Interventional Tumor Therapy
Minimally Invasive, Maximally Effective

There is a continuous expansion of indications for interventional therapies in oncology. Thanks to new, innovative imaging, the number of difficult interventions on large organs, such as the lung or the liver, is on the increase.

By Martina Lenzen-Schulte, M.D.

Malignant, round-focus lung carcinomas represent a growing challenge in terms of therapy. This is mainly due to two facts: Not only has bronchogenic carcinoma been the most common malignant disease worldwide for the past quarter of a century, but there has also been a steady increase in its incidence. With 1.2 million fatalities a year, lung cancer claims more lives than breast cancer, intestinal cancer and prostate cancer combined. By the time a diagnosis is made, 60 percent of all bronchogenic carcinomas are inoperable, and a substantial percentage of those do not respond to chemotherapy. For such patients, interventional procedures that destroy the neoplasms often represent their only option of prolonging their lives or improving their quality of life with comparatively few side effects. One of the underlying reasons for the frequency of bronchogenic tumors is that there is a high incidence of pulmo-

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Head of Diagnostic and Interventional Radiology,
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nary metastases among lung tumors in general. Their immense significance can be measured by the fact that 50 percent of all patients who die of some kind of cancer also have pulmonary metastases. While in the past the existence of pulmonary metastases meant the patients resigned to their fate, nowadays treatment is being initiated more and more often – sometimes even with curative intentions.

"We expect further growth in interventional oncology, mainly because of the increase in the number of patients with certain types of long-lasting disease, which interventional oncologists can help to control," adds Thomas J. Vogl, M.D., Director of the Institute for Diagnostic and Interventional Radiology at the University Hospital of Frankfurt in Germany.

Big Organ, Big Challenge

Prof. Dr. Vogl's institute is in a position to offer a total of ten interventional methods for the therapy of a variety of tumors, metastases and recidivist tumors. "Frankfurt has become a primary cancer center now," he says. "We offer outstanding service in interventional oncology, resulting in a bridge between conventional oncological therapies like chemotherapy, surgery and radiotherapy." For example, transarterial chemoperfusion (TACP) and transpulmonary chemoembolization (TPCE) have become particularly viable methods for the treatment of malignant tumors in the lung. "For us, it is very important and helpful to get a topographical overview of both the left and right lung so that we are able to assess the local vascular structures and the tumor's degree of vascularization," states Vogl, outlining the requirements. He goes on to explain that this was made possible for the first time by using the new Artis **zeego**

multi-axis system in combination with Large Volume *syngo* DynaCT. This new technology meets the users' wish to be provided with a precise, three-dimensional, real-time visualization of the vessels and surrounding soft and parenchymal tissue structures during intravascular therapies, such as a catheter embolization – and it should also be applicable to very big organs. Users also appreciate the unlimited freedom in the positioning of the C-arm, which increases the number of imaging variants enormously. "At the present time, we already use Large Volume *syngo* DynaCT in almost half of all interventions for lung cancer." says Vogl. "I wouldn't want to do without it now."

Saving Time, Adjusting the Position of the Catheter

syngo DynaCT offers many advantages – primarily for the patient, but also for the doctor, and not least of all for the institution. "We have improved our workflow because our interventions are faster and more precise – and due to better selection, we can reduce the number of treatment sessions per patient. This optimizes workflow both for the department and the patients," explains Vogl. In Frankfurt, this was proven by a study that examined the efficiency of Artis **zeego** combined with *syngo* DynaCT software. In the study, 31 patients were treated either by TACP or TPCE. They were suffering from primary lung tumors, pulmonary metastases or pleuramesotheliomas. "We were able to optimize the position of the catheter in 37.5 percent of the TACP patients and in 30 percent of the TPCE patients, thanks to the knowledge gained in an additional simulation performed prior to the treatment," says Vogl. "The conclusion that can be drawn from this study is stated very clearly in expert literature: 'The data collected in the course of selective, regional chemotherapy of thoracic malignant tumors shows that the peri-interventional evaluation of the vascular supply, the degree of vascularization, and the positional relations of the catheter systems prior to performing chemoperfusion and chemoembolization were able to be carried out with greater exactness.'" Furthermore, notes Vogl, it was possible to exclude the extravasation of chemotherapeutics as well as the existence of vascular shunts. This enabled the user to proceed with greater certainty during the intervention.

