

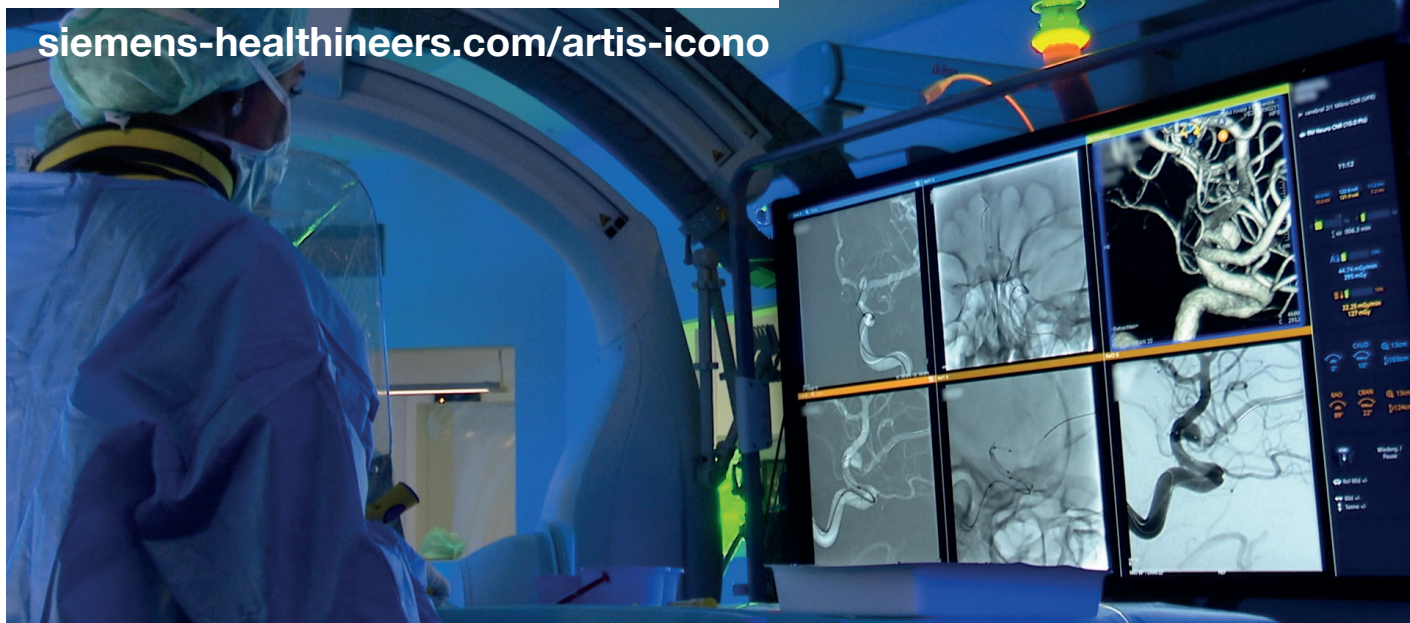
NeuroNews

September 2020 | Educational Supplement



Stroke treatment in the fast lane

[siemens-healthineers.com/artis-icono](https://www.siemens-healthineers.com/artis-icono)



SIEMENS
Healthineers

Meaningful innovation amid a rapidly-evolving field

The last five years have seen endovascular therapy for patients with acute ischaemic stroke proven undeniably effective, changing the face of stroke treatment forever. While the advent of mechanical thrombectomy has saved numerous lives and reduced disability in those that would have previously suffered from strokes' devastating effects, whole communities are now working around the clock to establish endovascular-capable centres to optimise stroke systems of care. This rapid evolution has shed light on the importance of advancing stroke services, as well as the technology involved. Only when these aspects converge to bring to life truly patient-centric solutions can meaningful innovation be achieved.

STROKE REMAINS AMONG THE leading causes of disability and death worldwide. They can occur either when blood flow through the artery supplying oxygen-rich blood to the brain becomes blocked, known as an ischaemic stroke, or when an artery leaks blood or ruptures, known as a haemorrhagic stroke. While the latter contributes to 13% of all strokes, the incidence of ischaemic stroke is a staggering 87%. With the World Stroke Organisation (WSO) stating that an estimated 1.9 million neurons can be salvaged with each minute saved in stroke management, rapid treatment remains a priority; crucial to patient recovery and their subsequent quality of life.

