Canon

Clinical Case Study

Infinix™-i 4DCT

Aquilion ONE ViSION Edition

Seamless Integration of CT and Angiography

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As a not-for-profit, CARTI (Central Arkansas Radiation Therapy Institute) is governed by a community board of directors, with all of the profits generated being put back in to its operation, which allows it to reinvest in cancer care in its community. CARTI offers the most technologically advanced radiation oncology treatments available, once they are proven effective for patient care. CARTI invests in new technology before 90 percent of the providers in the country.

CARTI, the largest private cancer center in Arkansas, recently installed the first Infinix™-i 4D CT with the Aquilion ONE™/ViSION Edition, the industry's first seamless integration radiology (IR) and CT technology into one solution. Clinicians at CARTI chose the Infinix-i 4D CT to enable them to perform interventional procedures, including ablations, chemoembolizations, kyphoplasties and selective internal radiation therapies.

"Interventional radiology and oncology is born from innovation, and technology advancements like the Infinix-i 4D CT create exciting new possibilities and prepare us for the future of care. For today's patients the system makes procedures that were difficult to perform and turns them into manageable cases that are easier, faster and more accurate."

—Dr. David Hays, director, Diagnostic and Interventional Radiology, CARTI

Infinix-i 4D CT Aquilion ONE/ViSION Edition is the only combined angio-CT system that offers 16 cm of CT coverage in one fast rotation

Canon Medical Systems' Infinix-i 4D CT seamlessly integrates the interventional lab and CT scanner for a paradigm shift in interventional workflow. The combined room is ideal for a variety of interventional radiology procedures, including:

- Transcatheter arterial chemoembolization (TACE)
- Selective internal radiation therapy (SIRT)
- Ablations (RFA, Microwave, Irreversible electroporation)
- Kyphoplasty and vertebroplasty

Infinix-i 4D CT efficiently integrates CT and IR into one seamless solution. True CT instead of "CT-Like" images on demand during procedures may offer:

- Reduced motion and breathing artifacts due to shorter acquisition times
- Improved Low Contrast Detectability and soft tissue visualization
- Whole Organ Body Perfusion* with volumetric scanning (up to 16 cm* of coverage in a rotation)
- Volumetric CT fluoroscopy (up to 16 cm* of coverage in one rotation)

CT images can assist in better visualization, improved device manipulation, confirmation of procedural goal, and as a result may increase efficiency.[1,2,3,4] Real CT imaging available on demand may help clinicians to:

- Reduce time-to and time-of procedure
- Eliminate patient transfer between CT and interventional suites
- Improve workflow

Dr. Hays commenting on the benefits of Infinix-i 4D CT added that ***"Volumetric CT fluoroscopy on Infinix-i 4D CT Aquilion ONE/ViSION Edition is very beneficial in the planning and execution of percutaneous tumor ablations, such as tumors in the dome of the liver or adjacent to critical structures. The added accuracy from this technology has enabled us to perform these procedures safely and efficiently. We also routinely perform Intra-Arterial Volumetric CT Arteriography scans during TACE procedures. The benefit over C-arm CBCT is the improved low contrast detectability, as well as faster scans with a wider field of view (FOV) that CT offers."***

**Only available with Infinix-i 4D CT with the Aquilion ONE/ViSION Edition*

Clinical Cases

CASE 1

Radiofrequency Ablation (RFA) followed by Sacroplasty

Patient History: A 54-year-old female with recurrent metastatic cancer presented for RF ablation of a sacral tumor with subsequent sacroplasty for stabilization of the bone. These procedures were performed under conscious sedation with local anesthesia.

Workflow: Volumetric CT fluoroscopy scans were used to localize the tumor and for needle guidance planning/placement (Figure 1). A guiding Trocar needle was initially placed with CT fluoroscopy guidance and a single RF ablation probe was placed into the targeted region of the sacrum (Figures 2-3). Upon completion of the ablation, the probe was removed and the angiographic ceiling-mounted C-arm was moved into position to guide the sacroplasty procedure (Figures 4-5). Cement was injected through a bone filler under fluoroscopic visualization. After this injection, helical CT scan was performed to confirm the extent of the injection. The scan confirmed that more filling of the targeted lesion was required and two more injections were performed for completion of the sacroplasty procedure under the C-arm with CT imaging confirming the end result (Figure 6).

Conclusion: Using the Infinix-i 4D CT Aquilion ONE/ViSION Edition, the clinician optimized workflow, efficiency, and patient comfort in the management of this patient's metastatic bone cancer, which required RF ablation under CT fluoroscopy guidance followed by sacroplasty under fluoroscopy. The utilization of volumetric CT fluoroscopy enabled the clinician to quickly and efficiently identify the region of interest and guide the needle placement with coronal and sagittal views covering up to 16 cm. The injection of cement was performed under the C-arm providing easy access to the patient and real time visualization of the injection. CT scans were performed to verify the accurate completion of the sacroplasty procedure. All of these steps were performed without moving the patient from one table to another, enabling the clinician to prioritize safety and efficiency.

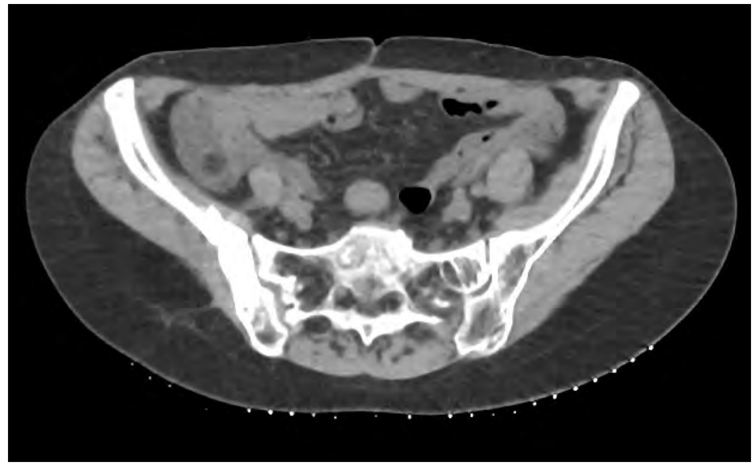


Figure 1. Axial CT image prior to needle placement.