"We also save time this way," Vogl states, noting another advantage of the Artis **zeego** / *syngo* DynaCT combination. One of the reasons why the new system has advantages to conventional CT imaging, he explains, is that users no longer need markers for navigation purposes, since the data is transmitted immediately during the intervention. "In Frankfurt, it takes us about 16 seconds to create a complete cone-beam CT," says Vogl. "Should all these advantages provide evidence of increasing the clinical benefits of this treatment in the future, it is foreseeable that such interventions will be on the increase not only in terms of quantity. We will also have a basis for an expansion of those areas where such a treatment is indicated."

Liver Tumors: Expanding Options

The benefits of Artis **zeego** also extend to another organ: the liver. "Although the liver represents the most common target of interventional tumor therapies, so to speak – as many as one-third of all interventions performed at the Frankfurt clinic are liver operations – we have not exhausted all of our options here," says Vogl. It has been proven that in 60-90 percent of all patients receiving TCPE because of liver tumors, *syngo* DynaCT can deliver additional information. In 40 percent of all cases, the catheter was readjusted.

Regardless of primary tumors, the liver is the organ which is most commonly affected by metastases. There is a particularly high incidence of hepatic metastases in patients with intestinal cancer. If left untreated, the median survival time of patients is between four and twenty months. In many cases – up to 40 percent of all intestinal cancer patients – hepatic metastases are initially the only distant metastases and therefore have increasingly moved into the focus of curative therapeutic endeavors. More and more, doctors are realizing that in some cases, the patient's life can be prolonged quite substantially if hepatic metastases are tackled specifically.

A study conducted by the Frankfurt research group showed for the first time that the one-year survival rate of all patients treated by TCPE and a combination of chemotherapeutics is just under 70 percent, and that an average of one-third of these patients is still alive three years later. There are few centers that have such a wealth of experience in the treatment of hepatic metastases of mammary carcinomas as Frankfurt's Institute for Diagnostic and Interventional Radiology and can supply such data. On the one hand, the results demonstrate the high significance of selectively destroying hepatic metastases. On the other, they are an indication that the options for treating liver tumors are far from being exhausted.

By expanding the indications for treatment, the new multi-axis system will correspondingly expand the number of patients that can be treated. "It is always difficult to justify the cost of investments. But at least in our experience, with the installation of Artis **zeego**, we are now able to offer interventional oncological procedures for patients with more advanced and difficult disease – in areas where we have not treated them before. This is especially true for lung cancer, but also for recurrent pelvic cancer and head and neck cancers. We think that as a result of this, we can expand both our experience and our services."

Martina Lenzen-Schulte, M.D., is a physician, author and medical journalist. She is a frequent contributor to medical magazines and the scientific pages of German-speaking public media.