In 2014, data from the MR CLEAN multicentre randomised clinical trial was published, evidencing that interventional treatment is the preferred choice in many stroke cases. The trial sent a ripple across the entire neurointerventional arena, and has since paved the way for a new era of stroke treatment. While the ESCAPE trial concluded that "rapid endovascular treatment improved functional outcomes and reduced mortality", the DAWN trial found that a large proportion of patients who were previously deemed untreatable may in fact benefit from thrombectomy. "Time alone should no longer be a disqualifier," the authors said.

While the latest studies have opened the time window for mechanical thrombectomy to 24 hours, improving treatment for millions of people every year, the number of patients eligible for treatment has risen. Stroke care therefore presents a double challenge: having to treat as fast as possible, and having to treat more patients than ever before.

Furthermore, with reports stating that the burden of stroke is only set to increase, primarily due to changing age structures throughout populations over the next

two decades, the need for transformative technologies has never been more crucial.

According to Christian Loewe, Vienna General Hospital, Austria, while mechanical thrombectomy is highly effective, it is not easy to implement. "We have moved away from very strict time windows. But the basic message for stroke care still holds: 'time is brain'. We have to diagnose and treat as quickly as possible."

Yet, in order to treat patients presenting with stroke on admission, physicians must determine whether they have suffered a haemorrhagic or an ischaemic stroke. Currently, the standard stroke workflow involves a neurological exam when the patient arrives at the hospital, followed by

transfer to either a computed tomography (CT) or magnetic resonance imaging (MRI) facility for a diagnostic brain scan. Depending on the results, the patient might be sent to the angiography suite for treatment.

However, this workflow can put 130 minutes between the patient's arrival at the hospital and reperfusion of the brain. Thus, in order to save time, Siemens Healthineers argues that the first logical step is to bring diagnosis (CT/MRI) and treatment (angio) closer together, ideally into the same room. Their combined solution consists of an angio system and a CT, so the patient stays on the same table as the modalities are switched, providing the potential to save valuable time.

Siemens Healthineers has set out to pioneer essential and timely stroke solutions to optimise the management of stroke patients.

For patients, faster treatment and short intervals between hospital admission and reperfusion are expected to positively influence clinical outcomes.

“The first logical step is to bring diagnosis (CT/MRI) and treatment closer together, ideally into the same room.”



ARTIS icono biplane

Angio-only one-stop-shop for acute stroke patients: Stroke in the fast lane

Since thrombectomy became established as the gold standard in 2015, many workgroups have worked to streamline the management of acute stroke patients. One such group at the University Medical Center Göttingen (Göttingen, Germany) did so by implementing a one-stop approach in an attempt to reduce door-to-groin times and further optimise functional outcomes for patients.

THE GÖTTINGEN TEAM PERFORMED a single-centre observational study from June 2016 to November 2018, utilising imaging acquired with the latest generation angiography suite at a comprehensive stroke centre.¹

According to Psychogios and colleagues, 230 consecutive adults with suspected acute stroke presenting within six hours after symptom onset with a moderate to severe National Institutes of Health Stroke Scale (NIHSS) were directly transported to the angiography suite. Noncontrast flat-detector CT and biphasic flat-detector CT angiography were acquired with an angiography system. In case of a large vessel occlusion, patients remained in the angiography suite, received intravenous recombinant tissue plasminogen activator (rtPA) therapy, and underwent thrombectomy.

Median door-to-reperfusion time for M1 occlusions was 64 minutes (interquartile range [IQR]: 56–87). Compared to 43 case-matched patients triaged with multidetector CT, median door-to-reperfusion time was reduced from 102 (IQR: 85–117) to 68 minutes (IQR: 53–89; $p < 0.001$). Rate of good functional outcome was significantly better in the one-stop management group ($p = 0.029$), while safety parameters (mortality or haemorrhage) did not differ significantly between groups.