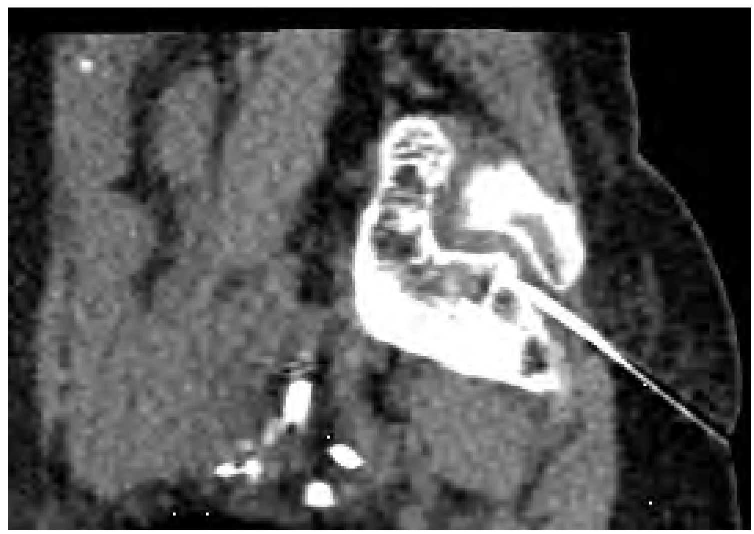


Figure 2. Sagittal view during needle placement.

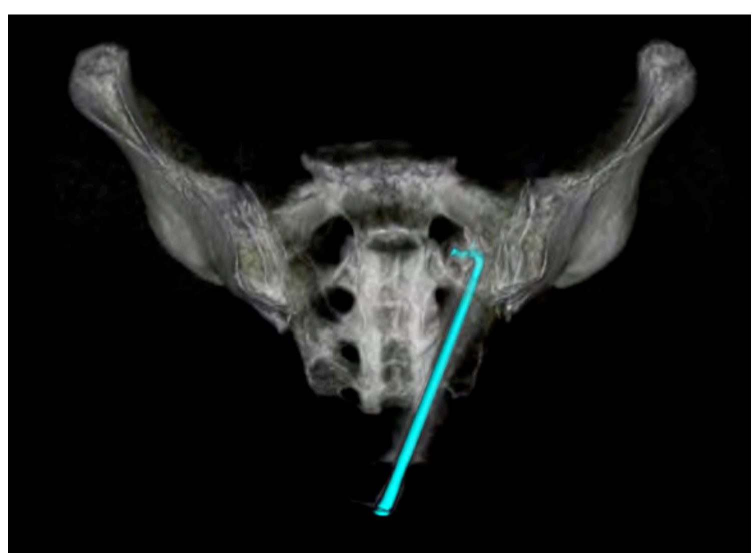


Figure 3. 3D rendering of needle entering sacrum.

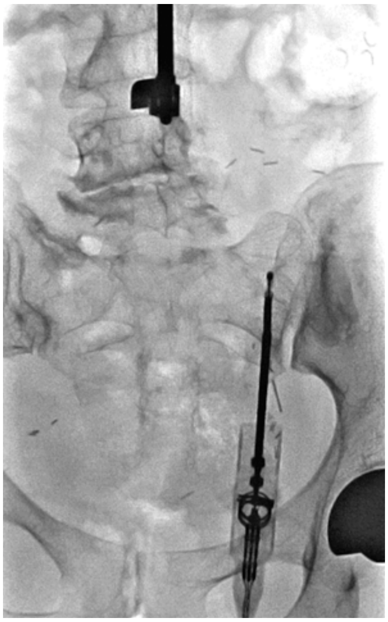


Figure 4. Angiographic fluoroscopy AP view of cement injector in place.

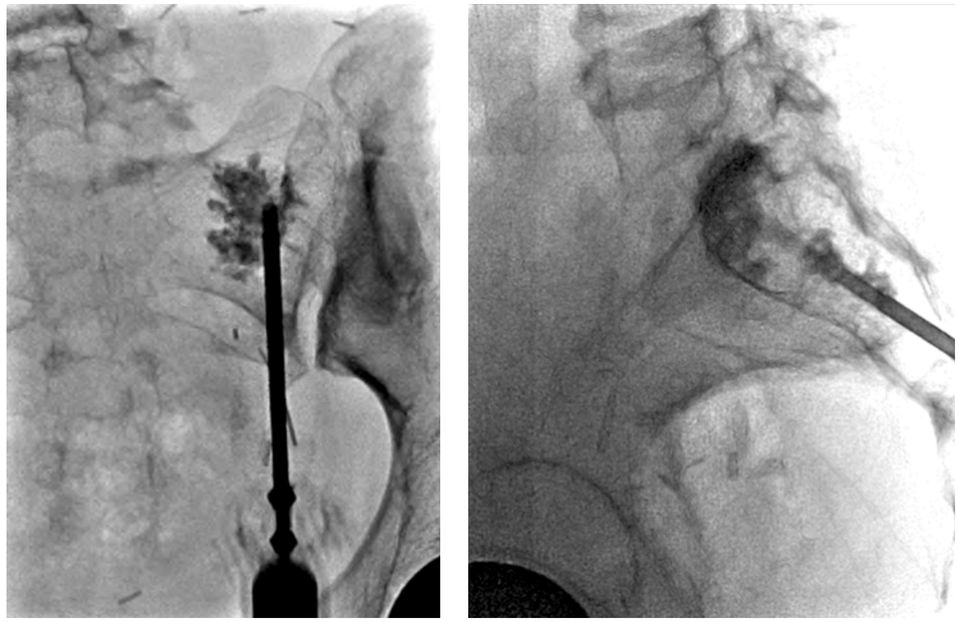


Figure 5. Angiographic fluoroscopy AP and lateral views of cement injected in the sacrum.

