A Case Report of Aortic Intramural Hematoma: From Diagnosis to Endovascular Treatment Guided by Transesophageal Echocardiography

Giovanni Benedetti, Giancarlo Trimarchi[1], Cataldo Palmieri, Umberto Paradossi, Sergio Berti, Antonio Rizza

Department of Cardiology and Cardiac Surgery, Fondazione Toscana Gabriele Monasterio, Massa, [1]Department of Clinical and Experimental Medicine, Cardiology Unit, University of Messina, Messina, Italy

Abstract

Aortic intramural hematoma (IMH) accounts for approximately 10%–25% of acute aortic syndromes (AAS), and multi-slice computed tomography and magnetic resonance imaging are the leading techniques for diagnosis and classification. In this context, endovascular strategies provide a valid alternative to traditional open surgery and transesophageal echocardiography (TEE) could play a role in therapeutic decision-making and in endovascular repair procedure guidance. A 57-year-old female patient with IMH extending from the left subclavian artery to the upper tract of the abdominal aorta, underwent endovascular aortic repair using an unibody single-branched stent grafting in the aortic arch and descending aorta with a side branch inserted in the left common carotid artery. To restore proper flow in the left axillary artery, a carotid-subclavian bypass graft was performed. The procedure was guided by angiography and TEE. Intraoperative TEE revealed aortic IMH with a significant fluid component in the middle tunic of the aorta with a wall thickness of over 13 mm. TEE was useful in monitoring of all steps of the procedure, showing the presence of the guidewires into the true lumen, the advancement of the prosthesis, and the phases of release and anchoring. This case highlights the importance of using multimodality imaging techniques to evaluate AAS and demonstrates the growing potential of TEE in guiding endovascular repairs.

Keywords: Acute aortic syndromes, aortic intramural hematoma, case report, endovascular aortic repair, multimodality imaging, transesophageal echocardiography

Introduction

Aortic intramural hematoma (IMH) accounts for approximately 10%–25% of acute aortic syndromes (AAS), and it occurs within the aortic wall in the absence of intimal disruption, caused by rupture of the vasa vasorum, allowing bleeding in the aortic media, with a final wall thickening major than 5 mm.[1] IMH is characterized by a variable natural history, ranging from fewer than 10% of cases with spontaneous resolution to 16%–47% of patients with progression to aortic dissection after rupture of the intimal layer and creation of an entry tear.[2] For these reasons, the main considerations in deciding between open surgery and endovascular treatment are the clinical presentation, timing, and the location within the aorta.[3,4]

Multi-slice computed tomography (MSCT) and magnetic resonance imaging (MRI) are the leading techniques for the diagnosis and classification of IMH.[5,6] In addition to the use of MSCT/MRI and angiographic imaging, transesophageal echocardiography (TEE) could play a role in therapeutic decision-making and in endovascular repair procedure guidance.[7]

Case Report

A 57-year-old female patient was referred to our hospital for AAS and underwent MSCT that revealed aortic IMH extending

Videos available on: https://journals.lww.com/JCEG

Access this article online

Quick Response Code:

Website: https://journals.lww.com/JCEG

DOI: 10.4103/jcecho.jcecho_21_24

Address for correspondence: Dr. Giancarlo Trimarchi, Department of Clinical and Experimental Medicine, Cardiology Unit, University of Messina, 98100 Messina, Italy.
E-mail: giancarlo.trimarchi18@gmail.com

Submitted: 24-Mar-2024 **Revised:** 10-Apr-2024
Accepted: 14-Apr-2024 **Published:** 28-Jun-2024

How to cite this article: Benedetti G, Trimarchi G, Palmieri C, Paradossi U, Berti S, Rizza A. A case report of aortic intramural hematoma: From diagnosis to endovascular treatment guided by transesophageal echocardiography. J Cardiovasc Echography 2024;34:85-9.

from the left subclavian artery (LSA) to the upper tract of the abdominal aorta. No cardiovascular risk factors, except for hypertension, emerged from the anamnestic collection. Medical treatment with blood pressure and pain control was the initial approach. After 15 days of admission to our unit, the patient presented a recurrence of thoracic pain resistant to opioids. MSCT evaluation showed an expansion of the IMH despite optimal medical therapy and proximal progression of the hematoma in the aortic arch with an origin in the space between the left common carotid artery (LCCA) and LSA [Figure 1].

