Radiology Case Reports 14 (2019) 1127–1131

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/radcr

Case Report

Congenital intravascular abdominal aortic band initially thought to be a metallic foreign body: Characterization using microanatomical CT reconstruction technique

Charles C. Shelton, BS[a], *Samuel C. Tyagi, MD*[b], *Sreeja Sanampudi, MD*[a], *Mohamed M. Issa, MD*[a], *Driss Raissi, MD*[a], *Conor M. Lowry, MD*[a], *Michael A. Winkler, MD, FSCCT, FICA*[a,*]

[a] *Department of Radiology, Gill Heart Institute, University of Kentucky Chandler Medical Center, Lexington, KY, USA*
[b] *Department of Surgery, Division of Vascular Surgery, University of Kentucky Vascular Medicine Clinic, Lexington, KY, USA*

ARTICLE INFO

Article history:
Received 17 May 2019
Revised 12 June 2019
Accepted 29 June 2019
Available online 15 July 2019

Keywords:
Aorta
Band
CT angiography
Intravascular foreign body
Postprocessing
Reconstruction

ABSTRACT

We present a patient with the initial misdiagnosis of a metallic foreign body in the abdominal aorta. Computed tomographic angiography utilizing microanatomical reconstruction technique revealed the structure to instead be a partially calcified abdominal aortic congenital fibrous band. Most congenital fibrous bands spanning the aortic lumen are proximal within the aorta and are thought to be supportive structures of the aortic valve leaflets. Congenital fibrous bands distal to the sinotubular junction are quite rare.

Introduction

Congenital fibrous bands traversing the lumen of aorta structure are usually related to the leaflets of the aortic valve and, when present, are thought to be supportive structures analogous to the chordae tendineae of the mitral valve.

Congenital bands distal to the sinotubular junction are much rarer. Dedicated PubMed and Google scholar searches of this topic yielded a total of 1 reported case [1]. As a conse-

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
* Corresponding author at: Thoracic and Cardiovascular Radiology, University of Kentucky, UK HealthCare Enterprise, 800 Rose Street, Room HX-313A, Lexington, KY 40536-0293, USA.
E-mail address: michael.winkler@uky.edu (M.A. Winkler).
https://doi.org/10.1016/j.radcr.2019.06.031

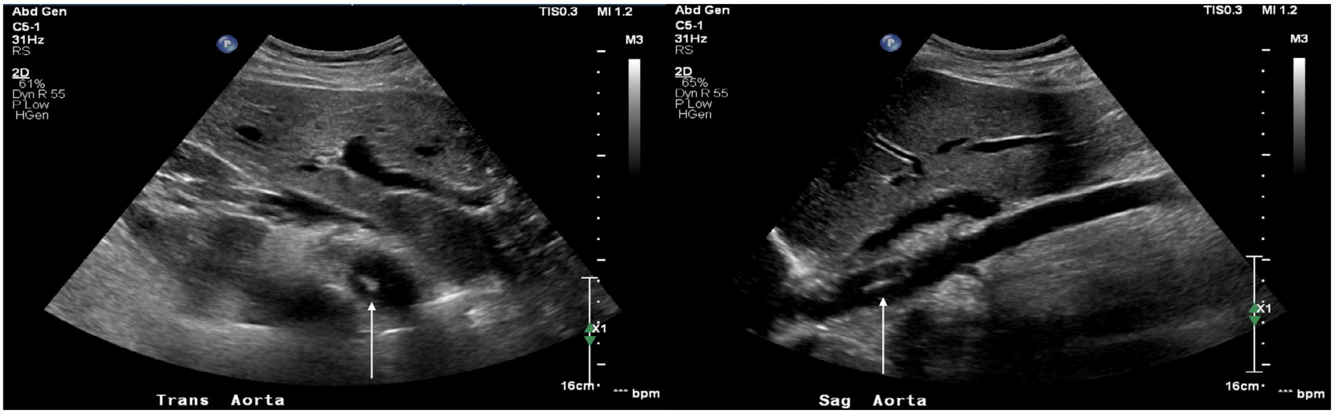

Fig. 1 – Axial and sagittal grayscale ultrasound images demonstrate an endoluminal hyperechoic structure in the abdominal aorta (white arrow).

quence of such rarity, and similarity to other entities (eg, intimal flaps and intraluminal thrombi), a congenital aortic band can mimic a pathological process and trigger a surgical intervention [1].

