syngo iFlow

Dynamic Flow Evaluation

Answers for life.

SIEMENS

“I think *syngo* iFlow imaging is going to be useful in a variety of circumstances. In particular, it is likely to be useful in comparing pre- and post-treatment acquisitions where we are trying to see how flow has changed not just through arteries, but also in the brain parenchyma. *syngo* iFlow* will also be of help in trying to analyze complex flow patterns as are often seen in obstructive diseases where there are complicated collaterals as well as in arteriovenous fistula and malformations.”

Charles M. Strother, MD
Professor of Radiology
University of Wisconsin School of Medicine and Public Health, Madison, USA

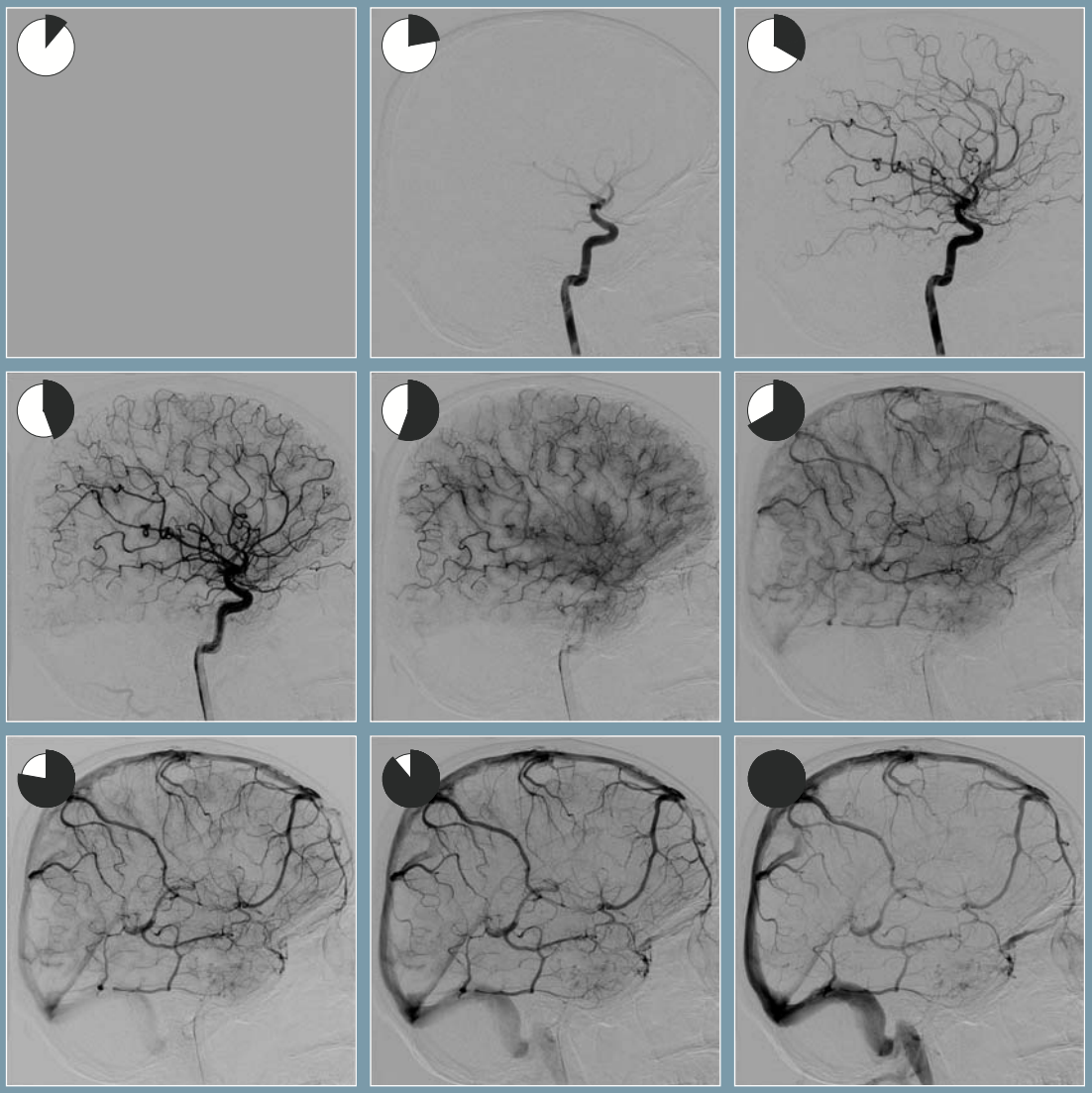
syngo iFlow
Dynamic flow evaluation

For the first time in the interventional suite, *syngo* iFlow allows the creation of a static image displaying dynamic information, making flow visualization easier.
syngo iFlow is a single image that shows the user the history of the contrast media through the vessels, in full color, at the click of a button.

