Dual-source CT virtual intravascular endoscopy for assessing aortic dissection: A preliminary study

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Purpose

Aortic dissection is a common vascular disease and it is the most frequent cause of aortic emergency which carries high morbidity and mortality. Aortic dissection can be a life-threatening event which is characterised by splitting of the aortic wall into true and false lumens by high pressure arterial blood entering the media through an intimomedial entrance tear. Multislice CT angiography is the preferred method for diagnosis of aortic dissection with a reported sensitivity and specificity of nearly 100% [1]. It is clinically important to differentiate the true lumen from false lumen and identify the lumen of origin in major branch vessels, since viscera supplied by the false lumen are at risk when the false lumen is spontaneously or surgically occluded. Traditionally, assessment of aortic dissection is based on 2D axial images, supplemented by 3D reconstructions. However, this may not be possible in all cases due to variable appearances caused by different types of dissection [2]. The purpose of this study is to present our preliminary experience of using dual-source CT virtual intravascular endoscopy (VIE) for evaluation of aortic dissection with the aim of determining the potential value of virtual endoscopy for identification of the entry site and assessment of dissection extent.

Methods

10 patients (7 male and 3 female, age range: 39-77 years, mean age: 55 years) suspected of aortic dissection undergoing multislice CT angiography were included in the study. All patients were performed on a dual-source CT scanner (Siemens, Definition, Forchheim, Germany) with a section thickness of 0.5-1.0 mm, pitch 1.0, with tube voltage of 120 kVp and tube current ranging from 300-500 mAs. Non-ionic contrast medium was administered at a flow rate of 4-6 ml/s, followed by 40-60 ml of saline chasing. The scan was performed with a bolus tracking technique with a CT attenuation of 120 HU as the triggering threshold at the ascending aorta to initiate the scan.

2D axial, multiplanar reformation and volume rendering images were generated in each patient to determine the type of aortic dissection, differentiation between true and false lumens, as well as identification of intimal tear. Virtual intravascular endoscopy was generated in each patient to demonstrate the intraluminal appearances of dissection, such as intimal flap separating the true lumen from the false lumen, intimal tear or entry site, extent of dissection, involvement of aortic branches.

Results

Aortic dissection was characterised as Stanford type A in eight patients and type B dissection in the remaining two patients based on 2D images. VIE was successfully generated in all of the patients with clear demonstration of the intraluminal changes related to the aortic

dissection. In addition to visualisation of true and false lumens and intimal flap, origins of the aortic branches involved by the dissection are clearly displayed on virtual endoscopic images (Figure 1). The entry site or intimal tear can be accurately determined by virtual endoscopy in most of the cases (Figure 2) when compared to conventional 2D or 3D visualisations. VIE is advantageous in this aspect as it enables generation of intraluminal views and clearly shows the communication between true and false lumen. Moreover, virtual fly-through of the aorta and its branches is not restricted by the narrowed true lumen, thus assessment of dissection extent is feasible with this visualisation tool.

Identification of vessel involvement by aortic dissection can be confirmed by 2D axial images in most of the situations. VIE could be used as a complementary tool to 2D images in indeterminate cases, as virtual fly-through allows the viewers to follow the direction of dissection and identify whether the individual aortic branches are involved by the dissection. VIE assessment of the vessel involvement is still possible even if in the presence of severely narrowed true lumen due to compression by the false lumen.

Intimointimal intussusception is an unusual manifestation of aortic dissection caused by circumferential dissection of the intimal layer. In intimointimal intussusception, CT scans may show one lumen wrapped around the other lumen in the aortic arch or descending aorta, with the inner lumen always being the true lumen. VIE typically shows the central true lumen surrounded by the peripheral false lumen via two intimal flaps.

Conclusion

High resolution CT imaging is the method of choice for diagnosis of aortic dissection and identification of true and false lumens, as well as determination of the aortic branches in relation to the dissection [3]. The most reliable direct imaging sign observed by CT for differentiating true from false lumens is the ability to demonstrate direct continuity between the true lumen and the lumen of the uninvolved aortic lumen distal or proximal to the dissected aortic segment. This may not always be possible because the dissection may extend proximally into the aortic root, or the origin of the intimomedial entrance tear is at the convexity of the aortic arch where the true and false lumens may be difficult to follow. The limitation of 2D CT imaging is complemented by 3D VIE visualisation. Our experience of using VIE for assessment of aortic dissection, especially in the identification of intimal tear shows the superiority of VIE over 2D views in the complex cases of dissection.

VIE not only allows for generation of static intraluminal views of the aorta and its branches, but also provides virtual fly-through and navigation of the entire aorta lumen, despite in the presence of a very-narrowed true lumen. Therefore, accurate assessment of the involvement to the artery branches by dissection in addition to the identification of entry site can be achieved with VIE visualization. Moreover, the extent of the entry site can be further explored by VIE and assessment of vessel involvement can be confirmed even if for the tiny branch such as coronary arteries.

Virtual intravascular endoscopy can be used as a complementary tool to conventional CT visualisations for accurate assessment of the aortic dissection. Virtual intravascular endoscopy is particularly valuable in the identification of entry site which could assist radiologists to determine the extent of dissection, so that better management could be achieved. Further studies based on a large cohort are needed to confirm its diagnostic value.

