# Multiple aneurysms in childhood

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**Arterial aneurysms in children are rare. When present, they are often associated with connective tissue disorders or arteritidies. Idiopathic aneurysms occurring at multiple sites throughout the arterial tree are rare, with only ten cases reported. This report describes a case of multiple arterial aneurysms of uncertain origin involving upper-extremity, extracranial cerebrovascular, aortoiliac, and renal arteries in a 14-year-old boy. The clinical presentation, vascular reconstruction, pathologic findings, and a brief review of the literature are described. (J Vasc Surg 2004;39:254-9.)**

Arterial aneurysms occur uncommonly in the pediatric population. When present, they are usually associated with connective tissue disorders (Ehlers-Danlos or Marfan's syndrome), arteritidies (Takayasu's, polyarteritis nodosa, or Kawasaki's disease), tuberous sclerosis, trauma, and infection. Multiple arterial aneurysms occurring at multiple sites without these associated disorders are rare.[1-11]

Herein we report a case of multiple idiopathic aneurysms involving several central and peripheral arteries in an adolescent patient. The clinical presentation, surgical management, and pathologic findings are emphasized.

## CASE REPORT

A 14-year-old Caucasian boy was evaluated for headache and depression at 8 years of age. On physical examination, he was found to have severe hypertension and a palpable left brachial artery aneurysm. Angiography demonstrated multiple arterial aneurysms involving the left vertebral, left brachial and radial, left renal, and both internal and external iliac arteries (Fig 1). Coronary angiography demonstrated no evidence of coronary artery aneurysms. There were no antecedent constitutional symptoms. There was no family history of aneurysmal disease. Skin biopsy was negative for vascular Ehlers-Danlos syndrome. Other serology, including inflammatory markers, was negative.

A 9-cm left vertebral artery aneurysm was excluded with coil embolization, and the left brachial artery was repaired with saphenous vein bypass graft. Histologic examination of the diseased brachial artery revealed no definitive pathologic diagnosis.

The patient received clinical follow-up with periodic computed tomography (CT) and magnetic resonance angiography (MRA). During a 5-year follow-up, a right renal artery aneurysm developed while the previously identified left renal artery aneurysm was associated with new branch renal artery occlusion (Fig 2). In addition, the common iliac and left internal iliac aneurysms increased in size. The patient received an aortobifemoral graft with bypass graft to the left hypogastric artery at another institution. The histologic examination of the aneurysm did not establish a definitive pathologic diagnosis. At no time were C-reactive protein levels or erythrocyte sedimentation rates elevated.

Over the next 18 months, the patient experienced worsening hypertension and flank pain. On follow-up imaging, the right renal artery aneurysm had increased to 4.5 cm, with involvement of the renal hilum and new branch aneurysms (Fig 3). At this time, the patient was referred to our facility for evaluation and treatment. Because of the large size, rapid growth, and worsening hypertension, right renal artery aneurysm repair was recommended.

At operation, a dominant true renal artery aneurysm and smaller branch aneurysms involving secondary vessels were identified (Fig 4). An ex vivo cold perfusion technique was used to facilitate hilar dissection and extend safe ischemia time. Preparation for ex vivo cold preservative perfusion included dissection of the renal artery, vein, and ureter. The kidney was mobilized from Gerota's space, and systemic anticoagulation was established with intravenous sodium heparin. Once anticoagulation was achieved, the renal artery and vein were divided, the ureter was controlled with a silicone loop, and the kidney was perfused with modified Travenol solution (Baxter Laboratories, Deerfield, Ill) chilled to 4°C. The kidney was then placed in ice slush. The aneurysms were resected, and 4 of 5 segmental renal artery branches were syndactylized. A fifth segmental branch was excluded. Renal artery reconstruction was performed with thin-walled 6-mm polytetrafluoroethylene, with the prior aortofemoral graft used as the inflow source. The kidney was replaced in an orthotopic position. Cold ischemia time totaled 80 minutes. The patient recovered uneventfully and was discharged home on oral labetalol (450 mg daily).

Pathologic examination of the renal artery aneurysm demonstrated chronic vasculitis and atherosclerosis with focal breakdown of the vessel wall, lymphohistiocytic infiltration, giant cells, and fragmentation of the elastic lamina (Fig 5). Pathologic specimens from two institutions involved in the surgical treatment of this patient demonstrated similar findings and were interpreted as nonactive vasculitis. Additional genetic and serologic testing was normal.

