Microcatheter injection reduces the amount of contrast medium during middle cerebral artery aneurysm embolization in a patient with chronic kidney disease

Kohta, Masaaki
Fujita, Atsushi
Matsuo, Kazuya
Yamashita, Shunsuke
Kohmura, Eiji

(Citation)
Radiology Case Reports, 15(5):542-544

(Issue Date)
2020-05

(Resource Type)
journal article

(Version)
Version of Record

Radiology Case Reports 15 (2020) 542–544

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/radcr

Case Report

Microcatheter injection reduces the amount of contrast medium during middle cerebral artery aneurysm embolization in a patient with chronic kidney disease

Masaaki Kohta, MD, PhD, Atsushi Fujita, MD, PhD, Kazuya Matsuo, MD, Shunsuke Yamashita, MD, Eiji Kohmura, MD, PhD*

Department of Neurosurgery, Kobe University Graduate School of Medicine, 7-5-1, Kusunoki-cho, Chuo-ku, Kobe 650-0017, Japan

ARTICLE INFO

Article history:
Received 10 January 2020
Revised 7 February 2020
Accepted 9 February 2020
Available online 6 March 2020

Key words:
Chronic kidney disease
Coil embolization
Contrast medium
Contrast-induced nephropathy

ABSTRACT

We describe a unique technique to reduce the amount of contrast medium by injecting diluted contrast medium from the microcatheter during neurointervention. A patient with severe renal impairment due to polycystic kidney was referred for endovascular surgery for wide-neck middle cerebral artery aneurysm. In order to reduce the amount of contrast medium, contrast medium was injected from the microcatheter placed in the middle cerebral artery during coil embolization; renal function decline was not observed after the procedure. This technique, therefore, reduces the amount of contrast medium and enables one to perform coil embolization safely.

Introduction

Endovascular coil embolization for cerebral aneurysms has recently become a common therapy. A large amount of contrast medium is sometimes administered during coil embolization for complicated aneurysms. Contrast-induced nephropathy (CIN) is a potential complication following exposure to contrast medium and is associated with poor clinical outcomes [1]. Chronic kidney disease (CKD) is, especially, one of the risk factors of CIN. The volume of contrast medium is considered to be an independent predictor of CIN [2]. Therefore, in order to prevent CIN, a novel contrast reduction method is used. In this case of coil embolization for wide-neck middle cerebral artery aneurysm, a unique technique to reduce the amount of contrast medium by injecting diluted contrast medium from the microcatheter is described here.

Abbreviations: CIN, Contrast-induced nephropathy; CKD, Chronic kidney disease; eGFR, estimated glomerular filtration rate; CT, computed tomography.

* Corresponding author.
E-mail address: kohta@med.kobe-u.ac.jp (M. Kohta).

https://doi.org/10.1016/j.radcr.2020.02.003

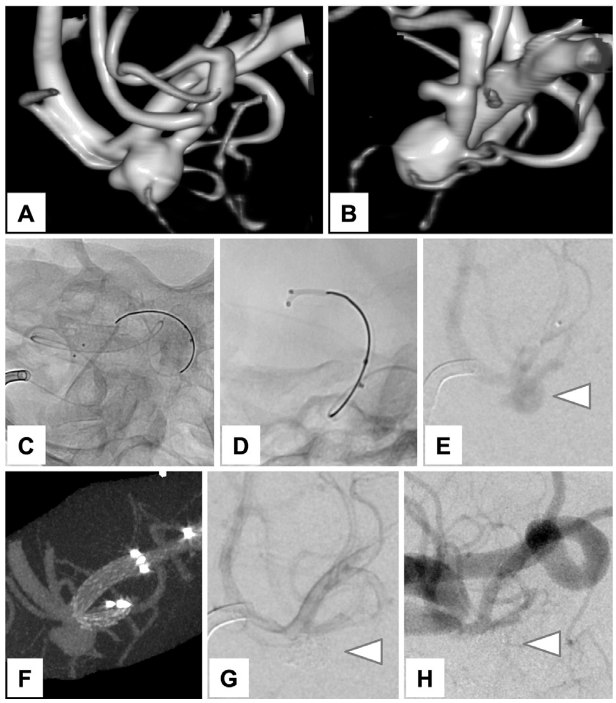

Fig. 1 – Preoperative 3D-digital subtraction angiography shows the right middle cerebral artery aneurysm (A,B). Navigating 2 microcatheters to the right middle cerebral artery (M1) (C,D). Right middle cerebral artery angiogram injected from the microcatheter placed at M1 shows the right middle cerebral artery aneurysm (E). Cone beam CT shows the Neuroform Atlas stent covering the aneurysm neck (F). Post-treatment angiogram shows complete obliteration of aneurysm (G). Angiogram 6 months after treatment shows no recurrence of aneurysm (H).