“Rate of good functional outcome was significantly better.”

Their experience with the angio-only approach showed that it is possible to dramatically reduce door-to-groin times while successfully differentiating between ischaemic and haemorrhagic stroke. Now, speaking to *NeuroNews*, Psychogios delves



Marios-Nikos Psychogios

into the details of his experience developing and implementing the angio-only approach, and highlights the benefit of imaging and treating stroke patients in the same room, without needing to transport them between modalities.

What was the rationale behind conducting this study?

Those involved in shaping the stroke paradigm have been talking about going direct to the angio since the end of noughties, around 2008/2009. The idea was to actually start doing it in Göttingen, and to collect data from patients to see if it is actually better for them to go through this pathway. We compared it to patients that had the normal workflow; first to the CT and then to the angio.

What results have you seen through using it so far?

Of course, the highlights are the cases that we managed to treat in half an hour. I started working in 2007, and with the first cases I saw as a resident, there used to be a door-to-reperfusion time of two hours; those were the highlights back then.

Being able to actually do this whole procedure—from admission to the

neurological examination to the *syngo* DynaCT, giving tissue plasminogen activator [tPA] and catheterising the patient in 25 or 30 minutes, well that is really a great experience.

We have seen that the reduction in time, as well as the quality of reperfusion, can result in really good patient outcomes. And this is something that you actually see in your everyday life. You can sense the change. Again, we used to see 10 patients with stroke, and perhaps two or three of them had good outcomes. Nowadays, we treat 10 patients, and around five or six have good outcomes, so it is a lot better.

Did any of the findings surprise you?

First of all, we found what we expected to find; we were faster going directly to the angio suite—so stroke patients had shorter door-to-groin and door-to-reperfusion times, compared to those going through the normal pathway. However, what we did not expect to see was the range or difference in good outcomes between the normal workflow patients and the angio-only patients.

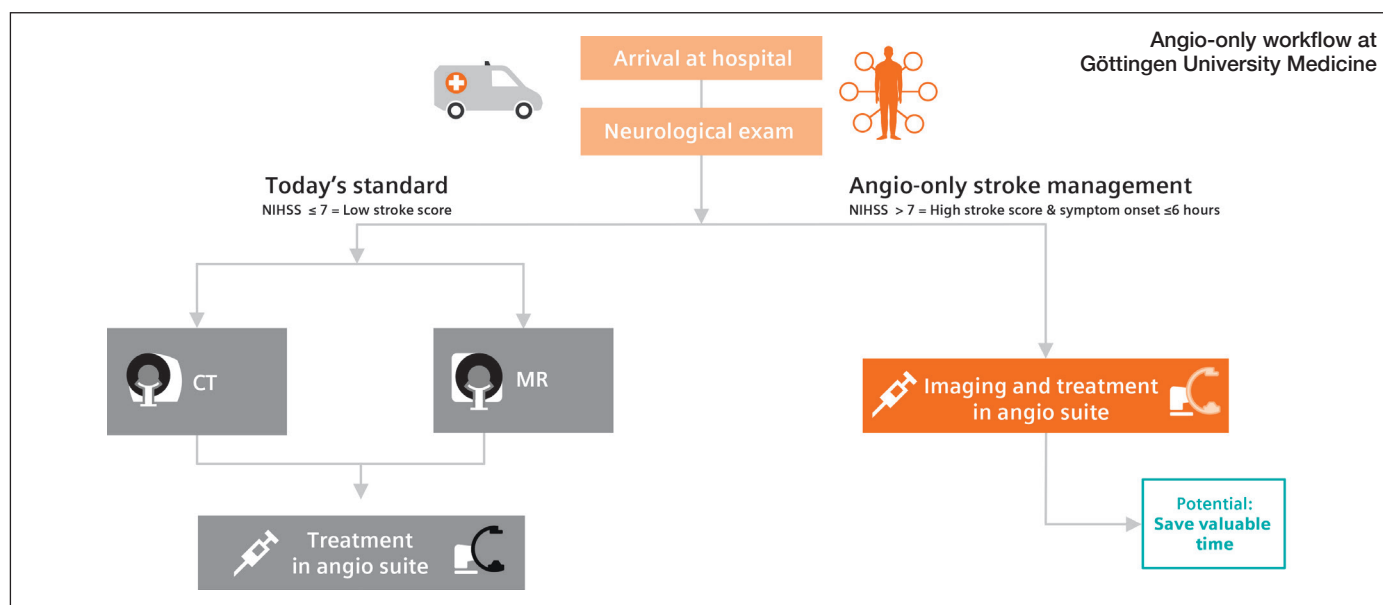
It also was a lesson for us, because we saw that being faster is not only better for 'time is brain', but it also helps to open more vessels. This has also been demonstrated in the meantime by the Hermes collaboration [pooled patient-level data from MR CLEAN, ESCAPE, REVASCAT, SWIFT PRIME, and EXTEND IA]; if your treatment is faster, you open more vessels. This factor explains the difference in the clinical outcomes that we saw in the study, and we expect to see again.