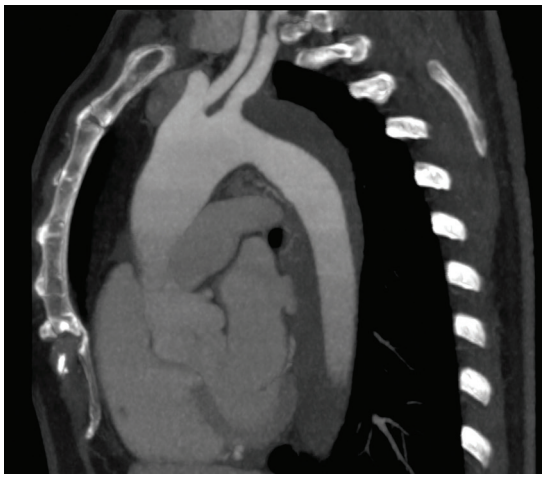

Figure 1: Computed tomography showing aortic intramural hematoma with an origin in the space between the left common carotid artery and left subclavian artery

Figure 2: Model of a castor single-branched thoracic aortic stent graft (Microport Medical, Shanghai, China)

The case was evaluated by the aortic team which decided to plan an endovascular aortic repair using a Castor prosthesis [Figure 2].

We planned to implant a unibody single-branched stent grafting in the aortic arch and descending aorta with a side branch inserted in the LCCA. To restore a good flow in the left axillary artery, TEVAR was followed in the same procedure, by carotid-subclavian bypass with polytetrafluoroethylene graft. The procedure was done in our hybrid operating theater, guided by angiography and TEE. Intraoperative TEE revealed aortic IMH with a significant fluid component in the middle tunic of the aorta with a wall thickness of 13 mm [Figure 3], as shown in Video 1.

The cross-section of the descending aorta showed an echo-lucent semilunar zone of the aortic wall [Figure 4].

During the procedure, TEE confirmed the position of the guidewire in the aortic lumen without damage of the IMH [Figure 5], shown in Video 2, and identified the device before its deployment [Figure 6], as shown in Video 3.

After the implantation of the endograft, TEE confirms the technical success of the procedure without expansion of the IMH [Figure 7].

In addition, TEE excluded intimal tears distal or proximal of the stent-graft and was useful to evaluate the presence of endo-leaks or early complications in adjacent aortic segments, as shown in Video 4. The flow within the carotid-subclavian bypass with polytetrafluoroethylene graft and its correct function have been evaluated by angiography and TEE [Figure 8].

The follow-up CT scan, performed 3 days after the procedure, confirmed the optimal positioning of the prosthesis, both in terms of the main and side branches, and the functioning of

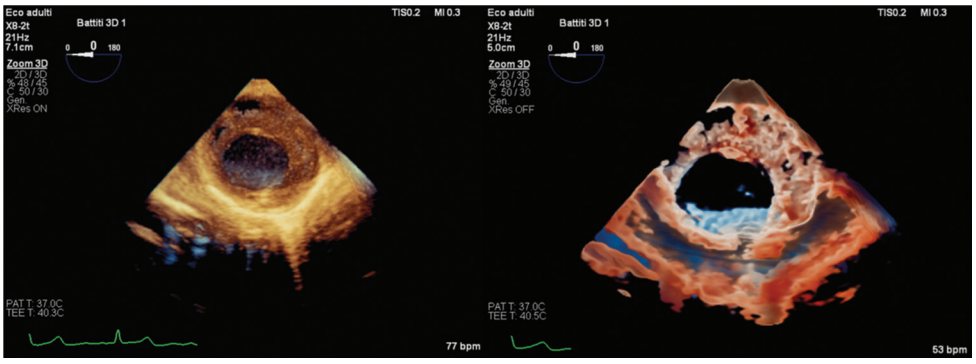

Figure 3: Intraoperative three-dimensional transesophageal echocardiography (3D-TEE) showing aortic intramural hematoma with a significant fluid component in the middle tunic of the aorta (yellow asterisk) and a wall thickness of 13 mm (on the left traditional 3D-TEE; on the right TrueVue plus light and Glass novel 3D modality)

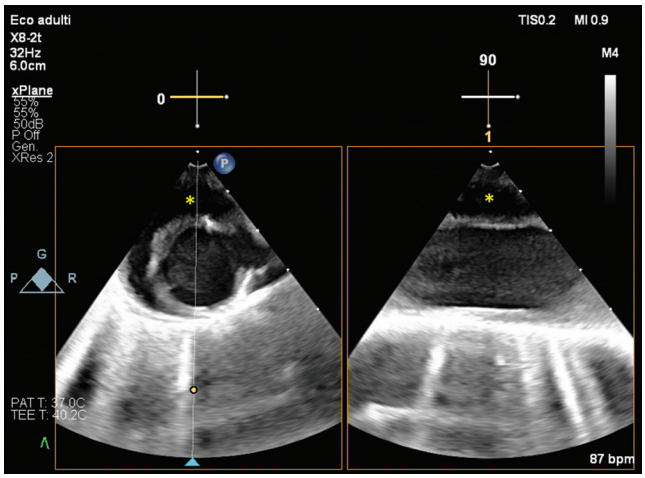

Figure 4: Intraoperative three-dimensional transesophageal echocardiography with X-plane modality, showing a cross-section of the descending aorta with evidence of a heterogeneous intramural hematoma with areas of varying echogenicity (yellow asterisk)