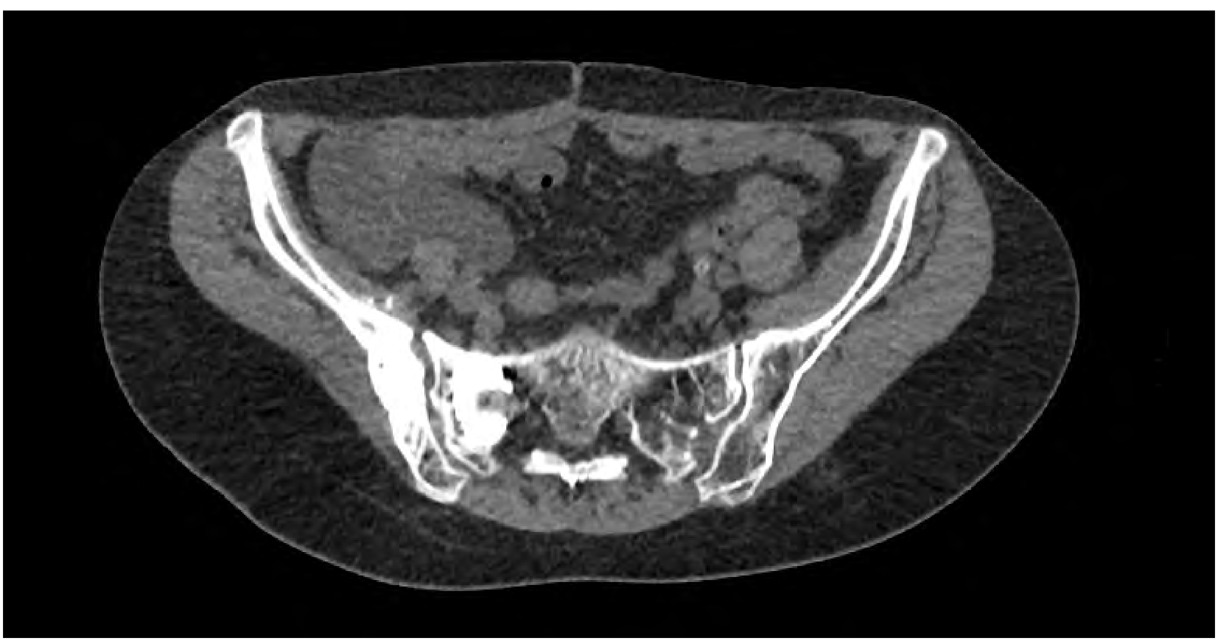


Figure 6. Verification: Axial CT image after cement injection and needle removal.

CASE 2

Radiofrequency Ablation (RFA) followed by Kyphoplasty

Patient History: A 64-year-old male with recurrent metastatic cancer in the spine previously treated with radiotherapy received RF ablation followed by kyphoplasty for pain management and stabilization. The procedures were performed under conscious sedation with local anesthesia.

Workflow: Two guiding Trocars were initially placed under Volumetric CT fluoroscopy guidance targeting the region of interest, a tumor in one of the vertebrae. A RF Ablation device was placed in each of the two guiding Trocars. The tips of the probes were placed within a specified distance from each other as determined by the device manufacturer to ensure appropriate ablation of the tumor based on isothermal contours. The distance between the electrode tips was measured on acquired CT images. Figure 1 shows the inserted needles in the region of interest in 3D CT renderings.

Following the insertion of the needles, the ablation was programmed for 15 minutes per ablation session. Impedance plots were observed to confirm the ablation progress. After the RFA the electrodes were removed and devices for cement injection were inserted for a subsequent kyphoplasty. Kyphoplasty was performed under angiographic fluoroscopy (Figures 2-3). Following the kyphoplasty the CT scanner was moved to position for a helical CT scan to verify that the procedure was successfully completed (Figure 4).

Conclusion: Clinician use of the Infinix-i 4D CT Aquilion ONE/ViSION Edition improved the workflow of a complex spinal procedure that involved RFA with two probes and a kyphoplasty. The wide detector z-axis coverage (up to 16 cm) of the CT scanner provided axial, coronal and sagittal views that enabled the clinician to easily plan the needle path from the skin entrance point to the tumor. The positioning of the RFA electrodes and the ablated region were easily confirmed with CT images. Angiographic fluoroscopy was used for the kyphoplasty segment of the treatment complementing workflow efficiencies and clinician comfort. Finally, CT imaging was used to verify the accurate completion of cement injection.

