Aortic intramural hematoma: Importance of advanced MDCT imaging technique at diagnosis and follow-up.

Poster No.: C-0828
Congress: ECR 2014
Type: Educational Exhibit
Authors: S. Boccalini, M. Castiglione Morelli, I. Budaj, L. Patrone, A. Galletto, G. A. Minetti, M. Buscaglia, S. Seitun, C. Ferro; Genova/IT
Keywords: Interventional vascular, Cardiovascular system, Arteries / Aorta, CT, CT-Angiography, Computer Applications-3D, Dissection, Acute, Hemorrhage
DOI: 10.1594/ecr2014/C-0828

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

The purpose of our educational exhibit is to:

1. Describe the classification, the main pathophysiology mechanisms and the clinical features of aortic intramural hematoma (IMH)
2. Illustrate a review of the main imaging findings of the disease with multidetector computed tomography (MDCT)
3. Describe the importance of advanced MDCT imaging technique for the diagnosis and assessment of natural history of IMH

Background

IMH accounts for 5-20% of cases of acute aortic syndrome together with aortic dissection (AD) and penetrating atherosclerotic ulcer (PAU) [1-5]. This pathology might evolve very dynamically in the short-term to regression, aortic enlargement, dissection, or even aortic rupture [1-5]. A huge advance in MDCT technology enables IMH-associated aortic lesions such as subtle intimal tears causing ulcer-like projections (ULPs) and aortic branch artery pseudoaneurysms (Ps) to be more frequently recognized. In this context, both the imaging quality and the deep knowledge of the main radiological manifestations of IMH are crucial.

Findings and procedure details

IMH Definition, Classification and Etiology

IMH is classically defined as a haematoma in the aortic wall that is distinguished from classic AD and haematoma secondary to PAU by the absence at imaging of any evident intimal tear [1-5]. The disease is classified in the same way as classic AD according to DeBakey or Stanford criteria [1-5] and it affects the descending aorta (Stanford type-B) more frequently, in almost 60% of cases [5].

Although the precise aetiology is still uncertain, the two most common pathogenetic theories are:

1. spontaneous rupture of the vasa vasorum in the media with intramural hemorrhage formation [6]; this is the most common theory reported in the literature;
2. microscopic (entry) tears in the aortic intima with false lumen thrombosis immediately thereafter, probably due to the absence of any re-entry (absence of outflow).

According to the last theory, in Japan, the term "thrombosed-type acute AD" has been preferably substituted for IMH [7]. A surgical study by Park et al. [8] showed that the prevalence of intimal tear in the ascending aorta or arch is high (73.0%) in the patients who were diagnosed as Stanford type A acute IMH. Therefore, in clinical practice IMH is defined as hemorrhage into the medial layer with thrombosed false lumen (absence of intramural longitudinal flow), regardless of small intimal tears [5].

Clinical Presentation and Natural History

The resulting hematoma may then propagate in an antegrade or a retrograde manner, producing symptoms that may be impossible to differentiate clinically from those of a classic AD [5]. Pain is characteristic of IMH, whereas malperfusion and pulse deficit are much less likely than with classic AD [5].

This pathology might evolve very dynamically in the short-term to [1-5]:

- Partial or complete resolution
- Remodelling:aortic aneurysm formation
- Rebleeding
- Development of an ulcer-like projection (ULP)
- Progression to AD
- Rupture

According to the IRAD (International Registry of Acute Aortic Dissection), overall in-hospital mortality is similar to that of classic AD, and correlates with IMH location, being higher for type A IMH [5]: mortality for type A IMH compared to AD was 26.6% versus 26.5%; mortality for type B IMH was less but did not differ significantly (4.4% versus 11.1%) from classic AD. Type A IMH were managed mostly with surgery, whereas type B IMH were more frequently treated medically [5].

Predictors of disease progression [1-10].

- Involvement of the ascending aorta
- Maximum aortic diameter on initial CT scan (#5cm Ascending Aorta; >4 cm Descending Aorta)
- Progressive maximal aortic wall thickness
- Enlarging aortic diameter
- Persistent pain and/or hemodynamic instability
- Interval increase of associated pleural effusion
• Associated ULP

Role of MDCT Imaging

Typical features of IMH

At unenhanced MDCT[9]:
- IMH appears as hyperdense crescent-shaped wall thickening (usually >5 mm) due to intramural hemorrhage (Fig. 1 on page 6);
- displacement of sub-intimal calcification toward the aortic lumen may be observed (Fig. 1 on page 6);
- IMH tends to maintain a constant circumferential relationship with the aortic wall and not to spiral longitudinally (Fig. 1 on page 6, Fig. 2 on page 7);
- unlike mural thrombus, IMH shows smooth interior border (Fig. 1 on page 6).