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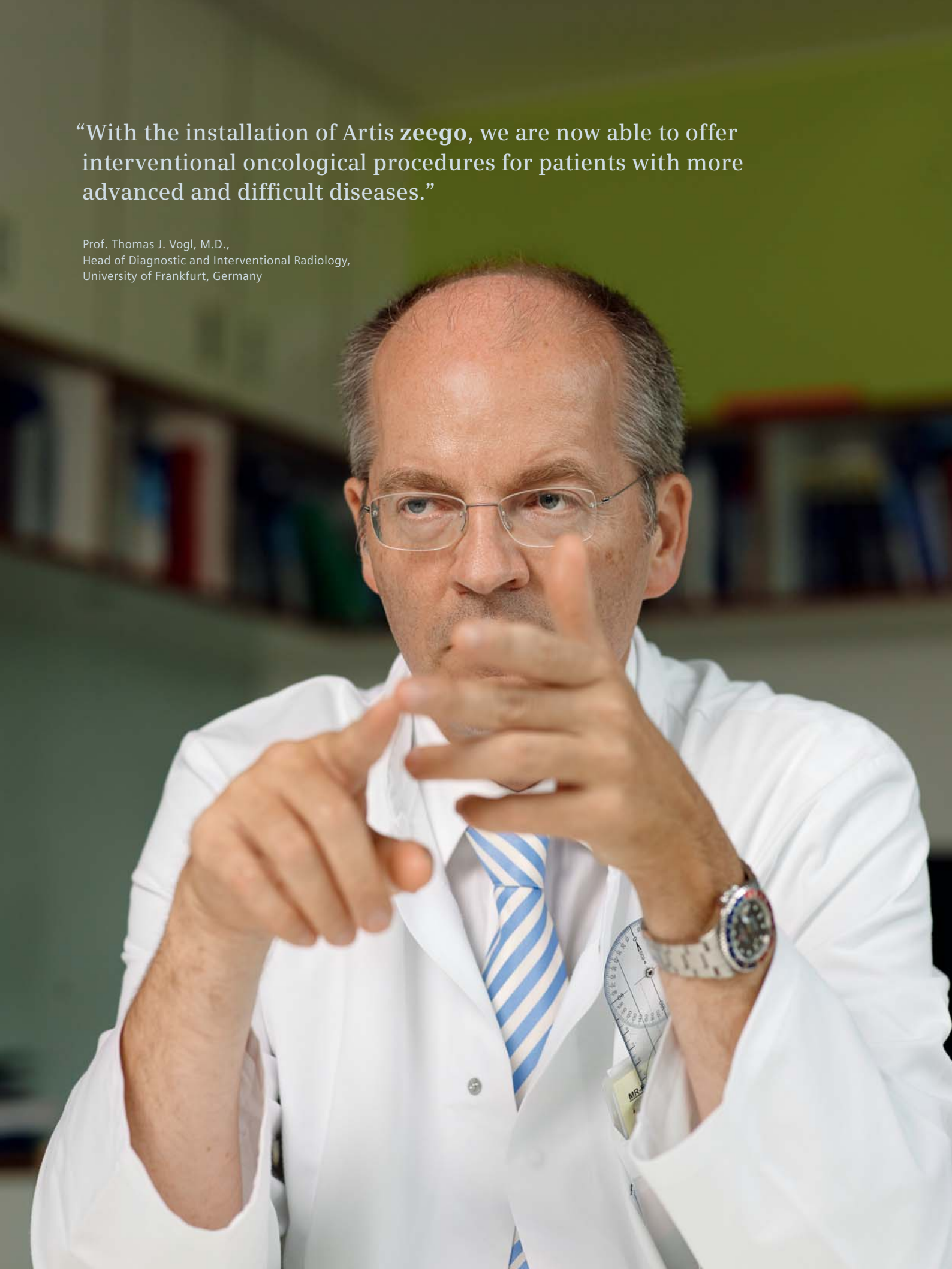

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Hepatic Arterial Chemoembolization
Supported by *syngo* DynaCT

Courtesy of Thomas J. Vogl, M.D.
Diagnostic and Interventional Radiology, Johann Wolfgang Goethe University, Frankfurt/M, Germany

Patient history
A 67-year-old male

Diagnosis
Liver tumor metastasis

Treatment
The tumor metastasis already measured 5 x 5 cm in the right lobe of the liver and originated from colorectal carcinoma. A decision was made for chemoembolization. Therefore a 5 French sidewinder catheter was positioned in the celiac trunk and a 3 French microcatheter was selected for the right hepatic artery.