References

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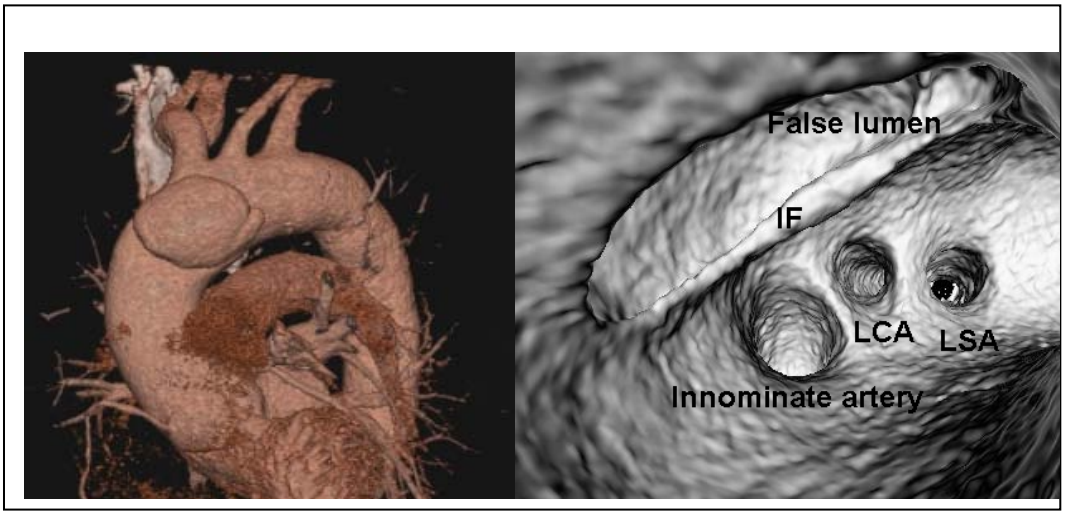

Fig 1. 3D volume rendering shows Stanford type A dissection in the ascending aorta. Virtual endoscopy confirms that the three main branches of the aortic arch arise from the true lumen. IF-intimal flap. LSA-left subclavian artery, LCA-left common carotid artery

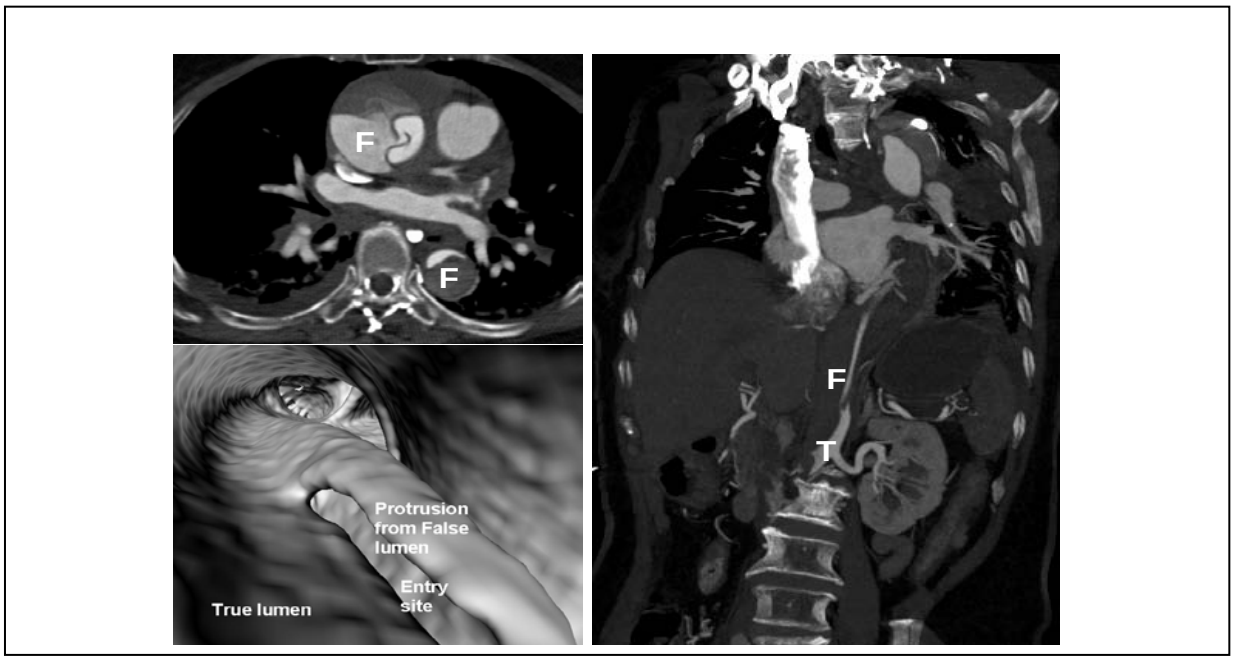

Fig 2. Stanford type A dissection with very narrowed true lumen due to compression from the false lumen (F). Virtual endoscopy identifies the entry site when viewing from inside the

true lumen. Coronal MIP image shows that dissection extends to involve abdominal artery branches.