Usefulness of Non-Contrast Enhanced Magnetic Resonance Angiography Using Silent Scan for Follow-Up after Y Stent-Assisted Coil Embolization for Basilar Tip Aneurysms

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**Aims and objectives**

In recent years, intracranial stent is used for the treatment of wide neck aneurysms. The Y stent-assisted coil embolization technique has been generally used for wide necked bifurcation aneurysms such as basilar tip artery [1-6].

Digital subtraction angiography (DSA) is the standard technique used as a follow-up after using an intracranial stent. However, DSA is an invasive technique that carries a risk of neurological complication, contrast materials, and X-ray radiation [7-10].

On the other hand, three dimensional time-of-flight magnetic resonance angiography (3D-TOF MRA) is widely used for follow-up of after coiled aneurysms, as a noninvasive substitute for DSA [11-14].

It was reported that 3D-TOF MRA was used after stent-assisted coil embolization [12,13], however, it is difficult that visualizing flow in an intracranial stent by 3D-TOF MRA owing to magnetic susceptibility and radiofrequency shielding. Therefore, contrast enhanced MRA (CE-MRA) is used for the follow-up after stent-assisted coil embolization. But, there is a problem of NSF and anaphylactic shock to use contrast media in CE-MRA and is not necessarily suitable for examination of the repetition [15-17].

Silent MRA is using silenz sequence that contains ultrashort echo time (UTE) combined with an arterial spin labeling (ASL). Data acquisition is based on 3D radial sampling and ASL technique is used a preparation plus for visualization of blood flow [18,19]. This is a non-contrast enhanced MRA technique. Therefore, it is easy for a patient and is usable for follow-up of the repetition.

UTE of silent MRA minimizes phase dispersion of the labeled blood flow signal and decrease magnetic susceptibility by coils and stents. Thus, silent MRA can evaluate the blood flow in an intracranial stent [19].

To the best of our knowledge, there have been no studies that using non-contrast enhanced MRA for follow-up after Y stent-assisted coil embolization for basilar tip aneurysms. Therefore, in this study, we evaluated the usefulness of silent MRA compared with that of 3D-TOF MRA for follow-up after Y stent-assisted coil embolization for basilar tip aneurysms.

**Methods and materials**

Between October 2014 and September 2015, seven aneurysm cases treating Y stent-assisted coil embolization were retrospectively examined. All patients had incidental unruptured aneurysms. All patients were followed up with silent MRA, 3D-TOF MRA, and
DSA. Both MRAs were performed in the same scan session. The average of the interval between the latest DSA and both MRAs was 27 days (range, 1 day to 180 days).

DSA of the catheter based intra-arterial cerebral angiography was performed with the following biplane angiographic systems: AXIOM Artis dTA (Siemens AG, Erlangen, Germany) until February 2014 and the Artis Q. BA Twin (Siemens AG) from March 2014 to present.

The intracranial stents were used Enterprise® stent (Codman & Shurtleff, Inc., Raynham, Mass, USA), Neuroform® stent (Boston Scientific, Natick, Massachusetts, USA), and Low-profile Visualized Intraluminal Support ; LVIS Jr. ® stent (MicroVention-Terumo, Tustin, California, USA).

Silent MRA and 3D-TOF MRA were performed in the same scan session on a 3Tesla MRI system (Discovery MR750w; General Electric Healthcare, Milwaukee, WI, USA) with 12-channel head neck coil. The scan parameters for acquisition in the silent MRA were as follows: repetition time (TR) / echo time (TE), 1116.4/0.016 msec; flip angle, 5°; field of view, 180×180 mm; matrix, 150×150; slice thickness, 1.2 mm; number of excitations (NEX), 1.5; bandwidth, ±20 kHz; and acquisition time, 7 min 40 seconds. The scan parameters for acquisition in the 3D-TOF MRA were as follows: repetition time (TR) / echo time (TE), 19/2.9 msec; flip angle, 15°; field of view, 200×200 mm; matrix, 416×192; slice thickness, 1.2 mm; NEX, 1; bandwidth, ±41.7 kHz; and acquisition time, 3 min 31 seconds. (3slabs, overlap:10, 1slab:32)

Visualization of parent artery with silent MRA and 3D-TOF MRA were compared with those of DSA images. The latest DSA images were used as a reference standard. Silent MRA and 3D-TOF MRA images were processed to maximum intensity projection (MIP) like a DSA image. Two experienced neuroradiologists (M.S and R.I) independently reviewed silent MRA and 3D-TOF MRA rated the conditions of visualization about the flow in each stents subjectively on a 5-point scale as follows: 1, not visible (almost no signal in the stent); 2, poor (structures are slightly visible but with significant blurring or artifacts, not diagnostic); 3, acceptable (acceptable quality diagnostic information with medium blurring or artifacts, diagnostic); or 4, good (good quality diagnostic information with minimum blurring or artifacts) ; or 5, excellent (the depiction is nearly equal to DSA).

The scores of the two observers were averaged and a Wilcoxon signed rank test was performed in the statistical analysis of the subjective scores for flow in stents. P<0.01 was considered statistically significant.

Furthermore, we evaluated the visualization of the neck remnant of silent MRA and 3D-TOF MRA, in patients with pointed out of neck remnant by DSA.

Results
Patient data and calculated score was shown in table 1. Both observers gave silent MRA higher scores than 3D-TOF MRA in all cases. The average score ± SD for silent MRA was 4.07 ± 0.70, and for 3D-TOF MRA was 1.93 ± 0.80 (p<0.01). Neck remnants were pointed out by DSA in five cases. Silent MRA was able to point out five cases, visualization of the neck remnant in all cases were similar to DSA, however, 3D-TOF MRA was able to point out only one case.

Figures 1-3 show the silent MRA, 3D-TOF MRA and DSA images for each case.

Images for this section:

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<thead>
<tr>
<th>Case Number</th>
<th>Age</th>
<th>Sex</th>
<th>Interval between DSA and MRA (day)</th>
<th>Slents</th>
<th>1st stent location and stent size</th>
<th>2nd stent location and stent size</th>
<th>In stent flow score Silent MRA</th>
<th>In stent flow score 3D-TOF MRA</th>
<th>Neck remnant Silent MRA</th>
<th>Neck remnant 3D-TOF MRA</th>
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</table>

Table 1 Summary of patients date, stents date and two observers scores

Note: F: Female, N: Neuroform, E: Enterprise, L: LVIS Jr., Rt.: Right, Lt.: Left, PCA: posterior cerebral artery, Ob.: observer

Table 1

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Conclusion

In Y stent-assisted coil embolization for basilar tip aneurysms, silent MRA was able to visualize flow in Y stents more clearly than 3D-TOF MRA. Moreover, silent MRA was able to depict the neck remnants.

Silent MRA is useful for follow-up noninvasive imaging technique after Y stent-assisted coil embolization for basilar tip aneurysms.

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