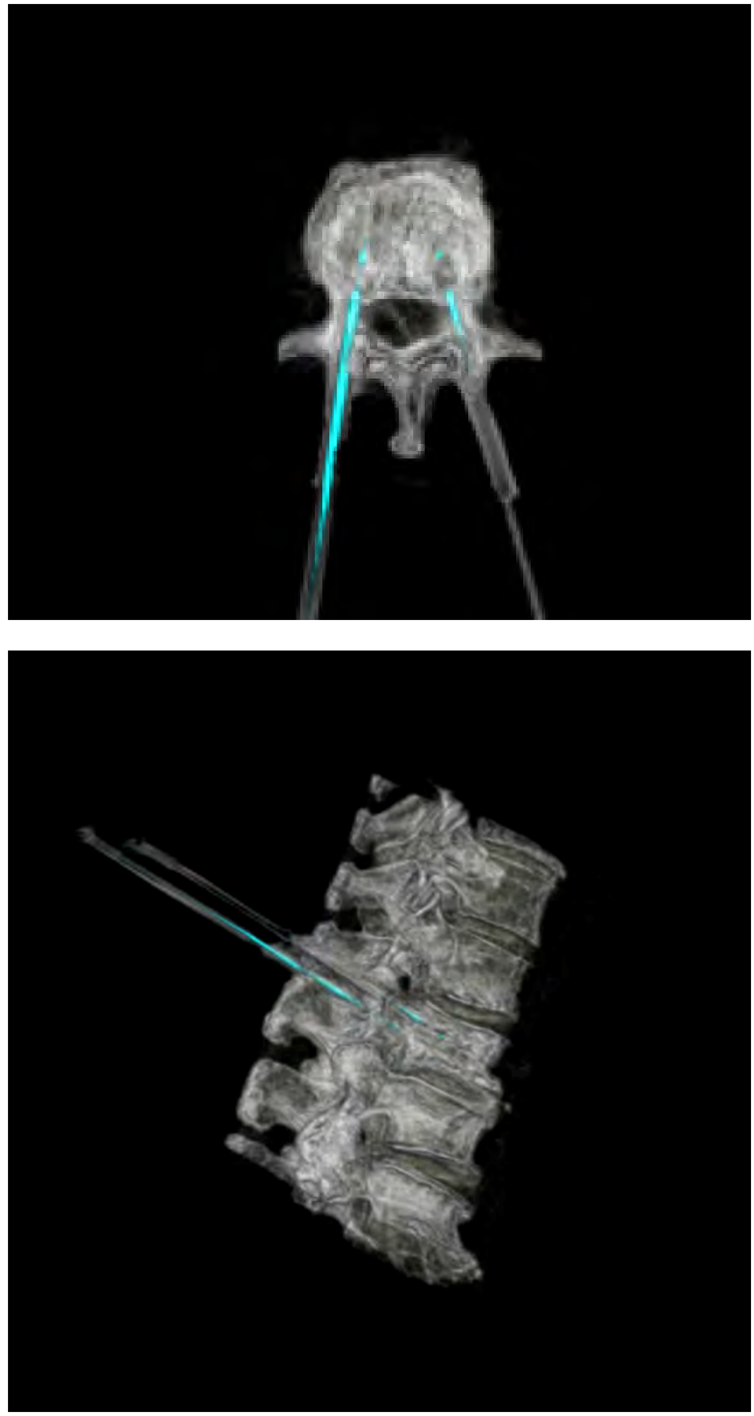


Figure 1. 3D renderings of the 2 needles entering the vertebra.

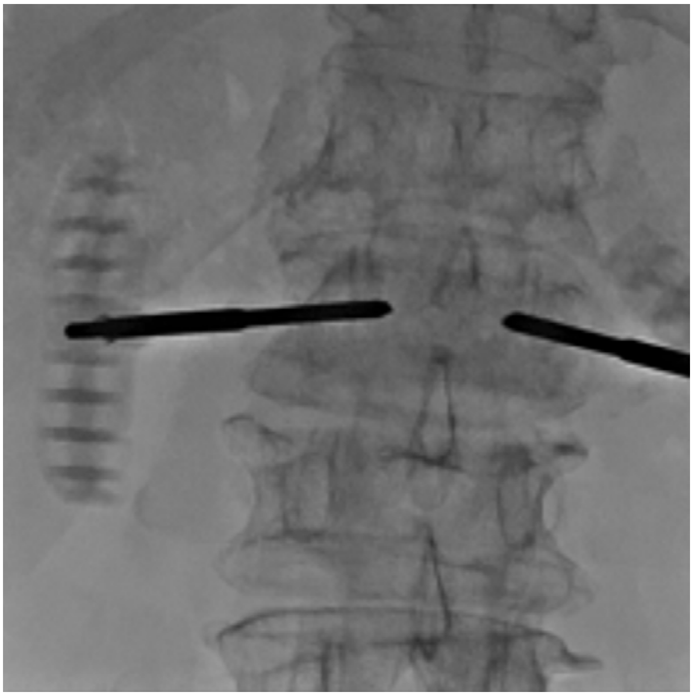


Figure 2. Angiographic fluoroscopy view of the two devices in place for cement injection.

Figure 3. Angiographic fluoroscopy image of the injection.

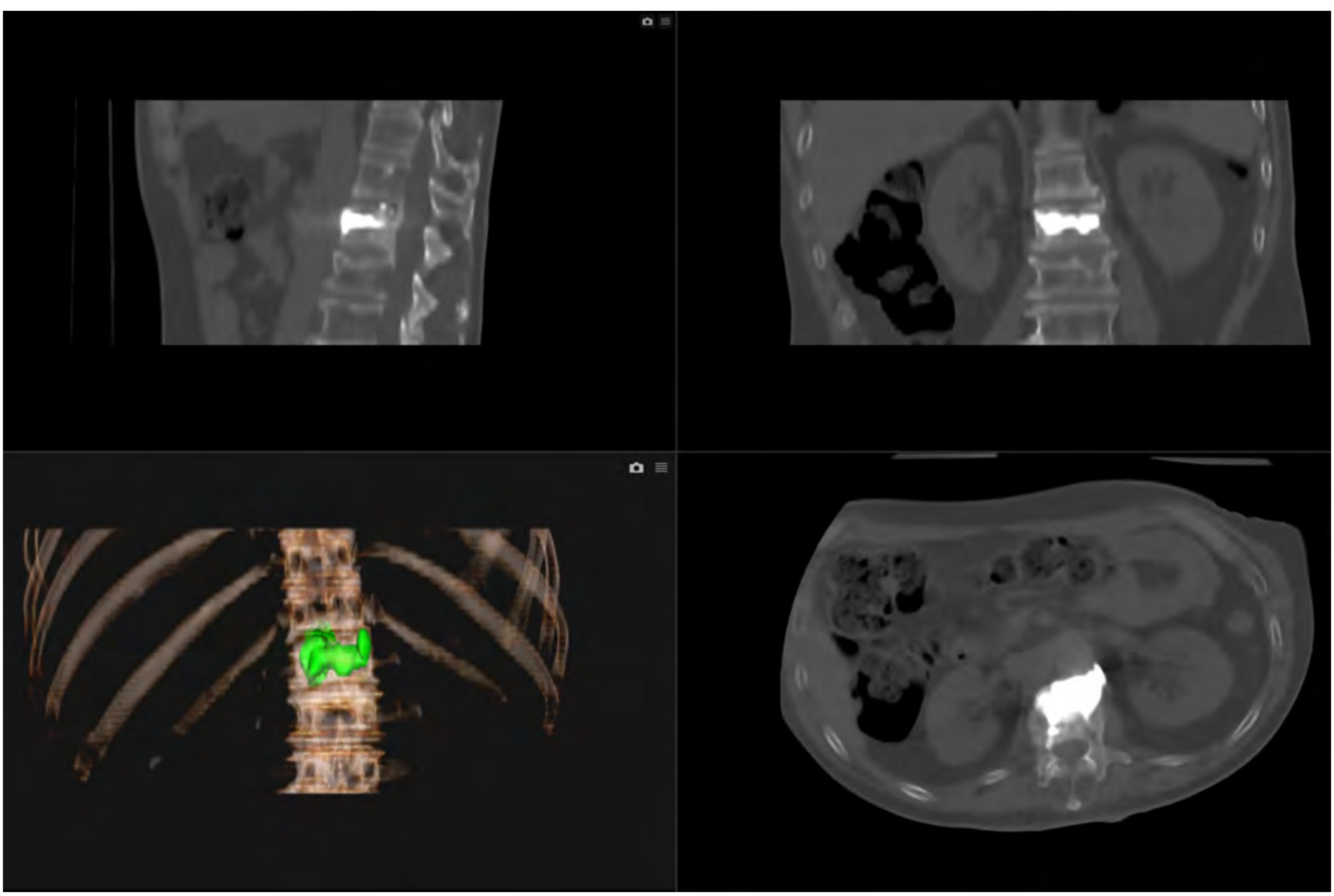


Figure 4. Sagittal, Coronal, Axial, and 3D CT images of the anatomical region of interest after kyphoplasty.

