

## White paper

# Use of Cone Beam CT (CBCT) in the angio suite improves safety and outcomes in interventional tumor treatment

Evidence shows *syngo* DynaCT affects patient care in up to 46% of cases

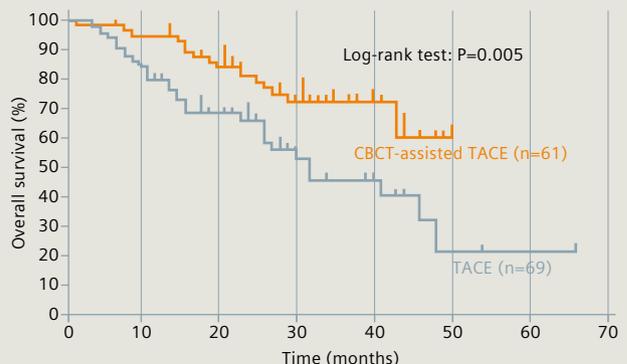
### Executive summary

*syngo* DynaCT can improve both the safety and outcome of interventional tumor treatment. Research shows that *syngo* DynaCT frequently affects a change of diagnosis, treatment planning, or treatment delivery.

For patients undergoing chemoembolization for hepatocellular carcinoma (HCC), additional information from *syngo* DynaCT has been shown to affect a change in diagnosis, treatment planning, or treatment delivery in 28% of cases [1]. Moreover, the use of CBCT in addition to angiography is associated with significantly higher ( $P=0.005$ ) overall survival rates in HCC patients receiving chemoembolization [2].

With the development of ever more sophisticated catheter-based interventions, the range of applications of *syngo* DynaCT continues to increase. Recently published studies demonstrate the benefits of *syngo* DynaCT in Prostate Artery Embolization (PAE) for the treatment of benign prostatic hyperplasia (BPH) [3] [4]. In PAE, intra-procedural 3D visualization helps mitigate the dangers of non-target embolization and has been shown to affect patient care in up to 46% of cases.

### Survival rate HCC patients



Source: Iwazawa J, Ohue S, Hashimoto N, Muramoto O, Mitani T. Survival after C-arm CT-assisted chemoembolization of unresectable hepatocellular carcinoma. *Eur J Radiol* (2012).

Overall survival of patients with unresectable hepatocellular carcinoma (HCC) after transarterial chemoembolization (TACE).

- [1] Tognolini A, Louie JD, Hwang G, Hofmann L, Sze D, Kothary N. Utility of C-arm CT in Patients with Hepatocellular Carcinoma undergoing Transhepatic Arterial Chemoembolization. *J Vasc Interv Radiol* 2010; 21:339–347.
- [2] Iwazawa J, Ohue S, Hashimoto N, Muramoto O, Mitani T. Survival after C-arm CT-assisted chemoembolization of unresectable hepatocellular carcinoma. *Eur J Radiol* (2012).
- [3] Bagla S, Rholl K, Sterling K, van Breda A, Papadouris D, Cooper J, van Breda A. Utility of Cone-beam CT Imaging in Prostatic Artery Embolization. *J Vasc Interv Radiol* 2013.
- [4] Carnevale F. Prostate Artery Embolization Compared to TURP for Treating BPH. *Interview in GEST (Global Embolization Symposium and Technologies) News*, 07 September 2014. <http://www.gestweb.org/blog/98-prostate-artery-embolization-compared-to-turp-for-treating-bph>

Use of CBCT is associated with significantly higher survival rates in HCC patients.

## Keywords

- Cone Beam Computer Tomography (CBCT)
- syngo DynaCT
- Interventional tumor treatment
- Chemoembolization
- Hepatocellular carcinoma (HCC)
- Benign prostatic hyperplasia (BPH)
- Prostate artery embolization (PAE)

### Transcatheter tumor embolization therapy

Transcatheter tumor embolization therapy is an interventional procedure where substances are injected into feeder vessels to block blood flow to the tumor and thereby shrink the lesion. Embolization substances include synthetic particles, drug-eluting beads (chemoembolization) and radioactive microspheres (radioembolization). Embolization can be used to treat both malignant and benign tumors.

