Case Report

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Innominate artery aneurysm, how to solve it?

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Abstract

We herein describe our experience with a congenital innominate artery aneurysm (IAA) that was managed with a simple surgical procedure. A 44-year-old woman was admitted for chest distress. Computed tomography angiography showed a 3.6-cm IAA arising from the aortic arch and compressing the trachea. A median sternotomy was performed with the patient under general anesthesia, and the IAA was found to involve the origin of the innominate artery and the bifurcation of the right subclavian artery and common carotid artery; however, the aorta was intact. An 8-mm Dacron graft was anastomosed to the ascending aorta and distal end of the IAA without cardiopulmonary bypass. The postoperative course was uneventful, and repeat computed tomography angiography revealed no evidence of recurrence 6 months postoperatively. We also herein present a literature review of this rare clinical condition.

Keywords

Innominate artery aneurysm, Treatment, Surgery

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Introduction

A supra-aortic vessel aneurysm is an uncommon form of aneurysmal disease, and only 3% of such aneurysms are innominate artery aneurysms (IAAs).[1,2] We herein describe our experience with an IAA that was managed with a simple surgical procedure and present a literature review on this rare clinical condition.

Case report

A 44-year-old woman was admitted for chest distress. She had undergone a

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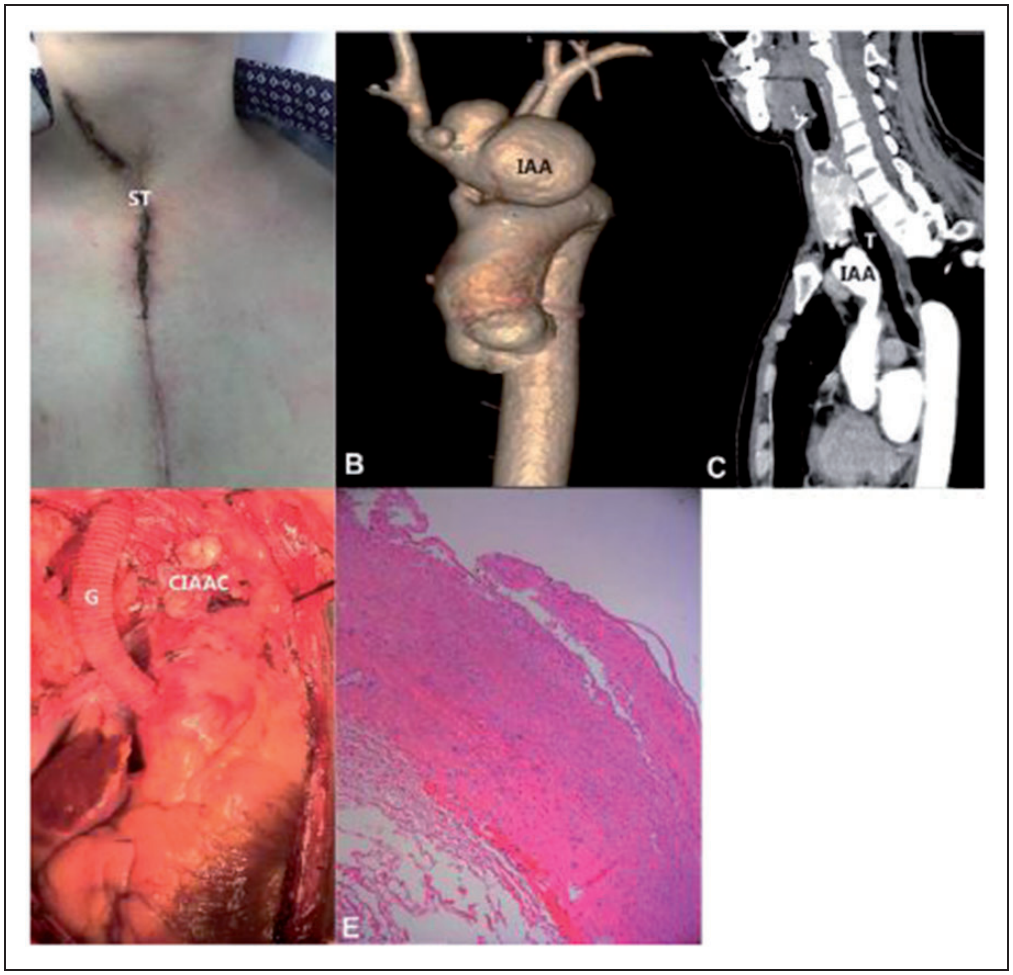

