Signature: © Pol J Radiol, 2013; 78(1): 64-68
DOI: 10.12659/PJR.883769

Polish Journal of Radiology
www.PolRadiol.com
CASE REPORT

Received: 2012.09.29
Accepted: 2013.01.15

Time-resolved Magnetic Resonance Angiography for assessment of recanalization after coil embolization of visceral artery aneurysms

Kenichiro Kurosaka, Tatsuya Kawai, Masashi Shimohira, Takuya Hashizume, Kengo Ohta, Yosuke Suzuki, Yuta Shibamoto

Department of Radiology, Nagoya City University Graduate School of Medical Science, Nagoya, Japan

Author's address: Kenichiro Kurosaka, Department of Radiology, Nagoya City University Graduate School of Medical Science, Nagoya, Japan, e-mail: kurosaka0@gmail.com

Summary

Background: Follow-up imaging after coil embolization of visceral artery aneurysms is important for detecting recanalization. However, CT examination is susceptible to coil artifacts, which sometimes makes it difficult to assess recanalization. We report 2 cases where recanalization was successfully visualized using time-resolved magnetic resonance angiography after coil embolization of visceral artery aneurysms (one case of right internal iliac artery aneurysm and one case of splenic artery aneurysm). Repeat coil embolization was successfully performed.

Case Report: **Case 1.** An 80-year-old male patient with right internal iliac artery (IIA) aneurysm underwent coil embolization. Aneurysm was located at the bifurcation of the right IIA and therefore, after making a femorofemoral bypass, the distal part of the right IIA, aneurysm and the common iliac artery were embolized with a coil. One year later, the size of the aneurysm seemed to have increased on CT. However, the details were not determined because of metal artifacts. Thus, time-resolved MRA was performed and showed minute vascular flow inside the aneurysm. Angiography was subsequently performed and blood flow inside the aneurysm was visualized similar to the findings in time-resolved MRA. Coil embolization was performed once more and vascular flow inside the aneurysm disappeared. **Case 2.** A 36-year-old male patient with a splenic artery aneurysm underwent coil packing with preservation of splenic artery patency. Four years later, coil compaction was suspected in a CT scan, but CT could not evaluate recanalization because of severe metal artifacts. Angiography was subsequently performed, showing recanalization of the aneurysm as did the time-resolved MRA. Therefore, coil embolization of the aneurysm and splenic artery was performed again.

Conclusions: Follow-up imaging after coil embolization of visceral artery aneurysms is important for detecting recanalization. However, it is sometimes difficult to assess recanalization with CT because of artifacts caused by metal. In our cases, recanalization of aneurysms was clearly shown by time-resolved MRA and re-embolization was successfully performed.

In conclusion, time-resolved MRA appears to be useful in assessment of recanalization of visceral artery aneurysms after coil embolization.

Key words: **visceral artery aneurysms • MR angiography • coil embolization • recanalization**

PDF file: http://www.polradiol.com/fulltxt.php?ICID=883769

Background

It is important to assess recanalization of visceral artery aneurysms at follow-up after coil embolization. However, it is not easy to evaluate in contrast-enhanced computed tomography (CT) because of artifacts caused by metal coils. Here, we report two cases of successful detection of recanalization after coil embolization of right internal iliac artery and splenic artery aneurysms using time-resolved magnetic resonance angiography (MRA).

Case Reports

Case 1

An 80-year-old male patient with right internal iliac artery (IIA) aneurysm underwent coil embolization. Aneurysm was located at the bifurcation of the right IIA and therefore, after forming a femorofemoral bypass, the distal part of the right IIA, aneurysm and the common iliac artery were embolized with a coil (Figure 1A, 1B). A follow-up CT was performed every 3 months thereafter. One year later, a coil compaction was suspected on CT scan images (Figure 1C, 1D) and the size of the aneurysm seemed to be increased. However, the details could not be identified because of metal artifacts. Thus, time-resolved MRA was performed and it showed minute vascular flow inside the aneurysm (Figure 1E). Angiography was performed and blood flow inside the aneurysm was visualized, similar to the findings in time-resolved MRA (Figure 1F). Subsequently, coil embolization was performed once more and vascular flow inside the aneurysm disappeared.