CASE 3

Trans-Arterial Embolization (TAE)

Patient History: 85-year-old male with elevated Alpha-Fetoprotein (AFP) and confirmed liver lesion by previous CT scanning was referred for embolization of this lesion. Embolization in this case was a bland embolization with 75 to 150 µm LC beads.

Workflow: Volumetric CT Perfusion is being used by the clinician for the liver tumor diagnosis and evaluation of treatments.[5] In this case, Volumetric CT Perfusion was initially performed, enabling the clinician to identify a hyper-perfused region in the right lobe of the liver. During the CT acquisition, an IV injection of iodinated contrast medium was followed by a saline flush. A series of low dose volumetric scans of the entire liver (16 cm of z-axis coverage) were acquired with the table and the gantry remaining at the same position for the duration of the scan. The volumetric scans were acquired every two seconds during the arterial phase of the protocol and every three seconds during the portal phase. The scan was performed with the patient breathing shallowly. After the acquisition, deformable registration was performed to align the volumes to compensate for breathing and peristalsis. Liver perfusion maps, including arterial flow, portal flow and hepatic perfusion index maps, were then generated using the dual input maximum slope analysis method. An area with high hepatic perfusion index, defined as the ratio of arterial flow to the sum of arterial and portal flow, was identified in the right lobe of the liver (Figure 1), enabling the clinician to confirm the presence of a malignant tumor.

After the CT Perfusion study the gantry moved back, the table and C-arm came into position for the embolization of the tumor. Digital Subtraction Angiography (DSA) of the Superior Mesenteric Artery (SMA), the Common Hepatic Artery (CHA) and Proper Hepatic Artery (PHA) were performed to identify the tumor feeder vessels (Figure 2). Figure 3 depicts late phase enhancement of the tumor by the PHA, which was super-selected for the chemoembolization and Figure 4 shows the TAE of the tumor.

Conclusion: Clinician use of the Infinix-i 4D CT Aquilion ONE/ViSION Edition improved the workflow of a TAE case. It provided perfusion maps without having to move the patient between CT and Angio suites, enabling the clinician to confirm a tumor in the right liver lobe. The tumor was embolized under the C-arm following super selection of the feeding vessel.

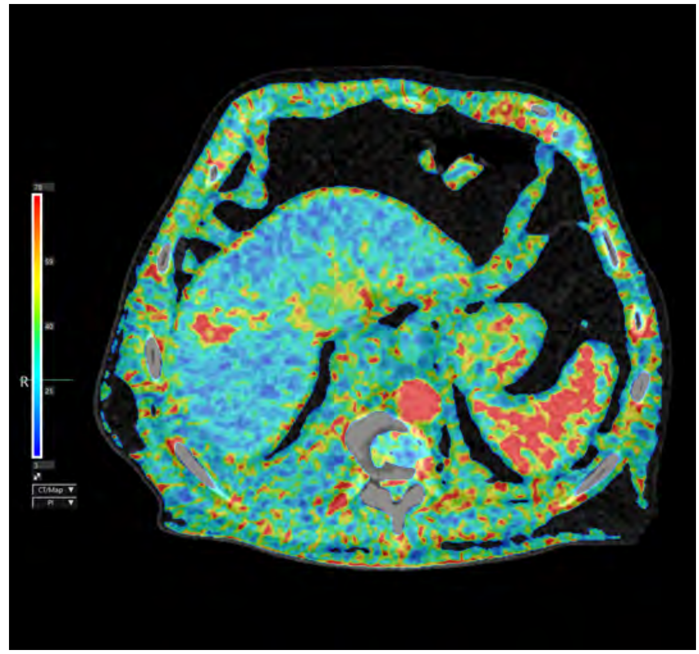


Figure 1. CT Perfusion Map of Perfusion Index (PI).

Superior Mesenteric Artery | Common Hepatic Artery | Proper Hepatic Artery

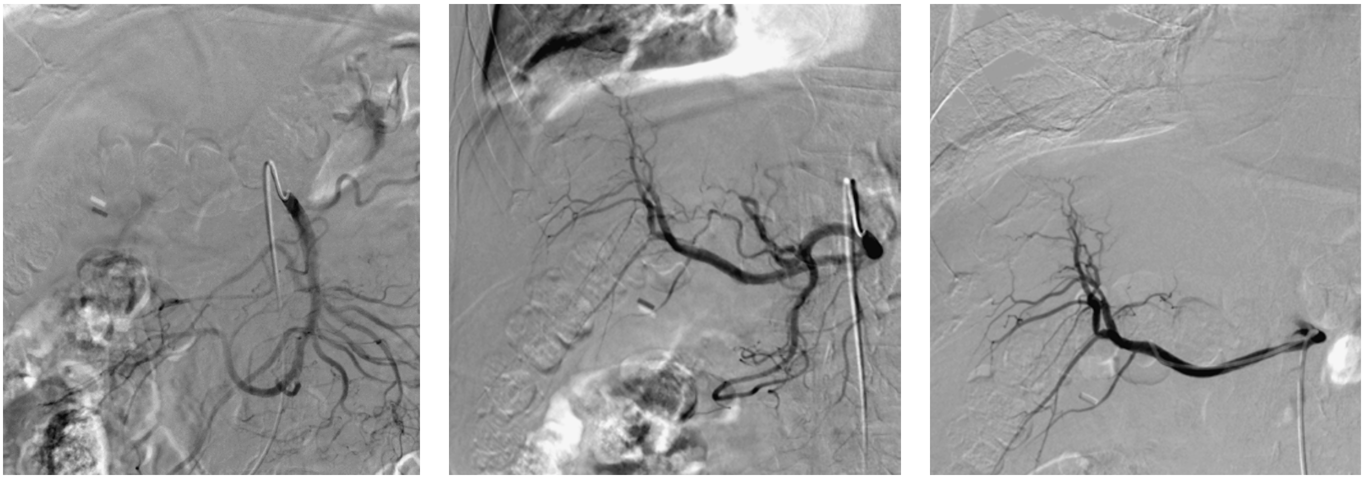


Figure 2. DSA of SMA, CMA and PHA.