Three months after surgery, duplex sonography demonstrated a patent repair without evidence of aneurysm recurrence. At the time of this report, the contralateral renal artery aneurysm and the radial artery aneurysm were stable in size and had not been repaired.

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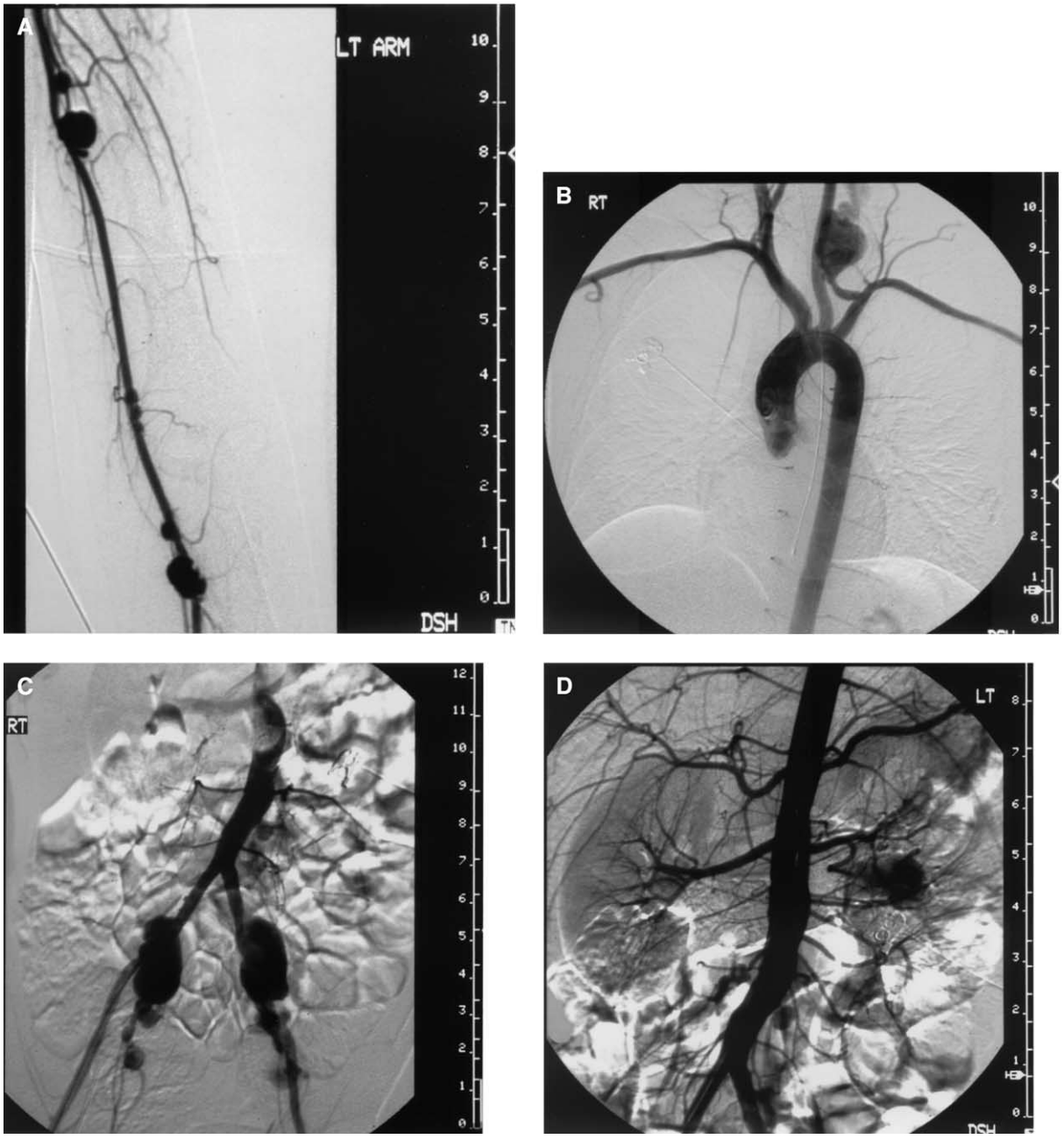


**Fig 1.** Angiograms from 1996 demonstrate **(A)** left brachial artery aneurysms, **(B)** a large left vertebral aneurysm, **(C)** bilateral iliac artery aneurysms, and **(D)** a left renal artery aneurysm. Note the right renal artery is completely free of aneurysmal disease.