Case report

A 60-year-old woman has been suffering from polycystic kidney. Magnetic resonance imaging revealed a right middle cerebral artery aneurysm which had not been detected since last 5 years. The size of aneurysm was 5.1 × 4.2 mm, neck 4.3 mm (Fig. 1A and B). Preoperative serum creatinine (Cr) and estimated glomerular filtration rate (eGFR) were 1.34 mg/dL and 32.1 mL/min/1.73m^2, respectively. The patient had strongly wished to undergo endovascular surgery. Thus, endovascular surgery was performed using a small amount of contrast medium so as to prevent renal function decline.

The patient received aspirin and clopidogrel for 1 week before treatment. In the procedure, the contrast medium iopamidol (Oypalomin 300; Fuji Pharma, Toyama, Japan) was diluted with heparinized saline. The concentrations of diluted contrast medium were 50% for depiction of artery and aneurysm and 10% for cone beam computed tomography (CT). Under general anesthesia, 6Fr Axcelguide (Medikit, Tokyo, Japan) was inserted from the right femoral artery into the right common carotid artery. 6Fr Fubuki (Asahi INTECC, Aichi, Japan) was inserted to the petrous portion of the right carotid artery (using 4 mL of 50% diluted contrast medium). Fifty percent diluted contrast medium was injected from Fubuki to acquire a road map image (using 6 mL of 50% diluted contrast medium). Then, Excelsior SL-10 STR (Stryker, Kalamazoo, MI) and Excelsior SL-10 45° (Stryker, Kalamazoo, MI) were inserted into the right middle cerebral artery (M1) (Fig. 1C, and D). Excelsior SL-10 STR was used for injecting contrast medium. The working angle was determined by the angiographic image with the microcatheter injection (Fig. 1E). About 0.8 mL of 50% diluted contrast medium was used for each microcatheter injection with a 1-mL syringe. Although coil embolization was performed with a simple technique initially, it was realized that stent-assisted technique was required because of wide-neck aneurysm. Excelsior SL-10 45° was removed and Excelsior SL-10 J-shaped (Stryker, Kalamazoo, MI) was inserted into the M2 branch alternatively. Neuroform Atlas stent 3 × 21 (Stryker, Kalamazoo, MI) was used to cover the aneurysm neck. A cone beam CT was performed to confirm that the stent was covering the aneurysm neck (using 50 mL of 10% diluted contrast medium) (Fig. 1F). Then, another Excelsior SL-10 STR was inserted into the aneurysm by the trans-cell approach. Finally, a complete occlusion was obtained with 6 coils (volume embolization rate: 31%) (Fig. 1G). About 33.5 mL of contrast medium (converts of undiluted contrast medium) was totally used. The total procedure time was 334 minutes.

Approximately 3 days after the procedure, serum Cr and eGFR were observed to be 1.52 mg/dL and 28.0 mL/min/1.73m^2, respectively. About 6 months after the procedure, angiography revealed a complete occlusion of aneurysm (Fig. 1H).

Discussion

In this study, coil embolization of wide-neck middle cerebral artery aneurysm was performed with a small amount of contrast medium without any renal function decline in the patient with CKD. During coil embolization, 50% diluted contrast medium was injected from the microcatheter placed in the middle cerebral artery (M1) using a 1-mL syringe. This technique reduces the amount of contrast medium. In this case of wide-neck aneurysm in the patient with CKD, this technique is helpful, whereas the Neuroform Atlas stent is particularly useful for stent-assisted coil embolization.

CIN is a potential complication in patients undergoing angiographic procedures and is associated with worse clinical outcomes [1]. The only techniques to reduce the risk of CIN are appropriate hydration and minimizing the amount of contrast medium [3]. Prophylaxis with intravenous normal saline is indicated in patients who are not undergoing dialysis and who have an eGFR less than 30 mL/min/1.73 m^2 [4]. In our case, eGFR was 32.1 mL/min/1.73 m^2, which was almost 30 mL/min/1.73 m^2 and the patient had polycystic kidney disease, which may cause renal functional deterioration. Therefore, intravenous normal saline was administered before and after the procedure. Previous studies have evaluated the removal of contrast medium from downstream arterial or venous system after arterial angiography [5,6]. These methods are, however, for subclavian intervention and coronary intervention and catheter for the removal of contrast medium can be placed downstream. However, in this case of cerebral aneurysm, the catheter for the removal of contrast medium cannot be placed downstream. Other techniques used in practice to minimize the amount of contrast medium include decreasing the size of the injection syringe and biplane image [7]. In this study, a 1-mL syringe and biplane image were used to reduce the amount of contrast medium. Moreover, microcatheter and 50% diluted contrast medium were also used, both of which have not been reported previously.

According to previous studies on CIN, the recommended maximum amount of contrast medium is as follows: (1) 5 × body weight (kg)/serum Cr (mg/dL) [8]; (2) 3.7 × creatinine clearance [9]; (3) 2 × calculated creatinine clearance [10]; and (4) eGFR [11]. In this study, it was possible to minimize the amount of contrast medium by injecting diluted contrast medium from the microcatheter placed at M1. Actually, for patients whose eGFR is greater than 30 mL/min/1.73m^2, such as our case, the usual amount of contrast medium can be used. However, our patient had decreased renal function due to polycystic kidney disease, and so we needed to reduce the amount of contrast medium. As a result, the total amount of contrast medium was 33.5 mL, which was almost the same value as the preoperative eGFR.