Real-time angiographic imaging is essential for transcatheter embolization procedures. In addition to conventional fluoroscopy and single planar digital subtraction angiography (DSA), 3D visualization of vascular and soft tissue detail is often key for procedure success [1]. Cone Beam CT is an advanced imaging technology that acquires C-arm flat-panel projection images in multiple viewing planes to reconstruct (CT-like) 3D images during the procedure in the angiography suite. This technology was pioneered by Siemens Healthcare and launched in 2004 under the product name syngo DynaCT.

### Benefits of syngo DynaCT in chemoembolization for hepatocellular carcinoma (HCC)

Hepatocellular carcinoma (HCC) is a leading cause of cancer-related death worldwide [5]. Surgery is the treatment of choice, however, many patients cannot undergo resection due to advanced disease or poor liver function [6] [7]. For these patients, local-regional therapies such as transhepatic arterial chemoembolization can delay tumor progression and even increase survival [7] [8].

Digital subtraction angiography (DSA) remains the primary imaging technique for image guidance during chemoembolization. However, the use of CBCT in addition to DSA is rapidly increasing [10] [11]. 3D volume-rendered images as well as multiplanar reconstructions of the hepatic arteries provide crucial navigational information for super selective catheterization.

Use of syngo DynaCT during embolization treatment improves visualization of the vascular distribution of the selected arterial territories and their corresponding areas of tissue perfusion. Studies confirm that the availability of Cone Beam CT in the angiography suite significantly increases the number and order of subselective hepatic arteries catheterized and treated [1] [12]. This maximizes treatment response while at the same time minimizing collateral damage due to nontarget embolization [1].

CBCT was pioneered by Siemens Healthcare. syngo DynaCT was launched in 2004.

- [1] Tognolini A, Louie JD, Hwang G, Hofmann L, Sze D, Kothary N. Utility of C-arm CT in Patients with Hepatocellular Carcinoma undergoing Transhepatic Arterial Chemoembolization. *J Vasc Interv Radiol* 2010; 21:339–347.
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*“syngo DynaCT is the most important software application for embolization procedures.*

*It identifies arteries feeding the prostate and helps me avoid non-target embolization.”*

Professor Francisco Cesar Carnevale, MD, PhD,  
Chief of Interventional Radiology,  
University of São Paulo, Brazil.

### Conclusion

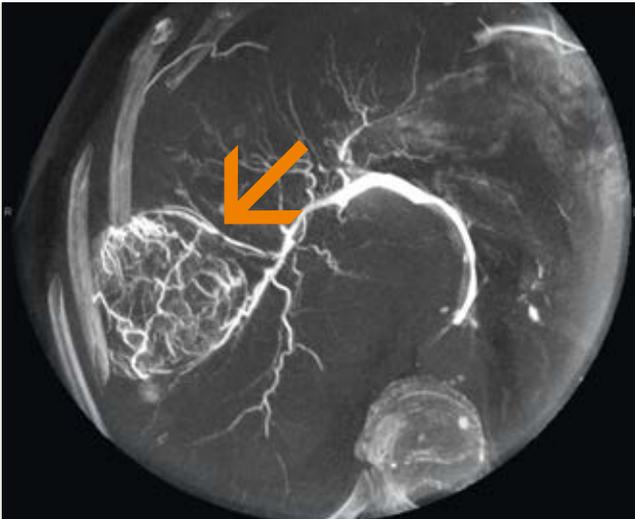
syngo DynaCT is an excellent adjunct to DSA and fluoroscopy and can improve safety and outcome of interventional treatment for both malignant and benign tumors. Current research shows that use of syngo DynaCT in embolization therapy frequently affects a change of diagnosis, treatment planning, or treatment delivery [1] [3].

For patients undergoing chemoembolization for hepatocellular carcinoma (HCC), syngo DynaCT has been shown to affect patient care in more than 28% of cases. Moreover, the use of CBCT in addition to angiography is associated with significantly higher overall survival rates ( $P=0.005$ ) in HCC patients receiving chemoembolization [2].

