

# Diagnostic challenges with transesophageal echocardiography for intraoperative iatrogenic aortic dissection: Role of epi-aortic ultrasound

Daniel Rhoades, Sudhakar Subramani

Department of Anesthesia, University of Iowa Hospitals and Clinics, Iowa City, IA, USA

## ABSTRACT

Iatrogenic aortic dissection is a rare and serious complication of cardiac surgery with an incidence between 0.12% and 0.16%. Dissections involving an intimal flap can be detected using trans-esophageal echocardiography (TEE) with a sensitivity of 94%–100% and specificity of 77%–100%. Rarely, dissections can occur that are not detectable by TEE. There have been reports of iatrogenic dissection in the ascending aortic cannulation site; however, a dissection at the antegrade cardioplegia cannulation site is very rare. It also presents challenges associated with early diagnosis and appropriate intervention. We are describing a rare case of aortic dissection at the antegrade cardioplegia cannulation site in the proximal ascending aorta. The dissection was unable to be visualized with TEE initially, and required epi-aortic ultrasound to diagnose dissection in timely manner.

**Keywords:** Antegrade cannula, aortic dissection, epi-aortic ultrasound

**Address for correspondence:** Dr. Sudhakar Subramani, Department of Anesthesia, University of Iowa Hospitals and Clinics, Iowa City, IA 52242, USA.  
E-mail: drsudhakar77@yahoo.co.in

**Submitted:** 08-Jan-2019 **Revised:** 27-Mar-2019 **Accepted:** 06-Jun-2019 **Published:** 22-Jan-2021

## INTRODUCTION

Iatrogenic aortic dissection is a rare and serious complication of cardiac surgery with an incidence between 0.12% and 0.16%.<sup>[1]</sup> Dissections involving an intimal flap can be detected using trans-esophageal echocardiography (TEE) with a sensitivity of 94%–100% and specificity of 77%–100%.<sup>[2]</sup> Rarely, dissections can occur that are not detectable by TEE. Here, we report a case of intraoperative type-A aortic dissection which was not visible on TEE and required an epi-aortic ultrasound examination to confirm both location and severity.

## CASE

A 73-year male presented for mitral valve repair with MAZE procedure. The patient had a medical history of severe

mitral valve regurgitation, paroxysmal atrial fibrillation, and coronary artery disease status post drug-eluting stent to mid left anterior descending artery. His surgical history included abdominal aortic aneurysm status post open abdominal aortic aneurysm repair and a thoracic aortic aneurysm without rupture status post thoracic endovascular stenting requiring subclavian and vertebral artery bypasses off of left common carotid. Anesthetic induction was done uneventfully with midazolam, fentanyl, propofol, and rocuronium. Monitors included ASA standard monitors, arterial line, pulmonary artery catheter, cerebral oximetry using a Fore-Sight device (CASMED, CT, USA), and TEE. The surgical procedure commenced and cannulas for cardiopulmonary bypass (CPB) included an aortic cannula, bi-caval venous cannulas, retrograde cardioplegia cannula, and antegrade cardioplegia cannula. TEE was

Video Available on: [www.annals.in](http://www.annals.in)

### Access this article online

Quick Response Code:



Website:

[www.annals.in](http://www.annals.in)

DOI:

10.4103/aca.ACA\_4\_19

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**For reprints contact:** [WKHLRPMedknow\\_reprints@wolterskluwer.com](mailto:WKHLRPMedknow_reprints@wolterskluwer.com)

