International Research Journal of Medicine and Medical Sciences
Vol. 4(4), pp. 38-42, November 2016
ISSN: 2354-211X
Full Length Research Paper

Double microcatheter technique for the treatment of irregular and wide-neck anterior communicating aneurysm

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Accepted 1 November, 2016

ABSTRACT

The purpose of this study is to evaluate the feasibility, complication and follow-up results of intrasaccular double microcatheter endovascular coil embolization of irregular and wide-neck anterior communicating aneurysm aneurysm. From July 2012 to December 2015, 11 cases with irregular and wide-neck anterior communicating aneurysm treated with double microcatheter technique were selected. All patients were admitted in our department with subarachnoid hemorrhage, The results, complications, and follow-up results were assessed. All anterior communicating aneurysms were successfully treated by using double microcatheter technique. The mean aneurysm neck size was 3.8 mm. The mean dome-to-neck ratio was 1.35. Immediate post-embolization angiograms demonstrated complete occlusion in 8 of 11 aneurysms. Near complete in 3. Imaging follow-ups were performed with magnetic resonance angiography or digital subtraction angiography for more than 12 moths. All cases showed stable occlusion. In conclusions, double microcatheter technique may be a safe and good technique for the treatment of irregular and wide-neck anterior communicating aneurysm aneurysm.

Keywords: Aneurysm, embolization, double microcatheter technique, wide neck, irregular.

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INTRODUCTION

With the advances in technique, coil embolization of wide-neck aneurysms has evolved rapidly and has become an efficient treatment Technique comparing with microsurgical clipping. However, embolization of complex and wide-neck aneurysms remains a great challenge. For the past years, various devices have been developed to treat wide-neck aneurysms, including balloon remodeling and intracranial stents (Thorell et al., 2005; Perez-Arjona and Fessler, 2004). These techniques have been introducted for irregular and wide-neck anterior communicating (AcomA) aneurysm. However, the introduction of device into intracranial vessels may increase the risk of vascular injury and thromboembolism. Therefore, to overcome these complications, we used double microcatheter technique instead of stents or ballons, which is based on the creation of a stable coil frame with two coils through two microcatheter. The purpose of this study is to evaluate the feasibility, complication and follow-up results of intrasaccular double microcatheter endovascular coil embolization of irregular and wide-neck AComA aneurysm.

MATERIALS AND METHODS

Eleven aneurysms in eleven patients were treated with the double-microcatheter technique at the Second Affiliated Hospital of Bengbu Medical College from July 2012 to December 2015. Aneurysms which the adjuvant stent-assisted technique was used were excluded. All the patients presented with subarachnoid hemorrhage (SAH). Six patients were classified as Hunt–Hess I at the admission, four Hunt–Hess II, one Hunt–Hess III. Wide-neck was defined as neck diameter greater 4 mm or a dome-to-neck ratio less than 2 on digital subtraction angiography (DSA). Irregular was

defined as more than one aneurysms sac on DSA. Plane Integris Allura angiography units (Phillips Healthcare, Best, the Netherlands) were used. The size of each aneurysm and neck was measured in three dimensions (3D) angiographic images using the angiography unit software.

All procedures were performed under general anesthesia. A bolus of 3,000 U of heparin was administered after the guiding catheters were placed. Then, intermittent boluses of 1,500 U/h of heparin were administered during the entire procedure. With diagnostic angiography and 3D reconstruction, size, morphology and major branches originating from the aneurismal neck were carefully evaluated. For the double microcatheter technique, a 6-F or 8-F shuttle sheath was inserted into the internal carotid artery (ICA) from the right femoral artery using the Seldinger's method. The main purpose of the double-microcatheter technique was to obtain a stable coil frame by pushing one or two coils in aneurysm sac. The two different shape of microcatheter tips(ECHELON10.EV3.USA) were carefully navigated into the aneurysm sac with the guide of a microwire (Microvention, Tustin, CA, USA). Two coil loop size should be different selectively according to the morphologic characteristics of the aneurysm. Detachable coils were inserted. Multiple attempts to achieve a satisfactory and stable coil packing was performed. If the coiling failed to make a stable coil frame with two coils, the adjuvant stent-assisted technique was attempted.