“Being faster is not only better for ‘time is brain’; it helps to open more vessels.”

The opinions expressed are solely those of the featured physician and based on his own experience.

The statements by Siemens Healthineers customers described herein are based on results that were achieved in the customer's unique setting. Because there is no "typical" hospital or laboratory and many variables exist there can be no guarantee that other customers will achieve the same results.

M. Psychogios is employed by an institution that receives support from Siemens Healthineers for collaborations.



If you save around 30 minutes, you would expect to see a 10% better outcome. Having more than double that, as we did, showed that we were better at opening vessels. The techniques also evolved in the meantime, so this also influenced our patient outcomes for the better. I think it is an interaction between time and recanalisation.

In your opinion, what are the challenges with the current standard of care for treating stroke patients?

We used to be slow, and in my opinion, we are still not fast enough. So if you see in the older studies, we had door to groin times of two, or two and a half hours. Now we are faster than that; some centres are 90 minutes. But, in the end, this is not fast enough, because other specialities like cardiology can manage a door-to-reperfusion time or balloon time of 60 minutes. Again, for me, the importance of the angio-only approach is that you can achieve those times; you can get around the 60- to 70-minute mark pretty consistently.

“We used to be slow, and in my opinion, we are still not fast enough.”

Is your team happy with the new angio-only workflow?

Yes, we are happy. At the beginning, as with all change, it was more difficult. It required a lot of people to be placed on standby. But it has enabled us to make good decisions for



ARTIS icono Twin Spin; seamlessly switching between 2D and 3D images

our patients, and make them fast. So, after a few months using this workflow, we were happy.

Was there a steep learning curve with this approach?

Not so much for our team in particular, because we have been a pioneering team in *syngo* DynaCT, its usage, and research, so we have a lot of physicians and post-doc's that actually know what DynaCT is and how to reconstruct the images.

I think in another team without this experience, such as the colleagues that I have spoken to and helped implement this approach in their daily practice, the learning curve has been not as steep. But, at least in the German speaking countries, most have radiology backgrounds, which makes it easier for them to implement this in their everyday work.

Did you expect to see any changes in cost per case?

Well, that was a very interesting discussion with my team at the beginning of this, because they thought that it was going to be more work. But after six months, they understood that it was less work for the team, because we were faster per case.

You are not doing a CT first and then going to the angio. If you get the logistics right, you can save costs per every case for your hospital. And this is just the direct costs, as you also have savings coming from the patients having a better outcome.

I think the majority of the cost savings—the really important part—is going to come from all these patients with better outcomes that can go back to work, and who do not need a lot rehabilitation time after the stroke.

How integral is a good quality imaging system for the angio-only approach?

It is really important. This is why neuro-systems like ARTIS icono offer more opportunities for us physicians, because we have to exclude the haemorrhage and give thrombolysis plasminogen activator (tPA)—the medication for thrombolysis—which is still the gold standard. So, the first step is to exclude a haemorrhage. We showed in our Göttingen study that we can actually exclude this and give tPA with the angio-only approach. That was a really important part of having better image quality.