Case 2

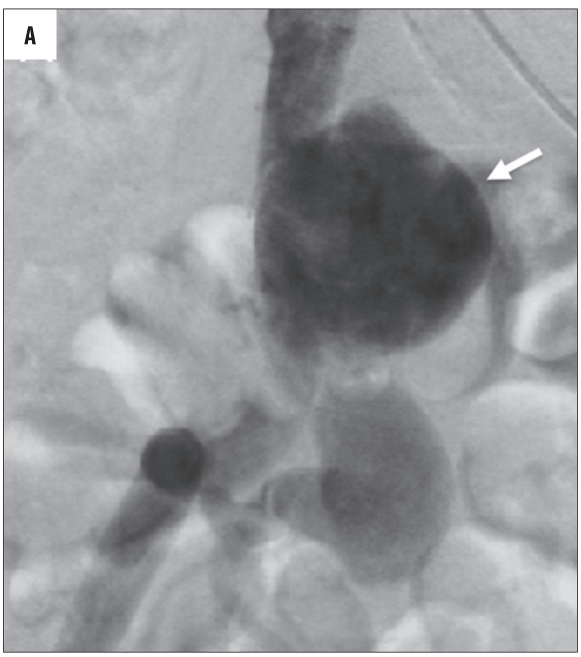
A 36-year-old male patient with splenic artery aneurysm underwent coil packing with preservation of splenic artery patency (Figure 2A, 2B). A CT examination was performed every 6–12 months as follow-up. Four years later, a coil compaction was suspected in CT scan imaging (Figure 2C, 2D), but CT evaluation of recanalization was not possible because of severe metal artifacts. Therefore, time-resolved MRA was performed. It showed complete recanalization of the aneurysm (Figure 2E). Angiography was subsequently performed, showing recanalization of the aneurysm as did the time-resolved MRA (Figure 2F). Then, coil embolization of the aneurysm and the splenic artery was performed again.