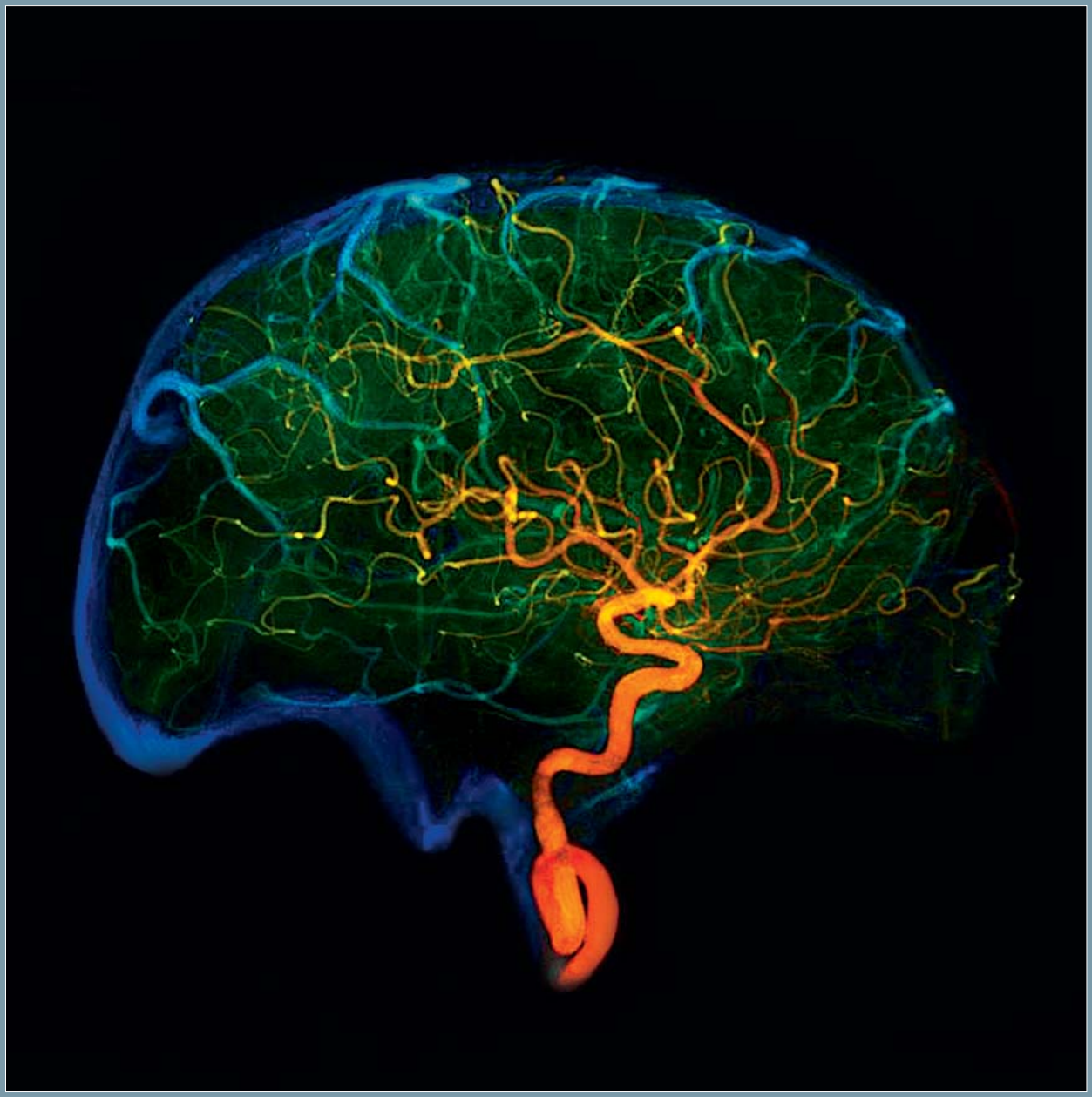
This dynamic flow evaluation provides a greater understanding of the contrast flow within the pathology, greater ease in visualizing the success of a procedure and assists the clinician in image review by showing a complete Digital Subtraction Angiography (DSA) run in a single image.

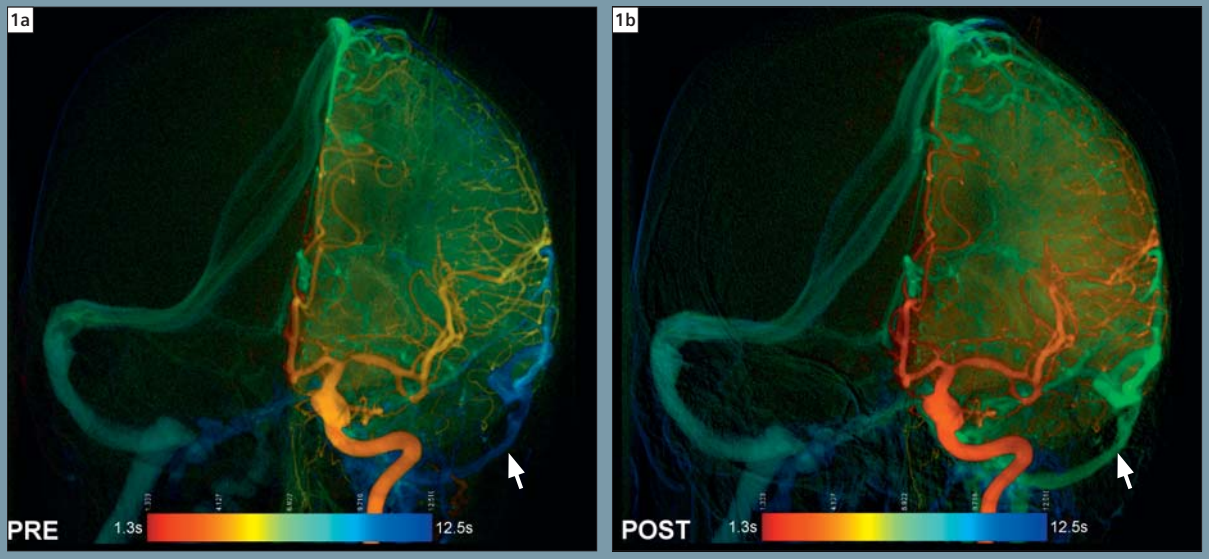
Benefits

- A complete DSA series in one color image
- Easily visualize vascular structures
- Demonstrate the early vascularization of tumors
- Clearly demonstrate post-procedural results

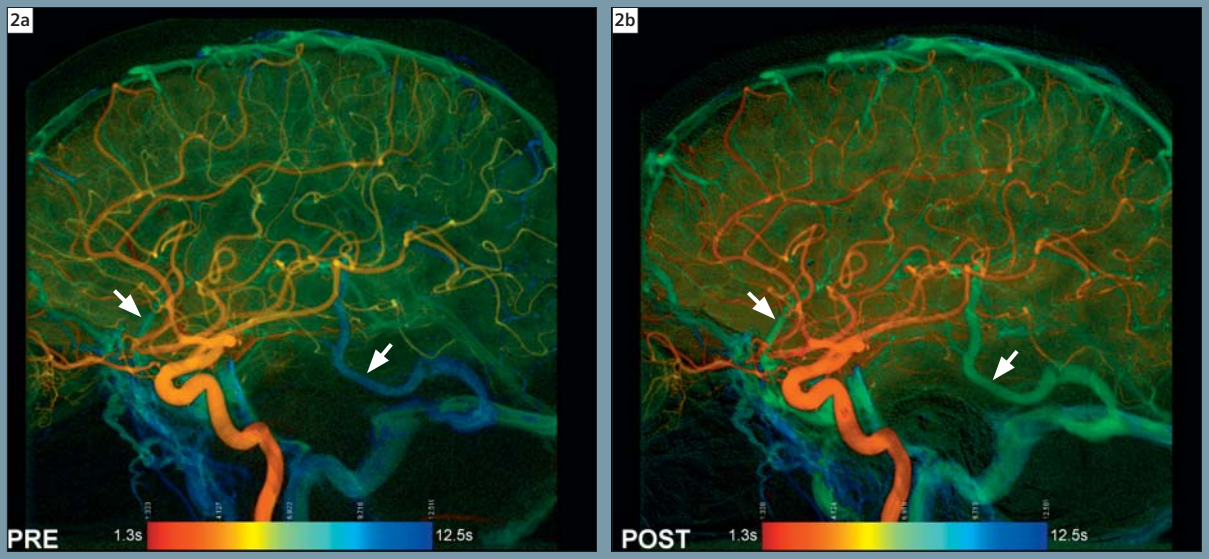


In the *syngo* iFlow function, the maximum opacification of each pixel is provided with a time from injection. This time is then represented by a color. It is important to note that the colors (ranging from red to blue) represent early, middle and late flow in the section of the DSA sequence that you are reviewing; the colors do not necessarily relate to the arterial, parenchymal or venous phase of contrast flow. The DSA section you wish to review can easily be selected within the *syngo* iFlow function.