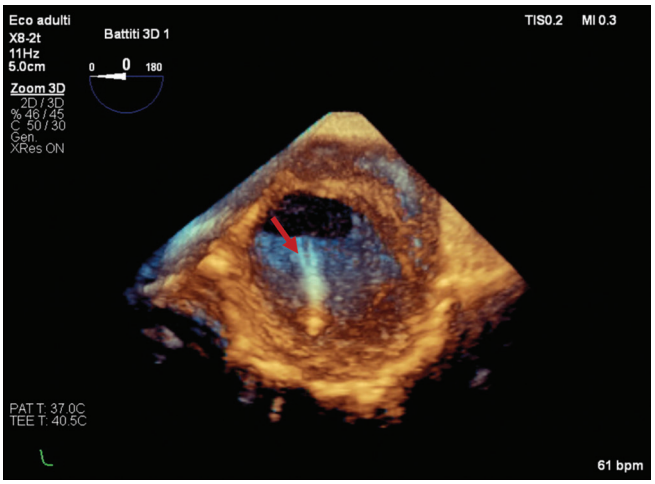

Figure 5: Intraoperative three-dimensional transesophageal echocardiography confirmed the position of the guidewire (red arrow) in the aortic lumen without damage of the intramural hematoma

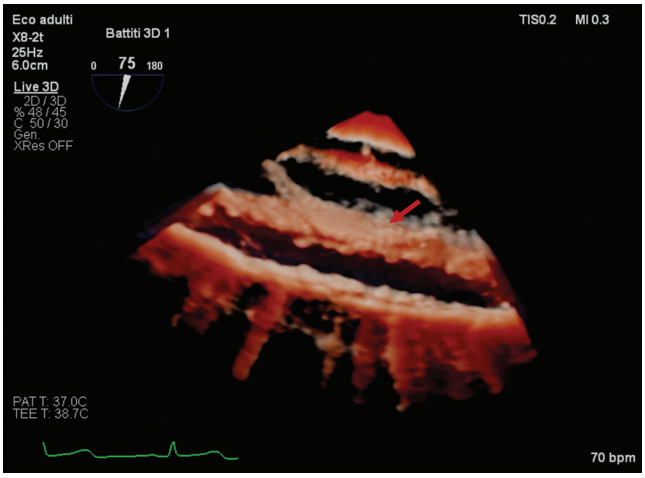

Figure 6: TrueVue plus light three-dimensional transesophageal echocardiography modality, showing the prosthesis (red arrow) in the true lumen before its deployment

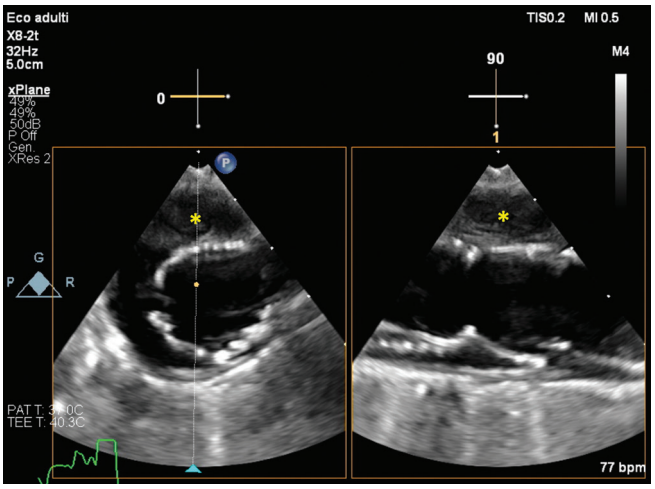

Figure 7: Intraoperative three-dimensional transesophageal echocardiography with X-plane modality, confirms the correct apposition of the prosthesis to the wall and technical success of the procedure without expansion of the intramural hematoma (yellow asterisk)

the carotid-subclavian bypass in the absence of iatrogenic dissections, thrombosis, or occlusion and with preserved distal perfusion [Figure 9].