We present a patient referred to our tertiary center with a diagnosis of intra-aortic foreign body. The structure of interest, when reimaged with computed tomographic angiography (CTA) utilizing microanatomical reconstruction technique, proved to be a congenital aortic band. The microanatomy reconstruction technique revealed the true nature of the aortic band and obviated the need for procedural or surgical intervention.

Case report

A 37-year-old lady presented to the referring facility with nausea, vomiting, and right upper quadrant pain. In addition to cholelithiasis, an ultrasound revealed a thin, long, linear object within the aorta. A diagnosis of "foreign body" was rendered by the outside radiologist, which triggered an emergency transfer to our tertiary institution.

Upon arrival at the emergency department, the patient was again imaged with ultrasound (Fig. 1) and with CTA (utilized conventional reconstruction technique, Fig. 2). The emergency radiologist confirmed the presence of sludge in the gallbladder but there was no evidence of cholecystitis, a conclusion concordant with the patient's normal WBC count and benign abdominal exam. However, like the community radiologist, he opined that a metallic foreign body was present within the aorta. A vascular surgery consultant was summoned in response but decided that, whatever the nature of the object, it was unlikely to be harmful, and deemed the patient safe to discharge.

Unfortunately, the patient continued to experience abdominal pain, now comorbid with anxiety related to the presumptive "metallic foreign body" within her aorta, prompting a follow-up outpatient visit to our vascular surgery clinic. Upon questioning, the patient only reported a single invasive procedure in her past which involved the use of a needle: placement of an epidural catheter for anesthesia during parturition. Despite assurances that it would be nigh impossible for a needle to fragment during that procedure and migrate into her aorta, the patient continued to suffer from anxiety. To better determine the nature of the object and confirm for the patient its benign nature, a repeat CTA scan was performed utilizing a special microanatomy reconstruction protocol to optimize the axial images generated for postprocessing.

Methods

A helical CTA of the abdomen was performed with a Somatom Force Scanner (Siemens Medical Solutions, Forchheim, Germany) utilizing both automated kVp selection and current modulation. The energy peak selected was 90 keV and the reference charge 476 mAs. The dose length product for the scan was 369 mGy cm. A saline flush was utilized to check the pressure tolerance of the patient's right antecubital intravenous access. 100 mL of body temperature (37°C) iohexol (Omnipaque, GE Healthcare Bio-Sciences Corp., Piscataway, NJ). 350 mg/mL contrast media was injected at 5 mlLs via a dual chamber automated programmable power injector (Medrad Stellant, Bayer Healthcare LLC, Whippany, NJ), followed by a 50 mL saline flush at the same rate. Bolus tracking was utilized to trigger the scan once attenuation of 200 Hounsfield Units was achieved in the aorta, with an 8-second delay to allow for breath holding instructions.

Images were reconstructed using a soft vascular kernel (b36) and a model based iterative algorithm (ADMIRE) set at maximum strength. A displayed field of view (DFOV) of 50×50 mm was utilized for a dedicated reconstruction of the segment of the aorta containing the structure of interest. A stack of 0.5 mm thick slices reconstructed at an interval of 0.1 mm, spanning a distance of 93.3 mm in the z axis, was created, containing a total of 935 images. The use of a standard 512 by 512 storage matrix was mandated by the scanner software.

Once the images were transferred to the advanced image postprocessing client/server (Aquarius Intuition, Terarecon, Foster City, CA), the images were subjected to interpolation to