Prof. T. Vogl, M.D. and the newly installed Artis **zeego** at Johann Wolfgang Goethe University, Frankfurt/M, Germany

Examination protocol

Primary reconstruction

Mode	DynaCT Full HU Normal
Matrix	512 x 512

Contrast medium injection parameters

Quantity	57 cc
% Contrast (dilution with saline)	33 %
Injection rate	3 cc / sec.
Injection duration	19 sec.
X-ray delay	3 sec.
Catheter type / size	5F Sidewinder / 3F Microcatheter
Injection site	right hepatic artery
Iodine concentration	320 mg / cc

Viewing and post-processing

VRT	yes
MPR	yes
Slice thickness	0.7 mm
Window levels	W231 / C55

Secondary reconstruction

Mode	DynaCT
VOI	manual
Slice matrix	512 x 512
Kernel	EE
Image characteristics	sharp

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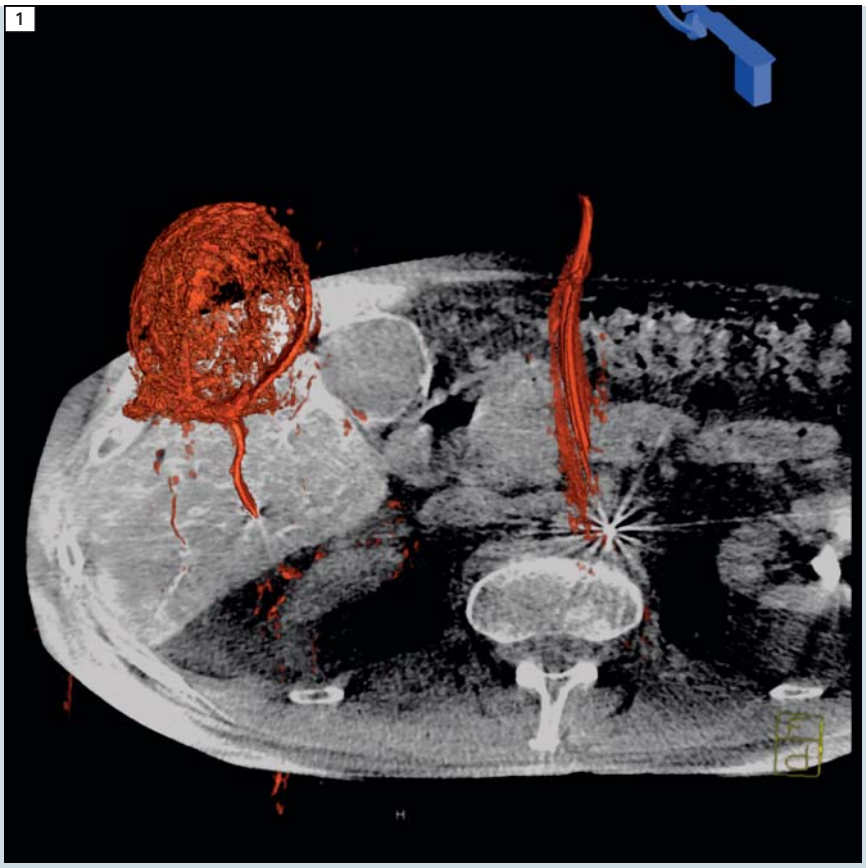
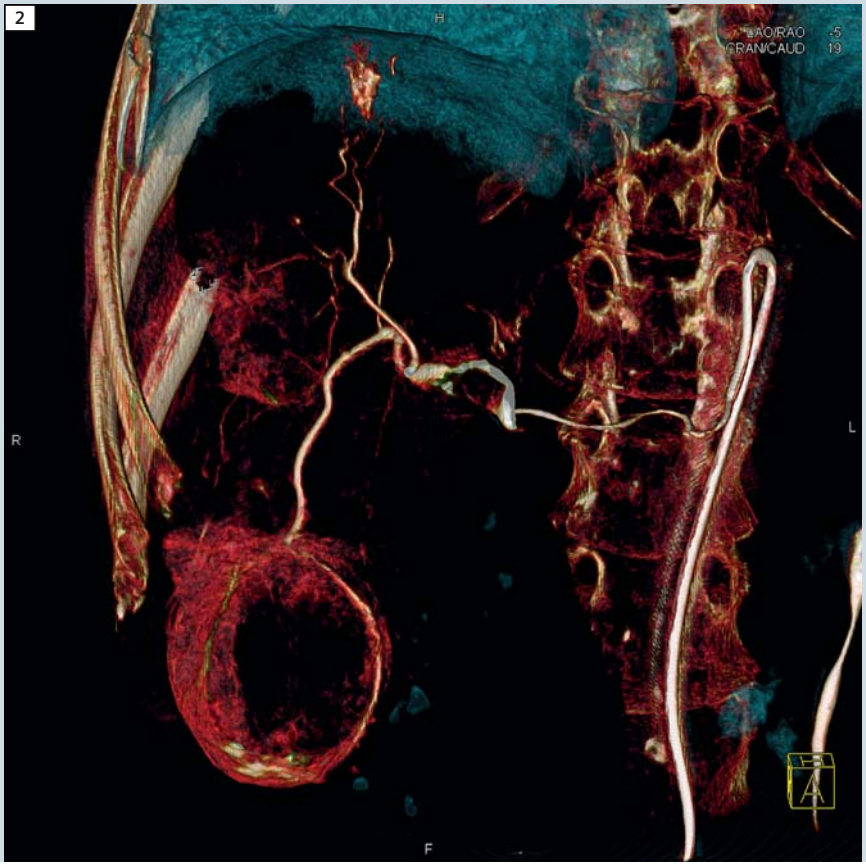
1 Embedded MPR visualization by *syngo* iDentify.