At enhanced MDCT IMH[9]:
- IMH does not show contrast-enhancement (Fig. 1 on page 6).

Ulcer-like Projections (ULPs)

ULPs represent subtle sites of intimal disruption that may be observed at initial MDCT study or may develop during imaging follow-up (Fig. 3 on page 8, Fig. 4 on page 9, Fig. 5 on page 10, Fig. 6 on page 10, Fig. 7 on page 11, Fig. 8 on page 11):
- Prevalence of ULPs at imaging (initial ULPs, newly developed ULPs or both): 15-78% [7-8, 11-15]. Studies using CT scan with slices thickness >=2.5 mm (range: 2.5-5 mm) reported the lowest prevalence (15-33%) [11, 15], whereas recent studies using latest MDCT technology with para-millimetric thickness (range: 1-1.5 mm) reported the highest prevalence of ULPs (71-78%) [7, 12].
- Mean time between the initial event and the first appearance of ULPs: 17.8 days - 2.4 months, mainly within 30 days from the onset [17, 11, 13, 15];
- Progression (aortic enlargement, dissection, rupture) of ULPs: 31-70% of cases [7-8, 11-15]; it is higher for ULPs developed in the ascending aorta and decreases moving to the proximal descending aorta [7-8, 11-15] (Fig. 6 on page 10, Fig. 7 on page 11, Fig. 8 on page 11).

**Aortic Branch Artery Pseudoaneurysm (Ps) in the context of IMH**

- The pathogenesis of these lesions entails injury to the branch artery origin during the propagation of a dissecting hematoma[16-17]

- Ps are intramural collections of contrast material at the level of a branch artery, from which the aortic branch itself originates, associated with a small communication in the intimal-medial flap (between the true and false lumen of the IMH), corresponding to the branch artery origin (Fig. 9 on page 12).

- Ps may extend both along the aortic circumference and in a craniocaudal direction

- Ps more frequently involve intercostal, bronchial or lumbar arteries, in contrast to visceral vessels[16-17].

- The temporal presentation and sequential changes in size varied significantly. Most Ps were associated with complete or incomplete resorption or stability (86-95%)[16-18].

- In general, Ps appear to bear a relatively benign clinical course[16-19], although in some circumstances they need to be treated with endovascular embolization[20].

**Importance of Advanced MDCT Imaging Technique**

The above observations suggest that the detection (imaging prevalence) of ULPs is strictly dependent on the MDCT technology applied, e.g. many subtle and tiny ULPs may be overlooked at initial imaging study. Furthermore, using sub-optimal slice thickness (>=2.5 mm), many Ps may be confused with ULPs and vice versa; this may negatively affect the imaging prognostication and the management of the disease in the individual patient with acute IMH.

Therefore, advanced MDCT imaging technique with ECG-gating for a motion-artifact-free evaluation of the ascending aorta using sub-para-millimetric slice thickness (0.7-1.2 mm) is recommended in the acute phase evaluation and during the follow-up. Especially for type A IMH, that often requires surgical intervention, coronary assessment is very important for a correct treatment planning.

An evaluation based on MPR reconstruction images is also essential for a detailed, precise and complete examination of the vessels. MPR images, which include curved
planar reformation (CPR) and sagittal, coronal, and oblique reformations, are typically isotropic tomographic images (Fig. 10 on page 12, Fig. 11 on page 13, Fig. 12 on page 13).

CPR MPR are obtained from a cutting plane parallel to the vessel and passing through its center, thus showing the anatomical details of the chosen vessel in one plane. The images of the vessel can be angled and rotated in all directions and planes, therefore highlighting some details that could be lost with an axial evaluation only. On the reconstructed images the real dimensions of the vessel and of the hematoma perpendicular to the longitudinal aortic axis can be easily measured and orthogonal images of the selected level are shown.

With virtual angioscopy, internal vessels are seen as if a virtual endoscope is penetrating the body and viewing the vessel from the inside thus facilitating the detection of small ULPs. This allows an interactive fly-through animation with arbitrary positioning within the vessel (Fig. 13 on page 14 - Movie). In particular, it can be useful to assess the morphology of the ULPs (transversal vs. longitudinal tear respect to the major aortic axis) (Fig. 14 on page 14).

Images for this section:
**Fig. 1**

**A.** IMH at Unenhanced MDCT: hyperdense crescent-shaped wall thickening (arrows). Note the displacement of sub-intimal calcification (arrowhead).

