

Surgical Treatment for Brachiocephalic Artery Aneurysm with Takayasu Arteritis Using Isolated Cerebral Perfusion

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Case report

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Abstract

Background: Takayasu arteritis (TA) is a chronic inflammatory disease that induces stenosis, occlusion, or aneurysmal degeneration of the aorta and its major branches. In the surgical treatment of TA, anastomotic aneurysm can be problematic. Furthermore, atherosclerotic complications should be considered in surgical treatment for elderly TA patients.

Case presentation: Here, we report a case of brachiocephalic artery (BCA) aneurysm with TA for which surgical treatment was successful. For avoidance of anastomotic aneurysm, both distal and proximal anastomosis were reinforced with Teflon felt strips. Preoperative computed tomography detected severe atherosclerotic changes in the arch vessels. The patient underwent partial arch replacement using isolated cerebral perfusion (ICP) for brain protection and recovered without any neurological deficits.

Conclusions: In avoidance with anastomotic aneurysm, reinforcement of the anastomosis was introduced. ICP was effective for brain protection in case with severe atherosclerotic changes.

Background

The pathologic feature of chronic inflammation in Takayasu arteritis (TA) leads to stenosis, occlusion, or aneurysmal degeneration of the aorta and its major branches [1]. Although it has been found that the involvement of arch vessels is detected more frequently in Japan [2, 3], there have been few reports describing the surgical treatment for arch vessel aneurysm in TA. For aneurysms in TA, because simple patch repair or partial clamping should be avoided due to the increased risk of developing anastomotic aneurysms [4, 5], reinforcement of the suture lines has been recommended [1]. Furthermore, in order to prevent this complication, suppression of active or persisting inflammation with corticosteroid is reported [1, 3].

Moreover, atherosclerotic changes become problematic in elderly TA patients. In aortic surgery for patients with severe atherosclerotic changes, brain protection is a priority. While many reports have described brain protection techniques during aortic arch repair, isolated cerebral perfusion (ICP) may be promising in these cases [6]. In this report, the surgical treatment of brachiocephalic artery (BCA) aneurysm focused on brain protection was discussed. Furthermore, the method of preventing anastomotic aneurysms was described.

Case Report

A 78-year-old male patient with TA was referred to our hospital for the treatment of a BCA aneurysm. He had been treated for TA with 10 mg/day oral administration of prednisolone for 24 years. He was also treated for hypertension at a local hospital and had no history of cardiovascular diseases. Computed tomography showed a BCA aneurysm measuring 32 mm in diameter with a thickened aortic wall ranging from the orifice of the BCA to the bifurcation of the right common carotid and right subclavian artery (Fig. 1a). Computed tomography also showed severely atherosclerotic changes in the arch vessels

(Fig. 1b). C-reactive protein level was 0.2 mg/dl, and erythrocyte sedimentation rate was 6.0 mm/hour. Taking into consideration of the patient's comorbidities, partial arch replacement with ICP was scheduled. Following median sternotomy, cardiopulmonary bypass was established with femoral artery cannulation (Fig. 2a) and bicaval drainage with a low flow (0.5 L/min). When the cardiopulmonary bypass got stabilized, direct cannulation of bilateral carotid arteries was added with a proximal clamp not to flush debris to the distal site (Fig. 2a). Total cardiopulmonary bypass was gained by additional cannulation through the ascending aorta and an 8-mm graft anastomosed to the right subclavian artery (Fig. 2a). The chronic inflammation changes compatible with TA, such as wall thickening and increased hardness, were observed in the ascending aorta (Fig. 2b). When the body temperature reached to 25 °C, lower body circulatory arrest was introduced. The orifice of the right subclavian artery was closed with a continuous 4 - 0 polypropylene suture through inside of the aneurysm. The orifice of arch vessels presented with severe atherosclerotic changes. Partial arch replacement with 28 mm quadrifurcated graft (Triplex®, Terumo Corporation, Tokyo, Japan) was performed with an open distal anastomosis technique. After distal anastomosis, the neck vessels including right subclavian artery, right carotid artery, and left carotid artery, were reconstructed with each branch of the artificial graft individually (Fig. 2c). Both distal and proximal anastomosis were reinforced with Teflon felt strips at inner and outer side of the aortic wall. Weaning from cardiopulmonary bypass was uneventful, and the patient recovered without any neurological deficits. Postoperative brain imaging detected no significant cerebral infarctions. Postoperative computed tomography demonstrated no anastomotic aneurysms and no abnormal flow in the aneurysm (Fig. 1c). Pathological results reported that the intima of the aorta had focal and raised plaques. During the perioperative period, management with additional prednisolone infusion was done, and the patient has never experienced episodes of exacerbation of inflammation. The patient remained free from any major adverse aortic and cerebrovascular events 1 year after surgery.