## DISCUSSION

Arterial aneurysm disease in children is rare. In this case of a 14-year-old Caucasian boy with arterial aneurysms at multiple sites, initial presentation demonstrated brachial and vertebral artery aneurysms in addition to left renal, bilateral iliac, and aortic aneurysms. Initial treatment included embolization of the vertebral artery and saphenous bypass graft of the brachial artery aneurysm. Over the course of 5-year follow-up, the iliac aneurysms increased in size and the patient received aortoiliac reconstruction. A new right renal artery aneurysm developed that grew to 4.5 cm over a 20-month period. Numerous pathologic and serologic examinations failed to establish a definitive diagnosis.

Pediatric aneurysms are caused by a heterogeneous group of disorders, including connective tissue disorders, arteritidies, tuberous sclerosis, trauma, and infection. Classification of these pediatric aneurysms has been pro-

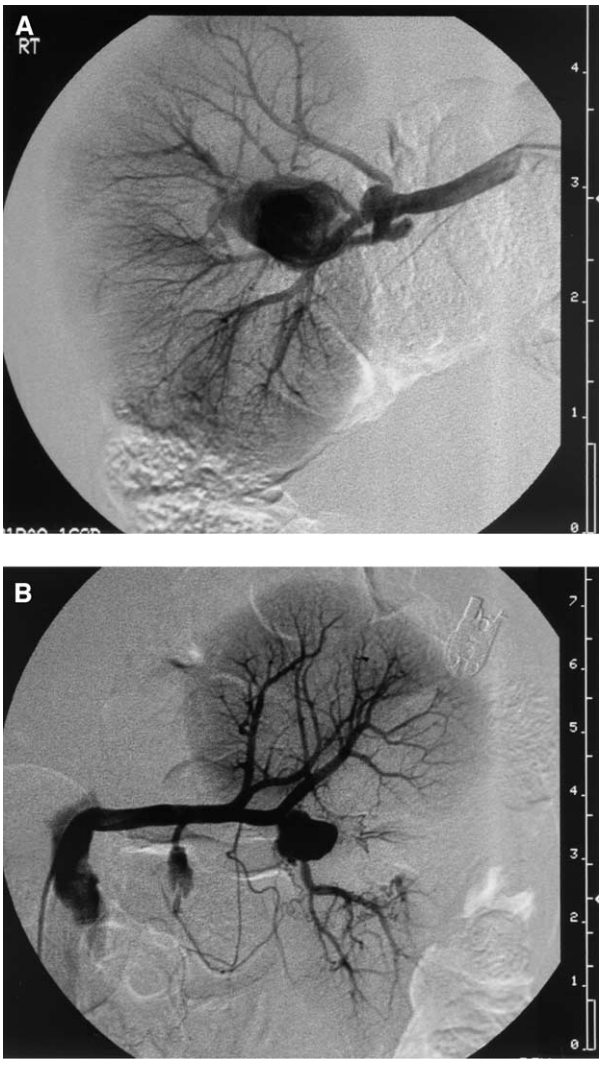


**Fig 2.** Selective angiograms from 2000 demonstrate **(A)** a large right renal artery aneurysm with two smaller aneurysms and **(B)** occlusion of the prior renal artery aneurysms with left renal infarction and new branch aneurysms.

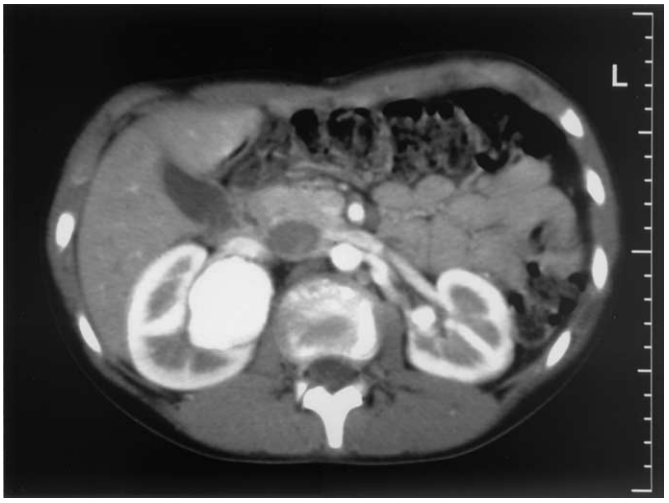


**Fig 3.** Contrasted CT scan from 2002 demonstrates a 4.5-cm right renal artery aneurysm within the renal hilum. A small left renal artery aneurysm with mural thrombus is demonstrated.

posed.[12,13] To date, only ten cases of multiple idiopathic aneurysms occurring in young patients have been reported (Table).