2 *syngo* InSpace VRT reconstruction.



Selective Pulmonary Artery Chemoembolization

Supported by Large Volume *syngo* DynaCT

Courtesy of Thomas J. Vogl, M.D.
Diagnostic and Interventional Radiology,
Johann Wolfgang Goethe University,
Frankfurt/M, Germany

"We use Large Volume *syngo* DynaCT in more than 70% of our interventions. It helped us to become faster and more precise and to improve the overall workflow for our department and the patient."

Prof. T. Vogl, M.D., Head of Diagnostic and Interventional Radiology, University of Frankfurt, Germany

Patient history
56-year-old male

Diagnosis
Left lung metastases

Treatment
The metastases in the left lung originated from colorectal carcinoma. Selective left pulmonary chemoembolization was performed by using a 5 French pigtail catheter.

Examination protocol

Primary reconstruction

Mode	DynaCT Full HU Normal
Matrix	512 x 512

Contrast medium injection parameters

Quantity	75 cc
% Contrast (dilution with saline)	33 %
Injection rate	3 cc / sec.
Injection duration	25 sec.
X-ray delay	1 sec.
Catheter type / size	5F Pigtail catheter
Injection site	pulmonary artery
Iodine concentration	320 mg / cc

Viewing and post-processing

VRT	yes
MPR	yes
Slice thickness	0.7 mm
Window levels	W1200 / C600

Secondary reconstruction

Mode	DynaCT
VOI	manual
Slice matrix	512 x 512
Kernel	EE
Image characteristics	sharp