With ARTIS icono, you get even better image quality because the times of the scan are around a third of what they used to be. The conventional protocols are around 20 seconds, whereas the new protocols are seven seconds. This is an immense advantage for image quality, as again, stroke patients are not very still on the table, so this helps a lot.

How important is the syngo DynaCT Multiphase for the angio-only approach?

I think it is an important alternative. Of course there are a lot of different approaches to CT angiography (CTA). Some people just want a single phase CTA, but the multiphase CTA has additional options which I like a lot, and also it gives you more tools because you can do additional things with your CTA; acquire more information on collaterals for instance. Again, this has been shown through the team in Calgary [the ESCAPE collaborators], that you can actually use it to select patients, even after the six-hour time window.

Do you think that the syngo DynaCT Multiphase has the power to enable the angio-only workflow even beyond the six-hour time window?

Yes. The ESCAPE trial has shown that you can select with a multiphase CTA even after the six-hour mark, up to 12 hours. That is what the syngo DynaCT Multiphase protocol also enables you to do.

One advantage of Multiphase DynaCT compared to MSCT perfusion is that it is not as sensitive to motion artefacts: if one volume suffers from motion artifacts the others are not necessarily affected and the visualisation of collaterals is still possible. Stroke patients sometimes cannot understand you, so they often do not stay very still. Having a protocol that deals with these cases is very helpful.

Will stroke imaging become more important as the paradigm continues to evolve?

Some aspects will, yes. Some physicians are really minimalistic on their approach of imaging, and others want all the information to form their decision. I think having neuro-systems that can give you solid basic imaging information, or advanced examinations like perfusion in the angio, is really important. The future is all about personalised medicine, so you need to give physicians the opportunity to have choices.

“The future is all about personalised medicine; you need to give physicians the opportunity to have choices.”

How important is perfusion imaging in the angio suite for stroke treatment?

While there are many studies that have previously demonstrated that it is not important in the first six hours, at the moment, evidence shows that beyond six hours, it is a really useful thing to have. I think that the syngo DynaCT Multiphase

protocol helps in this direction. But, I think it is important to be able to have all those tools in your arsenal. For example, it is very important if you have a patient with distal embolus, and you want to see where the occlusion is. This is an area where perfusion is really good, because then there is a strong argument for treating the patient with distal emboli.

The treatment paradigm for stroke is evolving quickly. Will ARTIS icono play a part in its future?

Yes, definitely. The ARTIS icono provides a better image quality for syngo DynaCT, which will help us make final decisions. You also have the syngo DynaCT Sine Spin which provides a better image quality in the infratentorial region. And, you have faster protocols, which reduces movement artefacts, and that again, leads us to better decisions.

I am confident that ARTIS icono will play a part in the future of stroke treatment and also all the different protocols that are available; e.g. the syngo DynaCT Multiphase. I think this will be a really cool tool to have as a physician, and will enable us to exercise personalised medicine in our daily practice.