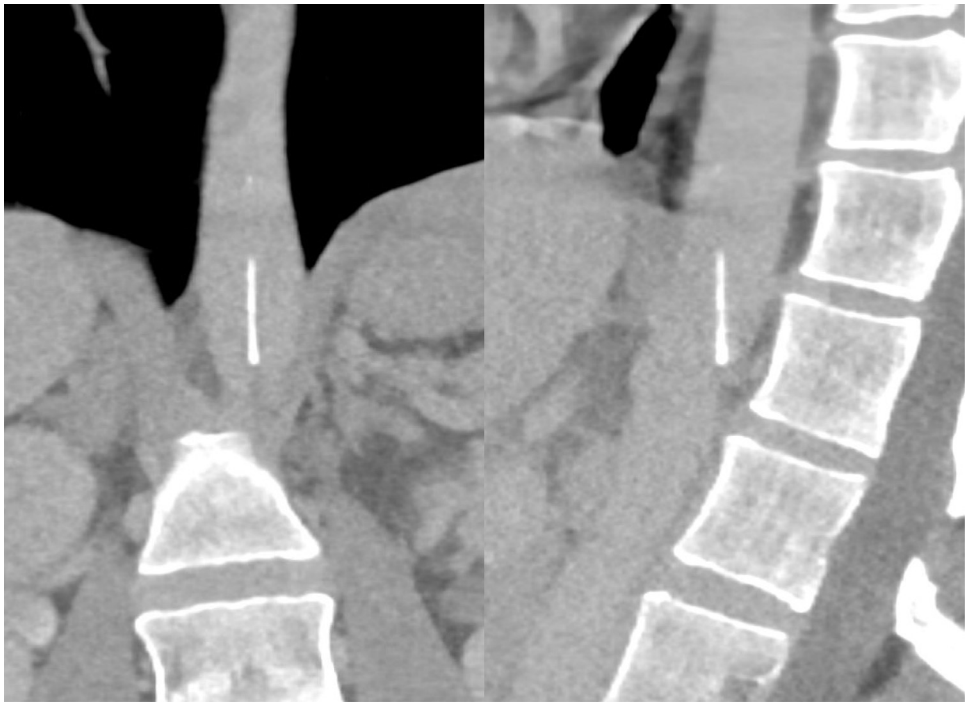

Fig. 2 – Coronal and Sagittal CTA images from initial CTA show a linear structure traversing the abdominal aortic lumen at the level of the T12-L1 intervertebral disk which was thought to represent a metallic foreign body.

increase their perceived spatial resolution. The DFOV was decreased further, to 35 × 35 mm, to control the computational expense for manipulation of the large data set. This resulted in a pixel size of ~70 microns within the axial plane. Because the reconstruction interval at the scanner was 0.1 mm, z-axis subvoxel sampling occurred when the interpolated images were loaded into object space, yielding a voxel size of 70 × 70 × 100 microns. Multiplanar and curved planar reformatted images were then created for the purpose of diagnosis and for demonstration to the surgeon and patient (Fig. 3).

Results

A 55 mm taught band of fibrous tissue was identified extending from the anterior to posterior wall of the aorta in an oblique superior to inferior course (Figs. 3 and 4). The band, although rarified to less than 1 mm in diameter at its midpoint, was 2 mm in diameter at its origin and 3 mm in diameter at its insertion. The distal half of the band exhibited heavy, but subtly irregular calcification. No evidence of prior instrumentation, dissection, atherosclerosis, or vasculitis was present. Based on the morphology of the object and the absence of the above-mentioned pathologies, the presumptive diagnosis of metallic foreign body was exchanged for a diagnosis of congenital aorta band.

Discussion

In this case, 3 techniques of reconstruction were utilized to improve spatial resolution and allow for the visualization microanatomical detail: reduction in DFOV, maximization of slice overlap, and iterative reconstruction.

The standard storage matrix for CT images is 512 × 512 [2]. Consequently, the true nominal in-plane resolution of a scanner can only be demonstrated in a clinical setting by reconstructed images less than, or equal to, 512 times the nominal resolution. The nominal in-plane resolution of the Somatom Force scanner is 0.24 by 0.24 mm. Consequently, a DFOV less than ~122 mm is necessary to display its best spatial resolution. Further reductions in DFOV, either at the scanner or with postprocessing client/servers, forces interpolation and consequently the perceived imaging quality.

With helical CT datasets, a minimized reconstruction interval maximizes slice overlap. This forces subvoxel sampling of axial images as they are loaded into the advanced imaging client/server, a process that improves z-axis spatial resolution, both in actuality and in perceived quality [3]. The minimum slice thickness and reconstruction interval for the Somatom Force scanner are 0.5 mm and 0.1 mm, respectively.

As spatial resolution is optimized noise increases, as there is less projection data to summate for the visualization of each voxel. To reduce noise, iterative reconstruction algorithms need to be implemented [4]. Presently, model based iterative reconstruction algorithms, such as ADMIRE are the state of the art for this technology.