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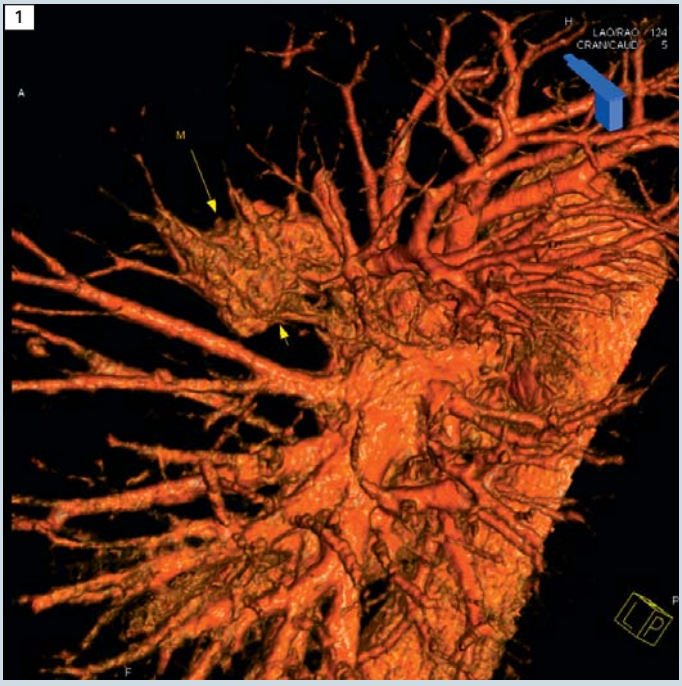

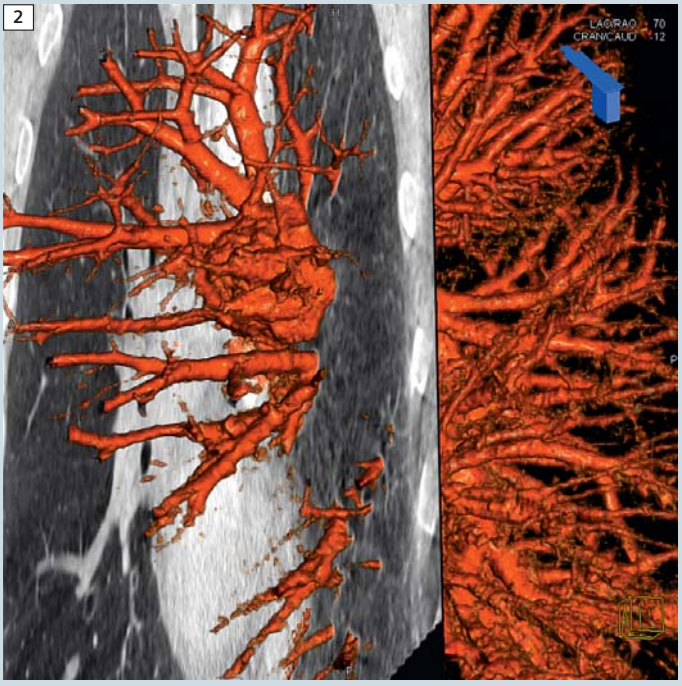

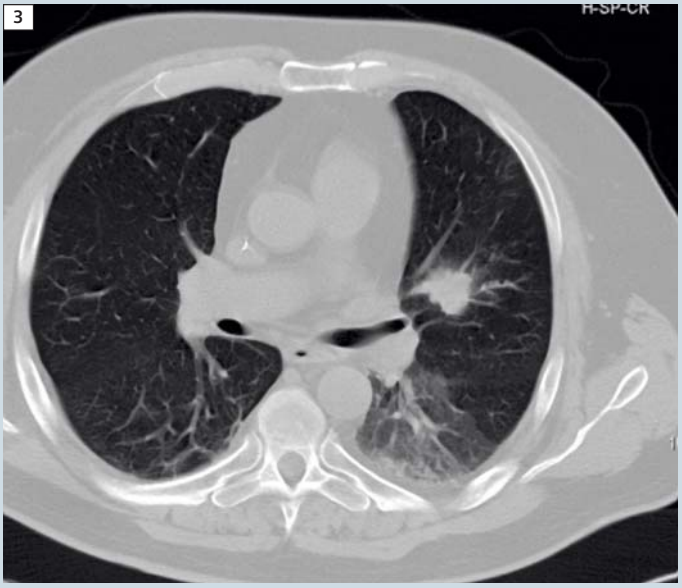

1 *syngo* InSpace 3D shows the tumor with its feeding arteries.

2 Embedded MPR visualization of the pulmonary tumor with surrounding vessels.

3 MPR slice of *syngo* DynaCT