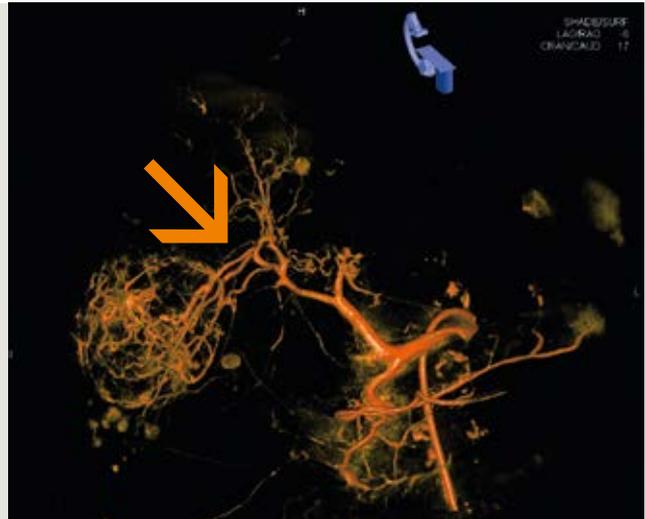
Recently published research demonstrates the benefits of syngo DynaCT in prostate artery embolization (PAE) for the interventional treatment of benign prostatic hyperplasia [3]. In PAE, intra-procedural 3D visualization helps mitigate the dangers of non-target embolization and has been shown to affect patient care in up to 46% of cases.

[1] Tognolini A, Louie JD, Hwang G, Hofmann L, Sze D, Kothary N. Utility of C-arm CT in Patients with Hepatocellular Carcinoma undergoing Transhepatic Arterial Chemoembolization. *J Vasc Interv Radiol* 2010; 21:339–347.  
[2] Iwazawa J, Ohue S, Hashimoto N, Muramoto O, Mitani T. Survival after C-arm CT-assisted chemoembolization of unresectable hepatocellular carcinoma. *Eur J Radiol* (2012).  
[3] Bagla S, Rholl K, Sterling K, van Breda A, Papadouris D, Cooper J, van Breda A. Utility of Cone-beam CT Imaging in Prostatic Artery Embolization. *J Vasc Interv Radiol* 2013.

syngo DynaCT was shown to affect patient care in 46% of PAE cases.



syngo DynaCT soft tissue imaging showing HCC and tumor feeding vessels. Courtesy of Medizinische Hochschule Hanover, Germany.



syngo DynaCT 3D volume rendering of tumor feeding vessels. Courtesy of Medizinische Hochschule Hanover, Germany.

According to Tognolini et al. *syngo DynaCT* provided information which was not apparent or discernible with DSA in 36% of patients. This additional information resulted in a change in diagnosis, treatment planning, or treatment delivery in 28% of the HCC patients. Use of *syngo DynaCT* enabled visualization of angiographically occult tumors in 15% of patients and indicated incomplete treatment in 7.1% [1].

Virmani et al. demonstrated that Cone Beam CT images caused angiographic operators to place catheters in a position different from that originally anticipated in 39% of patients [13].

Iwasawa et al. reports that the use of CBCT in addition to angiography during transarterial chemoembolization in patients with unresectable hepatocellular carcinoma (HCC) was associated with significantly higher overall ( $P=0.005$ ) and local progression-free ( $P=0.003$ ) survival rates than patients receiving chemoembolization with angiography alone [2].

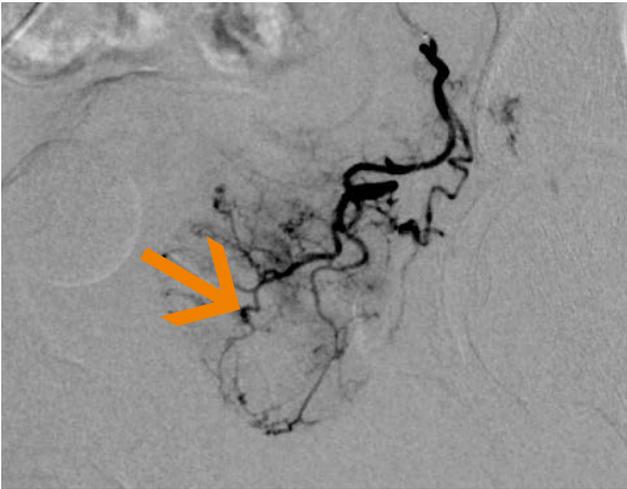
**syngo DynaCT provided information not apparent in DSA in 36% of patients.**

