APPLIED RADIOLOGY
PEDIATRIC RADIOLOGICAL CASE

Polyarteritis nodosa in a pediatric patient

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CASE SUMMARY

A 13-year-old Hispanic female with no significant past medical history presented to an outside facility with episodic vomiting, abdominal pain, 20-lb unintentional weight loss, and malaise over a four-week span. Visits to the urgent care and emergency room during this time period resulted in diagnoses of gastroesophageal reflux and gastritis with unsuccessful treatment regimens. Just prior to her presenting admission, she developed a fever and worsening abdominal pain followed by a grand mal seizure at home and additional four episodes at the outside hospital. Her severely elevated blood pressure (reaching upwards of 190/110 mmHg) was difficult to control, leading to her subsequent transfer to a higher level of care at our institution.

IMAGING FINDINGS

Initial imaging workup of her malignant hypertension and seizures included a duplex renal ultrasound and MRI of the brain. Renal duplex ultrasound (Figure 1) was normal. Initial MRI demonstrated multifocal cortical/subcortical ischemic changes, which raised the concern for vasculitis versus an atypical appearance of acute hypertensive encephalopathy (Figure 2). Additional laboratory findings were significant for hematuria, proteinuria and elevated creatinine. Nephrology and rheumatology were subsequently consulted. Pertinent lab values included an elevated erythrocyte sedimentation rate. She was negative for hepatitis B antibody/surface antigens, antiglomerular basement membrane antibody, antinuclear antibodies and anti-neutrophil cytoplasmic antibody (ANCA). C3/C4 levels were normal.

Abdominal CT angiography was performed (Figure 3) and demonstrated normal parenchymal and branch pattern of the renal arteries into the hilum. Three-dimensional reconstructed images demonstrated normal renal arteries to the second order.

Given the imaging, clinical and biochemical findings, polyarteritis nodosa became the working diagnosis, prompting angiography. Cerebral angiogram demonstrated no abnormal intracranial vascularity or aneurysm. When evaluating the right vertebral artery, the right thyrocervical trunk and distal branches, as well as the right internal mammary, demonstrated a beaded appearance (Figure 4). Subsequent renal angiogram (Figures 5-7) demonstrated innumerable sub-centimeter second order branch intrarenal aneurysms. Additionally, there was beaded appearance of the gastroduodenal artery and bilateral inferior intercostal arteries (Figure 7). These angiographic findings further supported the working diagnosis of polyarteritis nodosa.

The patient was treated with steroids, cyclophosphamide and antihypertensives. Her hospital stay was complicated by bowel resection secondary to ischemic vasculitis in addition to widespread fungal and bacterial disease secondary to immunosuppression. After a prolonged hospital course, she was ultimately discharged to an inpatient rehabilitation facility.

DIAGNOSIS

Polyarteritis nodosa (PAN).

Differential diagnosis includes microscopic polyangiitis, systemic lupus erythematosus, Wegener granulomatosis, Churg-Strauss and fibromuscular dysplasia. PAN can share