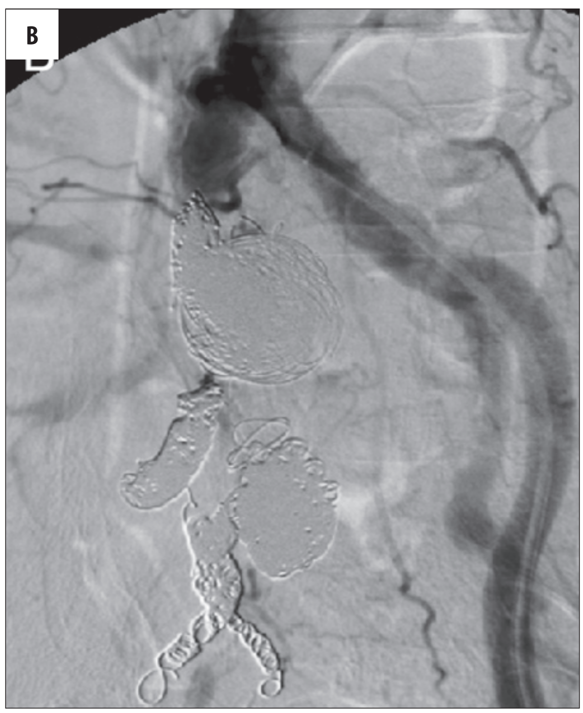
Image acquisition and reconstruction

All studies were performed with a 1.5-T MR system (Achieva, Philips Healthcare, Best, The Netherlands), using a five-element cardiac surface coil. Time-resolved MRA imaging was acquired with a 3D MRA T1-weighted fast field echo (T1-FFE) sequences with the following parameters: repetition time/echo time =4.7/1.4 msec., flip angle =40, FOV =400 with 80% rectangular FOV, matrix 336×227, slice thickness =3 mm interpolated to 1.5 mm and 25 slices were acquired to cover slab thickness of 37.5 mm. A SENSE factor of 2.5 and a keyhole factor of 20% were used to reduce the number of in-plane phase encoding steps, resulting in a temporal resolution of 1.7 seconds. Each slab was set to include the aneurysm and portions of the aorta and parent artery in the temporal phase. Twenty-five 3D volumes were acquired consecutively following a 5-second reference scan. Data acquisition began simultaneously with contrast media (0.1 mmol/kg of Gd-chelate) injection at a flow rate of 2 mL/sec, followed by a saline flush of 30 mL during breath holding. All source images from each frame were reconstructed using a maximal intensity projection algorithm.

Discussion

Visceral artery aneurysms are clinically important because of high incidence of rupture and life-threatening hemorrhage associated with mortality rates of 20–75% depending on the location of the aneurysm [1]. Considering the natural history of visceral artery aneurysms and the risk of rupture, there is a general consensus in the literature to treat such lesions even when patients are asymptomatic [2]. Endovascular procedures are used increasingly more often for the treatment of the aneurysms. It was reported that particularly coil embolization had evolved, with new devices and technologies allowing to achieve