Discussion

This clinical case presents several peculiarities both regarding the interventional procedure carried out and the multimodal imaging approach used for lesion characterization and intraprocedural guidance. MSCT represents a cornerstone in the diagnosis of intraparietal aortic hematoma as it allows for optimal and precise characterization of its location and extension, being essential in planning the most appropriate therapeutic approach. MSCT also allows understanding of whether the hematoma is perfused and monitoring its possible progression.[5] In this case, following the observation of the proximal extension of the hematoma involving the LSA associated with worsening of the painful symptoms, it was decided to submit the patient to endovascular repair treatment, according to current guidelines.[1] Based on the information from the MSCT data, a hybrid approach was chosen. This involved using the Castor prosthesis with the side branch positioned in the LCCA, instead of the LSA. In addition, a carotid-subclavian bypass was created to maintain peripheral perfusion. The decision to use the Castor single-branched thoracic aortic stent graft (Microport Medical, Shanghai, China) is based on its capability to serve as a compelling alternative to surgery in the endovascular treatment of distal aortic arch diseases, yielding positive outcomes in the short and medium term.[8]

In this context, intraprocedural TEE evaluation was essential for characterizing the lesion. It revealed a heterogeneous hematoma with areas of varying echogenicity, indicating a mixed composition of solid and fluid components. These findings

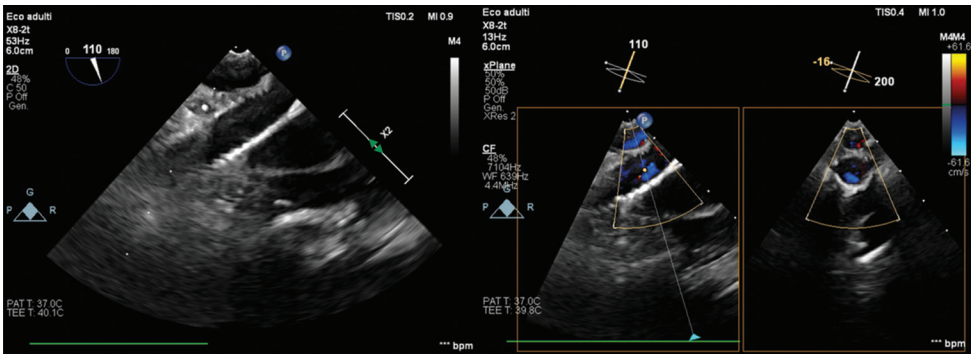

Figure 8: Intraprocedural transesophageal echocardiography (TEE) the flow within the carotid-subclavian bypass with polytetrafluoroethylene graft and its correct function (on the left two-dimensional (2D)-TEE; on the right 3D-TEE with X-plane modality plus Color-Doppler)

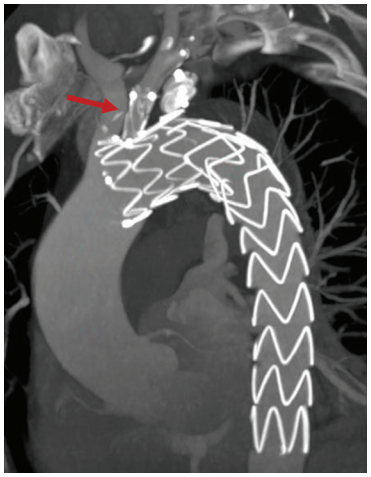

Figure 9: Sagittal oblique reformatted computed tomography angiography (CTA) maximum-intensity-projection reformatted image obtained with wide window width shows metallic detail of prosthesis, with side branch positioned in the left common carotid artery (red arrow)

were further highlighted by the use of three-dimensional, which, through TrueVue Glass mode, allowed visualization of the exact composition of the hematoma, both before and after prosthesis deployment. Furthermore, the use of TEE proved essential in evaluating the patency of the carotid-subclavian bypass and assessing its flow using color Doppler. Alternative ultrasound approaches such as transthoracic evaluation[9] and the use of paraspinal acoustic windows[10] were not found to be helpful in this case.

