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ORIGINAL ARTICLE

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Aortic rupture: comparison of three imaging modalities

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Abstract We report a case of a 56-year-old man with traumatic aortic rupture (TAR) sustained in a motor vehicle accident diagnosed by helical computed tomography, aortography, and transesophageal echocardiography. A large majority of patients with TAR never make it to the hospital, and for those who do, a timely diagnosis is critical for survival. We discuss the merits and pitfalls of the three imaging modalities.

Keywords Echocardiography · Aorta · Rupture · Blunt trauma

Case report

A 56-year-old previously healthy man was brought to the emergency department after a motor vehicle accident (MVA). He was a restrained driver, and the airbag deployed after a so-called T-bone collision in which another car slammed head-on into his door.

On admission, he was alert and oriented. His blood pressure was equal in both arms, and his pulse was regular at 90 beats per minute. The chest was tender over the left clavicle and chest wall. The patient moved all four extremities.

A helical contrast computed tomography (HCCT) of the chest revealed fractures of left clavicle and second rib, left pulmonary contusion, and a small left hemothorax. In addition, there was hemorrhage in the mediastinum especially posteriorly. On standard HCCT images, a focal contour bulge was seen in the aortic arch at the level of the aortic isthmus (Fig. 1a). Reformatted coronal CT image revealed a mushroom-like traumatic aortic pseudoaneurysm located medial to the aortic isthmus adjacent to a mediastinal hematoma (Fig. 1b).

A cardiothoracic surgeon was consulted immediately. Upon his request, an aortogram was performed; it demonstrated a double density in the curvature of the distal aortic arch (Fig. 2).

Traumatic aortic rupture (TAR) was confirmed on transesophageal echocardiogram (TEE), which demonstrated a tear of the aortic wall measuring 0.7 cm in diameter just distal to the ostium of the left subclavian artery. The tear was surrounded by a 1.6×2.5-cm echo dense periaortic space indicative of blood extravasation and pseudoaneurysm formation (Fig. 3).

The patient was taken to the operating room where the TAR was repaired with a 28-mm Hemashield graft. He had no postoperative complications and was discharged home on postoperative day 6.

Discussions

TAR is predominantly caused by deceleration injury sustained during MVAs and falls of more than 3 m [1]. Less commonly, it results from displaced clavicular and thoracic vertebral fractures [2].

It is estimated that only 15–20% of individuals survive TAR, with the majority of victims dying in the field [3–6]. Difficulty in diagnosing TAR further diminishes the overall survival rate. With prompt diagnosis and surgery, survival reaches 69–80% in patients who make it to the

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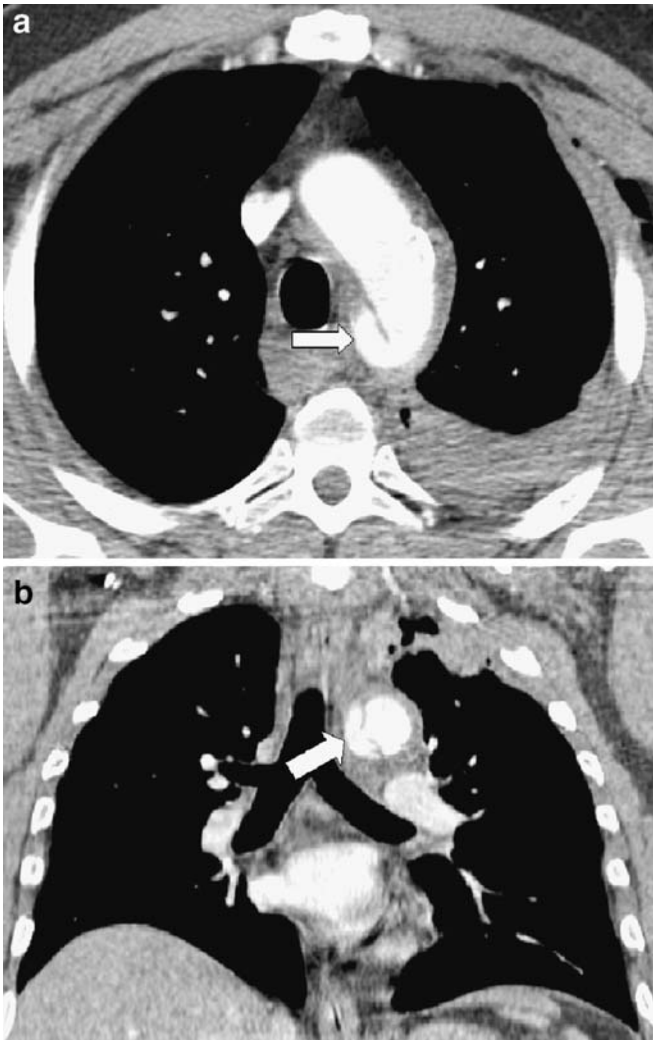