Analysis

The sex, age, neck size, grade of aneurism occlusion, dome-to-neck ratio, clinical outcome, complication, follow-ups were assessed. Immediate angiographic results were analyzed. The rate of occlusion was classified as complete if aneurysm was densely packed without opacification of the sac or neck, as near complete if there was small neck remnant, as incomplete if there was persistent sac opacification (Cloft, 2006). Imaging follow-ups were performed with Magnetic Resonance angiography or DSA. And clinical follow-ups were available in all patients. MR angiography or DSA was performed 3~6 months after the producer. Another evaluation was performed 1 year later. Outcome evaluations were classified as stable, thrombosis, compaction and regrowth. Clinical outcome evaluations were performed using the Glasgow outcome Scale (Gos) (Jennett et al., 1981): (5) good recovery, (4) moderate disability, (3) sever disability, (2) vegetative status, and (1) dead.

RESULTS

Patient characteristics and clinical outcome were shown in table 1. All AcomA aneurysms were successfully treated by using double microcatheter technique. The mean aneurysm neck size was 3.8 mm (range 3.0 to 4.6 mm). The mean dome-to-neck ratio was 1.35 (range1.2 to 1.5). Immediate post-embolization angiograms demonstrated complete occlusion in 8 of 11 aneurysms. Near complete in 3. Imaging follow-ups were performed with MR angiography or digital subtraction angiography for more than 12 moths. All cases showed stable occlusion.

Table 1. Summary of patient characteristics treated with double microcatheter technique only.

Case	Sex	Age	Neck size	Dome to neck	Indication	Occlusion	Complicate	Gos
1	F	50	3.4	1.3	SAH	Near Complete	None	Good recovery
2	M	49	4.1	1.2	SAH	Complete	None	Good recovery
3	F	61	3.6	1.5	SAH	Complete	None	Good recovery
4	F	38	4.6	1.3	SAH	Complete	Hyperpyexia	Good recovery
5	M	65	3.8	1.5	SAH	Complete	None	Good recovery
6	F	54	4.3	1.4	SAH	Complete	None	Good recovery
7	F	74	3.9	1.4	SAH	Complete	Thrombosis	Good recovery
8	M	55	3.7	1.2	SAH	Near Complete	Hyperpyexia	Good recovery
9	M	66	3.3	1.4	SAH	Near Complete	None	Good recovery
10	F	64	3.0	1.5	SAH	Complete	None	Good recovery
11	F	58	4.2	1.2	SAH	Complete	None	Good recovery

Complications

Procedure-related complications developed in 3 (28%) of 11 aneurysms, one symptomatic thromboembolic complications developed in one of our cases, who was treated by using Tirfiban Hydrochloride from case one. Finally, case one recovered after treating without neurologic defect. Another cases developing hyperpyexia because of cerebral vasospasm, which were treated by using lumbar puncture and 3H (Hypertension, Hypervolemia and Hemodilution) therapy, recovered.

DISCUSSION

Compared to conventional neurosurgical treatment, endovascular embolisation of intracranial aneurysms has been an efficient treatment (Molyneux et al., 2009). The effectiveness of the coil technique has been confirmed and it became the first-line method of treatment in intracranial aneurysms. However, wide-necked aneurysms represent one of the most unfavorable aneurysm configuration (Baxter et al., 1998; Akpek et al., 2005; Kwon et al., 2005; Lee et al., 2011; Kim and Park,

2011; Kwon et al., 2006; Cho et al., 2013; Hwang et al., 2011; Kwon et al., 2006). Different devices and techniques have been developed to overcome the technical limitations associated with treating wide-neck aneurysms, including multiple microcatheter, balloon remodeling, intracranial stents. Since 1998, Baxter et al. (1998) described the double microcatheter technique on the first time, more reports have appeared in the literature about aneurysms treated with a similar method (Lee et al., 2011; Kim and Park, 2011; Kwon et al., 2006; Cho et al., 2013; Hwang et al., 2011). Our study shows that the double microcatheter technique may be a feasible primary method for treating irregular and wide-neck AComA aneurysm. Complete or near complete occlusion was achieved on all cases.