Despite its low incidence, IMH can progress to aortic dissection, penetrating aortic ulcer, or even rupture.[11] TEE offers the benefit of more detailed visualization of the intimal layer and improved detection of possible disruptions compared to MSCT and MRI. This helps to better define disease progression and potential complications.[12] Furthermore, TEE allows monitoring of all steps of the procedure, showing the presence of the guide into the true lumen, the advancement of the prosthesis, and the phases of release and anchoring. In the case of prostheses equipped with side branches for the supra-aortic trunks, as in the case of the Castor, TEE allows evaluation of the correct sealing of the prosthesis and the patency of the side branch.[13] After stent-graft implantation, any additional potential issues have to be ruled out by TEE, such as pericardial effusion and new-onset left ventricular dysfunction.[14] Another benefit of using TEE during endovascular aortic repair is the decrease in fluoroscopy time and the amount of iodinated contrast medium. This ultimately reduces exposure to ionizing radiation and the risk of contrast-induced nephropathy.[13]

Conclusions

The case of a 57-year-old woman presented with an aortic IMH was successfully treated through transcatheter implantation of a Castor prosthesis and the creation of a carotid-subclavian bypass. This case emphasizes the key role of employing multimodality imaging techniques in evaluating AAS and illustrates the emerging potential of TEE in guiding endovascular repairs.

Authors' contributions

Material preparation, data collection, and analysis were carried out by G. B., G. T., A. R., G. B., and A. R. the supervisors. A. R. performed the endovascular aortic repair. The draft of the manuscript was written by G. B. and G. T. and all the authors commented on previous versions of the manuscript. All authors have read and agreed to the published version of the manuscript.

Declaration of patient consent

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

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Isselbacher EM, Preventza O, Hamilton Black J 3rd, Augoustides JG, Beck AW, Bolen MA, *et al.* 2022 ACC/AHA guideline for the diagnosis and management of aortic disease: A report of the American Heart

Association/American College of Cardiology joint committee on clinical practice guidelines. Circulation 2022;146:e334-482.
2. Brown JA, Arnaoutakis GJ, Kilic A, Gleason TG, Aranda-Michel E, Sultan I. Current trends in the management of acute type a aortic intramural hematoma. J Card Surg 2020;35:2331-7.
3. Vacirca A, Dias Neto M, Baghbani-Oskouei A, Huang Y, Tenorio ER, Estrera A, *et al.* Timing of intervention for aortic intramural hematoma. Ann Vasc Surg 2023;94:14-21.
4. Muratori M, Mancini ME, Tamborini G, Mushtaq S, Annoni A, Fusini L, *et al.* Approach to the patient with acute aortic syndromes in light of the new consensus statement on multimodality imaging in thoracic aortic diseases. J Cardiovasc Echogr 2023;33:109-16.
5. Ferrera C, Vilacosta I, Cabeza B, Cobiella J, Martínez I, Saiz-Pardo Sanz M, *et al.* Diagnosing aortic intramural hematoma: Current perspectives. Vasc Health Risk Manag 2020;16:203-13.
6. Salamone I, Carerj ML, Barbaro U, Virga V, Zito C, Bracco A, *et al.* The usefulness of a multimodality approach in a case of subtle iatrogenic aortic dissection: Sometimes is better to look and wait. J Cardiovasc Echogr 2019;29:62-4.
7. Castro-Verdes M, Yuan X, Mitsis A, Li W, Nienaber CA. Transesophageal ultrasound guidance for endovascular interventions on the aorta. Aorta (Stamford) 2022;10:3-12.
8. Rizza A, Trimarchi G, Di Sibio S, Bastiani L, Murzi M, Palmieri C, *et al.* Preliminary outcomes of zone 2 thoracic endovascular aortic repair using castor single-branched stent grafts: A single-center experience. J Clin Med 2023;12:7593.
9. Parato VM, Notaristefani C, Gizzi G, D'Agostino S. Transthoracic echocardiographic diagnostic accuracy in detecting "Type-B" aortic dissection. J Cardiovasc Echogr 2021;31:45-7.
10. Conti S, Dell'Uomo M, Dominici M, Forte MB. The utility of paraspinal acoustic windows for the evaluation of acute dissection of descending thoracic aorta in the emergency setting. J Cardiovasc Echogr 2022;32:218-20.
11. Sorber R, Hicks CW. Diagnosis and management of acute aortic syndromes: Dissection, penetrating aortic ulcer, and intramural hematoma. Curr Cardiol Rep 2022;24:209-16.
12. Moral S, Cuéllar H, Avegliano G, Ballesteros E, Salcedo MT, Ferreira-González I, *et al.* Clinical implications of focal intimal disruption in patients with type b intramural hematoma. J Am Coll Cardiol 2017;69:28-39.
13. Trimarchi G, Benedetti G, Palmieri C, Rizza A. A case of type b aortic dissection: The role of transesophageal ultrasound guidance in thoracic endovascular aortic repair. J Cardiovasc Echogr 2023;33:148-52.
14. Hirose N, Orihashi K, Miyashita K, Tashiro M, Kihara K, Yamamoto M. Advantages of transesophageal echocardiography during stent grafting for aortic dissection: A report of three cases. Ann Vasc Dis 2018;11:557-61.