Fig. 1 **a** Axial image from contrast enhanced CT scan demonstrating a focal contour bulge of the aortic arch (*arrow*) consistent with a pseudoaneurysm due to traumatic aortic injury. **b** Reformatted coronal CT image showing the traumatic aortic pseudoaneurysm (*arrow*) located medial to the aortic isthmus and adjacent to mediastinal hematoma. The pseudoaneurysm exhibits the characteristic mushroom-like appearance with the neck of the aneurysm resembling the stalk and the body resembling the cap of a mushroom

hospital [7, 8]. Traditionally, the three diagnostic modalities for diagnosing TAR have been aortography, HCCT, and TEE.

In the past, aortography had long been accepted as the gold standard for diagnosing TAR [9]. However, aortography is invasive and in as many as 10% of patients may result in serious adverse side effects such as full aortic rupture, acute renal failure, anaphylaxis, and entry-site hematoma [10]. In addition, because TAR occurs predominantly at the aortic isthmus, as many as 9–26% of patients could have false-positive findings such as persistent ductus arteriosus [8, 11, 12].

HCCT is very reliable in diagnosing TAR with sensitivity and specificity approaching that of aortography [13, 14]. However, Fabian et al. [15] found a 7% false-positive rate with the diagnosis of TAR given incorrectly to patients

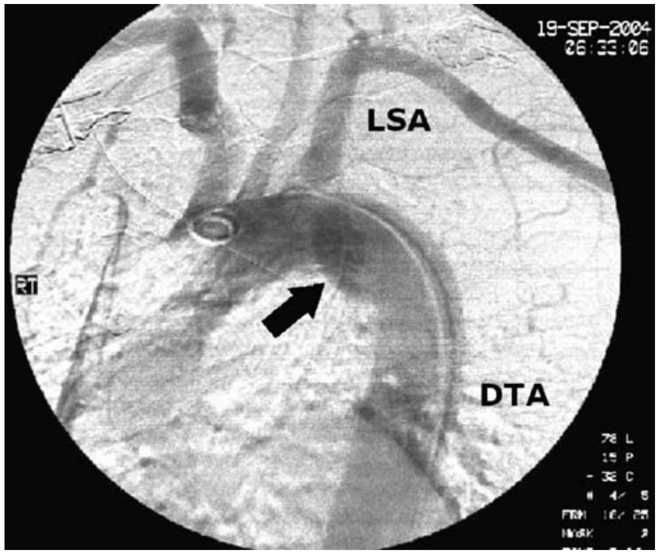

Fig. 2 Aortogram showing a double density (*arrow*) and irregularity of the medial aspect of the distal aortic arch and proximal descending thoracic aorta (DTA) just past the origin of the left subclavian artery (LSA) indicative of aortic rupture at the isthmus

with ductus arteriosus diverticulum subsequently revealed during surgery and patients with spurious intimal defects not seen on repeat HCCT imaging. With modern multidetector CT scanners, reformatting of the images can be done in any plane to better demonstrate the site of aortic injury and differentiate aortic injury from ductus diverticulum. This can further improve the accuracy of CT for making the diagnosis of TAR.