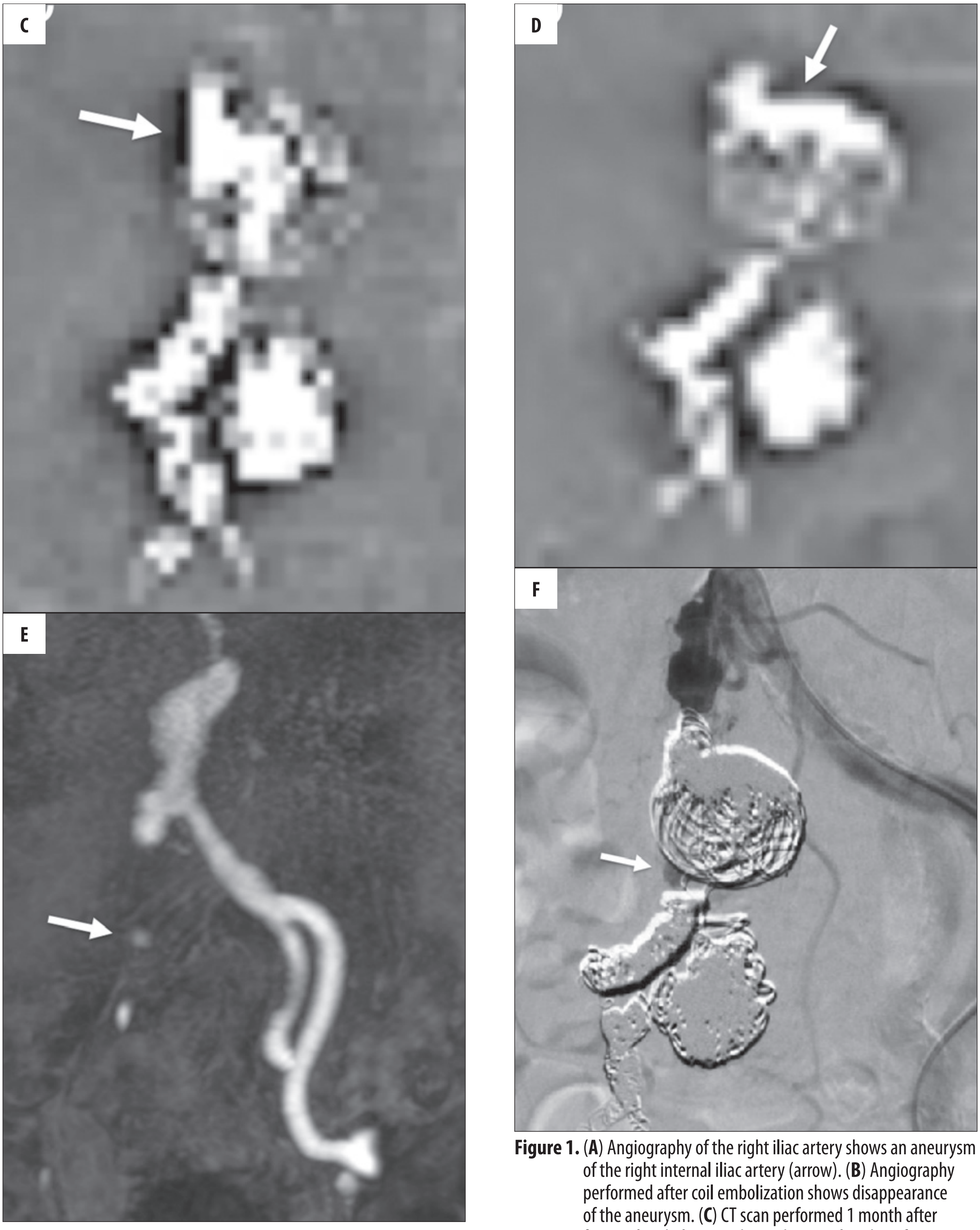


Figure 1. (**A**) Angiography of the right iliac artery shows an aneurysm of the right internal iliac artery (arrow). (**B**) Angiography performed after coil embolization shows disappearance of the aneurysm. (**C**) CT scan performed 1 month after from coil embolization shows dense coil packing from common iliac artery to aneurysmal neck (arrow). (**D**) CT scan performed 1 year after from coil embolization shows change of the coil shape (arrow), suggesting coil compaction. (**E**) Time-resolved MRA shows enhancement inside the aneurysm in the arterial phase (arrow), suggesting recanalization. (**F**) Repeat angiography shows enhancement inside the aneurysm, similar to the findings in time-resolved MRA (arrow).

better outcomes in treatment of intracranial aneurysms [3]. Nevertheless, recurrence due to coil compaction and/or aneurysm regrowth still remains a limitation of this method and requires long-term imaging follow-up [4–7]. Situation is similar in case of visceral artery aneurysms. Digital subtraction angiography (DSA) is an invasive procedure that involves risks of complications such as formation of a pseudoaneurysm at the puncture site [8]. CTA is very effective in