The geometric features of the AComA aneurysm from our study were irregular and wide-neck. Hypoplasia of A1 segment of anterior cerebral artery is found in case 2, 5 and 8, with bilateral anterior cerebral territory perfused from single internal carotid artery via AcomA. The maximum diameter of aneurysm from our case is 4.6 mm, the average diameter of our cases is 3.8 mm. Irregular and wide-neck morphology are character of difficult aneurysm that may preclude simple coil embolization (Cloft et al., 2000). In this study, we have used the double microcatheter technique to treat irregular and wide-neck AComA aneurysm which has been considered as difficult to treat without adjuvant therapy (Brinjikji et al., 2009). Figure 1 showed irregular and wide-neck AComA aneurysm from case ten.

Figure 1. A 64-year-old female with a left AcomA aneurysm. A. Wide-necked aneurysm in the AcomA aneurysm; B. Simultaneous use of two microcatheters; C. Postembolic angiogram showing complete aneurysmal occlusion.

The double microcatheter technique has been introduced as a technique for coiling wide-neck aneurysms. The two ports of coil delivery allow two angles of opportunity for two coils intermingling with each other in order to create a stable, initial coil frame. The coils may be deployed in sequence or alternatingly. Selection of a coil to detach depends on either the stability of the coil or in consideration of the preferred microcatheter location in the sac. This method was similar with Kim et al. (2014).

Compared with the balloon- or stent-assisted techniques, the double-microcatheter technique shows several advantages. Advantage of this technique is that a microcatheter is not only feasible to navigate in small or narrowed tortuous arteries, but also microcatheter is technically accessible. These large-profile devices tend to be riskier in developing procedural complications, such as the parent artery rupture, initial injury, and procedure-related thromboembolic complications (Shapiro et al., 2008; Sluzewski et al., 2006; Xu et al., 2015). Another advantage of the double-microcatheter technique is that the patients do not receive a pre- or post-procedural antiplatelet aggregation therapy. In case of a ruptured aneurysm, the risk of hemorrhages would increase by pre-procedural antiplatelet preparation (Tumialan et al., 2008). Cases of procedure-related thromboembolic complications with the double-microcatheter technique would not be higher than those with the other protective device assisted techniques. Layton reported that incidence of thromboembolic complications with balloon- and stent-assisted techniques ranges from 4 to 14% and from 0 to 21%, respectively (Layton et al., 2007). In our study, one symptomatic thromboembolic complications developed one of our cases, who was treated by using Tirfiban Hydrochloride from case one. Finally, case one recovered after treating without neurologic defect. Final advantage of the double-microcatheter technique is that use of a second microcatheter will be cheaper than a balloon or a stent.

The limitations of this study include patient-selection bias and limited number of case. When the aneurysm neck is too large to be protected with a microcatheter, this technique could not be used.

Conclusions

Double microcatheter technique may be a safe and effective method for the treatment of irregular and wide-neck AComA aneurysm. Especially in cases of irregular and wide-neck AComA aneurysm, which are not suitable for other protective techniques, it is a reliable alternative method for endovascular treatment of these aneurysms with an acceptable procedure-related complication rate.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the contribution of Da-wei Wang, Hao Wang, Qing Chao for selecting these patients. The work of many authors has contributed to the formulation of ideas presented in this essay; it has not been possible to recognise all of these contributions. The authors declare that they have no conflicts of interest.

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Citation: Zhang Q-J, Zhang H, Shu H-S, Gao G, 2016. Double microcatheter technique for the treatment of irregular and wide-neck anterior communicating aneurysm. Int Res J Med Med Sci, 4(4): 38-42.