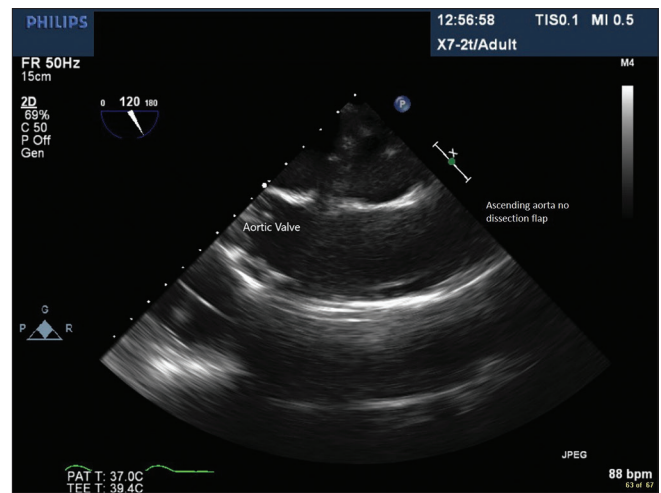
**How to cite this article:** Rhoades D, Subramani S. Diagnostic challenges with transesophageal echocardiography for intraoperative iatrogenic aortic dissection: Role of epi-aortic ultrasound. *Ann Card Anaesth* 2021;24:83-6.

used to facilitate placement of the cannulas and confirm proper placement prior to initiation of CPB. The initiation of CPB was uneventful. The mean arterial pressures and CPB circuit pressures were within the acceptable range during the CPB. The MAZE procedure was completed, and the mitral valve was repaired using a new cord in the P2-3 leaflet area. The heart was closed, de-aired, and restarted in sinus rhythm without incident, and the patient was weaned from CPB.

Upon TEE evaluation of the repaired valve, there was moderate regurgitation near the A3/P3 scallop. No cannulas were removed during the valve assessment with TEE except retrograde cardioplegia. Decision was made to reinitiate CPB, and the valve was repaired with another new cord in the P3 leaflet area. Reassessment of valve after second CPB showed no regurgitation. Upon removal of the antegrade cardioplegia cannula, a bluish hue was noted at the cannulation site. Immediate TEE assessment could not visualize the cardioplegia cannulation site in the mid-ascending aorta due to a slightly dilated aortic root causing changes in structural anatomy [Figure 1]. Alternatively, an epi-aortic ultrasound probe was used immediately which confirmed an aortic dissection at the antegrade cardioplegia cannula site using the short-axis mid ascending aorta view [Figure 2 and Video 1]. During the preparation for the placement of retrograde cardioplegia line, the dissection advanced proximally toward the root and was able to be seen on TEE [Figure 3]. CPB was reinitiated after the placement of retrograde cardioplegia line. The patient was then cooled to 25°C and circulatory arrest was achieved. The dissected area was resected up under the right innominate artery, performing a hemiarch repair using Gelweave graft. The side branch of the graft was cannulated and a cross clamp was placed on the graft proximal to the side port, and circulation was restarted. After assessing the integrity of the aortic arch, the remaining part of dissection was resected up to the sino-tubular junction. The proximal part of graft was sutured. The patient was weaned from bypass with minimal inotropic and vasopressor support without major complications. Postoperatively, the patient's hospital course was complicated by delirium. He was discharged on postoperative day 9 with baseline cognitive function.

## DISCUSSION

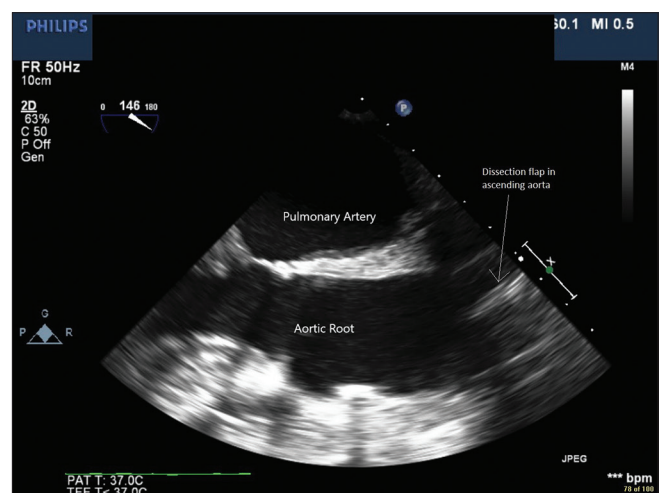
Iatrogenic aortic dissection is a rare but devastating complication of cardiac surgery. During dissection, intraluminal blood perforates the tunica intima and separates the tunica media along the path of the vessel. Dissections are different from sub-adventitial hematoma