Figure 1. (a) Photograph showing a macroscopic view of the tracheotomy scar (TS). (b) Three-dimensional reconstruction of computed tomography showing the innominate artery aneurysm (IAA). (c) Sagittal computed tomography view showing that the IAA compressed the trachea (T) but did not involve the origin of the innominate artery. (d) Operative photograph showing the replaced graft (G) and closed IAA cavity (CIAAC). (e) Histologic examination showed degeneration of the elastic lamina.

tracheotomy 28 days after birth for unknown reasons, and the tracheotomy scar was evident on physical examination (Figure 1(a)). Transthoracic echocardiography demonstrated normal cardiac structure and function, with a left ventricular ejection fraction of 65% and an ascending aorta diameter of 2.8 cm. Computed tomography angiography showed an IAA (3.6 cm) arising from the aortic arch and compressing the trachea (Figure 1(b) and (c)).

With the patient under general anesthesia, the right neck was incised along the medial edge of the sternocleidomastoid muscle. The distal IAA was then visualized proximal to the bifurcation of the right subclavian artery and common carotid artery, but the origin of the IAA could not

be exposed. Therefore, a median sternotomy was made and the IAA was found to involve the origin of the innominate artery and the bifurcation of the right subclavian artery and common carotid artery; however, the aorta was intact.

After systematic heparinization (1 mg/kg), the distal ascending aorta was side-clamped, and a 5-0 Prolene suture was used to anastomose an 8-mm Dacron graft to the ascending aorta in an end-to-side fashion. Both the origin and distal end of the IAA

Table 1. Summary of 120 case reports of innominate artery aneurysms.

Year	First author	Number of patients	Mean age (y)	Sex
1844–1948	Gordon-Taylor	52	47.75	Male: 32, Female: 12, N/A: 8
1951	Lane	1	N/A	N/A
1953	Kirby	1	N/A	N/A
1960	Cook	3	N/A	N/A: 3
1960	Zintel	1	50	Male
1971	Murray	1	N/A	N/A
1972	Thomas	1	N/A	N/A
1979	Schumacher	1	N/A	N/A
1983	Ketonen	2	N/A	N/A
1988	Tominage	1	N/A	N/A
1991	Bower	6	56.8	Male: 5, Female: 1
1993	Adkins	1	76	Female
1996	Villegas-Cabello	1	69	Male
1999	Najafi	1	53	Male
2001	Chiappini	1	19	Male
2001	Guibaud	1	43	Male
2001	Kasashima	1	45	Male
2001	Kieffer	27	52.4	Male: 18, Female: 9
2001	Park	1	33	Male
2001	Puech-Leao	1	44	Male
2004	Ikonomidis	1	54	Female
2004	Mellisano	1	71	Male
2005	Saito	1	50	Female
2006	Oruganti	1	36	Male
2007	Da Col	1	75	Female
2007	MacLean	1	55	Female
2007	Takach	1	63	Female
2009	Yang	1	10	Male
2010	Taha	1	46	Male
2011	Oswal	1	28	Male
2011	Lu	1	66	Male
2012	Angiletta	1	16	Female
2012	Constenla	1	63	Male
2013	Erdinc	1	81	Male
2016	Jiang	1	44	Female

N/A: not available.

were clamped, the distal innominate artery and IAA were fully visualized, and the distal innominate artery and other end of the Dacron graft were connected in an end-to-end manner. Next, distal perfusion of the innominate artery was restored; the cross-clamping time was only 6 min. Finally, both the origin of the innominate artery and the IAA cavity were closed by suturing (Figure 1(d)). Histological examination showed degeneration of the elastic lamina of the excised aneurysmal tissues (Figure 1(e)). The postoperative course was uneventful, and the patient was discharged at 5 days. Repeat computed tomography angiography revealed no evidence of recurrence 6 months postoperatively.

Discussion

IAAs account for 3% of supra-aortic vessel aneurysms and may lead to devastating complications, including thrombosis, distal embolization, compression of adjacent tissues and organs, and even rupture.[3] The incidence of rupture is 11% in such patients.[4] In particular, IAAs are more liable to rupture when the diameter exceeds 3 cm.[4,5] Since 1844, approximately 120 cases of IAA have been reported in the literature (Table 1). Three types of IAA have been described based on the extent of involvement of the innominate artery origin and aorta (Table 2): (A) no involvement of the origin of the innominate artery, (B) involvement of the origin of the innominate artery but not of the aorta, and (C) involvement of both the innominate artery and aorta.[4]