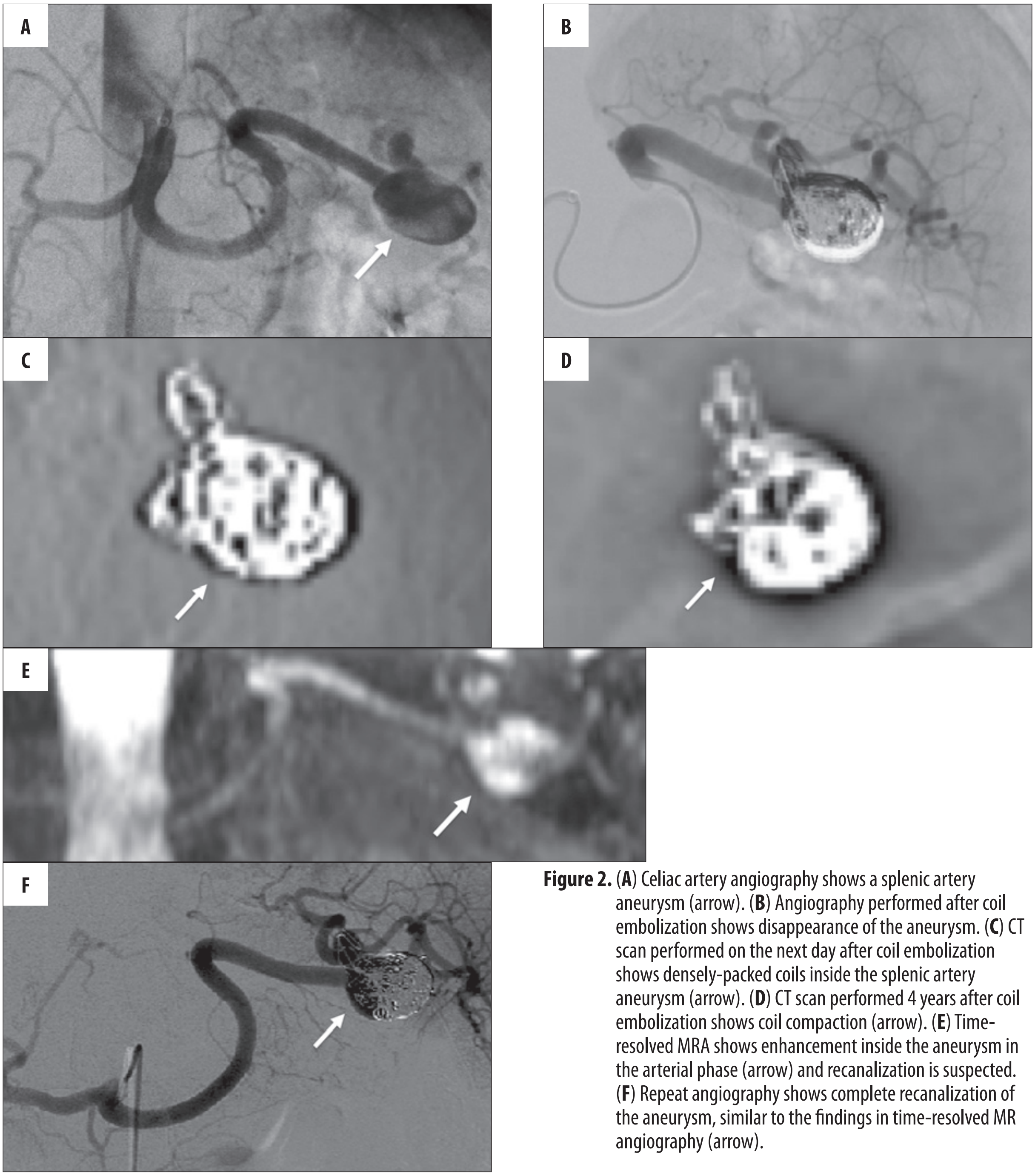


Figure 2. (**A**) Celiac artery angiography shows a splenic artery aneurysm (arrow). (**B**) Angiography performed after coil embolization shows disappearance of the aneurysm. (**C**) CT scan performed on the next day after coil embolization shows densely-packed coils inside the splenic artery aneurysm (arrow). (**D**) CT scan performed 4 years after coil embolization shows coil compaction (arrow). (**E**) Time-resolved MRA shows enhancement inside the aneurysm in the arterial phase (arrow) and recanalization is suspected. (**F**) Repeat angiography shows complete recanalization of the aneurysm, similar to the findings in time-resolved MR angiography (arrow).

detecting aneurysms; however, metal artifacts limit its use after coil embolization [9]. Recently, MRA became a valuable option for noninvasive follow-up, as it offers a non-invasive, high-resolution alternative to DSA for screening after coil embolization due to its high sensitivity in detecting flow and absence of ionizing radiation [10]. Furthermore, platinum coils are known to produce very few artifacts in MR imaging, and thus, MRA is likely to be useful for follow-up after coil embolization [11]. However, conventional MRA methods possess relatively poor temporal resolution. An early attempt to perform time-resolved MRA with a keyhole technique was reported [12]. In this approach, the outer edges of k-space are sampled only once, followed by multiple, repeated acquisitions of the central lines of k-space. In the keyhole technique, emphasis is placed on obtaining high-contrast information about the inner k-space as a trade off for spatial resolution of the outer k-space. More frequent sampling of the outer edges of k-space by using time-resolved imaging with contrast kinetics may help improve sampling of the outer edges of k-space, where detail and edge information are contained. Recently, Choi et al. [13] reported the usefulness of time-resolved MRA in follow-up after stent-assisted coil embolization of intracranial aneurysms. They demonstrated that, by using a time-resolved MRA technique, venous contamination or peri-aneurysmal enhancement could be effectively eliminated.

