

➤ **Case Report** ◀

Impact of High-Resolution Epiaortic Ultrasonographic Imaging on Evaluating Aortic Wall Pathology

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There has been no definitive method, other than pathological findings, to identify the degeneration of the tunica media in the aortic wall (TM). We describe how high-resolution intraoperative epiaortic ultrasonographic imaging identifies changes in the TM of patients with aortic dissection. This method shows great promise in facilitating presymptomatic diagnoses of various aortic wall pathologies.

Keywords: aortic dissection, tunica media, high-resolution epiaortic ultrasonography

Introduction

We previously reported that synchrotron radiation-based X-ray phase-contrast tomography (XPCT) imaging revealed densitometrical changes in the tunica media in the aortic wall (TM) of patients with acute type-A aortic dissection (AADA).^{1,2} However, the application of XPCT entails the use of hazardous levels of radiation. To replicate XPCT findings in clinical practice, we investigated the ap-

plication of high-resolution ultrasound in intraoperative epiaortic ultrasonographic (EAU) imaging.

Case Report

Three patients (A: normal aorta, B: chronic aortic dissection, C: AADA) were selected. Before beginning cardiopulmonary bypass, the midascending aorta was exposed and an EAU examination was conducted using EPIQ CVx and an eL18-4 transducer (maximum frequency: 22 MHz, theoretical axial resolution 35 μm, Philips Ultrasound, Inc., Bothell, WA, USA). Further image processing and analysis of the ultrasonographic intensity (UI) data were performed using ImageJ software (<http://rsbweb.nih.gov/ij/index.html>).

In Case-1, a 51-year-old male with aortic and mitral valve regurgitation underwent a double valve replacement. EAU imaging showed that the UI remained unchanged throughout the TM (Fig. 1A). In Case-2, a 47-year-old female with chronic dissection in the ascending aorta underwent a valve-sparing aortic root replacement. EAU imaging of the aorta section that had not been dissected clearly showed high linear changes in the UI in the middle of the TM (Fig. 1B). In Case-3, a 71-year-old female with AADA underwent a root and hemiarch replacement. High linear changes in the UI were observed in the middle of the TM, and aortic dissection was observed as an extension of those linear changes (Fig. 1C). In summary, EAU imaging of the aortic wall in patients with AADA clearly shows high linear changes in the UI in TM, even at the nondissected aortic wall; compared with these findings, that of the aortic wall in patients without AADA does not show it. A line profile of the UI between the intima and adventitia showed that the UI remained unchanged in Case-1 (Fig. 1D) and exhibited a high peak in the middle of TM in Case-2 (Fig. 1E) and Case-3 (Fig. 1F). These results indicated clear differences in the UI throughout TM between normal and pathological aortas.


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Received: September 15, 2021; Accepted: December 1, 2021
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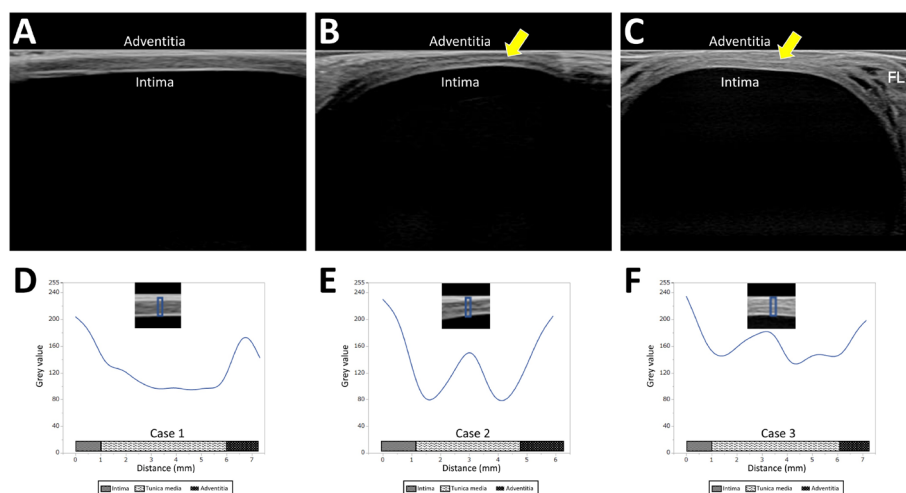


Fig. 1 High-resolution epiaortic ultrasound imaging and line profile of ultrasound intensity of three patients. **(A)** Case-1 with no aortic pathology. **(B)** Case-2 with chronic aortic dissection. High-intensity linear changes were observed in the middle of the tunica media (indicated by the yellow arrow). **(C)** Case-3 with acute type-A aortic dissection. The tunica media was separated according to the line of high intensity (yellow arrow). **(D)** A line profile of the intensity from the intima to the adventitia (indicated by the blue square) in Case-1. **(E)** A line profile of the intensity (blue square) in Case-2. **(F)** A line profile of the intensity (blue square) in Case-3. FL: false lumen of the aorta

Discussion

Intraoperative EAU imaging of the ascending aorta is a widely applied strategy for reducing atherosclerotic emboli.³⁾ However, it has not been used to evaluate the TM of the aortic wall. This study is the first to use recently available high-resolution ultrasound in EAU imaging to visualize changes in the UI throughout TM. These findings were consistent with changes in TM of patients with AADA, which were obtained using XPCT.²⁾ Therefore, high-resolution ultrasonographic imaging could surrogate XPCT findings in clinical settings and lead to significant improvements in the presymptomatic diagnosis of various aortic wall pathologies, including aortic dissection.

Conclusion

High-resolution intraoperative epiaortic ultrasonographic imaging could show great promise in facilitating presymptomatic diagnoses of various aortic wall pathologies.

Disclosure Statements

We have no conflicts of interest to disclose.

Additional Note

We have obtained written informed consent from these

patients for reporting the data.

Author Contributions

Study conception: SH, TT
 Data collection: SH, TT
 Analysis: SH, TT
 Investigation: SH, TT
 Writing: SH, TT
 Funding acquisition: none
 Critical review and revision: all authors
 Final approval of the article: all authors
 Accountability for all aspects of the work: all authors

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