1 AP projection pre-treatment (a) and post-treatment (b)



2 Lateral projection pre-treatment (a) and post-treatment (b)

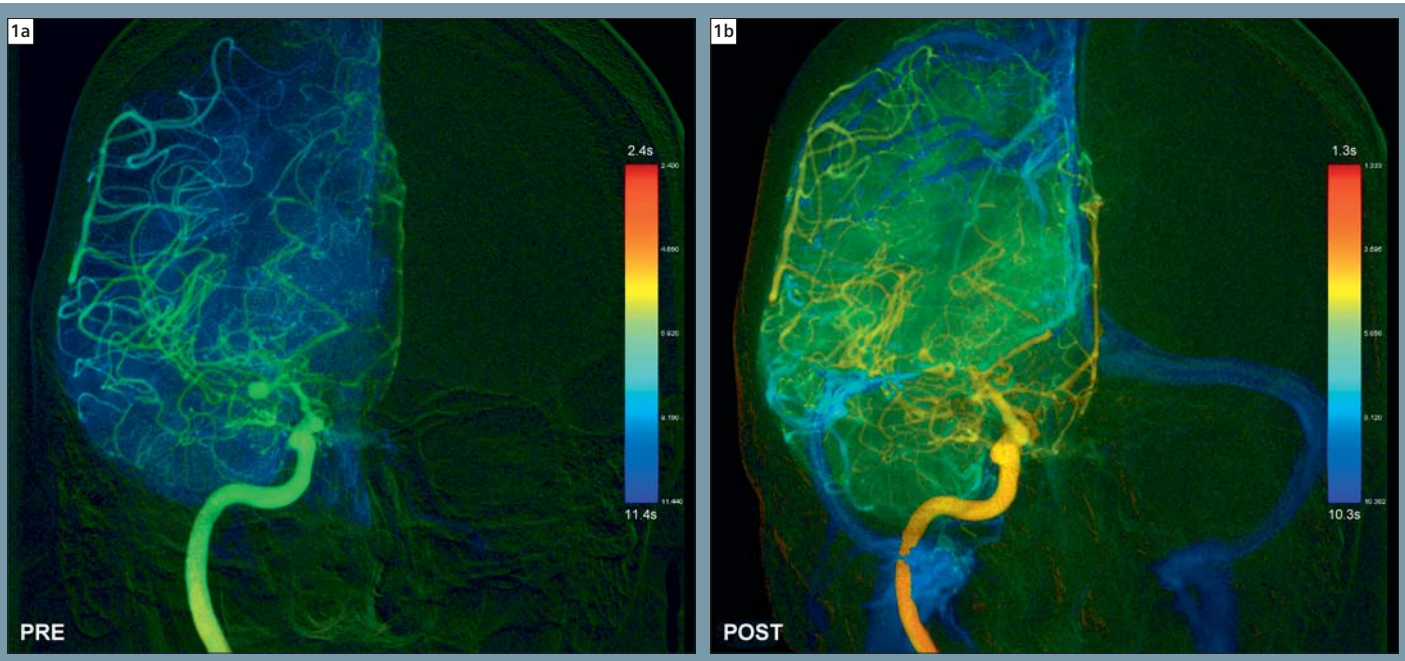
Stenosis of the left MCA

History
85-year-old female with history of left hemisphere TIAs and acute left MCA stroke.

Diagnosis
CTA, CTP and MRA revealed a severe stenosis at the origin of the left MCA with marked decreased perfusion of the left MCA territory. A 2D DSA confirmed the severe MCA stenosis.

Treatment
Percutaneous transluminal angioplasty and stenting were performed without adverse events. A 2D DSA done at the end of treatment demonstrated approximately 30-40% residual stenosis in the MCA. Flow into the left MCA territory was markedly improved.

Comments
The improvement in flow to the left MCA distribution with faster flow of contrast through the brain parenchyma is much more easily appreciated on the color-coded images than on the DSA acquisitions. Notice the color of the large vein of Labbe and the middle cerebral vein draining the left middle cerebral territory changing from blue to green on the post-treatment color-coded image (white arrows).