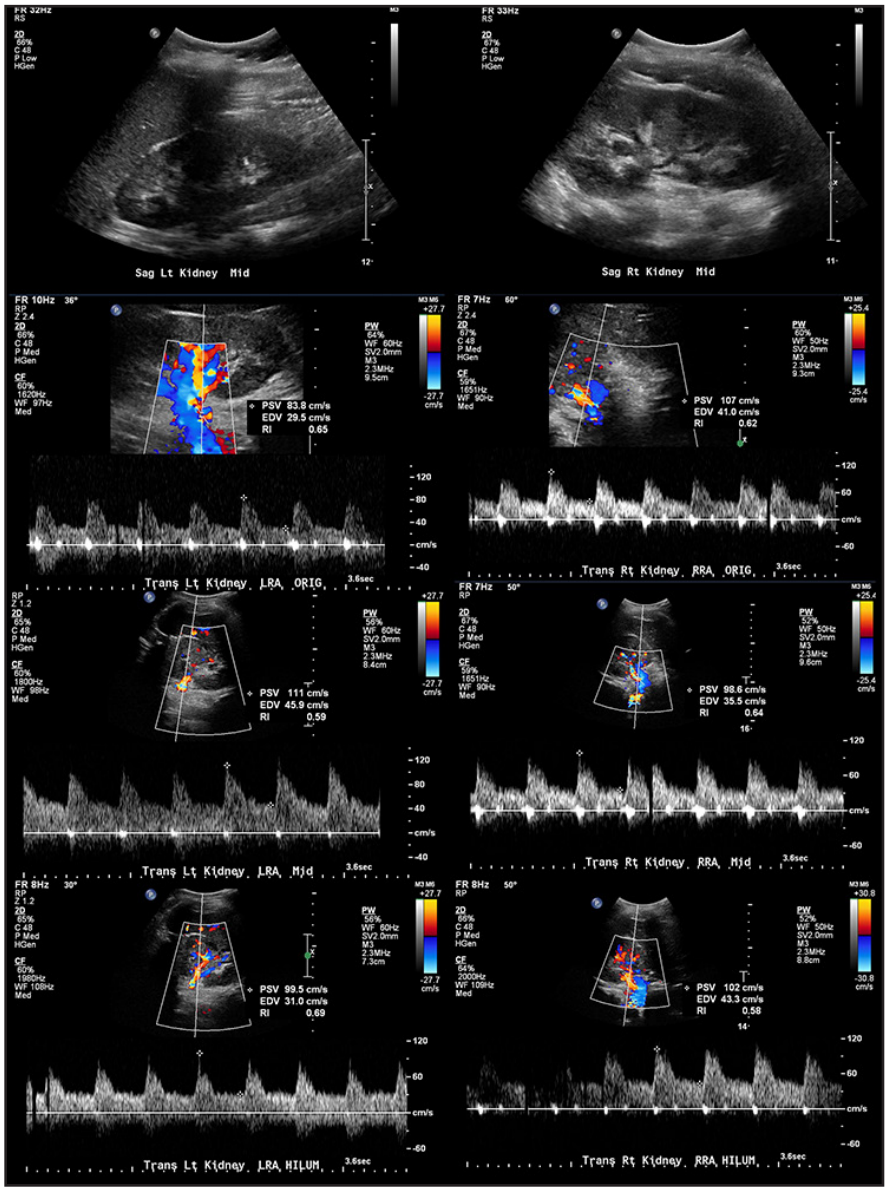

FIGURE 1. *Normal renal duplex ultrasound.*

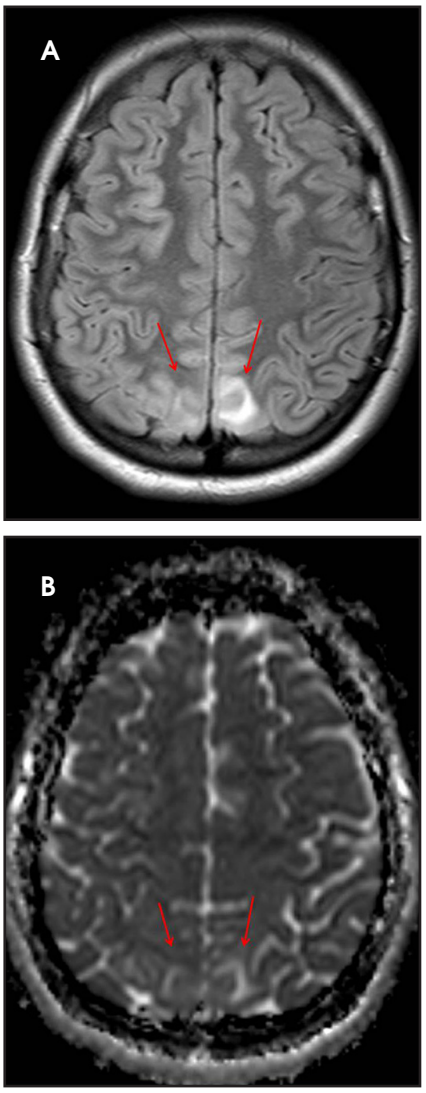

FIGURE 2. *Axial FLAIR (A) and ADC (B) images of the brain demonstrate hyperintensity in the posterior parietal region without diffusion restriction. .*

