Assessment of risk factors in de novo aneurysm development

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Abstract:
Aneurysms that occur anywhere in intracranial except where primary aneurysms develop, are called “de novo aneurysms”. The risk factors and formation time of de novo aneurysms are not fully known. Congenital, environmental and hemodynamic factors can play a role in aneurysm development. The 43-year-old female patient was operated with the middle cerebral artery superior trunk aneurysm in our clinic. She came to us again after 17 months with a severe headache. In computed cranial tomography angiography, the middle cerebral artery superior trunk placement aneurysm was found to have a partial clip and “de novo aneurysm” was developed. She was re-operated for “de novo aneurysm”. In this study, the risk factors in development of “de novo aneurysms” were discussed in the light of literature through this patient.

Keywords:
De novo aneurysm, microsurgery, risk factors

Introduction

Spontaneous subarachnoid hemorrhage (SAH) is a serious complication that develops after intracranial aneurysm (IA) rupture. The prevalence of IAs is reported as 1%-5%.[1] In a small number of patients with IA, a second aneurysm may develop except the primary localization. This second aneurysm is called the “de novo aneurysm.” In the literature, “de novo aneurysm” was first reported by Graf and Hamby.[2]

Risk factors and formation time of de novo aneurysms are not fully known. Therefore, there is no accepted follow-up protocol for the determination of “de novo aneurysm” development. After the aneurysm treatment, it is difficult to determine which patients need aggressive surveillance in terms of “de novo aneurysm” development.[1,3] The aim of this study is to discuss the risk factors in the development of “de novo aneurysm” in light of literature.

Case Report

A 43-year-old female patient, who was presented to the emergency department with headache and unconsciousness, was diagnosed with SAH in the right sylvian localization in computed cranial tomography (CCT). After a digital subtraction angiography (DSA), superior trunk aneurysm of the middle cerebral artery (MCA) [Figure 1] was seen to be the cause of hemorrhage. Fisher grade was 1, Glasgow coma score (GCS) was 14, and Hunt–Hess grade was 2. After the right pterional craniotomy, the aneurysm was clipped. She came to us again after 17 months with a severe headache complaint. GCS and Hunt–Hess grade of her were 15 and 1. SAH was not observed in CCT. In CCT angiography, the MCA superior trunk placement aneurysm was found to have a partial clip and “de novo aneurysm” was developed on the right M1 [Figure 2]. The de novo aneurysm on the M1 was clipped from the right pterional old craniotomy. Then, MCA superior trunk aneurysm, which was a partial clip, was explored and total obliterated. The patient was discharged without any postoperative deficit. No new

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aneurysm and vascular pathology were observed in the CCT angiography of the patient, a year after the last operation [Figure 3].

![Figure 1: Superior trunk aneurysm of middle cerebral artery](image1)

![Figure 2: De novo aneurysm on the right M1](image2)

![Figure 3: Computed cranial tomography angiography image after last operation](image3)

**Discussion**

In the literature, the risk of developing a “de novo aneurysm” after the diagnosis of primary aneurysm is reported to be between 0.37% and 4.15% for each year.\[^{4,5}\] In conducted studies, de novo aneurysm formation was spotted between 3 and 15 years after the first aneurysm was identified.\[^{3,5-9}\] Congenital, environmental, and hemodynamic factors play a role in aneurysm development.\[^{10}\] In the development of de novo aneurysms, as in our case, female gender and smoking are particularly among the reported risk factors.\[^{4,10}\] Smoking has been stated as a risk factor for de novo aneurysm formation, as it may cause elastase and alpha antitrypsin imbalance, and therefore, it may increase the effect of hemodynamic stress on the vascular wall.\[^{11,12}\] In our case, there was more than one pack of cigarettes per day before and after the first operation. A study by Kemp et al. that evaluated the risk factors for de novo aneurysm development showed that 37.8% of the patients had hypertension and the presence of hypertension was also reported as a risk factor.\[^{4}\] Again, our case was receiving medical treatment for hypertension. There is no statistically significant difference between the ruptured or unruptured aneurysm patients in de novo aneurysm formation.\[^{10}\] Although she had headache, and SAH was diagnosed in the first aneurysm, SAH was not observed during the diagnosis of “de novo aneurysm.” In the meta-analysis carried out by Giordan et al., de novo aneurysms were mostly (>80%) detected during follow-up for more than 5 years.\[^{3}\] Our case was detected in the imaging performed as a result of severe headache 17 months after the first aneurysm operation. In the same study, Kemp et al. found that there were no statistically significant differences in “de novo aneurysm” hemorrhage between hypertension, diabetes mellitus, tobacco–alcohol usage, polycystic kidney disease, and previous history of SAH.\[^{4}\]

Other risk factors including radiation exposure, familial aneurysm history, presence of multiple aneurysms at the time of initial diagnosis, and young age (<40 years) have been reported.\[^{1,4,13}\] These risk factors were not present, in our case. In a meta-analysis by Hu et al., the appearance of the first aneurysm in internal carotid artery localization has been reported as another risk factor.\[^{1}\] In our case, the “de novo aneurysm” was developed in the proximal MCA (M1), although the first aneurysm was in the MCA superior trunk. Hemodynamic changes have also been shown to have a major impact on the development of de novo aneurysms.\[^{14}\] De novo aneurysms, due to changes in blood flow after carotid artery occlusion, are very well documented.\[^{4,13}\] Partial clipping of the first aneurysm in our case may have caused hemodynamic changes.
Perhaps, as Koeleveld et al. indicated, de novo aneurysms are actually a special case of multiple aneurysms. Many studies deem that aneurysm scans are ineffective because they can be of high cost. In the meta-analysis conducted by Giordan et al., it was thought that the screening could be done in a span of 5–10 years. However, as highlighted in our study, we reckon that there might be de novo aneurysms occurring in the early period and the controls should be annual due to the high mortality rate in case of bleeding.