1 AP projection pre-treatment (a) and post-treatment (b)

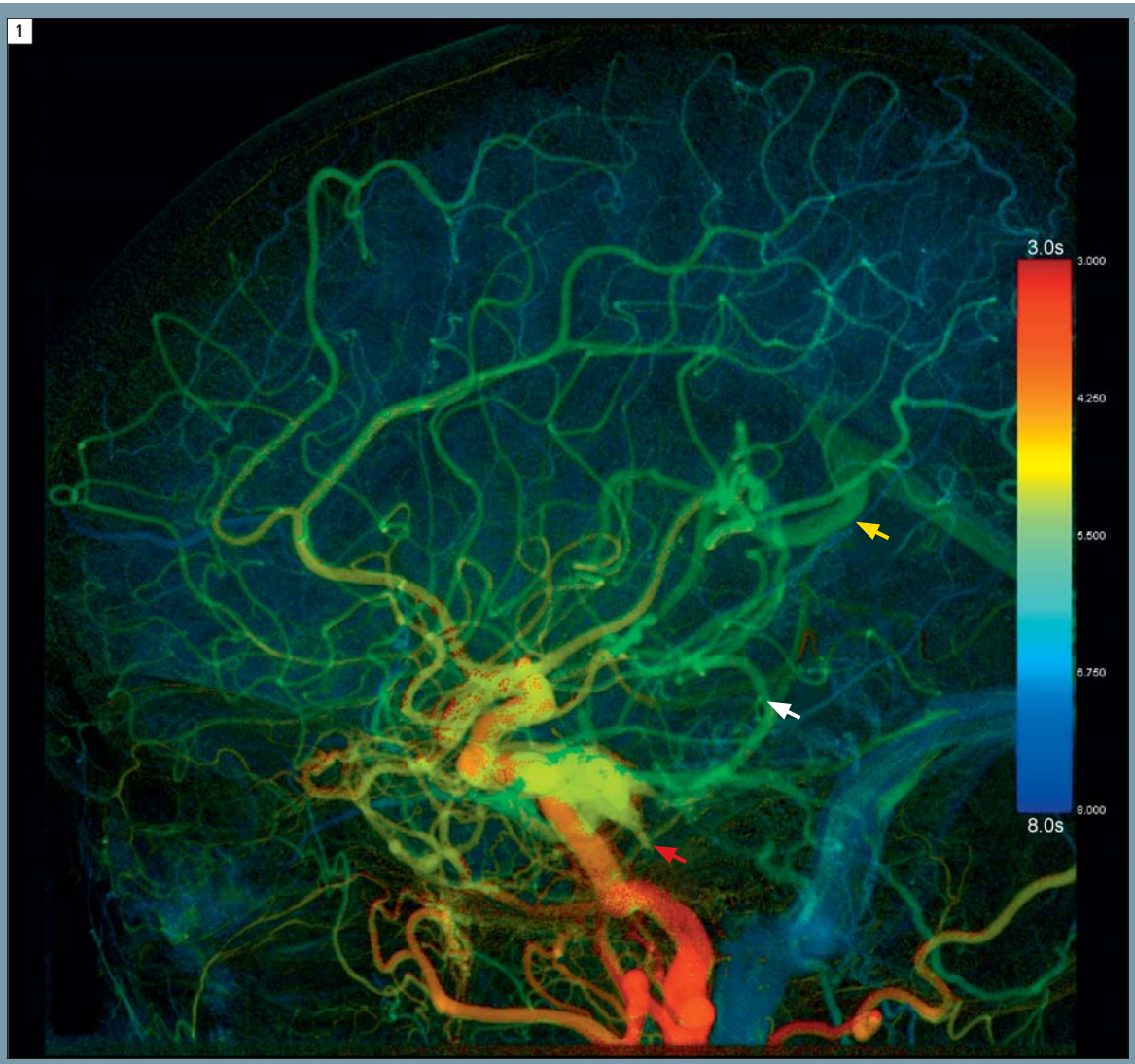
Aneurysm coiling and vasospasm

History
38-year-old male seen 6 days after an acute sub-arachnoid and intra-parenchymal hemorrhage

Diagnosis
DSA showed a 5-6 mm right middle cerebral aneurysm, a 1.5 mm anterior communicating artery aneurysm. There was also severe vasospasm much worse on the right than on the left.

Treatment
Both aneurysms were coiled and the vasospasm was also treated.

Comments
The color-coded image of the right internal carotid DSA prior to treatment shows late opacification of the right cerebral hemisphere parenchyma. The parenchymal opacification is also not uniform. The color-coded image done at the end of treatment shows much earlier and more uniform parenchymal opacification. The impact of the vasospasm treatment on parenchymal blood flow is more easily appreciated on the color-coded images than on the DSA images. Notice the green color in the internal carotid artery on the pre-treatment image and the orange color in the same artery on the post-treatment image. Also note the filling of the dural sinuses on the post-treatment image but not on the pre-treatment images. This indicates improvement in the circulation time with faster flow from the internal carotid artery, through the brain parenchyma and into the dural sinuses. This reflects the decreased resistance resulting from vessel dilatation after treatment of the vasospasm.



1 Lateral projection of arterial phase

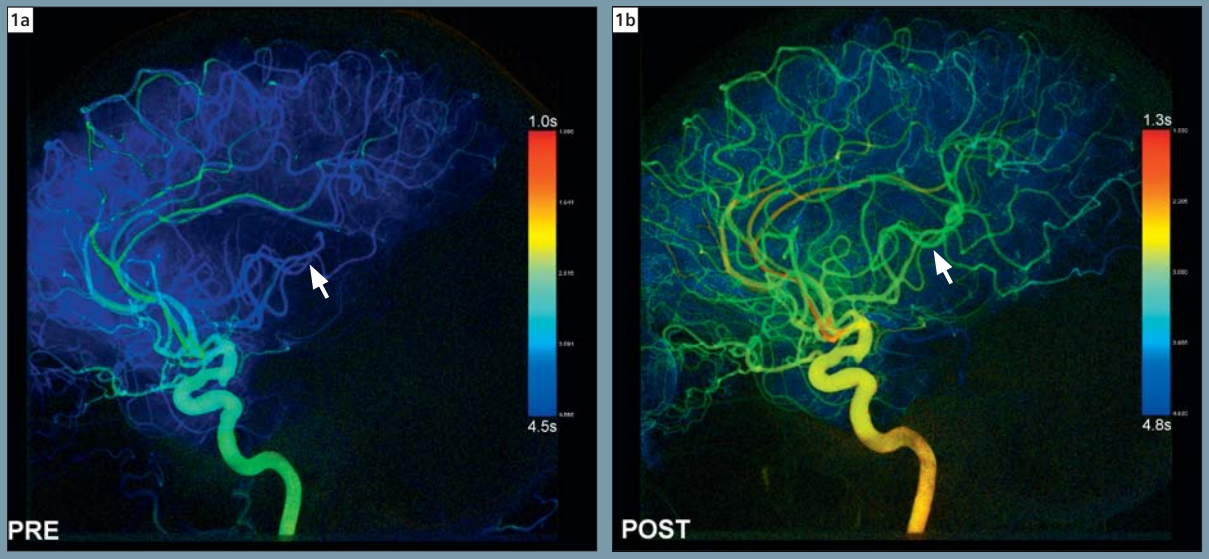
Dural arteriovenous fistula

History
64-year-old female with a history of right-sided headache and diplopia. CT and MRI demonstrated a possible right carotid-cavernous fistula.

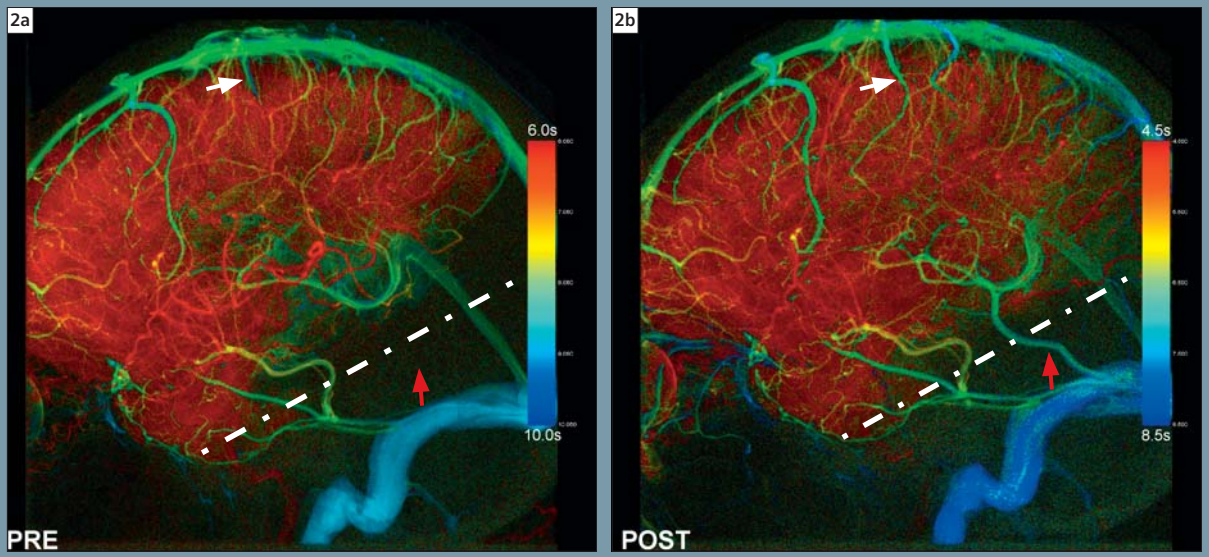
Diagnosis
2D DSA revealed a right-sided dural arteriovenous fistula with arterial supply from both internal and external carotid arteries. The inferior petrosal sinuses appeared to be occluded. Drainage from the cavernous sinuses was retrograde into intracranial veins.

