LETTER / Thoracic imaging

Unusual late discovery of interrupted aortic arch by ultrasonography and three-dimensional MDCT

Keywords Aortic arch; Interrupted aortic arch; Doppler ultrasound imaging; Computed tomography; Hypertension

Dear Editor,

Interrupted aortic arch (IAA) in adults is a rare condition with few cases reported so far. IAA is defined as a complete luminal discontinuity between the ascending and descending segments of the aorta [1]. The downstream chronic ischemia leads to the development of arterial networks from supra- towards infra-diaphragmatic arterial territories [2,3]. We illustrate herein the role of ultrasonography and three-dimensional (3D) multidetector-row computed tomography (MDCT) and the need for a comprehensive evaluation, including morphological and hemodynamic functional findings for the diagnosis of IAA.

A 43-year-old man was referred to our Institution because of persisting hypertension (175/85 mmHg) although he was receiving olmesartan (40 mg/day) and amlodipine (10 mg/day). One month after the introduction of indapamide (2.5 mg/day), blood tests evidenced a marked rise in serum creatinine level (10 to 17 mg/L) and hypokalemia suggesting secondary hyperaldosteronism. Pulsed-Doppler ultrasonography revealed no abnormalities of renal arteries but showed abnormal spectral waveforms (Fig. 1) known as “tardus-parvus” consisting in delayed acceleration time, decreased peak systolic velocity and low resistive index [4]. These findings were also observed in the abdominal aorta, but not in supra-aortic arteries. The systolic pressure gradient between lower and upper limbs was 95/175 mmHg (ratio, 0.54; Normal > 0.95). Altogether these findings were highly suggestive of a hemodynamic barrage in the descending thoracic aorta. Aortic coarctation (AC) was suggested and this assumption was reinforced by the presence of multiple collaterals. The internal thoracic arteries and branches of the subclavian arteries were dramatically enlarged (4.5 mm; Normal < 1.5 mm) with increased anterograde systolic and diastolic flows towards both epigastric arteries. The epigastric arteries were also enlarged with a reversed flow towards the common femoral arteries that gave blood supply to both lower limbs. Because of strong suspicion of AC, electrocardiogram-gated MDCT angiography of the thorax and abdomen was performed. MDCT examination using 3D display disclosed complete interruption of the descending aorta.

![Figure 1](image1.png)

Figure 1. Pulsed Doppler ultrasound imaging in a 43-year-old patient with resistant arterial hypertension. a: pulsed Doppler velocity waveform in the proximal right renal artery. The acceleration time is increased (0.128 s; Normal < 0.07 s), the peak systolic velocity is increased (42.0 cm/s; 50 < Normal < 120 cm/s) and the resistive index is dramatically decreased (0.44; 0.50 < Normal < 0.75). Altogether these changes are constitutive of a severe “tardus-parvus” aspect; b: pulsed Doppler velocity waveform recorded in the abdominal aorta shows a similar “tardus-parvus” aspect, with an increased acceleration time (0.136 s), a decreased peak systolic velocity (56.9 cm/s) suggesting the presence of an upstream hemodynamic barrage in the thoracic descending aorta and a decrease in the resistive index (0.72) suggesting distal vasodilation.
thal thoracic aorta just after the left subclavian artery (Fig. 2A and B). The final diagnosis was thus IAA. Major dilatation of the intercostal, diaphragmatic and internal thoracic arteries was observed (Fig. 2C). In addition, internal thoracic arteries were anastomosed with the epigastric arteries (Fig. 2D). After multidisciplinary discussion, the patient had a successful surgical end-to-end aortic anastomosis.

IAA is classified into three different categories, depending on the location of the interruption [1]. Our patient had a type A IAA, the most frequent one in adults (79% vs. 16% for type B and 3% for type C) [4,5]. Type A consists of a discontinuity of the aortic arch downstream of the left subclavian artery. Type B, is a discontinuity between the left common carotid and left subclavian arteries. Type C is a discontinuity between the brachiocephalic trunk and left common carotid artery. IAA differs from AC, which is an incomplete or even mild stenosis of the juxtaductal thoracic aorta, distal to the left subclavian artery. However, it is postulated that IAA may represent the ultimate stage of AC because of reported cases of AC that progressed to IAA [4,5].

MDCT using ECG-gated data acquisition is the imaging modality of choice for the assessment of thoracic aorta abnormalities and evaluation of the associated collateral arterial networks [6–8]. MDCT provides information about the type of IAA and the various collateral vessels that provide anastomotic routes between the aortic arch and the abdominal aorta. Such evaluation is of paramount importance for further therapeutic decision. Three-dimensional display enhances visualization of associated complex collateral networks. Three-dimensional magnetic resonance angiography obtained after IV administration of a gadolinium chelate may also provide useful information regarding the presence of unsuspected supra-aortic artery anatomical variations [9].

The diagnosis of IAA and AC is rarely established in adulthood in developed countries, as aortic abnormalities are detected during perinatal screening [10]. Treatment of IAA in adult is primarily based on surgery. Although no specific approach has demonstrated superiority, extra-anatomic bypass procedure for aortic repair through a midline approach is often the favorite option, as it avoids bleeding during surgery due to collateral vessels damage [11]. Our patient had a successful end-to-end aortic anastomosis. However, patients with IAA can be managed conservatively with

![Figure 2](image-url)

Figure 2. Three-dimensional multidetector-row computed tomography (MDCT) angiography of the thorax and abdomen reveals interrupted aortic arch (IAA). a: maximum intensity projection (MIP) reconstruction using thin slab in the oblique coronal plane of MDCT data shows IAA (arrow) distal to the origin of the left subclavian artery (arrowhead). This presentation corresponds to type A IAA; b: MIP reconstruction using thick (40mm) slab in the oblique coronal plane of MDCT data confirms IAA (arrow) with no persisting communication; c: three-dimensional volume-rendered image from MDCT data shows IAA and spontaneous arterial anastomoses (arrow) from intercostal arteries between pre- and post-interruption aortic segments; d: three-dimensional volume-rendered image from MDCT data confirms presence of a complex anastomotic arterial network involving internal thoracic arteries, left axillary artery, intercostal arteries and epigastric arteries. Multiples anastomotic branches (curved arrow) connect internal thoracic arteries (white arrow) and epigastric arteries (black arrow) that finally supply the femoral artery. Arrowhead indicates the anastomotic vascular network between left axillary artery and intercostal arteries that supply the thoracic descending aorta downstream of the IAA.
antihypertensive drugs, pending a follow-up on a regular basis [5].

Disclosure of interest

The authors declare that they have no competing interest.

References


A. Pasteur-Rousseau a,b, L. Dridi c,∗, A. Fitoussi a, A.-S. Peric c, R. Dautry c, A. Dohan c, P. Bonnin a,b,d, P. Soyer b,d

a Department of functional investigations, hôpital Lariboisière, 2, rue Ambroise-Paré, 75010 Paris, France
b Inserm, U965, hôpital Lariboisière, 41, boulevard de la Chapelle, 75010 Paris, France
c Department of abdominal imaging, hôpital Lariboisière, 2, rue Ambroise-Paré, 75010 Paris, France
d Université Paris-Diderot, Sorbonne Paris Cité, 10, rue de Verdun, 75010 Paris, France

∗ Corresponding author.
E-mail address: lilya.dridi@yahoo.fr (L. Dridi)

http://dx.doi.org/10.1016/j.diii.2016.02.003
2211-5684/© 2016 Editions françaises de radiologie. Published by Elsevier Masson SAS. All rights reserved.