**Conclusion**

Risk factors for de novo aneurysm development can be reported as young age, female gender, smoking, radiation exposure, familial history of aneurysms, hypertension, and multiple aneurysms. However, there was no statistically significant correlation between these risk factors and de novo aneurysm hemorrhage. In symptomatic patients who have had an aneurysm operation previously and have these risk factors, magnetic resonance imaging angiography, CCT angiography, and DSA should be performed even if there is no SAH on CCT.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Hu S, Yu N, Li Y, Hao Z, Liu Z, Li MH. A meta-analysis of risk factors for the formation of intracranial aneurysms. Neurosurgery 2018;30:332.
2. Graf CJ, Hamby WB. Report of a case of cerebral aneurysm in an adult developing apparently de novo. J Neurol Neurosurg Psychiatry 1964;27:153-6.
3. Giordan E, Lanzino G, Rangel-Castilla L, Murad MH, Brinjikji W. Risk of de novo aneurysm formation in patients with a prior diagnosis of ruptured or unruptured aneurysm: Systematic review and meta-analysis. J Neurosurg 2018;131:14-24.
4. Kemp WJ 3rd, Fulkerson DH, Payner TD, Leipzig TJ, Horner TG, Palmer EL, et al. Risk of hemorrhage from de novo cerebral aneurysms. J Neurosurg 2013;118:58-62.
5. Miller CA, Hill SA, Hunt WE. “De novo” aneurysms. A clinical review. Surg Neurol 1985;24:173-80.
6. Burkhardt JK, Chua MH, Weiss M, Do AS, Winkler EA, Lawton MT. Risk of aneurysm residual regrowth, recurrence, and de novo aneurysm formation after microsurgical clip occlusion based on follow-up with catheter angiography. World Neurosurg 2017;106:74-84.
7. Edner G, Almqvist H. The Stockholm 20-year follow-up of aneurysmal subarachnoid hemorrhage outcome. Neurosurgery 2007;60:1017-23.
8. Wermter MJ, van der Schaaf IC, Veltzhi BK, Algra A, Buskens E, Rinkel GJ, et al. Follow-up screening after subarachnoid haemorrhage: Frequency and determinants of new aneurysms and enlargement of existing aneurysms. Brain 2005;128:2421-9.
9. Yoneoka Y, Takeda N, Akira I, Ibuchi Y, Kumagai T, Sugai T, et al. Ruptured de novo intracranial aneurysms. Acta Neurochir (Wien) 2004;146:979-81.
10. Tonn J, Hoffmann O, Hoffmann E, Schlake HP, Sörensen N, Roosen K. “De novo” formation of intracranial aneurysms: Who is at risk? Neuroradiology 1999;41:674-9.
11. Giordan E, Brinjikji W, Vine RL, Lanzino G. Risk of de novo aneurysm formation in patients with unruptured intracranial aneurysms. Acta Neurochir (Wien) 2018;160:747-51.
12. Juvela S, Poussa K, Porras M. Factors affecting formation and growth of intracranial aneurysms: A long-term follow-up study. Stroke 2001;32:485-91.
13. Leblond R. De novo formation of familial cerebral aneurysms: Case report. Neurosurgery 1999;44:871-6.
14. Karamessini MT, Kagadis GC, Petsas T, Kambabatidis D, Konstantinou D, Sakellaropoulos GC, et al. CT angiography with three-dimensional techniques for the early diagnosis of intracranial aneurysms. Comparison with intra-arterial DSA and the surgical findings. Eur J Radiol 2004;49:212-23.
15. Wang YY, Rosenfeld JV, Lyon SM, O’Brien BJ. Rapid development of a de novo intracranial aneurysm following carotid occlusion. J Clin Neurosci 2008;15:324-30.
16. Koeleveld RF, Heilmann RB, Kluczuk RP, Shucart WA. De novo formation of aneurysm: Case report. Neurosurgery 1991;29:756-9.
17. Akyüz M, Tuncer R, Yilmaz S, Sindel T. Angiographic follow-up after surgical treatment of intracranial aneurysms. Acta Neurochir (Wien) 2004;146:455-50.
18. David CA, Vishteh AG, Spetzler RF, Lemole M, Lawton MT, Partovi S. Late angiographic follow-up review of surgically treated aneurysms. J Neurosurg 1999;91:396-401.
19. Ferns SP, Sprengers ME, van Rossum WJ, van den Berg R, Veltzhi BK, de Kort GA, et al. De novo aneurysm formation and growth of untreated aneurysms: A 5-year MRA follow-up in a large cohort of patients with coiled aneurysms and review of the literature. Stroke 2011;42:313-8.
20. Sprengers ME, van Rossum WJ, Sluzewski M, Rinkel GJ, Veltzhi BK, de Kort GA, et al. MR angiography follow-up 5 years after coiling: Frequency of new aneurysms and enlargement of untreated aneurysms. AJNR Am J Neuroradiol 2009;30:303-7.
21. Wiebers DO, Whisnant JP, Huston J 3rd, Meissner I, Brown RD Jr., Piepgras DG, et al. Unruptured intracranial aneurysms: Natural history, clinical outcome, and risks of surgical and endovascular treatment. Lancet 2003;362:103-10.