Discussion

The main pathologic feature of TA is the extensive destruction of the medial elastic fibers that maintain the strength of the aortic wall [4, 5]. This feature often leads to stenosis, occlusion, or aneurysmal degeneration of the aorta and its major branches [1]. Although the involvement of arch vessels has been detected more frequently in Japan [2, 3], there have been few articles about surgical repair for arch vessel aneurysms in TA.

Operative indications for BCA aneurysms include either ruptured or symptomatic aneurysms, such as distal embolization or compression of the adjacent structures. When the aneurysms are saccular or when their maximum transverse diameter is more than 3 cm, surgical repair should be considered, even when asymptomatic [7]. Although the present case did not present with any symptoms related to the aneurysm, a size of over 3 cm was the deciding factor for surgical treatment.

Treatment strategy for BCA aneurysm depends on the extent of involvement. When the lesion is extremely localized, endovascular repair can be performed, but this method is rarely enforceable. Mostly open surgical repair including graft interpose, patch plasty with partial clamp, and partial or total aortic arch

repair has been reported [7]. Patch plasty with partial clamp seemed desirable because circulatory arrest would have been avoided; however, anastomotic problems remained. Okita et al. reported a higher incidence of pseudoaneurysm or residual aneurysmal formation after patch repair for a saccular aneurysm of the aortic arch [8].

Furthermore, in TA, it often happens that the aorta has been affected by chronic inflammation, even though the preoperative images appeared to show a healthy and normal aorta. Because a serious long-term complication in TA includes anastomotic aneurysms, sites of normal tissue without inflammatory changes should be chosen as the anastomotic sites [4]. It is also important to exclude inflamed cervical vascular lesions [3]. In accordance with these reports, reinforcement of the sutures has been recommended [1]. In the present case, reinforcement of the proximal and distal anastomosis with Teflon felt strips at inner and outer side of aortic wall was performed. Because an anastomotic aneurysm may occur at any time after surgery, regular follow-up using multiple imaging modalities is mandatory [5]. Although systemic inflammation or steroid administration had reportedly little influence on formation of anastomotic aneurysm [4, 5], suppression of active or persisting inflammation with corticosteroids is recommended [1, 3].

In aortic surgery for patients with severe atherosclerotic changes, protection of the brain tissue is important. There have been many reports describing various strategies for brain protection; however, the optimal management remains unclear. Axillary or BCA perfusion seems promising, but turbulent flow in the proximal aortic arch may still dislodge the atheroma [6]. Furthermore, bilateral axillary artery perfusion may fail to reduce the risk of embolism of the left common carotid artery because blood flow from the axillary arteries spreads into the aortic arch, resulting in plaque disruption by jet flow [9]. Shiiya et al. introduced an isolation technique to address these issues [6]. This technique involves the concept of distributing blood flow to each neck vessels individually, resulting in the prevention of a distal embolism. Kasama et al. reported the advantage of this method by investigating ICP in elderly patients with severely atherosclerotic changes [9]. In the present case, this strategy enabled us to avoid jet flow from the aortic arch, and the patient recovered without any neurological deficits. Slowly establishment of the cardiopulmonary bypass through a femoral artery and additional carotid artery perfusion could prevent plaque embolism from the aortic arch. Further studies on the effectiveness of ICP are warranted.