Ehlers-Danlos syndrome (EDS) represents a group of diseases caused by an underlying disorder of collagen metabolism. The vascular form of EDS (type IV) stems from abnormal synthesis or secretion of type III collagen. This disorder predisposes arteries to medial degeneration and aneurysm formation involving the aorta and peripheral arteries. Arterial fragility makes treatment of EDS extremely difficult, and angiography alone results in severe complications in up to 67% of cases.[14] The diagnosis of EDS is confirmed by abnormal assays for type III collagen from cultured fibroblasts provided by skin biopsy. Although not confirmed, a minor form of EDS was suspected in one case of multiple aneurysms in childhood.[7] In the current case, EDS was excluded because of the presence of normal type III collagen synthesis and secretion by cultured fibroblasts.

Aneurysm disease in children resulting from Takayasu's arteritis (TA) is rare. The diagnosis of TA, or aortoarteritis, is based on a combination of clinical and angiographic features.[15] The "prepulseless" phase of the disease is typically characterized by constitutional symptoms of malaise, anorexia, fatigue, weight loss, anemia, myalgias, fevers, and night sweats, and the late "pulseless" phase results from occlusion of the affected arteries. No specific laboratory marker is associated with TA; however, the erythrocyte sedimentation rate is frequently increased during the active inflammatory phase. Typical angiographic findings include a combination of aneurysm formation and cylindrical segmental stenosis or occlusion. Histologic examination demonstrates medial degeneration with disruption of the elastic lamina. Giant cells may be present. Aneurysms occurring in children with TA usually involve the aorta or major branches, and few peripheral aneurysms have been described.[16,17] Only one case of aneurysms involving multiple vessels has been attributed to TA.[6] In the current case, giant cells demonstrated on histologic examination of the renal artery aneurysm were consistent with TA; however, a history of constitutional symptoms was absent and serologic examination for inflammatory markers was negative on multiple occasions. Nevertheless, this case may represent an atypical presentation of TA. To our knowledge, the combination of multiple central and peripheral aneurysms occurring in childhood has not previously been reported with this disease.

Kawasaki's disease is characterized by coexistent panarteritis and mucocutaneous lymph node syndrome, which includes sterile conjunctivitis, desquamation, erythema and

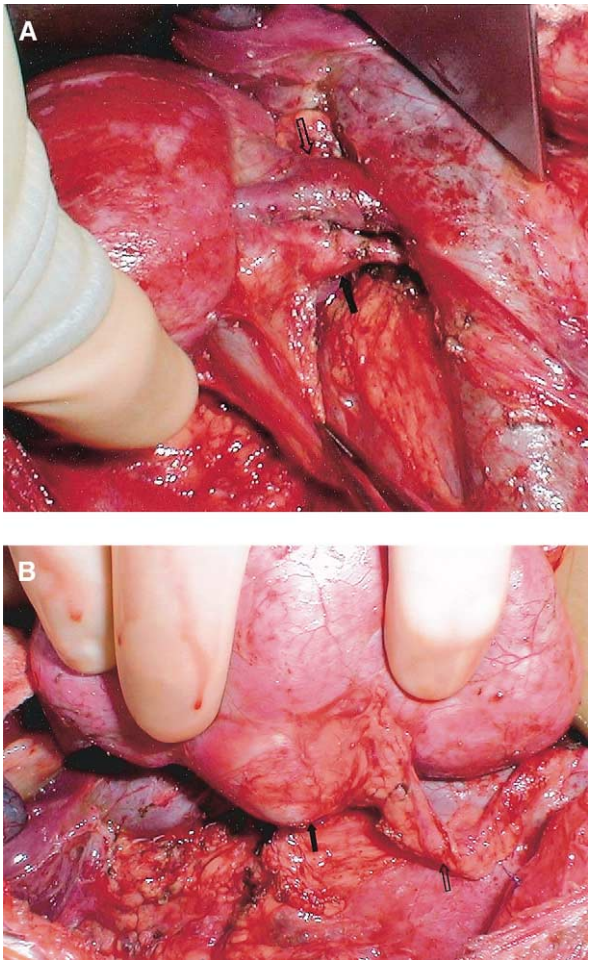


**Fig 4.** Intraoperative photographs demonstrate a right renal artery aneurysm with **(A)** branch renal artery involvement (renal artery: *solid arrow*; renal vein: *open arrow*) and **(B)** renal hilar involvement (aneurysm: *solid arrow*; ureter: *open arrow*).