similar imaging findings with these other entities (Table 1), requiring multidisciplinary correlation of disease for accurate diagnosis.

DISCUSSION

Polyarteritis nodosa, also known as Kussmaul-Maier disease, is a rare entity in the pediatric population.[1,2] As it is superseded only by Henoch Schonlein purpura and Kawasaki disease, it remains an important differential when vasculitis is suspected.[2] Although thought to possibly stem from infectious triggers of host response, the etiology is still unknown.[3] Disease onset most commonly occurs in the fifth to seventh decades with a male predilection. Increasing case reports suggest the disease in the pediatric population may occur more frequently than the literature suggests.[2] PAN is a disease of predominantly medium-sized vessels, but can also involve small vessels. Organ involvement includes kidneys, gastrointestinal tract, peripheral nervous system, skin, skeletal muscles, heart, liver, spleen and pancreas.[2,4,5] Clinical symptoms are usually secondary to organ ischemia from arterial branch occlusions.[5] The disease is summarized in Table 2.

According to the American College of Rheumatology (Table 3), criteria for polyarteritis nodosa includes

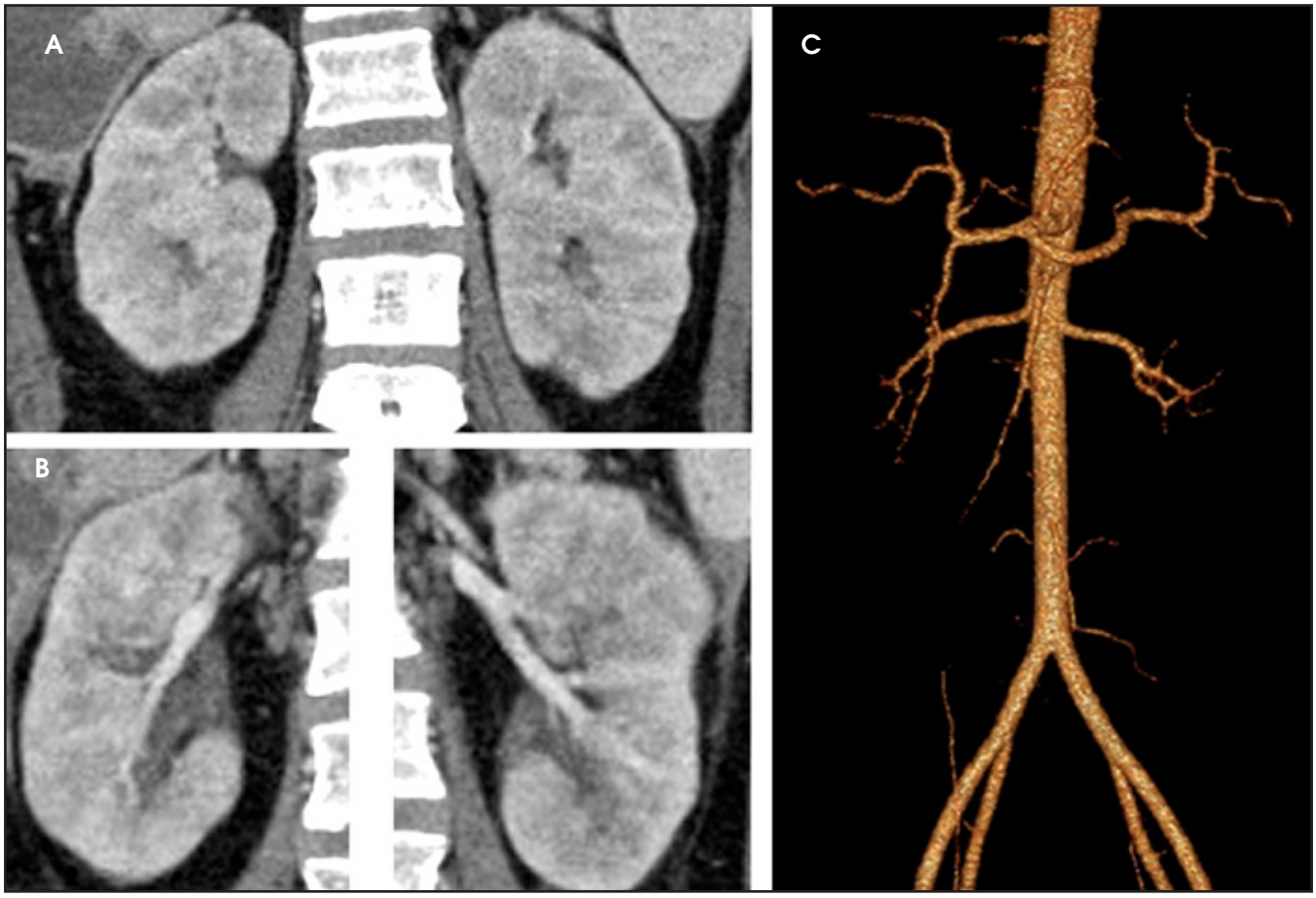

FIGURE 3. *Coronal CTA images of the abdomen demonstrates normal parenchymal and branch pattern (A, B) of the renal arteries into the hilum. CTA 3D reconstruction (C) demonstrates normal bilateral renal arteries to the second order. Note that the beaded appearance of the renal arteries seen on renal angiography is not well visualized.*

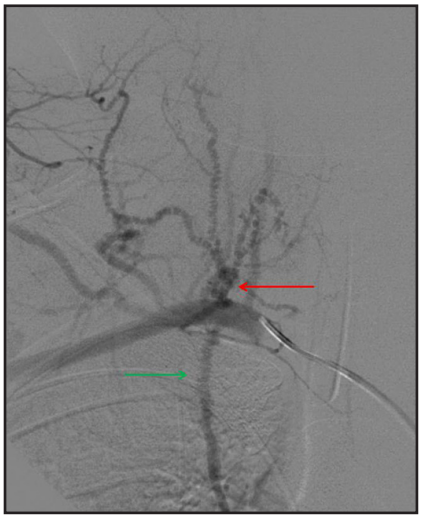

FIGURE 4. *Selective angiogram of the right subclavian artery demonstrates beaded appearance of the thryocervical trunk (red arrow) and the right internal mammary artery (green arrow).*

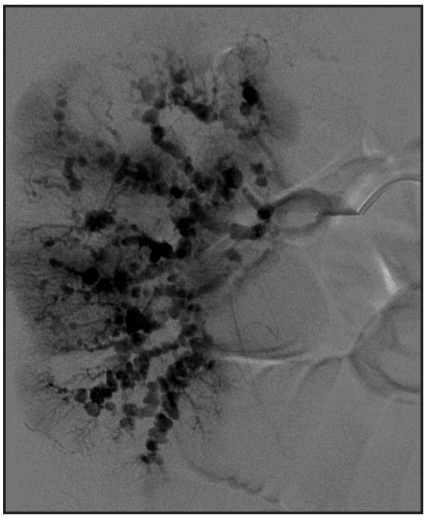

FIGURE 5*. Selective angiogram of the right renal artery demonstrates innumerable sub-centimeter aneurysms of the segmental and interlobar arteries of the right kidney.*

