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Original research

Usefulness of triphasic CT aortic angiography in acute and surveillance: Our experience in the assessment of acute aortic dissection and endoleak

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HIGHLIGHTS

- No standardized techniques actually exist for aortic CTA.
- Triphasic CTA is useful to provide correct and prompt diagnosis of AAD in emergency.
- Triphasic CTA is essential for first follow-up examination during surveillance.

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ABSTRACT

Introduction: Computed tomography angiography (CTA) has been widely used in the diagnostic evaluation of many aortic diseases, but no standardized techniques actually exist for aortic CTA. The aim of this study was to describe the usefulness of triphasic CTA in aortic assessment in both non-traumatic emergency and surveillance conditions.
Methods: We performed non ECG-gated CTA examinations with a 64-slice CT scanner using a triphasic protocol consisting of an unenhanced acquisition, and two (early and delayed) contrastographic phases with a delay of 25–30 s and 100–120 s respectively after the injection of contrast medium. Were retrospectively selected adult patients with imaging findings of acute aortic dissection (AAD) or endoleak (EL) from November 2012 to November 2014.
Results: AAD was detected in 36 (67%) patients: 23 type A-AADs, and 13 type B-AADs. The presence of EL was observed in 18 (33%) patients: 1 type Ia, 5 types IIa, 2 types IIb, 1 type IIIa and 9 types IIIb.
Discussion: Triphasic CTA is useful to provide correct and prompt diagnosis of AAD in emergency, allowing the evaluation of type and atypical forms of AAD, and the identification of possible branch-vessel involvement and complications. During surveillance, triphasic CTA assures accurate and complete assessment of all known and unknown ELs and it is essential for first follow-up examination.

Abbreviations: AA, aortic aneurysm; AAD, acute aortic dissection; CM, contrast medium; CTA, computed tomography angiography; EL, endoleaks; EVAR, endovascular aneurysm repair; HU, Hounsfield Unit; MIP, maximum-intensity projection; MPR, multiplanar reformation; SSD, shaded-surface display.

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Conclusion: Triphasic CTA represents a reliable imaging tool for aortic assessment in both non-traumatic emergency and surveillance after endovascular aneurysm repair. Modified protocol could be employed in selected patients and tailored in their known disease.

1. Introduction

Over the last two decades, computed tomography angiography (CTA) has been widely used in the diagnostic evaluation of many acute vascular diseases, and this technique currently represents the first line modality in the early diagnosis of abdominal aortic aneurysm (AA), acute aortic dissection (AAD) and pulmonary embolism [1,2]. CTA is also commonly used to follow-up patients treated with endovascular stents and stent grafts with the aim of assessing stent graft patency and stent graft-related complications [1,3].

Actually, no standardized techniques exist for aortic CTA, therefore practices, the type of scanners and acquisition protocols, contrast medium (CM) concentration and administered doses, delay times for contrastographic phases may vary from institution to institution [1,4,5]. Our hospital generally employs a triphasic protocol consisting of an unenhanced acquisition, and two (early and delayed) contrastographic phases. This protocol is chosen both when acute aortic syndrome is suspected and also when patients need to be followed-up to assess any endoleaks (ELs) after endovascular aneurysm repair (EVAR).

The aim of the current study was to describe the usefulness of triphasic CTA in aortic non-traumatic emergency and surveillance conditions presenting our center experience in diagnosing AAD and in assessing post-EVAR EL.

2. Materials and methods

2.1. Study population

This was a retrospective observational study conducted at a single university medical center and approved by our institutional review board. All triphasic CTA examinations performed at our institution from November 2012 to November 2014 were retrospectively reviewed in order to identify and select adult patients with AAD or post-EVAR EL imaging findings.

Our institutional database was checked to retrieve necessary and useful clinical information, such as the time of symptoms onset for patients admitted to our emergency department and the date of endograft repair or the time when EL was diagnosed for patients who underwent CTA EVAR follow-up.

2.2. CTA protocol and imagine analysis

Non ECG-gated CTA examinations were performed with a 64-slice CT scanner (GE Medical Systems, Milwaukee, WI) scanning from the lung apices to the pelvis before and after intravenous injection of CM, with respiration suspended whenever possible. After a scout view was obtained, initial unenhanced images were acquired. According to patient weight, 90–130 mL of 350 mg iodine/mL (Iomeron 350, Bracco) non-ionic CM were injected into a peripheral vein at a rate of 3–4 mL/s followed by a saline flush through a double-piston power injector. After unenhanced scanning, an early contrast-enhanced phase was acquired with automatic triggering settled at 100 Hounsfield Unit (HU) or with a delay of 25–30 s following CM administration. Then, a delayed contrast-enhanced phase was obtained at 100–120 s after CM injection.

Images were initially assessed in axial view and further elaborating multiplanar reformation (MPR) images in sagittal, coronal, oblique sagittal, and curved projections, maximum-intensity projection (MIP) and shaded-surface display (SSD) reconstruction generated on CT scan vendor workstation. According to the Stanford classification, acute type A dissection was defined as any dissection that involved the ascending aorta and/or aortic arch and acute type B as that involving the descending aorta (without any tear in or involvement of the ascending aorta) presenting within 14 days of symptom onset [6,7]. ELs were defined as leakage of CM outside the graft, but within the aneurysm sac and were classified into five types depending upon the origin of the leak (Table 1) [8–10].

3. Results

There were a total of 54 patients (37 Males, 17 Females; 43–78 years, mean age 61 years) included in the study (Table 2). CTA examinations performed at our emergency department revealed AAD in 36 (67%) patients: 23 cases of type A-AAD, and 13 cases of type B-AAD. CTA follow-up examinations showed the presence of EL in 18 (33%) patients: type Ia in 1 case, type IIa in 5 cases, type IIb in 2 cases, type IIIa in 1 case and type IIIb in 9 cases.

Patients with AAD were referred to our institution from 1 to 11 days (mean 3 days) after abrupt-onset pain, defined as sudden severe tearing pain in the chest, neck, or back, or any pain and severe symptoms that brought the patient to medical attention. ELs were assessed from 10 to 82 months (mean 46 months) after aneurysm repair performed at multiple hospitals; the date of endograft repair was not available in 5 patients, although, based on patient history, these patients had grafts placed more than 1 year before referral to our institution. ELs were already known in 6 patients and were newly diagnosed in the remaining 12 cases.

4. Discussion

4.1. Triphasic CTA in acute (non-traumatic) aortic disease

CTA is the practical test of choice in most settings and represents the most commonly used imaging technique for evaluation of suspected acute aortic syndrome and AAD in particular. The identification of an intimal flap and a true and a false aortic lumen are definitive signs of aortic dissection, which allow CTA to diagnose AAD with high sensitivity and specificity [7,11,12]. CM injection rates and technical parameters may vary based on institutional preferences and patients' characteristics, different CT vendors and configuration of scanners. However, protocols for assessing AAD have to include both unenhanced and contrast-enhanced image acquisitions, scanning of the entire aorta from the proximal arch vessels to the common iliac arteries distally, and appropriate optimization of aortic true lumen enhancement [3]. All of these necessary features are part of our institutional CTA protocol.

The primary role of unenhanced scanning is to detect medially displaced aortic calcifications [3]. The unenhanced images may also be helpful to assess high attenuation within the aortic wall