Treatment
Repeated attempts to gain access into the cavernous sinus through the inferior petrosal sinus were unsuccessful.

Comments
Color-coded blood flow confirms the right petrosal sinus occlusion (red arrow). The early opacification of the basal vein of Rosenthal (white arrow), the vein of Galen (yellow arrow), Straight Sinus and ipsilateral dural sinuses are also well seen. The extent of the shunting into intracranial veins is much easier to visualize on the color-coded image as compared to DSA.



1 Lateral projection of arterial phase pre- (a) and post-treatment (b)



2 Lateral projection of parenchymal phase pre- (a) and post-treatment (b)

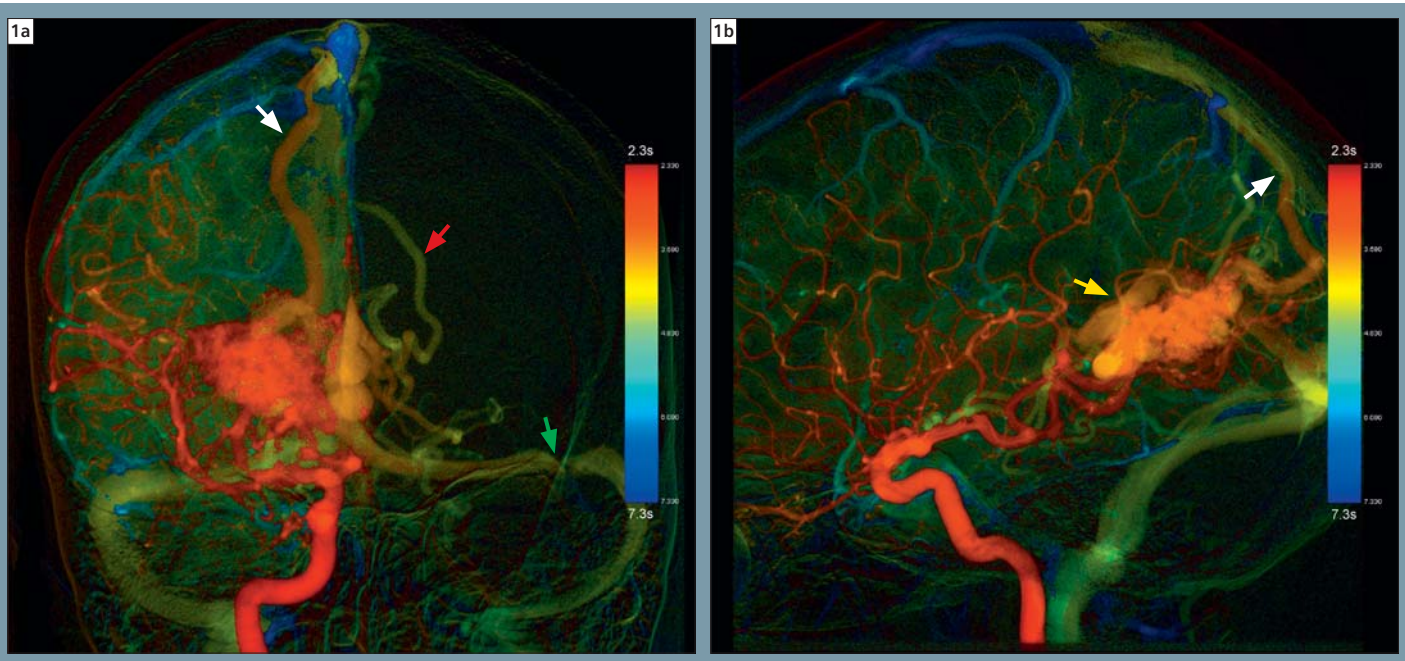
In-stent stenosis

History
74-year-old woman with a history of recurrent left-hemisphere transient ischemic attacks (TIAs) following previous angioplasty and stenting of a left middle cerebral artery stenosis.

Diagnosis
A CT perfusion study demonstrated increased transit times and decreased cerebral blood flow of the left cerebral hemisphere. CTA showed evidence of in-stent restenosis. Cerebral angiogram revealed an approximately ≥90% in-stent stenosis of the left M1 extending into the inferior division (M2 segment).

Treatment
Percutaneous transluminal balloon angioplasty resulted in a reduction of the stenosis by about 50%. There was markedly improved flow into the middle cerebral distribution. The patient did not experience any further TIAs.

Comments
Arterial Phase The lateral projection of the pre-angioplasty angiogram shows slow flow in middle cerebral branches, more in the inferior division than in the superior division (white arrow). After angioplasty flow is much faster in these branches. These changes are easier to visualize on the color-coded image than on the DSA.
Parenchymal Phase The lateral projection of the pre-angioplasty angiogram shows slow flow in the inferior division of the middle cerebral artery. There is also incomplete opacification of the middle cerebral territory (white dotted line shows expected limit of MCA territory). The vein of Labbe (red arrows) is not filled and cortical veins from the middle cerebral territory (white arrows) fill more slowly than do veins from the anterior cerebral territory. After angioplasty there is much faster flow in the middle cerebral cortical branches with good opacification of the entire middle cerebral territory. The vein of Labbe and other cortical veins from the middle cerebral territory now fill normally. These changes are much easier seen on the color-coded image than on the DSA.