**Figure 1:** Mid esophageal ascending aortic long axis view – unable to visualize the dissection in the antegrade cannula site when surgeon noticed blueish discoloration



**Figure 2:** Epi-aortic ultrasound short-axis view of proximal ascending aorta – able to demonstrate dissection in the ascending aorta



**Figure 3:** Mid esophageal ascending aortic long-axis view – able to visualize the dissection after few minutes

and must be differentiated in the operating room. Sub-adventitial hematomas are small, compressible, slow moving, and will stop enlarging upon initiation of CPB.<sup>[3]</sup> Dissections can progress rapidly, involve the entire aorta, and cause massive hemorrhage when adventitia is incised.<sup>[3]</sup> Risk factors for dissection include hypertension, atherosclerosis, genetic/congenital disorders, trauma, surgery, cocaine use, previous aortic manipulation, and inflammatory diseases.<sup>[3-6]</sup> Intraoperative precipitating events can include arterial cannulation, aortic cross clamp application, and removal of arterial cannulas.<sup>[7]</sup>

The overall mortality rate for iatrogenic type-A aortic dissection is approximately 24%–48%.<sup>[8]</sup> If the condition is recognized intraoperatively, surgical repair carries no significant increase in mortality.<sup>[8]</sup> In fact, it has been suggested that intraoperative diagnosis and repair with a dacron graft versus postoperative diagnosis and treatment of iatrogenic aortic dissection decreases the mortality to 20%–33% from 50%–78%, respectively.<sup>[9]</sup>

TEE is the leading way to detect and interpret the dissection intraoperatively and has been shown to enhance outcomes.<sup>[3]</sup> Since intraoperative TEE has been used routinely, mortality associated with iatrogenic type-A aortic dissection has decreased from 75% to 17%.<sup>[6]</sup> Intraoperative TEE used on acute type-A aortic dissection changes surgical plan in 39% of patients, giving credence to its utility in giving high-quality care.<sup>[10]</sup> Drawbacks to TEE include operator-dependent skill and variable visualization of the proximal arch and distal part of ascending aorta secondary to interposition of the trachea between ascending aorta and esophagus.<sup>[11,12]</sup> In the incidence, TEE examination is ineffective in detecting a dissection, other modalities are available and include magnetic resonance imaging, computerized tomography, aortography, and epi-aortic ultrasound exam (EAU).<sup>[10,12]</sup> Given the intraoperative nature of iatrogenic dissection, decision-making and time for intervention make TEE, EAU, and aortography the most reasonable options.<sup>[12]</sup> In this case, an EAU comprehensive exam was done.

The dissection could not be seen using the mid-esophageal ascending aorta long- and short-axis views and upper esophageal aortic arch long- and or short-axis views. TEE, which interrogates the ascending aorta from its posterior aspect may fail to delineate the dissection developing anteriorly at the site of antegrade cardioplegia cannulation, especially in the presence of aortic dilatation due to the distortion of the anatomy. On contrary, the epi-aortic

ultrasound has a potential to detect the dissection at an early stage, as the ultrasound probe is placed directly on the anterior aspect of the ascending aorta. Using the comprehensive EAU exam, dissection was visualized and treated [Figure 2]. An EAU comprehensive exam includes five views for the evaluation of ascending aorta and proximal arch. These views include proximal, mid, and distal views of the ascending aorta in the short-axis view and one long-axis view of the ascending aorta and proximal arch, respectively.<sup>[13]</sup>