Conclusions

We present the case of BCA aneurysm with TA that was successfully treated with partial arch replacement. In avoidance with anastomotic aneurysm, reinforcement of the anastomosis was introduced. ICP was effective for brain protection in case with severe atherosclerotic changes.

List Of Abbreviations

Takayasu arteritis; TA, brachiocephalic artery; BCA, isolated cerebral perfusion; ICP

Declarations

Ethical Approval and consent to participate: This case report was approved by the Institutional Review Board of Aichi Medical University Hospital.

Consent for publication: The patient provided permission to publish the features of his case. The identity of the patient has been protected.

Availability of data and materials: All data generated or analyzed during this study are included in this article.

Competing interests: The Authors declare that there is no conflict of interest. We received no financial support for this study.

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Authors' contributions: analysis: KS, KM; interpretation of data: KS, KM; drafting and revising the paper: KS; final approval of the paper: all authors; agreement to be accountable for the integrity of the case reports: all authors. All authors have read and approved the final manuscript.

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References

1. Regina G, Angiletta D, Bortone A, Fullone M, Marinazzo D, Pulli R. Aortic aneurysms in Takayasu arteritis. DOI; 10.5772/22745.
2. Ogino H, Matsuda H, Minatoya K, Sasaki H, Tanaka H, Matsumura Y, et al. Overview of late outcome of medical and surgical treatment for Takayasu arteritis. *Circulation*. 2008;118:2738–47.
3. Matsuura K, Ogino H, Matsuda H, Minatoya K, Sasaki H, Yagihara T, et al. Surgical outcome of aortic arch repair for patients with Takayasu arteritis. *Ann Thorac Surg*. 2006;81:178–82.
4. Miyata T, Sato O, Deguchi J, Kimura H, Namba T, Kondo K, et al. Anastomotic aneurysms after surgical treatment of Takayasu's arteritis: A 40-year experience. *J Vasc Surg*. 1998;27:438–45.
5. Miyata T, Sato O, Koyama H, Shigematsu H, Tada Y. Long-term survival after survival treatment of patients with Takayasu's arteritis. *Circulation*. 2003;108:1474–80.
6. Shiiya N, Kuniyama T, Kamikubo Y, Yasuda K. Isolation technique for stroke prevention in patients with a mobile atheroma. *Ann Thorac Surg*. 2001;72:1401–2.
7. Kieffer E, Chiche L, Koskas F, Bahnini A. Aneurysms of the innominate artery: Surgical treatment of 27 patients. *J Vasc Surg*. 2001;34:222–8.

8. Okita Y, Takamoto S, Ando M, Morota T, Yamaki F, Matsukawa R. Long-term results of patch repair for saccular aneurysms of the transverse aortic arch. *European journal of cardio-thoracic surgery*. 1997;11:953–6.
9. Kasama K, Uchida K, Karube N, Takebayashi S, Imoto K, Masuda M. Impact of isolated cerebral perfusion technique for aortic arch aneurysm repair in elderly patients. *Ann Thorac Surg*. 2019;107:533–8.

Figures



Figure 1

Preoperative computed tomography showing brachiocephalic artery aneurysm (black arrow) measuring 32 mm in diameter with thickened aortic wall



Figure 2

Preoperative computed tomography showing severe atherosclerotic changes in the aortic arch and orifice of the arch vessels



Figure 3

Postoperative computed tomography showing no anastomotic aneurysm and no abnormal flow in the previous aneurysm