1 AP (a) and lateral projection (b)

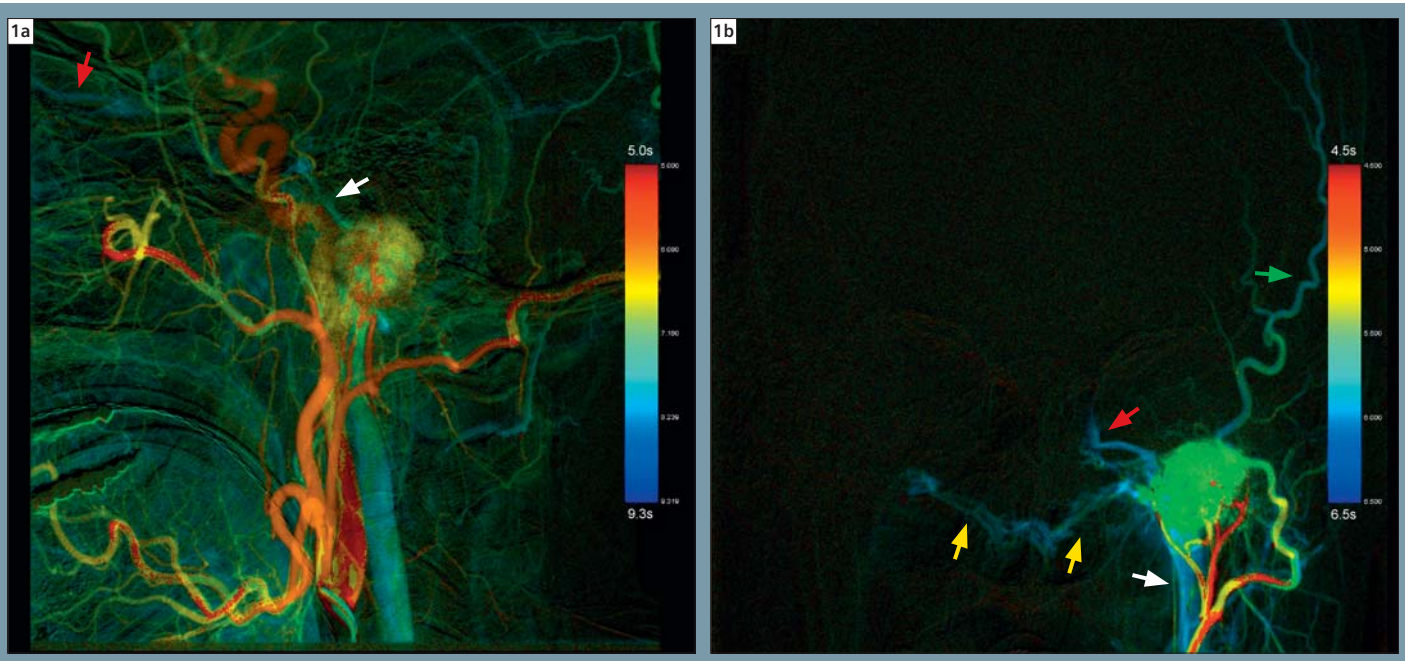
Arteriovenous malformation (AVM)

History
40-year-old female with a history of an incidentally found right occipital arteriovenous malformation (AVM).

Diagnosis
Cerebral angiogram demonstrated a 3 cm right occipital AVM fed from P2 and P3 branches of the right posterior cerebral artery. Venous drainage was into the Galenic system as well as into a cortical vein running parallel with the superior sagittal sinus.

Treatment
None

Comments
syngo iFlow provides an excellent composite picture of the entire AVM nidus, the feeding arteries and the venous drainage from both the AVM and **normal brain** on one single image. It is easy to visualize the AVM nidus with primary arterial supply from the posterior cerebral artery, the shunting into multiple cortical veins of the right hemisphere (white arrow), the deep venous system (yellow arrow) and cortical veins of the left hemisphere (red arrow). A stenosis in the distal portion of the left transverse sinus is also seen (green arrow). Because of the composite nature of the color-coded image, it is easier to see the relationship between arteries and veins that are filling and emptying at different time points.



1 Lateral projection of left common carotid artery angiogram (a) and AP projection of left occipital angiogram (b)

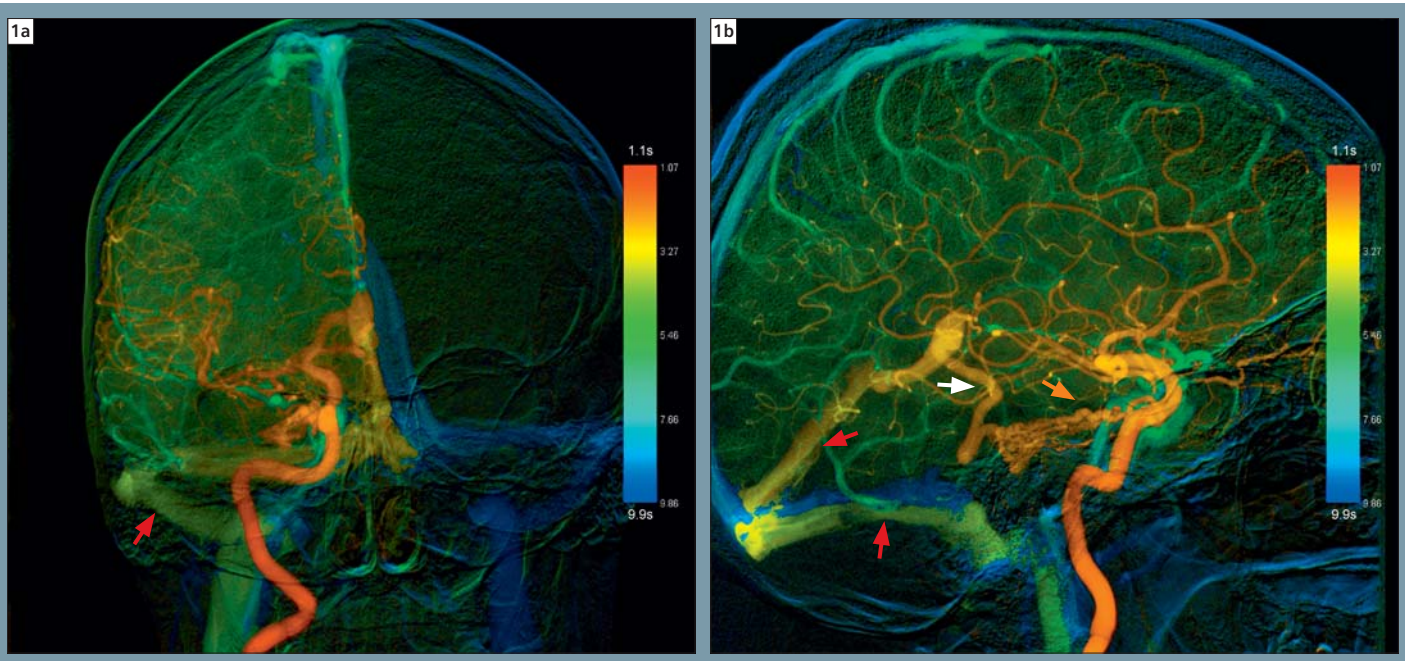
Glomus tumor

History
45-year-old female with a history of pulsatile tinnitus. CT and MRI revealed a left-sided mass at the jugular foramen consistent with a glomus jugulare tumor.