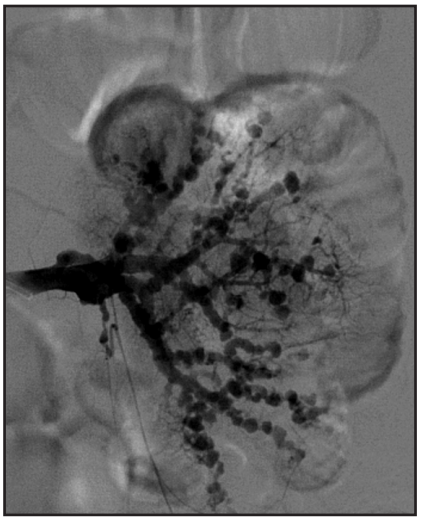

FIGURE 6. *Selective angiogram of the left renal artery demonstrates innumerable subcentimeter aneurysms of the segmental and interlobar arteries of the left kidney.*

Table 1. Selected differential diagnosis of polyarteritis nodosa

Diagnoses	Imaging	Other
Polyarteritis nodosa (PAN)	Aneurysms can be demonstrated on angiography, US, CT and MR. Inflammation and vessel wall thickening can be seen on CT or MR, the latter also effective in evaluating end organ ischemic changes. Angiography is a key modality.	American College of Rheumatology criteria – see Table 3. ANCA negative.
Microscopic polyangiitis (MPA)	Predominantly small vessel involvement. Although clinical features can be similar, MPA generally lacks microaneurysms, making angiography a useful adjunct. tool. Pulmonary involvement is more common.	p-ANCA positive with glomerulonephritis.
Wegener granulomatosis (granulomatosis with polyangiitis)	Predominantly small vessel involvement with ear/nose throat and pulmonary predilection, including cavitary pulmonary lesions.	C-ANCA positive with glomerulonephritis, less common than MPA. Ear nose throat symptoms such as sinusitis. Histopathology of granulomatous inflammation.
Churg-Strauss syndrome	Predominantly small vessel. May have transient pulmonary consolidations or ground glass changes with or without. nodules. Cardiomegaly with arteritis.	p-ANCA positive with extravascular eosinophilia. Asthma is a common presentation.
Fibromuscular dysplasia	Predilection for renal and carotid arteries. Usually more "beaded" pattern than aneurysmal.	Noninflammatory with segmental collagen deposition. Correlation with non-elevated acute-phase reactants key differentiating factor.

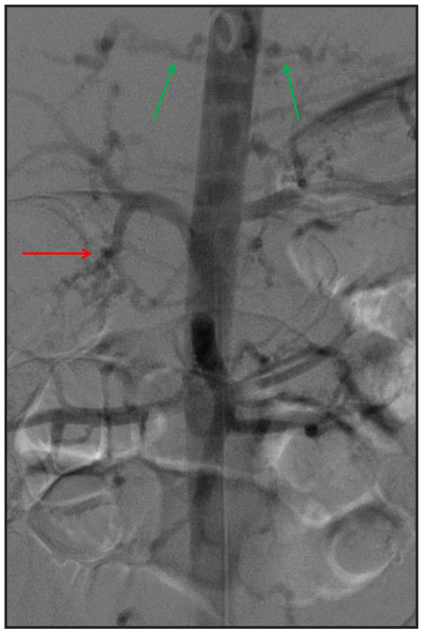

FIGURE 7. *Selective angiogram of the aorta demonstrates innumerable subcentimeter aneurysms of the abdominal visceral arteries including the gastroduodenal artery (red arrow). Additionally, there is beaded appearance of the inferior intercostal arteries (green arrows).*