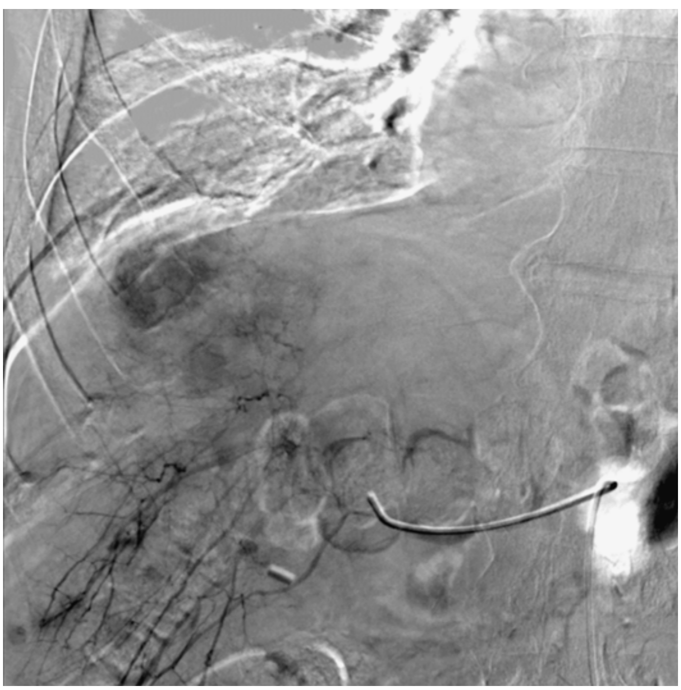


Figure 3. Late Phase of PHA showing the tumor.

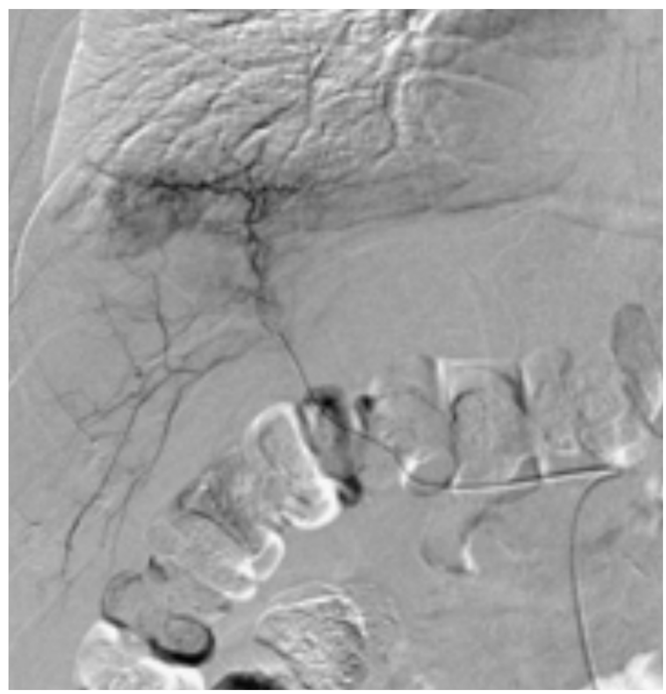


Figure 4. TAE.

CASE 4

Trans-Arterial Chemo-Embolization (TACE)

Patient History: 67-year-old male with biopsy proven cholangiocaricnoma in the left lobe of the liver was referred for chemoembolization of the mass after the patient could not tolerate conventional chemotherapy. LC beads of 75-150 µm were soaked in 75 mg Adriamycin chemotherapy.

Workflow: Contrast enhanced CT of the liver was performed following an IV injection of contrast media clearly depicting a liver tumor. The liver was segmented using the ViTAL Vitrea™ Software post-processing tools (Figures 1 and 2). The hepatic artery branch feeding the tumor was segmented and exported to be fused on live fluoroscopy images using Canon Medical Systems' Multi-Modality Fusion (MMF) software. 3D segmented CT images were overlaid on live 2D fluoroscopy images on the Infinix-i 4D CT exam room monitor. The fused image moved according to the C-arm rotation angle, sliding angle, Source to Image Distance, tabletop height, and tabletop panning (Figure 3). This assisted in the guidance and advancement of the catheter tip to the Proper Hepatic Artery (PHA). PHA DSA series were performed followed by super selective DSA acquisitions and chemoembolization of the tumor. Figure 4 shows presence and absence of blood flow around the tumor before and after the chemoembolization.

Conclusion: Infinix-i 4D CT Aquilion ONE/ViSION Edition offered CT imaging on demand in the interventional suite, enabling the clinician to clearly visualize the tumor and utilize image guidance with MMF to help prioritize efficient workflow and delivery of TACE.

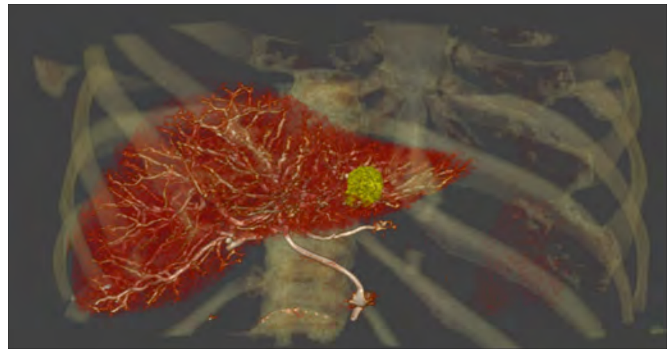


Figure 1. Contrast Enhanced CT Image of the Liver.