It is unclear why the antegrade cannula site dissected in our patient. There was no evidence of atheroma at the antegrade cannulation site prior to first CPB. Dissection at the antegrade cannula site is exceedingly rare. In a retrospective study of over 15,000 cardiac surgeries, intraoperative type-A aortic dissection occurred in seven patients, and only one case had a dissection at the antegrade cardioplegia site.<sup>[8]</sup> Iatrogenic aortic aneurysm most commonly occurred in patients with hypertension and pre-existing aortic pathology.<sup>[14]</sup> Pathology report on the affected area in this case was inconclusive; however, our patient had multiple risk factors for aortic dissection including coronary artery disease, hypertension, hyperlipidemia, previous aortic manipulation, and a history of two previous major vascular dissections.<sup>[3-5,13]</sup> All of these combined gave a strong propensity for vascular dissection. A high index of suspicion by the surgical and anesthesia team to further the investigation is always necessary to give potentially lifesaving interventions to patients.

## CONCLUSION

Intraoperative iatrogenic type-A aortic dissection is a rare but fatal event. Diagnosis and appropriate intervention in a timely manner will potentially decrease associated morbidity and mortality.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## REFERENCES

1. Fleck T, Ehrlich M, Czerny M, Wolner E, Grabenwoger M, Grimm M. Intraoperative iatrogenic type A aortic dissection and perioperative outcome. *Interact Cardiovasc Thorac Surg* 2006;5:11-4.
2. Evangelista A, Flachskampf FA, Erbel R, Antonini-Canterin F, Vlachopoulos C, Rocchi G, *et al*. Echocardiography in aortic diseases: EAE recommendations for clinical practice. *Eur J Echocardiogr* 2010;11:645-58.
3. Gukop P, Chandrasekaran V. Principles for management of intraoperative acute type A aortic dissection. *Aorta* 2015;3:191-4.
4. Pansini S, Gagliardotto PV, Pompei E, Parisi F, Bardi G, Castenetto E, *et al*. Early and late risk factors in surgical treatment of acute type A aortic dissection. *Ann Thorac Surg* 1998;66:779-84.
5. Braverman AC. Acute aortic dissection. *Circulation* 2010;122:184-8.
6. Singh A, Mehta Y. Intraoperative aortic dissection. *Ann Card Anaesth* 2015;18:537-42.
7. Ketenci B, Enc Y, Ozay B, Gunay R, Cimen S, Gorur A, *et al*. Perioperative type I aortic dissection during conventional coronary artery bypass surgery: Risk factors and management. *Heart Surg Forum* 2008;11:E231-6.
8. Narayan P, Angelini GD, Bryan AJ. Iatrogenic intraoperative type A aortic dissection following cardiac surgery. *Asian Cardiovasc Thorac Ann* 2015;23:31-5.
9. Still RJ, Hilgenberg AD, Akins CW, Daggett WM, Buckley MJ. Intraoperative aortic dissection. *Ann Thorac Surg* 1992;53:374-9.
10. Thorsgard ME, Morrisette GJ, Sun B, Eales F, Kshetry V, Flavin T, *et al*. Impact of intraoperative transesophageal echocardiography on acute type-A aortic dissection. *J Cardiothorac Vasc Anesth* 2014;28:1203-7.
11. Arora D, Mehta Y. Imaging the aorta. *Ann Card Anaesth* 2015;18:115.
12. Goldstein SA, Evangelista A, Abbara A, Arai A, Asch FM, Badano LP, *et al*. Multimodality imaging of diseases of the thoracic aorta in adults: From the American society of echocardiography and the European association of cardiovascular imaging. *J Am Soc Echocardiogr* 2015;28:119-82.
13. Glas KE, Swaminathan M, Reeves ST, Shanewise JS, Rubenson D, Smith PK, *et al*. Guidelines for the performance of a comprehensive intraoperative epi-aortic ultrasonographic examination: Recommendations of the American society of echocardiography and the society of cardiovascular anesthesiologists; Endorsed by the society of thoracic surgeons. *Anesth Analg* 2008;106:1376-84.
14. Stanger O, Schachner T, Gahl B, Oberwalder P, Englberger L, Thalmann M, *et al*. Type A aortic dissection after non-aortic cardiac surgery. *Circulation* 2013;128:1602-11.