Table 2. Summary of polyarteritis nodosa

Etiology	Unknown, may be secondary to immune-complex deposition. Associated with Hepatitis B virus.
Incidence	2-9 cases per million annually
Gender ratio	Male:female 2:1
Age predilection	5th-7th decades
Risk factors	Hepatitis B
Treatment	Glucocorticoids as first line Addition of cyclophosphamide increases survival rate HBV-associated PAN requires addition of antivirals Plasmapheresis for refractory cases Large aneurysms treated with catheter embolization to avoid risk of rupture Surgery to treat GI complications
Prognosis	5-year survival rate of < 15% Relapse in 40% of patients with median survival of 33 months 50% of patients with abdominal involvement develop acute surgical abdomen with mortality rate of 12.5%
Findings on imaging	Angiographic findings include segmental stenosis and beading, aneurysms, segmental narrowing, arterial caliber variation, and pruning of the peripheral vascular tree CT and MRI can demonstrate evidence of end-organ damage, arterial wall thickening, or arterial occlusions.

Table 3. Adapted from American College of Rheumatology criteria for classification of polyarteritis nodosa. At least 3 findings required for diagnosis.

- Weight loss less than or equal to 4 kg
- Livedo reticularis
- Testicular pain or tenderness
- Myalgias
- Mono or polyneuropathy
- Diastolic blood pressure of > 90 mmHg
- Elevated BUN/Cr
- Presence of hepatitis B reactants in serum
- Arteriographic abnormality
- Presence of granulocyte or mixed leukocyte infiltrate in arterial wall biopsy

any three of the following 10 criteria: weight loss greater than or equal to 4 kilograms, livedo reticularis (mottled reticular pattern over the skin, extremities or torso), testicular pain or tenderness (not due to infection, trauma or other causes), myalgias, mononeuropathy or polyneuropathy, diastolic blood pressure greater than 90 mmHg, elevated blood urea nitrogen or serum creatinine levels (not due to dehydration or obstruction), presence of hepatitis B surface antigen or antibody in serum, arteriographic abnormality (aneurysms or occlusions of the visceral arteries not due to arteriosclerosis, fibromuscular dysplasia or other noninflammatory causes), and presence of granulocyte or mixed leukocyte infiltrate in an arterial wall biopsy.[6] In our patient, four of these criteria were met.

Definitive diagnosis is made by tissue biopsy of a symptomatic organ. Characteristic pathologic findings are fibrinoid necrotizing inflammatory foci in the walls of small or medium-sized arteries with multiple small aneurysms.[4] The role of angiography is to confirm or support the clinical suspicion of PAN when there are no suitable biopsy sites available or when biopsy results are inconclusive. If PAN is strongly suspected, histological confirmation is not mandatory for diagnosis. Patients with the disease will show segmental stenosis and beading, aneurysms, segmental narrowing, arterial caliber variation, and pruning of the peripheral vascular tree.[7,8] Although CT and MRI remain suboptimal as compared to conventional angiography, both modalities can demonstrate evidence of end-organ damage, arterial wall thickening, arterial aneurysmal dilatation or arterial occlusions.[7] Renal cortical scintigraphy with technetium 99m dimercapto-succinic acid (DMSA) can demonstrate areas of photopenia relating to ischemia.[3]

Polyarteritis nodosa is usually fatal if left untreated with a 5-year survival rate of less than 15 percent.[5] Development of an acute abdomen is associated with a 50 percent mortality rate.[1] Prompt treatment with corticosteroids and cyclophosphamide improves 5-year survival to 80 percent,[5] making early recognition paramount. Additional treatments include plasma exchange and plasmapheresis, which can provide added benefit in refractory cases. Large aneurysms may be treated with catheter embolization to avoid risk of rupture.[7]

CONCLUSION

Polyarteritis nodosa is a rare entity in the pediatric population that should be considered in patients of any age with symptoms related to vasculitis. It shares similar angiographic findings with other vasculitides necessitating multidisciplinary correlation for accurate diagnosis. Early diagnosis can lead to significant improvement in survival rates. If PAN is strongly suspected, histological confirmation may be substituted by positive angiographic findings. CT and MRI can demonstrate evidence of end-organ damage and vascular pathology.

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