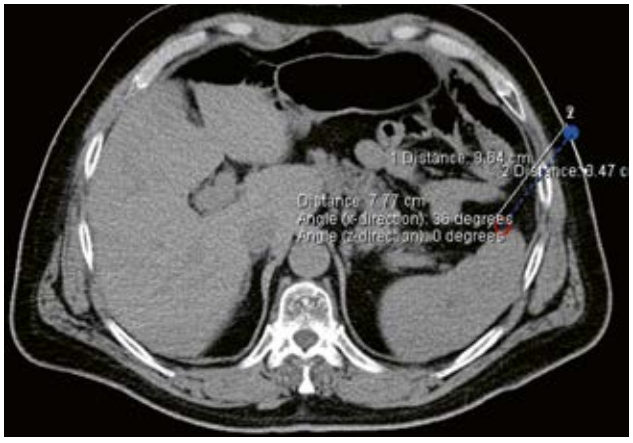
2 Intraprocedural imaging during preablation embolization. (a) Planar DSA imaging to depict splenic vasculature. (b) Axial slice of intra-arterial CT image showing splenic lesion. (c) Identification of tumor feeder vessels using *syngo* Embolization Guidance package. (d) Fluoroscopic image of the point of embolization and contrast pooling into the tumor as well as the vessel path overlaid from intra-arterial CT.

acquired from the splenic artery to map out the tumor feeder vessels. The contrast (Omnipaque 350) was administered at a rate of 3 mL/s for a duration of 14 s and a total volume of 42 mL. Multiplanar reformatted (MPR) images of the intra-arterial CT clearly illustrated the hypovascular tumor and the vessels supplying the splenic segment harboring the target tumor (Fig. 2b), which was not obvious on planar DSA images. After delineating the feeder vessels, superselective catheterization of the splenic artery branch supplying the area of interest was performed successfully, and the target feeding branches were embolized to stasis using 900-micron particles (Embozene) in order to reduce potential heat-sink effect (Fig. 2c–2d).

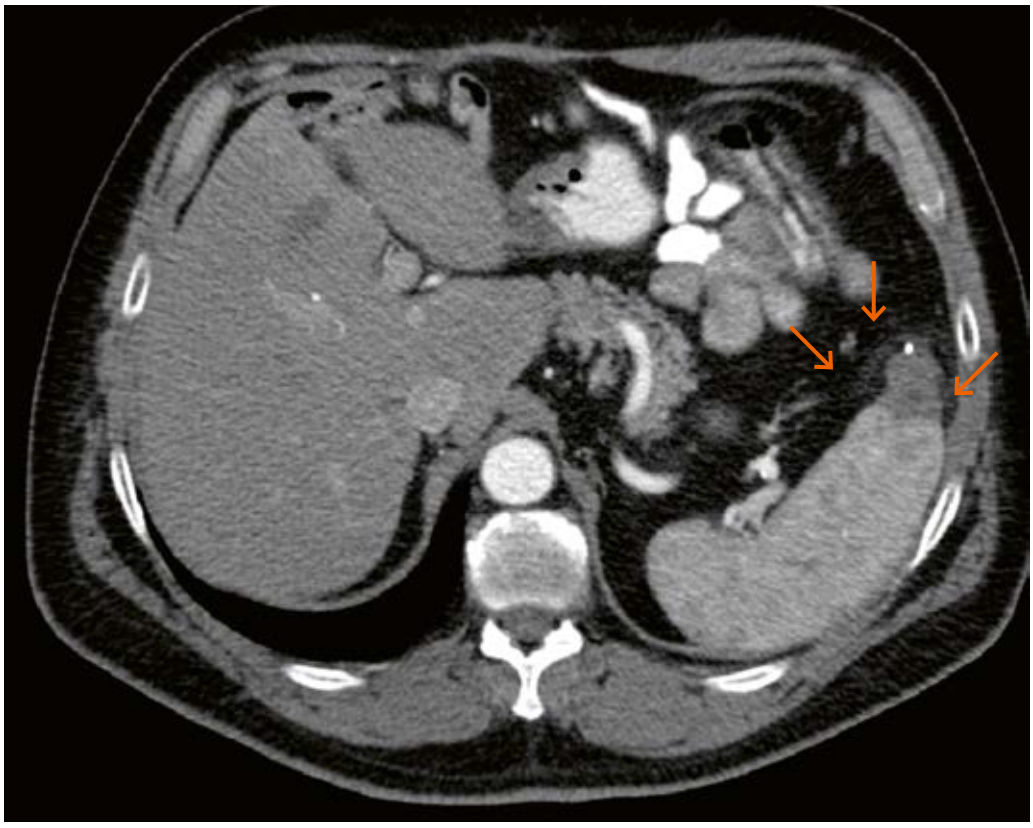
Following the embolization, microwave ablation under CT guidance was performed. In general, the spleen is prone to bleeding during insertion and removal of ablation needles. Therefore, femoral access was maintained throughout the ablation procedure to mitigate bleeding under angiography where needed. An initial noncontrast CT scan was acquired to plan the ablation needle path. Prior to inserting ablation probes, hydrodissection of perisplenic space with separation of the splenic flexure of the colon was performed successfully under CT guidance using an 18-gauge needle (Fig. 3a–3b). Two microwave antennas were inserted under CT guidance, and microwave ablation was performed







3 Intraprocedural imaging during microwave ablation. (a)–(b) Cross-sectional slices showing the space between spleen and colon before and after hydrodissection. (c) Axial slice showing the path planning on CT images for placing ablation probes. (d) Axial slice showing the ablation probe. (e) Immediate postablation intra-arterial CT highlighting the ablation margin and (f) Immediate postablation DSA confirming no evidence of bleeding.



4 Follow-up CT imaging showing successful ablation of the splenic metastasis.

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for 10 minutes at 65 W and a maximum temperature of 134 °C. Immediately after the removal of the ablation probes, the patient became tachycardic and hypotensive. A DSA was therefore acquired to rule out any bleeding caused by vasovagal reaction. Intra-arterial contrast-enhanced CT, also performed toward the end of the ablation procedure, confirmed the ablation margins and indicated no bleeding from the ablation (Fig. 3).

Follow-up imaging

Ablation and preablation embolization were performed successfully in the same setting with both angiographic and CT imaging. Follow-up CT imaging after 2 months showed primary efficacy of the combined embolization-ablation procedure with no residual disease (Fig. 4). Patient has remained disease-free for 11 months.

Comments

This combined embolization and ablation procedure was performed in an Angio-CT suite equipped with a CT scanner (SOMATOM Definition Edge with 128 slices) and a flat-panel C-arm angiography system (Artis Q, ceiling-mounted) with a common patient table, thus facilitating the advantages of imaging and image guidance using the two modalities. Since embolization is an intra-arterial therapy, it is performed in an angiography suite, while ablation, a percutaneous procedure, is traditionally performed using CT or ultrasound imaging. However, the combination of a CT scanner and angiography system allowed us to perform these two procedures in the same setting and with successful interplay of the technical and imaging information between the two procedures. For example, intra-arterial CT imaging was used to accurately identify the vessels feeding the splenic segment harboring the tumor during the embolization procedure under angiography imaging. Similarly, immediate postablation assessment of potential bleeding and ablation margins was performed, respectively, using DSA and CT imaging acquired with intra-arterial access. As a safety measure, CT-guided hydrodissection was performed to avoid ablation of critical structures, and femoral access was maintained for angiographic detection and embolization of possible bleeding. In summary, combining CT and angiography systems not only has the potential to enable these complex combined techniques, but also to bring the existing interventional therapies to a new level. ●

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