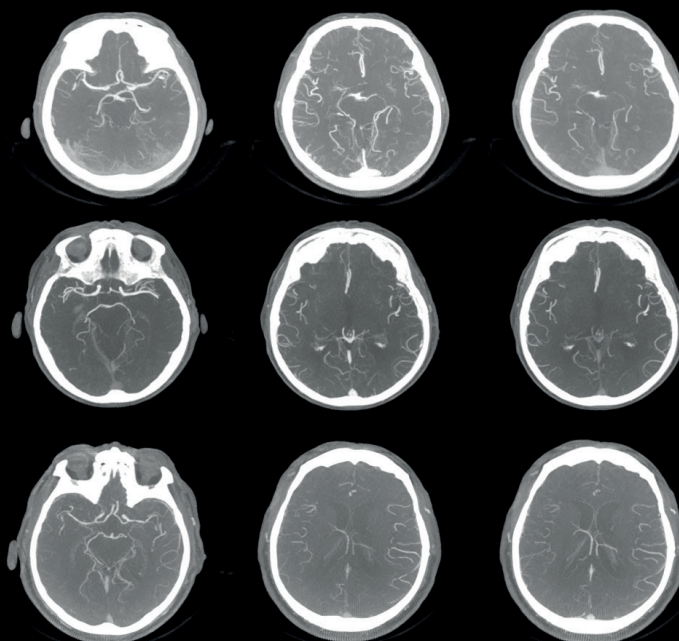
References

1. Psychogios, M. N., Maier, I. L., Tsogkas, I., Hesse, A. C., Brehm, A., Behme, D., ... & Goyal, M. (2019). One-Stop Management of 230 Consecutive Acute Stroke Patients: Report of Procedural Times and Clinical Outcome. *Journal of Clinical Medicine*, 8(12), 2185.

ARTIS icono syngo DynaCT Multiphase

Time-resolved collateral vessel imaging with syngo DynaCT Multiphase enables physicians to visualize cerebral collateral vessels with time-resolved syngo DynaCT, depicting 10 different time points within a period of 60 seconds. It allows for:

- Seamless integration into the interventional suite
- Sounder decisions based on time-resolved CTA information
- Time savings through the angio-only approach



ARTIS icono: Enhanced image quality and evolving workflows

As new devices continue to be introduced onto the neurointerventional market, physicians are being exposed to a mounting array of both possibilities and challenges. By providing a broad range of Roadmap features, alongside enhanced digital subtraction angiography (DSA) image quality, ARTIS icono allows physicians to individualise their approach to treatment. Moreover, with real-time pixel shift, small patient movements are corrected on the fly in the live acquired image.

“WE HAVE BEEN WORKING WITH ARTIS icono for around a year and a half now, and we have witnessed how the system has advanced to what it is today,” René Chapot (Alfried Krupp Hospital, Essen, Germany) tells *NeuroNews*, as he expands on how the simultaneous speed and precision of the new system has changed the workflow entirely.

What is your experience so far with ARTIS icono, and how does it differ from conventional imaging?

A lot of things have changed. The quality of the imaging is one step ahead, which is definitely very obvious as soon as you work with it. For instance, you have the ability to see each drop of the liquid embolic during its injection, through pre-existing embolic agents. And this is really difficult.

The other striking advantage is the whole mechanical part; the way the system moves. For example, the machine can be placed alongside the axis of the patient to look at the groin. When you need to, it is good to be able to check the groin without having to change the organisation of the room.

But the most important elements are the multitude of sequences; the injection of contrast, the Roadmap feature, and memory of the position that after a while you lose. The new technology affords all of this. So if you have memorised a series, a particular run, you take the picture and place it as a reference image, and the system can make its way exactly back to this picture automatically, in terms of where you have moved and the exact angulation.

This has a lot of implications. At the end of the procedure you want to check if all arteries of the brain are still in place, and as soon as you have a slight change in angulation, you may not see it. But by having strictly



René Chapot

the same position each time, then you can compare in a much more reliable way.

For me, that is the most important function—the DSA Roadmap, which is associated with the mechanical functions of

“For me, the most important function [is] the DSA roadmap, which is associated with the mechanical functions of ARTIS icono.”

ARTIS icono. It is what makes the model stand out. The mechanical infrastructure is very complicated to build; it is a very high level of technology. It is not easy to create

something that is both very fast, precise, in addition to having a good quality imaging and a good rotational system—you need the machine to move very fast. This quality of movement and precision occurs through the three systems that interact: the A-plane, the B-plane and the table.

How important is good 3D image quality in stroke treatment?

Stroke is an important focus because it is a large field, which is an important reason to advance the technology. For stroke treatment, the quality of cone beam CT has definitely advanced because of the way the A-arm rotates; due to the additional movement that has been brought in, the artefacts are reduced. It is a striking difference.

Has it enabled faster and more confident decisions?

I would say that it definitely changes the workflow. Because contrast agents, and fluoroscopy for easy and simple things, are spared, and you can go faster to the point you need, which is the dedicated working projection.

It is an evolution in the technology. The key point of an angio system is to produce fluoroscopy, which it does. The DSA Roadmap is a feature that can change the whole workflow.