Although there is a form of congenital band related to the aortic valve, these band forms are inherently different in nature from the band we have describe above.

Congenital aortic bands are ribbons of elastic tissue that extend into the aortic wall and with potential locations throughout the aorta [5]. However, most aortic bands arise in close proximity to the aortic valve in association with valve

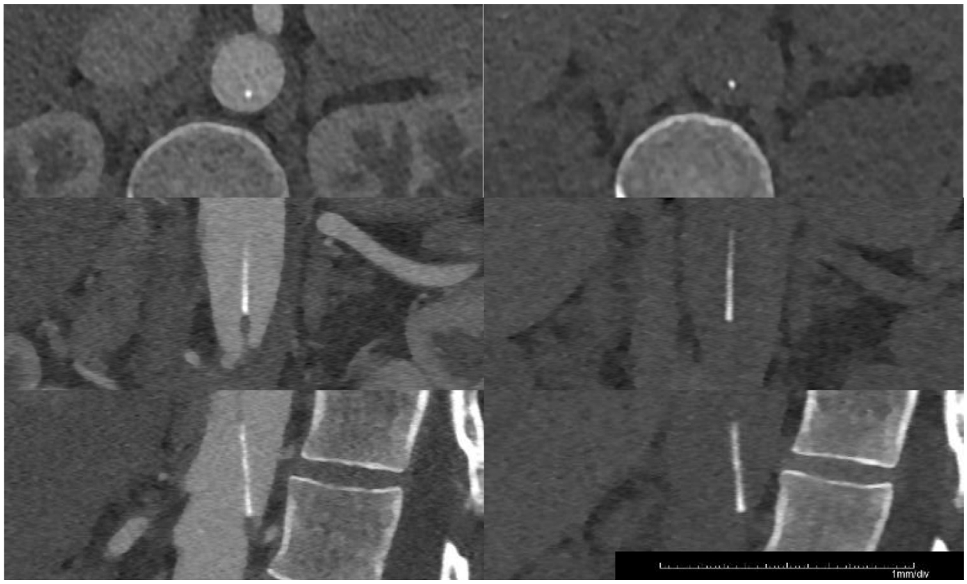

Fig. 3 – Follow-up axial (top), coronal (middle), and sagittal (bottom) CTA (left) and noncontrast CT (right) images utilizing microanatomy reconstruction show the structure to be a partially calcified intravascular band extending from the anterior to the posterior aortic wall.