**B.** IMH does not show contrast-enhancement.

**Differential Diagnosis:**

**IMH vs. thrombosed FL:** tends to maintain a constant circumferential relationship with the aortic wall and not to spiral longitudinally

**IMH vs. mural thrombus:** smooth interior border
Fig. 3

MDCT axial views. Type B IMH of the descending aorta (yellow arrows)- same case as in Fig. 2. Note a newly developed ULP at the descending aorta (blue arrows) after 6-day follow-up. Pleural effusion is a common finding in the acute phase (asterisk).

Fig. 4

MDCT paracoronal (A) and virtual angioscopy (B) views- same case as in Fig. 3. Note a newly developed ULP at the descending aorta (yellow arrows), well visualized at virtual angioscopic view (B).
Fig. 5

Type-B IMH with ULP

MDCT axial (A-B) and paracoronal (C) views. Note an initial ULP at the descending aorta that in a short period follow-up enlarged (arrows). Also IMH thickness increased (arrowheads). Pleural effusion is a common finding in the acute phase.

Fig. 6

Type-A IMH after OR of Asc Ao

Acute phase

Type A IMH after open repair of the ascending aorta. MDCT axial (on the left) and 3D VR view (on the right) showing persistent IMH of the descending aorta (yellow arrows). Note the presence of an ULP at the middle descending aorta (blue arrow).
Fig. 7

Same case as in Fig. 6. Note the progression of the IMH at the proximal level to frank aortic dissection (AD) (green arrows); the enlargement of the initial ULP at the middle descending aorta (yellow arrows); a newly developed ULP just caudally (red arrow).

Fig. 8

Type-A IMH after open repair of Ascending Aorta

Acute phase 5-month FU

MDCT 3D views. Same case as in Fig. 7. At imaging FU, IMH evolved to segmental aortic dissection (AD) at the proximal descending aorta (arrowhead) and to bifocal ULPS at the descending aorta (arrows).
**Fig. 9:** Pseudoaneurysms of the intercostal arteries at D8 and D9 level. A small pleural effusion can be seen on the left (asterisk). MDCT unenhanced (on the left) and contrast-enhanced (on the right) axial views, from cranial to caudal. Type B IMH of the descending aorta (yellow arrows) extending from the left subclavian artery to the lower abdominal aorta.
Fig. 10

MDCT curved planar reformation (CPR) (on the left), orthogonal (in the middle) and parasagittal (on the left) images- same case as in Fig. 10. Type B IMH of the descending aorta (yellow arrows) extending from the left subclavian artery to the lower abdominal aorta.

Fig. 11

Type B IMH → 6-Month Follow up

Type B IMH- same case as in Fig. 10-11. At imaging FU, complete resorption of IMH with aneurysm evolution at the isthmus level (A) and development of an ULP at the proximal descending aorta (B).
Fig. 13: Virtual angioscopy: a fly-through animation from the proximal descending aorta to the ascending aorta (the aortic valve leaflets can be seen at the proximal extremity) demonstrating two intimal tears (see also fig. 14).
MDCT curved planar reformation (CPR) image (on the left) and virtual angioscopic views (on the right). Type A IMH of the ascending and descending aorta (yellow arrows) extending from the aortic root to the thoraco-abdominal passage. Note the better morphology delineation of the ULPs at virtual angioscopic views (blue arrows). LCC= left common carotid artery; LSA=left subclavian artery

Fig. 14
Conclusion

Because a dynamic change in morphology or rapid evolution of IMH might be frequently observed, close clinical and imaging follow-up is mandatory. MDCT play a key role in assessing IMH and IMH-associated lesions (ULPs and Ps). Advanced MDCT imaging is fundamental for the diagnosis, assessment of natural course and of the acute and chronic complications during follow-up.

Personal information

S. Boccalini Department of Radiology and Interventional Radiology, IRCCS-University Hospital San Martino-IST, Genova, Italy sara.boccalini@yahoo.com

M. Castiglione Morelli Department of Radiology and Interventional Radiology, IRCCS-University Hospital San Martino-IST, Genova, Italy.

I. Budaj Department of Radiology and Interventional Radiology, IRCCS-University Hospital San Martino-IST, Genova, Italy.

L. Patrone Department of Radiology and Interventional Radiology, IRCCS-University Hospital San Martino-IST, Genova, Italy.

A. Galletto Department of Radiology and Interventional Radiology, IRCCS-University Hospital San Martino-IST, Genova, Italy.

G.A. Minetti Department of Radiology and Interventional Radiology, IRCCS-University Hospital San Martino-IST, Genova, Italy.

M. Buscaglia Department of Radiology and Interventional Radiology, IRCCS-University Hospital San Martino-IST, Genova, Italy.

S. Seitun Department of Radiology and Interventional Radiology, IRCCS-University Hospital San Martino-IST, Genova, Italy.

C. Ferro Department of Radiology and Interventional Radiology, IRCCS-University Hospital San Martino-IST, Genova, Italy.
References