Looking into the future, do you think that the ARTIS icono will play an important role in stroke treatment?

From all the neuroendovascular procedures, the numbers [of stroke patients] have been exploding since stroke can be treated by mechanical thrombectomy. From this point of view, there is no doubt that more angio systems are required, and they represent an important step in the technical evolution.

Beyond stroke, are you currently utilising ARTIS icono for other neurointerventions?

The goal of treating AVMs now is not to reduce it, but to cure it. But a very dedicated system is required to see not only all of the arteries, but also the veins.

So the 3D acquisition techniques enable us to get so called MPR, where it is possible to analyse how all vessels are connected—the venous segmentation of the AVM.

Once you understand the anatomy of the veins, then you can decide where to put the catheter to enable access to the AVM through a dedicated way using this machine.

Thrombectomy in stroke using syngo DynaCT Sine Spin

Case Description

Patient history

83-year-old male patient.

Diagnosis

CTA in another hospital showed an acute occlusion of the left middle cerebral artery in the M1 segment.

Treatment

Intracranial thrombectomy with stent retriever under general anesthesia. Thrombectomy in several manoeuvres with Solitaire X stent retriever and Tigertriever to reopen the vessel.

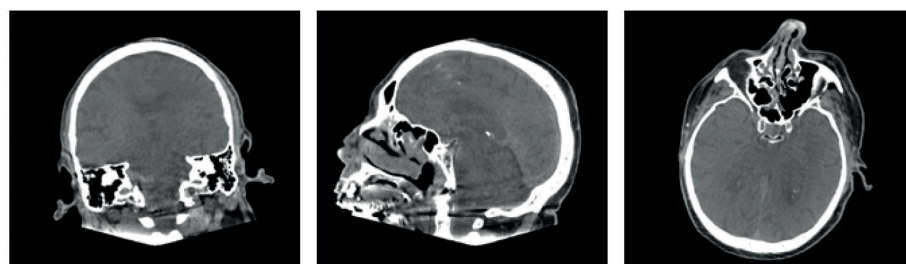
General Comments:

Upon arrival of the patient in our department from the other hospital, the initial CT was three hours old. With a native syngo DynaCT Sine Spin, we could check for potential bleeding and demarcation of the infarct before starting thrombectomy. The final syngo DynaCT Sine Spin showed a blood-brain barrier disorder, which influences the further treatment of the patient.

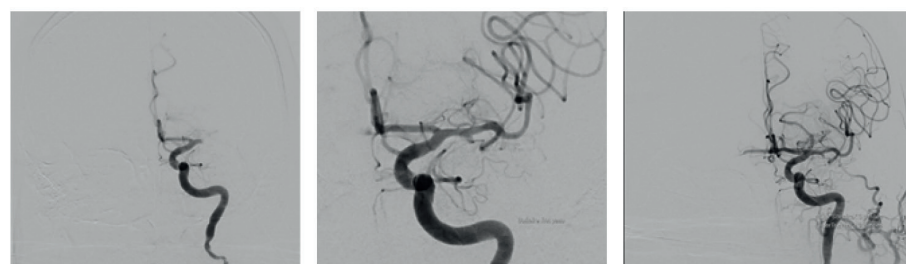
Tips & Tricks:

The correct location of the intubation tube is very important for good image quality. Position the ventilation hose from the mouth towards the foot end.

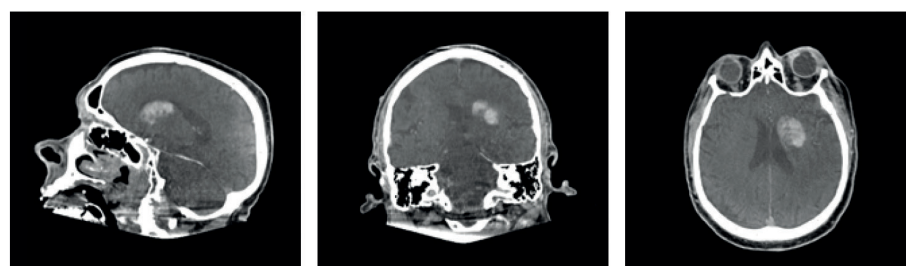
Courtesy of René Chapot, Alfred Krupp Hospital, Essen, Germany



Pre-interventional syngo DynaCT Sine Spin



DSA imaging during intervention



Post-interventional syngo DynaCT Sine Spin

Pipeline flow diverting stent follow-up

Case Description

Patient history

67-year-old female patient.