In our experience of coil embolization for middle cerebral artery aneurysm, the average amount of contrast medium was 253 mL (234-270 mL, n = 5). Therefore, our microcatheter technique provided a reduction in the amount of contrast medium of about 200 mL. In contrast, for diagnostic CT angiography, the amount of contrast medium was about 60 mL. The amount of contrast medium for our technique was also smaller than that of other procedures, such as diagnostic CT angiography.

For our procedure, no special skills are required. The only skill that is needed for is the ability to safely navigate the microcatheter into the intracerebral artery. However, this procedure takes more time compared with the usual procedure for middle cerebral artery aneurysm coil embolization; the average procedure time was 223 minutes (185-299 minutes, n = 5) in our experience.

In the present case of wide-neck aneurysm in the patient with CKD, this technique is helpful, whereas the Neuroform Atlas stent is particularly useful for stent-assisted coil embolization. The Neuroform Atlas stent is a self-expandable nitinol stent which can be delivered through a 0.0165-in microcatheter. It has a combination of open- and closed-cell design with relatively large cell size. Hence, the Neuroform Atlas stent can be placed through the same microcatheter used for the consequent coil embolization of the aneurysm with the help of the jailing technique. Because one microcatheter placed in the middle cerebral artery is needed for injecting contrast medium, the Neuroform Atlas, which can be delivered through the same microcatheter used for the consequent coiling, is extremely useful.

This study has a limitation that should be considered. The use of this technique is during the embolization of an aneurysm having a relative small parent artery, such as middle cerebral artery. In the case of the aneurysm in the large parent artery, such as internal carotid artery, it may be difficult to depict aneurysm clearly by injecting contrast medium from the microcatheter.

Conclusion

We demonstrated a unique coil embolization technique with a small amount of contrast medium without renal function decline in the patient with CKD. During coil embolization, 50% diluted contrast medium was injected from the microcatheter placed in the middle cerebral artery. This technique reduces the amount of contrast medium and enables one to perform coil embolization safely.

REFERENCES

[1] James MT, Samuel SM, Manning MA, Tonelli M, Ghali WA, Faris P, et al. Contrast-induced acute kidney injury and risk of adverse clinical outcomes after coronary angiography: a systematic review and meta-analysis. Circ Cardiovasc Interv 2013;6(1):37–43.

[2] Kane GC, Doyle BJ, Lerman A, Barsness GW, Best PJ, Rihal CS. Ultra-low contrast volumes reduce rates of contrast-induced nephropathy in patients with chronic kidney disease undergoing coronary angiography. J Am Coll Cardiol 2008;51(1):89–90.

[3] Hafiz AM, Jan MF, Mori N, Shaikh F, Wallach J, Bajwa T, et al. Prevention of contrast-induced acute kidney injury in patients with stable chronic renal disease undergoing elective percutaneous coronary and peripheral interventions: randomized comparison of two preventive strategies. Catheter Cardiovasc Interv 2012;79(6):929–37.

[4] Davenport MS, Perazella MA, Yee J, Dillman JR, Fine D, McDonald RJ, et al. Use of intravenous iodinated contrast media in patients with kidney disease: consensus statements from the American College of Radiology and the National Kidney Foundation. Radiology 2020:192094.

[5] Michishita I, Fujii Z. A novel contrast removal system from the coronary sinus using an adsorbing column during coronary angiography in a porcine model. J Am Coll Cardiol 2006;47(9):1866–70.

[6] Sanon S, Barsness GW, Gulati R. A novel technique to reduce contrast exposure during subclavian interventions. Vasc Endovascular Surg 2017;51(2):84–6.

[7] Nayak KR, Mehta HS, Price MJ, Russo RJ, Stinis CT, Moses JW, et al. A novel technique for ultra-low contrast administration during angiography or intervention. Catheter Cardiovasc Interv 2010;75(7):1076–83.

[8] Cigarroa RG, Lange RA, Williams RH, Hillis LD. Dosing of contrast material to prevent contrast nephropathy in patients with renal disease. Am J Med 1989;86(6 Pt 1):649–52.

[9] Laskey WK, Jenkins C, Selzer F, Marroquin OC, Wilensky RL, Glaser R, et al. Volume-to-creatinine clearance ratio: a pharmacokinetically based risk factor for prediction of early creatinine increase after percutaneous coronary intervention. J Am Coll Cardiol 2007;50(7):584–90.

[10] Gurm HS, Dixon SR, Smith DE, Share D, Lalonde T, Greenbaum A, et al. Renal function-based contrast dosing to define safe limits of radiographic contrast media in patients undergoing percutaneous coronary interventions. J Am Coll Cardiol 2011;58(9):907–14.

[11] Ogata N, Ikari Y, Nanasato M, Okutsu M, Kametani R, Abe M, et al. Safety margin of minimized contrast volume during percutaneous coronary intervention in patients with chronic kidney disease. Cardiovasc Interv Ther 2014;29(3):209–15.