In our cases, recanalization of aneurysms was clearly shown by time-resolved MRA. We could find coil compaction in CT scan images; however, it was impossible to assess recanalization using CT because of severe metal artifacts. We think that time-resolved MRA is a suitable modality to assess recanalization even after coil embolization. However, this examination takes a long time and injection of contrast medium is required. Thus, we recommend routine follow-up by plain radiography and performing time-resolved MRA only whenever necessary. Namely, time-resolved MRA should be performed when coil compaction is suspected in an, x-ray.

In conclusion, time-resolved MRA appears to be useful in assessment of recanalization of visceral artery aneurysms after coil embolization.

References:

1. Shanley CJ, Shah NL, Messina LM: Common splanchnic artery aneurysms: splenic, hepatic, and celiac. Ann Vasc Surg, 1996; 10: 315–22
2. Liu Q, Lu JP, Wang F et al: Visceral artery aneurysms: evaluation using 3D contrast-enhanced MR angiography. AJR Am J Roentgenol, 2008; 191: 826–33
3. Molyneux AJ, Kerr RS, Yu LM et al: International subarachnoid aneurysm trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised comparison of effects on survival, dependency, seizures, rebleeding, subgroups, and aneurysm occlusion. Lancet, 2005; 366: 809–17
4. Raymond J, Guilbert F, Weill A et al: Long-term angiographic recurrences after selective endovascular treatment of aneurysms with detachable coils. Stroke, 2003; 34: 1398–403
5. Byrne JV, Sohn MJ, Molyneux AJ et al: : Five-year experience in using coil embolization for ruptured intracranial aneurysms: outcomes and incidence of late rebleeding. J Neurosurg, 1999; 90: 656–63
6. van Rooij WJ, Sluzewski M: Opinion: imaging follow-up after coiling of intracranial aneurysms. AJNR Am J Neuroradiol, 2009; 30: 1646–48
7. Gallas S, Januel AC, Pasco A et al: Long-term follow-up of 1036 cerebral aneurysms treated by bare coils: a multicentric cohort treated between 1998 and 2003. AJNR Am J Neuroradiol, 2009; 30: 1986–92
8. Paulson EK, Nelson RC, Mayes CE et al: Sonographically guided thrombin injection of iatrogenic femoral pseudoaneurysms: further experience of a single institution. AJR Am J Roentgenol, 2001; 177: 309–16
9. Wallace RC, Karis JP, Partovi S et al: Noninvasive imaging of treated cerebral aneurysms, part I: MR angiographic follow-up of coiled aneurysms. AJNR Am J Neuroradiol, 2007; 28: 1001–8
10. Spilberg G, Carniato SL, King RM et al: Temporal Evolution of Susceptibility Artifacts from Coiled Aneurysms on MR Angiography: An In Vivo Canine Study. AJNR Am J Neuroradiol (Epub ahead of print), 2012; 33(4): 655–60
11. Koganemaru M, Abe T, Uchiyama D et al: Detection of neck recanalization with follow-up contrast-enhanced MR angiography after renal artery aneurysm coil embolization. J Vasc Interv Radiol, 2010;21: 298–300
12. Jaspers K, Nijenhuis RJ, Backes WH: Differentiation of spinal cord arteries and veins by time-resolved MR angiography. J Magn Reson Imaging, 2007; 26: 31–40
13. Choi JW, Roh HG, Moon WJ et al: Time-resolved 3D contrast-enhanced MRA on 3.0T: a non-invasive follow-up technique after stent-assisted coil embolization of the intracranial aneurysm. Korean J Radiol, 2011; 12: 662–70