Diagnosis

Ophthalmic aneurysms on right and left side treated with pipeline embolisation devices (PEDs).

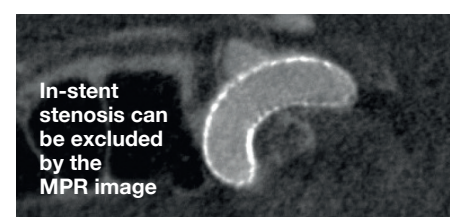
Treatment

Longitudinal follow-up of implanted pipeline embolisation devices (PEDs) using 3D-DSA acquisition and syngo DualVolume visualisation on ARTIS icono biplane system. Diagnostic angiogram to follow up right ophthalmic aneurysm treated with three PEDs and left ophthalmic

aneurysm treated with a single PED. Volumetric imaging acquired on right ophthalmic aneurysm using ARTIS icono. The study shows residual contrast inflow into the right ophthalmic aneurysm and opacification within the extruding vessel, as well as good vessel wall apposition of the three PEDs. Downstream vasculature is well opacified and no in-stent stenosis is observed.

General Comments:

For the volumetric imaging, we used a 4s Dyna3D run in Twin Spin mode. For the first time, ARTIS icono gives us the ability to perform the 3D run without the need to park the lateral plane.

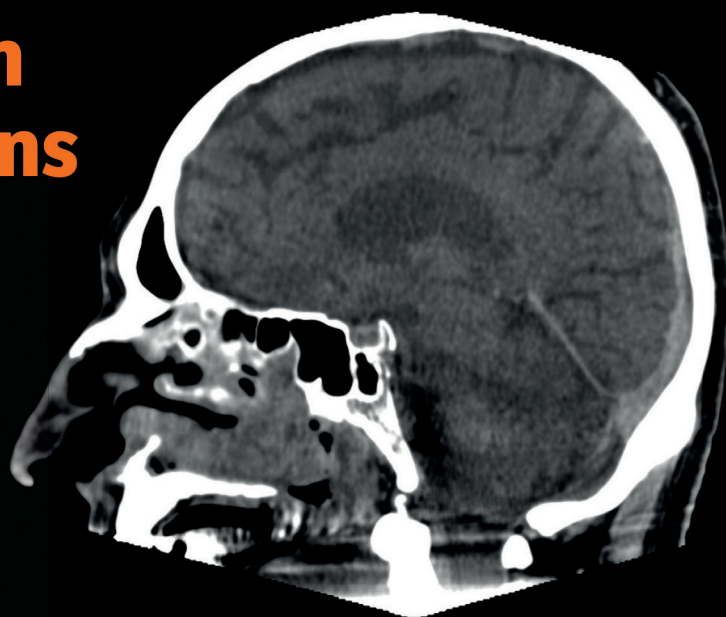


Courtesy of David Niemann, University of Wisconsin Hospitals and Clinics, USA

Results from case studies are not predictive of results in other cases. Results in other cases may vary.

ARTIS icono.
An icon of innovation.

A breakthrough in neuro interventions



Transforming care delivery in image-guided therapy

Minimally invasive interventions hold a vast potential for growth and innovation: the ARTIS icono family was designed to help you realize that potential.

By reinventing cone beam CT based on a revolutionary new acquisition trajectory, ARTIS icono sets new standards in neuro interventions and supports an angio-only approach in stroke treatment.

[siemens-healthineers.com/artis-icono](https://www.siemens-healthineers.com/artis-icono)

*The system ARTIS icono is not commercially available in all countries.
Future availability cannot be guaranteed.*

SIEMENS
Healthineers