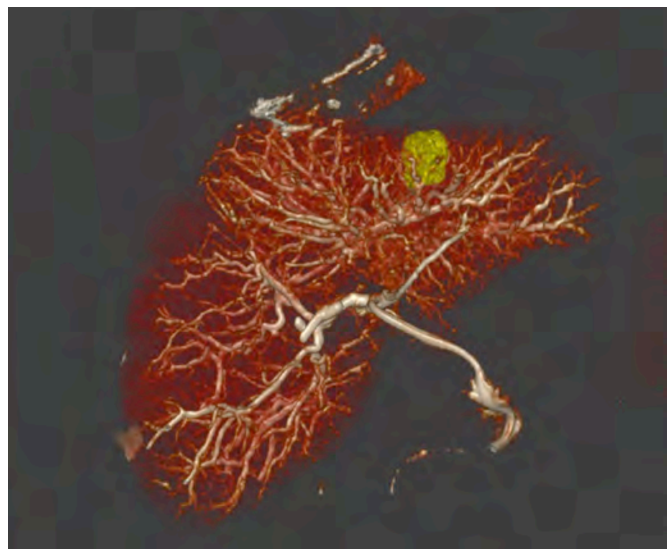


Figure 2. Segmented Liver.

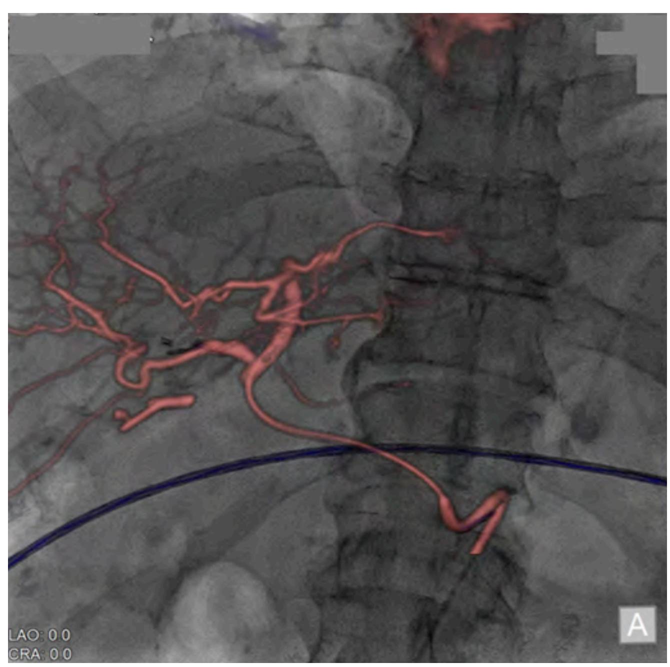
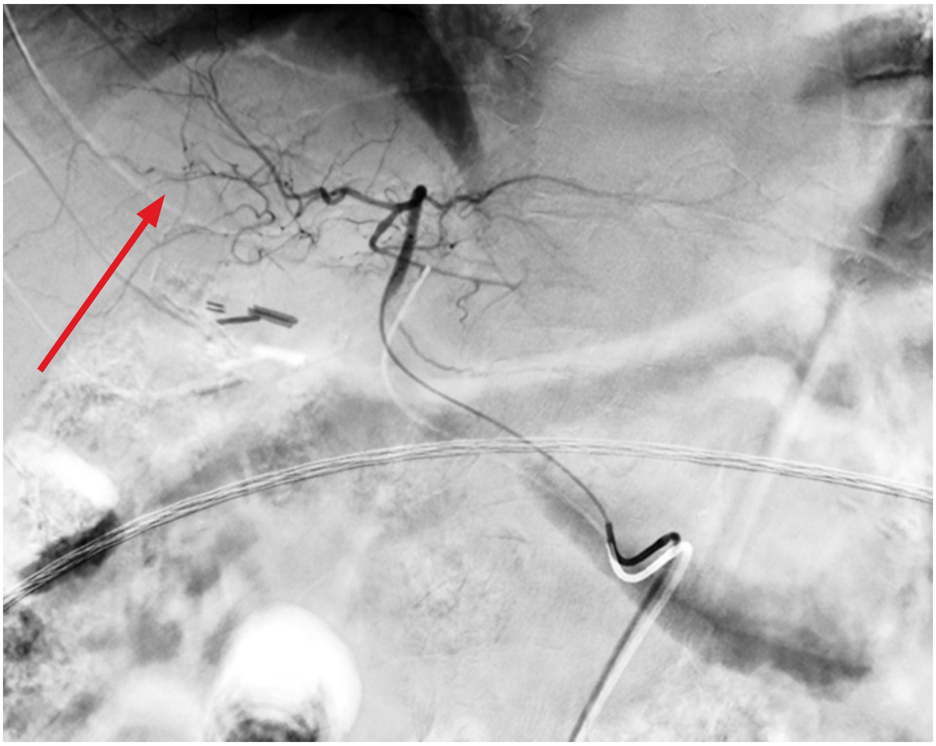


Figure 3. Fusion of segmented vasculature with live fluoroscopy.

Before



After

Figure 4. DSA of PHA before and after TACE.

CASE 5

Trans-Arterial Chemo-Embolization (TACE)

Patient History: 67-year-old female with history of hepatoma. MRI scan revealed a liver tumor and questioned the presence of a second one. The patient was referred for embolization of the lesions in the right lobe confirmed with MRI. Selective Arteriogram of the mesenteric artery followed by a super selective arteriogram of the right hepatic artery with coiling were performed prior to TACE with microsphere drug eluting beads. A follow up MRI showed improvement of the two lesions treated with TACE and a new lesion in the left lobe. The patient was referred for follow up TACE.

Workflow:

a. The patient was placed under Total Intravenous propofol Anesthesia (TIVA). The C-arm was moved from its park position to the table for the identification of the feeder vessels of the tumor in the left lobe. During an initial angiographic series the left gastric vessel was identified. A series of DSA were performed to guide the advancement of a micro-catheter into the accessory left hepatic artery arising in this patient from the left gastric artery (Figure 1).

b. An Intra-Arterial (IA) injection of 3 cc of iodinated contrast at 1cc/sec without delay at 200 psi was injected. The CT scanner was moved to position to perform Volumetric (16 cm of z-coverage) IA CT. The scan confirmed that the Region of Interest (ROI) was successfully targeted and that there was no flow of contrast into the extrahepatic branches (Figure 2). Multi-Modality Fusion (MMF) of the segmented CT image with live fluoroscopy is depicted in Figure 3.

Figure 1. Accessory Left Hepatic Artery.