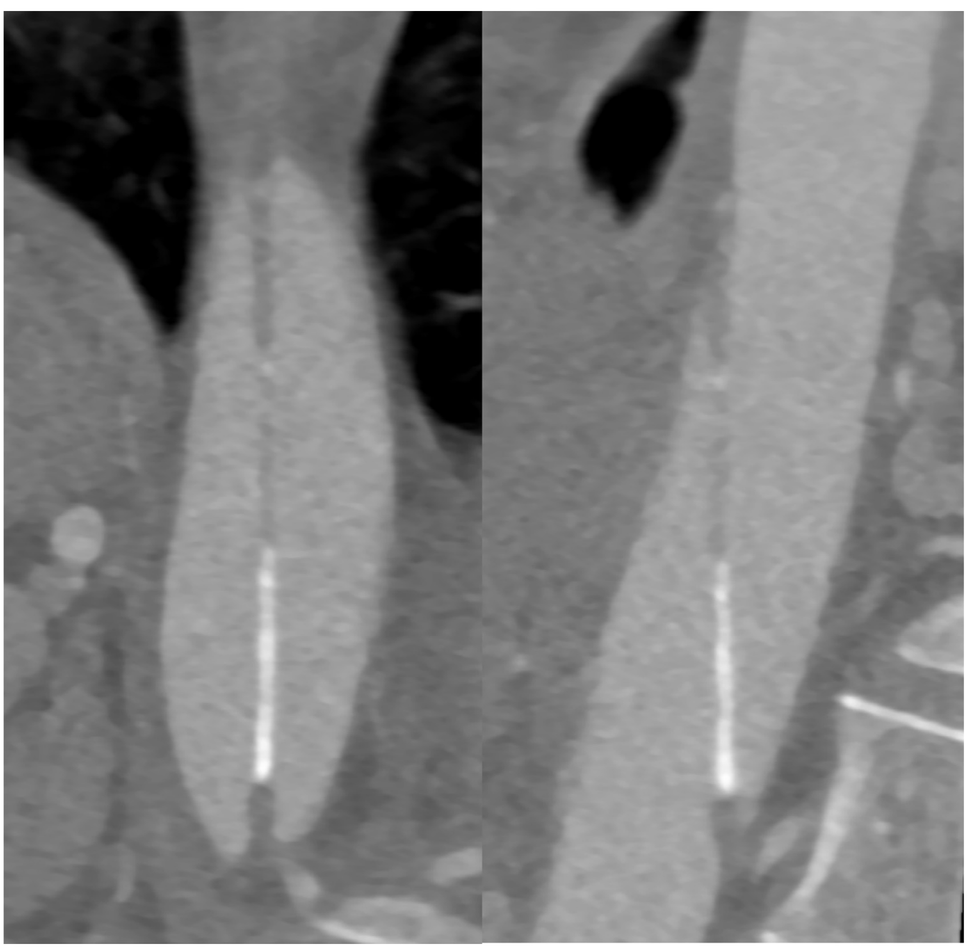

Fig. 4 – Follow-up double oblique multiplanar reformatted CTA images utilizing microanatomy reconstruction show the structure to be a partially calcified intravascular band extending from the anterior to the posterior aortic wall.

leaflets. Due to shared histological features with the aortic artery wall, these bands were thought to be congenital in nature [5]. For example, on 1 occasion, a congenital aortic band was mistaken for an aortic pseudodissection based on radiological similarities. Further investigation and operative procedure were required to prove elastic tissue that is contiguous with the aortic artery wall is actually a congenital aortic band [1].

Webs and flaps in the aorta are similar in appearance to the band we describe but do not occur in isolation, but instead as the consequence of aortic dissection. Cobwebs are string like expansions of media that arise from the false lumen following an aortic dissection and extend to the dissection septum [6]. Cobwebs are medial remnants and do not contribute to the integrity of the aortic wall. Cobwebs can serve as a marker during percutaneous repair techniques due to their specificity to the false lumen following dissections [6].

Occasionally, aortic thrombus can have an elongated appearance, but never the elegant perfectly straight strut like appearance of this congenital band. Furthermore, thrombus typically occurs in the setting to atherosclerosis, trauma, dissection, or aneurysm. Aortic thrombi are typically circumferential with calcifications that can lead to weakening of underlying arterial wall [7]. Although ultrasound and traditional CT with contrast have been widely used in identification of aortic aneurysms and associated intraluminal thrombi, magnetic resonance imaging has been proven to identify structural variations of thrombi [7].

Conclusion

In this case, the scarcity of reported cases of nonvalvular congenital aortic bands in the medical literature was challenging for us in both emergent and outpatient settings. CTA with microanatomical reconstruction technique allowed us to make a thoughtful and confident diagnosis that obviated an invasive course of inquiry.

Conflict of Interest

The authors have no competing interests to disclose.

REFERENCES

[1] Bonde P, Yuh DD. Intra-aortic intimal band presenting as an aortic pseudodissection. J Thorac Cardiovasc Surg 2010;139(4):e64–5.
[2] Mahesh M, Cody DD. Physics of cardiac imaging with multiple-row detector CT. Radiographics 2007;27:1495–509.
[3] Kasales CJ, Hopper KD, Ariola DN, TenHave TR, Meilstrup JW, Mahraj RP, et al. Reconstructed helical CT scans: improvement in z-axis resolution compared with overlapped and nonoverlapped conventional CT scans. Am J Roentgenol 1995;164:1281–4.
[4] Liu Lu. Model-based iterative reconstruction: a promising algorithm for todays computed tomography imaging. J Med Imaging Radiat Sci 2014;45(2):131–6.
[5] Torres ET. Congenital elastic band of aortic valve. Am. Heart J 1953;45:630.
[6] Williams DM, et al. Aortic cobwebs: an anatomic marker identifying the false lumen in aortic dissection–imaging and pathologic correlation. Radiology 1994;190(1):167–74.
[7] Labruto F, Blomqvist L, Swedenborg J. Imaging the intraluminal thrombus of abdominal aortic aneurysms: techniques, findings, and clinical implications. J Vasc Interv Radiol 2011;22(8):1069–75 quiz 1075.