Diagnosis
DSA done prior to pre-operative embolization showed a typical pattern of vascularity with supply to the tumor from the ipsilateral occipital artery as well as the ascending pharyngeal artery. Venous drainage was into the internal jugular vein with retrograde filling of the petrosal sinus, cavernous sinus and superior ophthalmic vein. Following embolization there was no longer any tumor stain and no abnormal venous drainage.

Treatment
Embolization was performed by successively selecting each of the feeder branches. An angiogram done at the end of embolization demonstrated no significant residual tumor blush.

Comments
The pre-embolization color-coded image (1a) shows the venous drainage from the tumor much more clearly than the DSA, with clear visualization of retrograde filling of the inferior petrosal sinus (white arrow) and superior ophthalmic vein (red arrow).
The color-coded image of a selective occipital artery injection (1b) is particularly useful in showing the venous drainage from the tumor. Notice opacification of the jugular vein (white arrow), cavernous sinus (red arrow) and occipital sinuses (yellow arrows) at the same time as opacification of the cutaneous branch of the occipital artery (green arrow); all of these structures have the same color, indicating simultaneous opacification.



1 AP projection (a) and lateral projection (b)

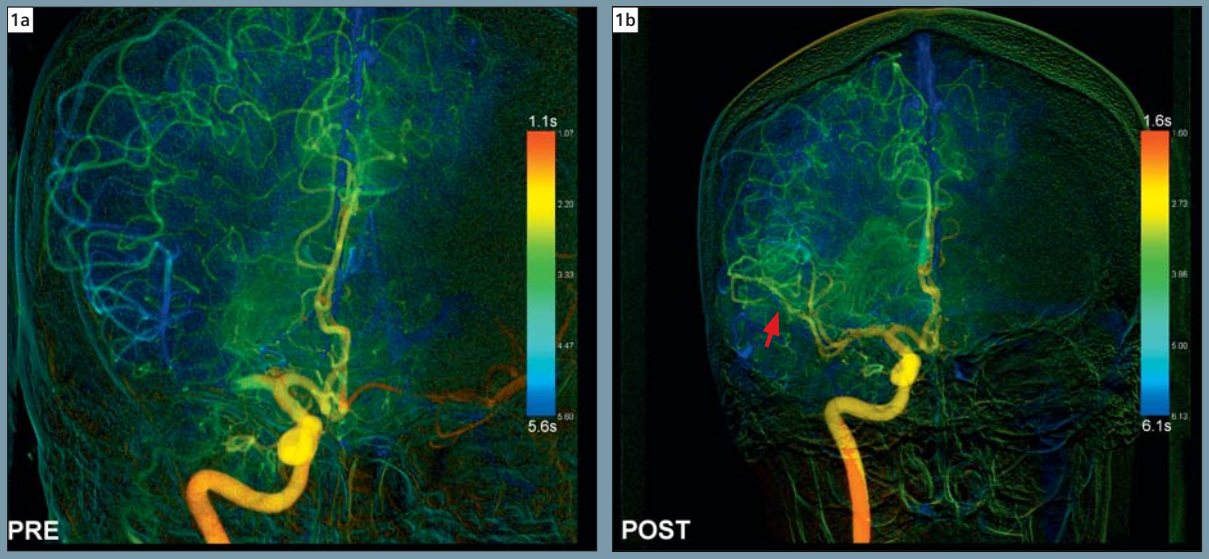
Dural arteriovenous fistula

History
60-year-old male with a 5-year history of trigeminal neuralgia.

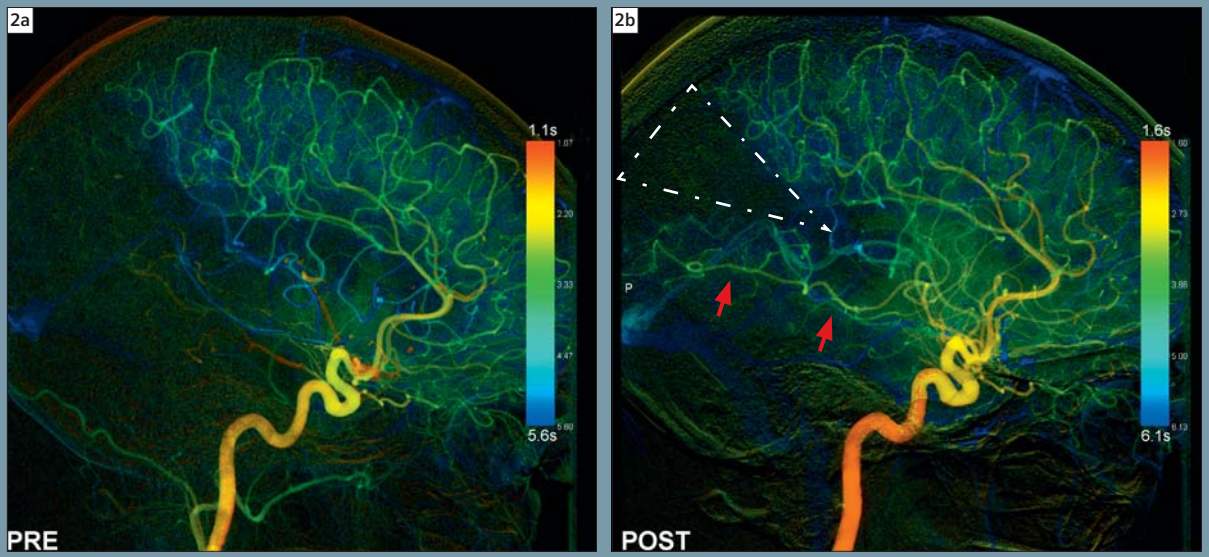
Diagnosis
MRI found dural arteriovenous fistula on the right side of cerebellopontine angle. Angiogram further classified it as Type I which is supplied by the Bernasconi-Cassinari artery and drains antegrade into a dilated deep vein and then into the straight sinus and the transverse sinus.

Treatment
The fistula was treated with transvenous coil embolization via the straight sinus.