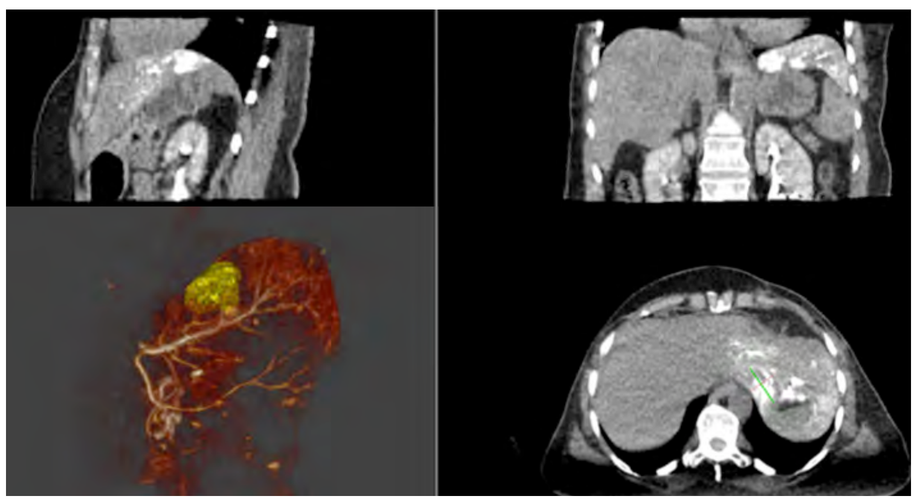


Figure 2. Sagittal, Coronal, Axial and 3D segmented CT images from the Volumetric CT IA perfusion series confirming the correct targeting of the left tumor and avoidance of the diaphragm.

Figure 3. Fusion (MMF) of the segmented IA CT contrast enhanced vessel with fluoroscopy showing the wire guide and the coil.

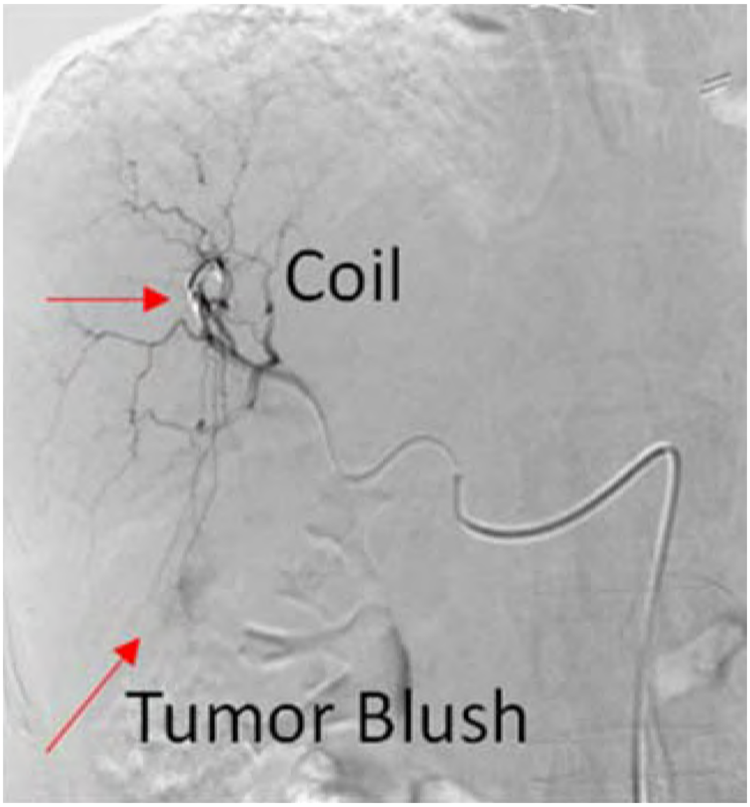


Figure 4. Right Hepatic Artery, coil, and tumor blush.

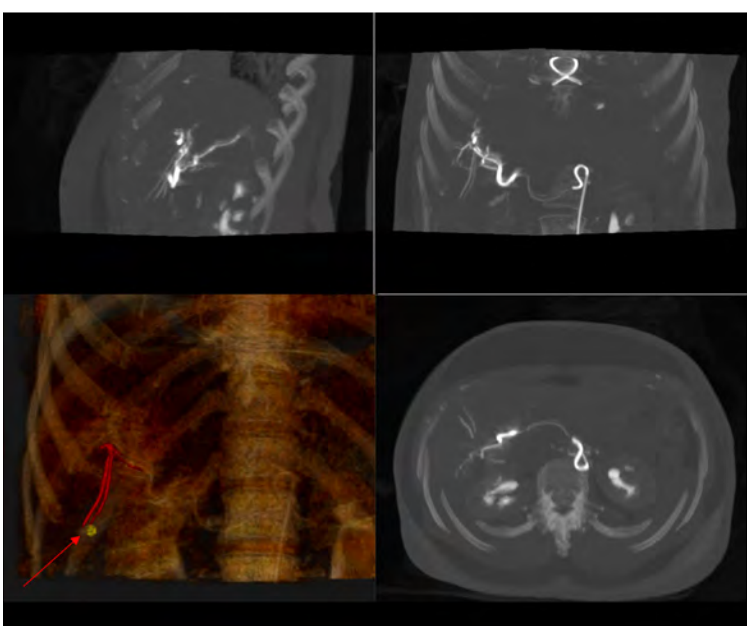


Figure 5. Sagittal, Coronal, and Axial CT images from the IA Volumetric CT arteriography series show the feeder vessels. The 3D rendering depicts the feeder vessels leading to the residual tumor.

c. The CT scanner was moved back and the C-arm was moved to position for TACE. TACE was performed using microsphere drug eluting beads.

d. After the completion of the left lobe tumor TACE, a repeat TACE of the previously treated right lobe tumor was performed. Under fluoroscopy guidance the catheter was advanced to the right hepatic artery (Figure 4).

e. The CT scanner was moved to position again to perform IA Volumetric (16 cm of z-axis coverage) CT arteriography. An Intra-Arterial (IA) injection of 5 cc of iodinated contrast at 2cc/sec without delay at 200 psi was performed. CT images confirmed the targeting of the tumor (Figure 5).

f. Finally, TACE was performed with the aforementioned Drug Eluting Beads.

Conclusion: The workflow of a complicated TACE procedure involving two tumors in two lobes was improved with the use of the Infinix-i 4D CT Aquilion ONE/ViSION Edition by the clinician. IA Volumetric CT arteriography assisted in confirming correct targeting of ROIs avoiding sensitive tissue such as the diaphragm and stomach. It accommodated confirmation of a small volume of contrast agent.

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