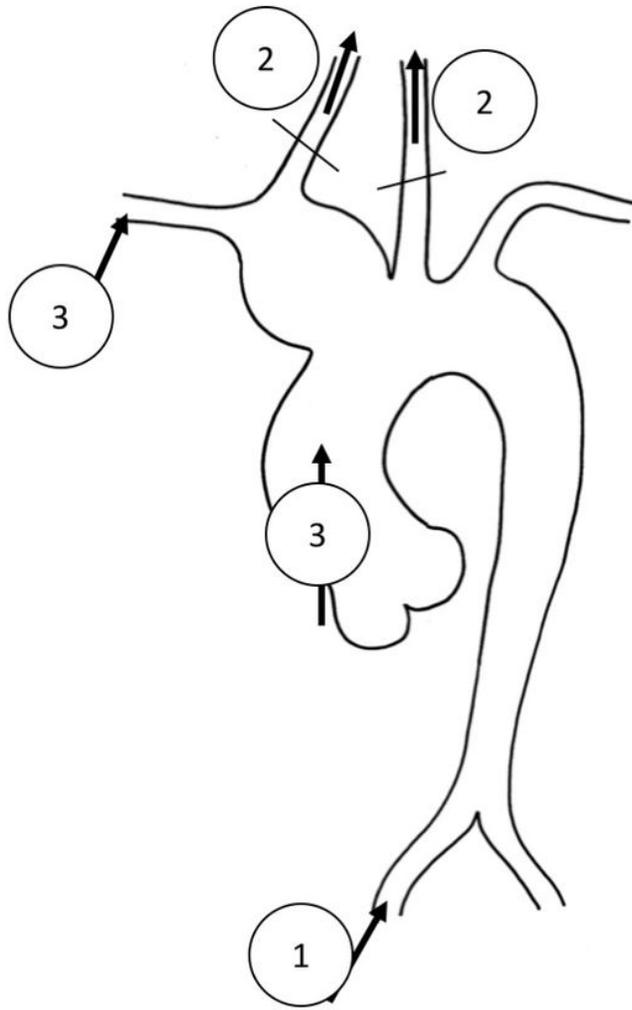


Figure 4

Schematic drawing of the isolated cerebral perfusion technique. Black arrows indicate perfusion sites and the numbers representing the order of perfusion