Previous studies have shown that IAAs are mainly caused by atherosclerosis; other causes may include syphilis, tuberculosis, Kawasaki disease, Takayasu arteritis, Behçet disease, connective tissue disorders, and angiosarcoma.[6,7] Among 120 patients with IAAs, the etiology was unknown in 70 (58.3%), trauma in 17 (15.3%), Takayasu arteritis in 8 (7.2%), atherosclerosis in 7 (5.8%), syphilis in 5 (4.5%), chronic dissection in 3 (2.7%), infection in 3 (2.7%), Kawasaki disease in 1 (0.9%), Behçet disease in 1 (0.9%), iatrogenic injury in 1 (0.9%), arteritis in 1 (0.9%), with a proximal false aneurysm in an aorto-innominate bypass graft in 1 (0.9%), Marfan syndrome in 1 (0.9%), and mural aortic angiosarcoma in 1 (0.9%).

Table 2. Classification and etiology of 120 cases of innominate artery aneurysms.

Classification	Etiology
A: 53, B: 27, C: 16, N/A: 24	N/A: 70 Trauma: 17 Takayasu arteritis: 8 Atherosclerosis: 7 Syphilis: 5 Chronic dissection: 3 Infection: 3 Arteritis: 1 Behçet disease: 1 Iatrogenic injury: 1 Kawasaki disease: 1 Marfan syndrome: 1 Mural aortic angiosarcoma of endothelial origin: 1 Proximal false aneurysm of an aorto-innominate bypass graft: 1

N/A: not available.
A: no involvement of the origin of the innominate artery, B: involvement of the origin of the innominate artery but not of the aorta, C: involvement of both the innominate artery and aorta

Clinically available approaches to IAA include ligature, surgical repair, medical treatment, and endovascular treatment (Table 3). Before 1950, all patients with IAA described in the literature underwent ligature of the IAA, but this technique was associated with a very high mortality rate of 42.3% (22/52). After 1950, the mortality rate associated with surgical repair of IAA was 4.7% (3/64), and 3 late deaths occurred due to cancer, stroke, and vasculitis with heart disease.

Table 3. Treatment and outcomes of 120 cases of innominate artery aneurysms.

Treatment access	Number	CPB	Outcome
Conservative	1	0 of 1	Survived
Stent-graft by catheter	4	0 of 4	All survived
Hybrid endovascular repair (full median sternotomy and debranching)	1	0 of 1	Survived
Ligature of innominate artery	52	0 of 52	Survived: 30 of 52
Open surgical repair	1	0 of 1	Survived
Open surgical repair (full median sternotomy with anterior neck dissection)	6	0 of 6	All survived
Open surgical repair (full median sternotomy)	46	17 of 46	Survived: 43 of 46
Open surgical resection	2	1 of 2	Both survived
Open surgical repair (upper hemisternotomy)	4	2 of 4	All survived
Open surgical repair (partial median sternotomy)	1	0 of 1	Survived
Open surgical repair (L-shaped incision on right side of neck and chest)	1	0 of 1	Survived
Open surgical repair (full median sternotomy) after stent treatment	1	0 of 1	Survived

CPB: cardiopulmonary bypass

Although no death occurred among the four patients managed with endovascular treatment, surgical repair is currently the standard approach to IAA. In fact, endovascular treatment is also limited by the classification of IAA. Endovascular treatment is indicated in patients with an intact origin of the innominate artery, while hybrid endovascular repair (full median sternotomy and debranching) is suitable for patients with an aneurysm of innominate artery and aorta. Although no reports have described such a technique, endovascular treatment may be feasible for patients with an aneurysm of the origin of the innominate artery but not of the aorta.

Midline sternotomy is the exposure technique of choice. Among all 64 patients who underwent surgical repair, full median sternotomy was applied in 53 and partial median sternotomy was applied in 5. Cardiopulmonary bypass may be beneficial in such patients. Among all 64 patients who underwent surgical repair, 20 underwent cardiopulmonary bypass. When cardiopulmonary bypass is unavailable, the simple procedure used in the present case is an excellent choice. Surgical repair is indicated when both the aorta and origin of the innominate artery are involved. The extent of involvement was described in 111 patients: innominate artery origin in 26 (23.4%), innominate origin and aorta in 15 (13.5%), and innominate artery distal to its origin in 70 (63.1%). Among the 64 patients who underwent surgical repair, the operation was completed without cardiopulmonary bypass in 67.2% (43/64), including the current case; the remaining 21 patients (32.8%) with aortic and innominate involvement were managed under cardiopulmonary bypass.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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