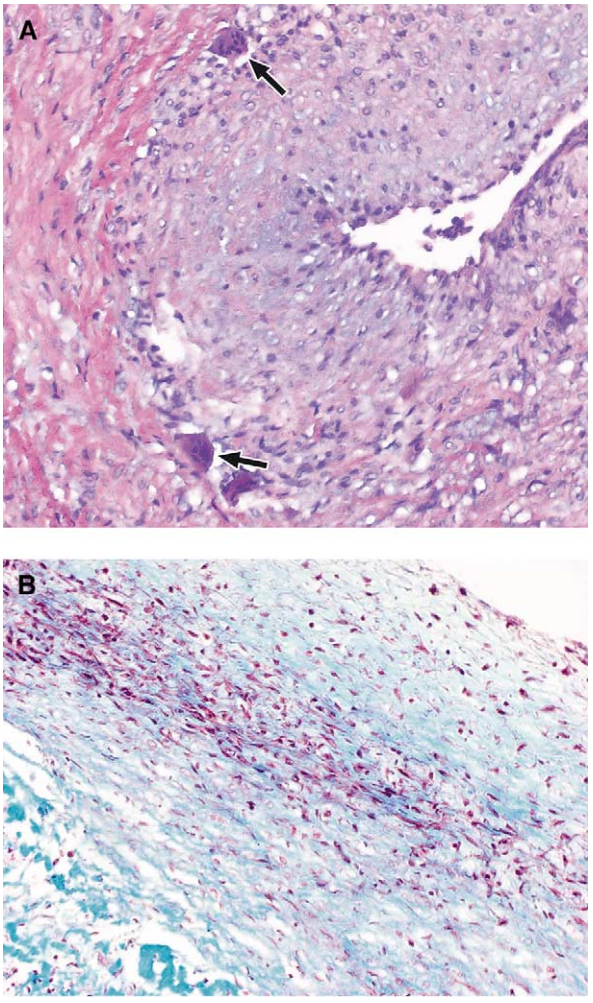


**Fig 5.** Photomicrographs of the right renal artery branch aneurysm demonstrate perimedial giant cells (*arrowheads*) and lymphohistiocytic infiltration **(A)** H&E, ×200 magnification; **(B)** elastic trichrome, ×400 magnification.

fissuring of the lips, and edema of the hands and feet. Aneurysms involving the coronary arteries occur most frequently, and the axillobrachial and iliofemoral vessels are less frequently diseased. In one case of multiple aneurysms occurring in a child, Kawasaki's disease was cited as a possible origin.[7] The diagnosis of Kawasaki's disease was considered unlikely in the current case because of the absence of the typical clinical syndrome in combination with normal coronary angiography.

The finding of an arterial aneurysm in childhood should prompt a thorough evaluation for other aneurysms. Imaging of the entire vascular tree is warranted in these children. Antecedent constitutional symptoms and family history of aneurysm disease should be sought. Before invasive studies, vascular EDS should be excluded with skin biopsy to avoid complications of angiography. Although angiography remains the standard imaging technique in many centers, recent advances in noninvasive imaging (ie, computed tomography angiography and magnetic resonance angiography) have made these modalities particularly useful in children.

Prevention of aneurysm-related complications is the primary goal of vascular reconstruction in these children. Reports of untreated aneurysms in young patients progressing to rupture or causing embolic complications have been described.[1,2,6,18] In addition, progression of aneurysm disease and formation of new aneurysms over the course of follow-up has been described.[3-5,9] The development of pediatric aneurysms mandates close surveillance of the entire vascular tree to identify enlarging or new aneurysms before complications. Of particular concern in the current case was the rapid enlargement of the right renal artery aneurysm over a 20-month follow-up period.