Comments
Thanks to the composite nature of *syngo* iFlow, the entire fistula, the feeding arteries and the venous drainage can be visualized on a single image. It is easy to visualize the fistula with primary arterial supply from the Bernasconi-Cassinari artery (orange arrow), the draining into a dilated deep vein (white arrow) and venous sinuses (red arrows) of the right hemisphere. The composite nature of the color-coded image clearly depicts the relationship between arteries and veins that are filling and emptying at different time points.
The distinct color difference between the sagittal sinus and the draining veins and sinuses of the fistula delineates the draining system of the fistula clearly. The graduated color differences illustrate the antegrade flow in the draining veins and sinuses.



1 AP projection pre-treatment (a) and post-treatment (b)



2 Lateral projection pre-treatment (a) and post-treatment (b)

MCA occlusion

History
75-year-old male with acute left hemiparesis.

Diagnosis
CTA revealed right middle cerebral artery (MCA) occlusion (M1 segment) with marked decreased perfusion of the right MCA territory. A 2D DSA confirmed these observations.

Treatment
After mechanical thrombectomy using the Penumbra System, flow into the right MCA territory was markedly improved. MRI performed one day after treatment revealed infarction of the right striatum.

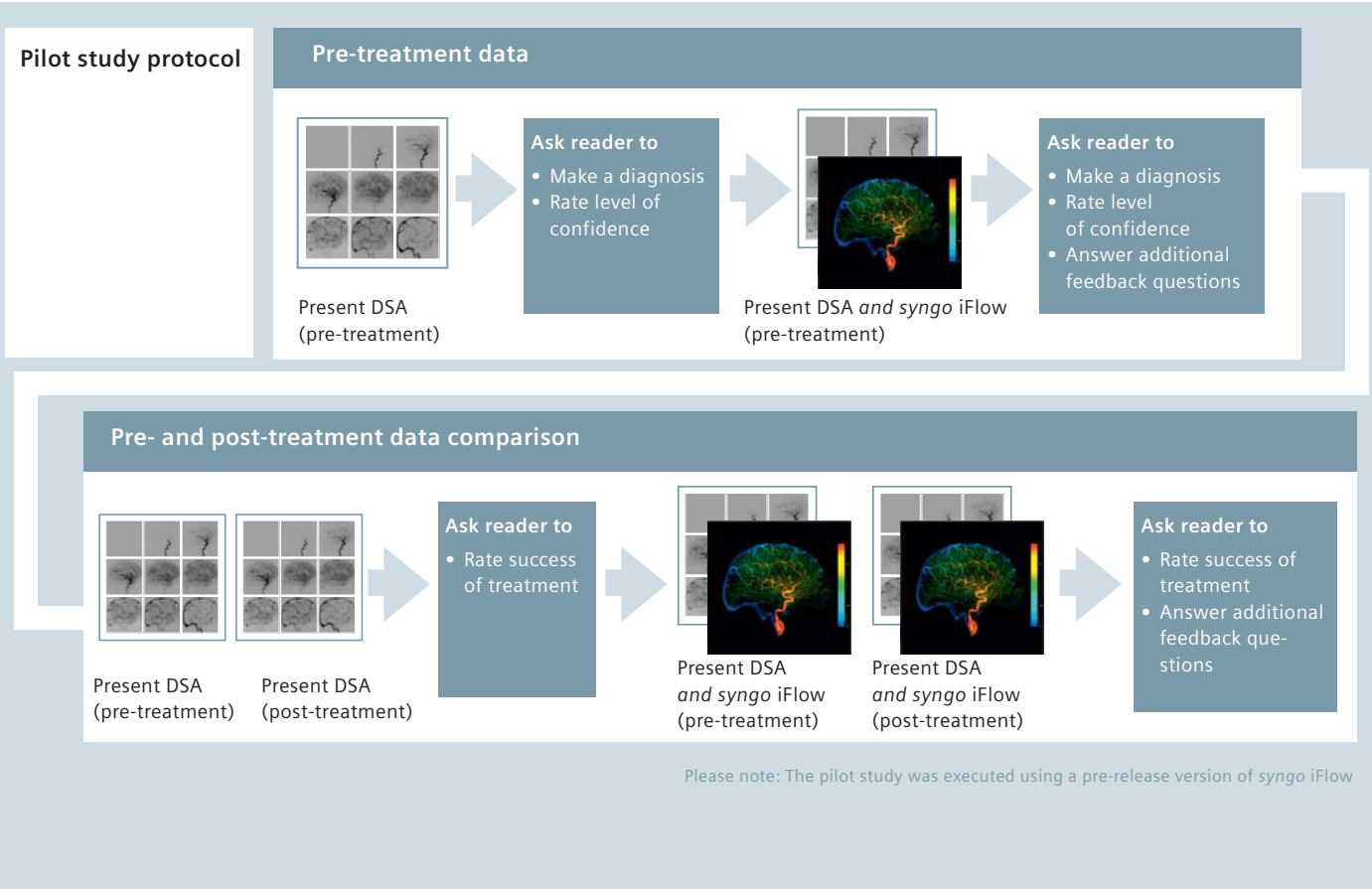
Comments
On the composite image it can be easily observed that blood flow was not only restored in the right MCA (red arrows), but also improved in the upstream carotid. This is much more easily appreciated on the color-coded images than on the DSA acquisitions. Flow to part of the MCA territory was not restored after the recanalization (area surrounded by white dotted lines), which was in agreement with the MRI findings after the procedure.

syngo iFlow – A clinical study

Study design

The pilot study for *syngo* iFlow* consisted of six readers, including three expert readers who are experienced neuroradiologists from the University of Wisconsin and three novice readers who are fellows in neuroradiology and residents from the same institute. The readers were asked to evaluate 26 medical cases, consisting of six different pathologies

- Arteriovenous malformation (AVM) and fistula
- Stenosis
- Stroke
- Aneurysm
- Vasospasm
- Tumor



Please note: The pilot study was executed using a pre-release version of *syngo* iFlow

"*syngo* iFlow is a valuable addition to the tools available for the display of 2D DSA acquisitions. At no added X-ray dose or contrast medium, it improves the conspicuity of findings on DSA images. It seems particularly useful in situations where there are complex flow patterns as well as in evaluating acquisitions done prior to and after a therapeutic intervention."

Charles M. Strother, MD Professor of Radiology
University of Wisconsin School of Medicine and Public Health, Madison, USA

Study results

- In more than 20% of the cases, physicians found that *syngo* iFlow made both diagnosis and treatment planning easier than using DSA alone*
- In more than 20% of the cases, the physicians changed their evaluation of the success of the procedure after using *syngo* iFlow to analyze the opacified blood flow in the post-treatment images*
- In more than 40% of the cases, physicians found that *syngo* iFlow made the evaluation of post-treatment images easier*

*Full statistics will be presented in a future publication.

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