### Benefits of *syngo DynaCT* in prostatic artery embolization (PAE)

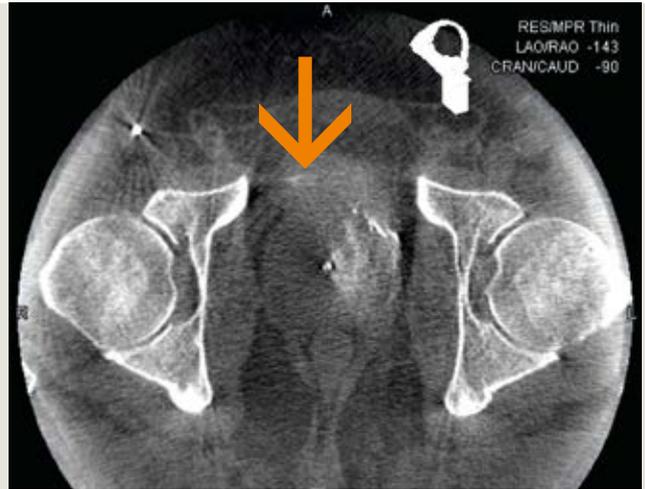
Benign prostatic hyperplasia (BPH) affects approximately 210 million men worldwide [14]. While the prevalence rate for men aged 45–49 is 2.7%, it increases to 24% by the age of 80 years [15]. Incidence of BPH is likely to rise in the foreseeable future as the global male population lives longer. Surgical treatment, e.g. transurethral resection of the prostate (TURP) remains the most widely performed therapy, but TURP can have significant side effects, including sterility.

Prostate artery embolization (PAE), a new interventional treatment option for BPH, appears to be safe and effective, resulting in significant improvements in IPSS (International Prostate Symptoms Score), quality of life, maximal flow rate, and prostate volume reduction [4]. However, one of the most challenging aspects of performing PAE is to correctly identify the prostatic arteries and differentiate them from the surrounding non-target arteries.

- [1] Tognolini A, Louie JD, Hwang G, Hofmann L, Sze D, Kothary N. Utility of C-arm CT in Patients with Hepatocellular Carcinoma undergoing Transhepatic Arterial Chemoembolization. *J Vasc Interv Radiol* 2010; 21:339–347.
- [2] Iwazawa J, Ohue S, Hashimoto N, Muramoto O, Mitani T. Survival after C-arm CT-assisted chemoembolization of unresectable hepatocellular carcinoma. *Eur J Radiol* (2012).
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Digital subtraction angiography (DSA) in PAE. Microcatheter positioned in the left inferior vesical artery prior to left lobe prostate embolization. Courtesy of Univ. São Paulo, Brazil.



*syngo* DynaCT acquired before embolization of left prostatic lobe shows risk of non-target embolization of bladder wall (arrow). Courtesy of Univ. São Paulo, Brazil.

New research shows the benefits of *syngo* DynaCT in PAE [3]. Here intra-procedural 3D visualization helps mitigate the dangers of non-target embolization which can lead to major complications and necessitate major surgery. In the study, performed at Inova Alexandria Hospital, a leading US institution for PAE research, *syngo* DynaCT allowed for the identification of potential sites of non-target embolization in 46% of patients, most notably the rectum, bladder and penis. Embolization of any one of these non-target sites can carry considerable morbidity, which was successfully mitigated with the use of *syngo* DynaCT [3].

It follows that use of *syngo* DynaCT can potentially improve both the safety and outcome of PAE procedures by helping operators to clearly distinguish between target and non-target embolization sites.

*syngo* DynaCT identified potential sites of non-target embolization, most notably in vessels feeding the rectum, bladder and penis.

[3] Bagla S, Rholl K, Sterling K, van Breda A, Papadouris D, Cooper J, van Breda A. Utility of Cone-beam CT Imaging in Prostatic Artery Embolization. *J Vasc Interv Radiol* 2013.

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