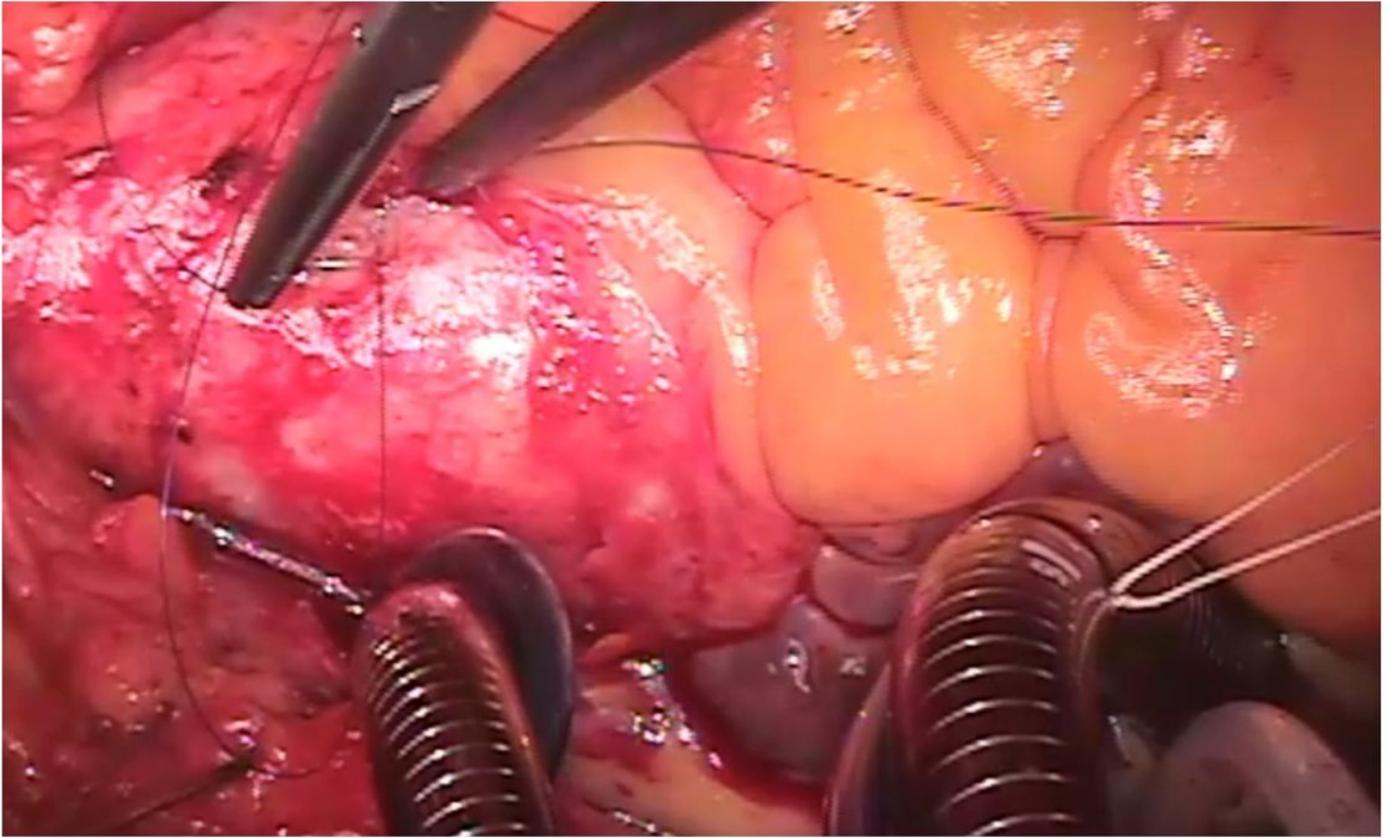


Figure 5

Intraoperative view showing thickening and hardness of the ascending aortic wall

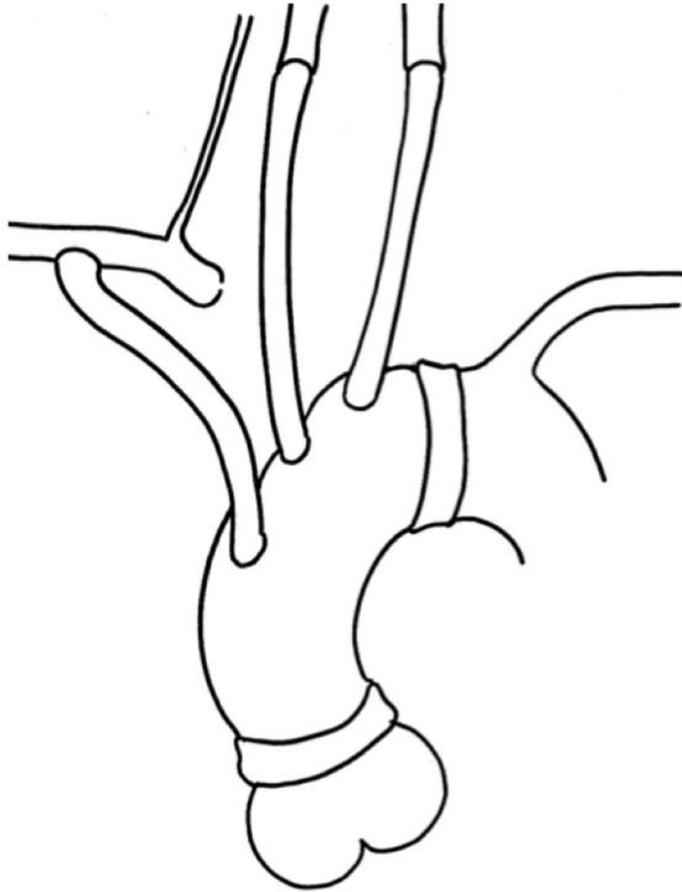


Figure 6

Completed drawing of partial arch replacement

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