The choice of arterial conduit is especially problematic in these young patients. Vascular reconstruction of the aorta, iliac arteries, and visceral vessels with prosthetic graft

Reports of multiple idiopathic aneurysms in children

| *Author* | *Year* | *Age (y)* | *Gender* | *Vessels involved* | *Repair* | *Outcome* |
|---|---|---|---|---|---|---|
| Miguel[1] | 1834 | 14 | M | AAA, upper extremity | none | Rupture/death |
| Williams[2] | 1975 | 5 | M | AAA, bilateral common iliac and renal, left brachial, bilateral radial | Aortic reconstruction, left nephrectomy | — |
| Short[3] | 1978 | 7 | F | AAA, bilateral renal, right brachial, common iliac and anterior tibial, bilateral popliteals | Extremity saccular aneurysms serially resected aotic and renal aneurysm left in situ | Good (14-year follow-up) |
| Schiller,[4] O'Hara[5] | 1983 | 8 | M | AAA, right renal, internal iliac, brachial, circumflex humoral, popliteal and posterior tibial, bilateral superficial femoral | 1) Aortic reconstruction | Good, discharged after closure of bile fistula (second operation) |
| | 1985 | | | | 2) Aortic reconstruction (redo) with ligation of right hypogatric and ex-vivo repair of right RAA | |
| Fee[6] | 1983 | 3 | | Left subclavian, ectasia of right common carotid, splenic and phrenic | Left subclavian aneurysm exclusion, left carotid/axillary bypass | Good (6-month follow-up) |
| Bordeaux[7] | 1990 | 7 | F | AAA, left internal iliac, left renal, left brachial, left popliteal and tiblial | Ruptured AAA reconstruction | Satisfactory (3-year follow-up) |
| Lanfermann[8] | 1990 | 6 | M | AAA, bilateral renal and common iliac, inferior mesenteric, right hepatic, bilateral internal carotid | none | — |
| De Letter[9] | 1991 | 18 | M | Right renal, splenic, bilateral iliac branch, right carotid, intracerebral, bilateral brachial | 1) Brachial aneurysm resection | Good (29-year follow-up) |
| | | | | | 2) Right nephrectomy<br>3) Right internal carotid ligation<br>4) Left brachial reconstruction<br>5) Left fem-pop reconstruction<br>6) Left brachial reconstruction | |
| Halpern[10] | 1997 | 6 | M | AAA, right brachial, radial and internal carotid | 1) Aortic reconstruction | Good (2-week follow-up) |
| | | | | | 2) Brachial artery reconstruction | |
| Checinski[11] | 2000 | 6 | F | AAA, bilateral renal | 1) Aortic reconstruction, left renal aneurysm excision<br>2) Embolization right RAA | — |
| Current case | 2002 | 10 | M | AAA, bilateral iliac and renal, left vertebral, brachial and radial | 1) Left vertebral embolization | Good (3-month follow-up) |
| | | | | | 2) Left brachial reconstruction<br>3) Aortoiliac reconstruction<br>4) Right RAA ex vivo repair | |

*AAA*, Abdominal aortic aneurysm; *RAA*, renal artery aneurysm.

was used in each of the previously reported cases with no case of graft failure at 2-week to 29-year follow-up. Our preferred conduit for pediatric renal artery reconstruction is autogenous internal iliac artery. However, the integrity of arterial autografts is uncertain in these instances. Consequently, prosthetic repair was performed in this case, syndactilizing the segmental branches to create a single distal anastomosis. Alternatively, cases requiring reconstruction of peripheral lesions, including the brachial artery reconstruction in the current case, have been successfully managed with autogenous venous conduit.[9,10]

Recent evidence suggests a role for medical therapy in limiting aneurysm growth. β-Blockade has been found to decrease aneurysm expansion, particularly in large aneurysms.[19] In addition, antimicrobial agents may have a role in the treatment of aneurysmal disease. Whether through their effects on matrix metalloproteinases or antibacterial activity, doxycycline and azithromycin have recently been shown to reduce aneurysm expansion.[20,21] Presently, the role of these agents in children has yet to be defined.

Multiple aneurysms in children are encountered rarely, but a presumed origin can be defined in most instances. However, in a few instances, the origin of arterial aneurysms remains elusive. Regardless of the cause, evaluation of the entire vascular tree should be considered for any child with aneurysm disease. Follow-up anatomic evaluation is

recommended to identify enlarging or new aneurysms to avoid associated complications. In selected cases, arterial reconstruction is warranted.

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