In contrast to aortography and HCCT, TEE is more specific for differentiating ductus arteriosus diverticula

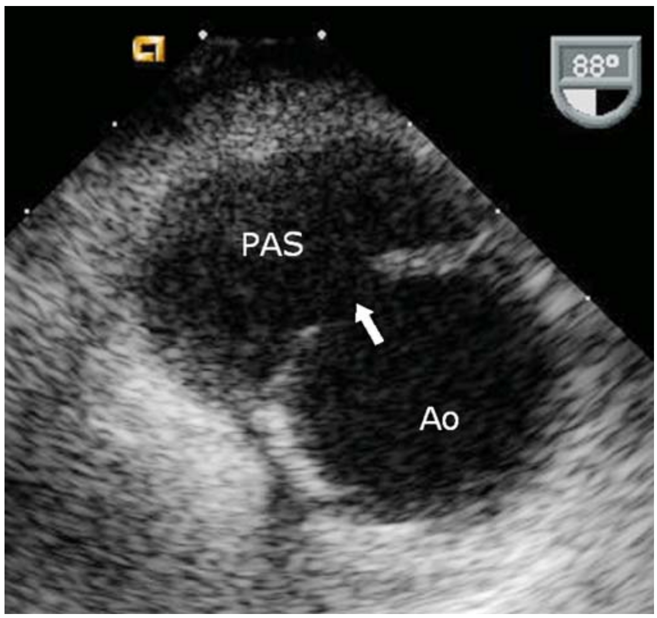

Fig. 3 TEE depicting a discontinuity (*arrow*) in the wall of the thoracic aorta (Ao) just distal to the ostium of the left subclavian artery consistent with aortic rupture. The discontinuity measures 0.7 cm or about 1/10 of the aortic perimeter and opens into a periaortic space (PAS) measuring 1.6×2.5 cm

from intramural hematomas and intimal tears [16, 17]. It is also less costly and available at the bedside [1]. Studies in the past have shown a sensitivity ranging from 63 to 100%, specificity between 84 and 98%, and an accuracy of 98% for TEE in detecting aortic rupture [1, 18, 19]. These ranges of sensitivity and specificity may be due to the fact that the use of TEE is operator dependent and requires a certain learning curve. Nonetheless, in experienced hands, TAR can be ruled out by TEE within minutes at bedside.

The main limitation for diagnosing TAR with TEE is a "blind spot" at the distal ascending aorta and proximal arch, the site of TAR in approximately 20% of patients [4]. Despite this limitation, TEE has the potential to serve as an initial test for diagnosing TAR in unstable patients and may shorten the time to surgical repair, which can lead to improved survival. However, HCCT should be the initial test of choice in stable patients who also need additional body imaging as part of the trauma protocol, and in patients with suspected TAR in whom TEE findings are inconclusive.

The use of TEE and HCCT singly or in combination could improve efficiency and cost of diagnosing TAR and may eliminate the need for aortography in all but a small group of patients.

References

1. Chirillo F, Totis O, Cavarzerani A et al (1996) Usefulness of transthoracic and transoesophageal echocardiography in recognition and management of cardiovascular injuries after blunt chest trauma. Heart 75(3):301–306
2. O'Conor CE (2004) Diagnosing traumatic rupture of the thoracic aorta in the emergency department. Emerg Med J 21 (4):414–419
3. Mollod M, Felner JM (1996) Transesophageal echocardiography in the evaluation of cardiothoracic trauma. Am Heart J 132 (4):841–849
4. Ahrar K, Smith DC, Bansal RC, Razzouk A, Catalano RD (1997) Angiography in blunt thoracic aortic injury. J Trauma 42 (4):665–669
5. Parmley LF, Mattingly TW, Manion WC et al (1958) Nonpenetrating traumatic injury of the aorta. Circulation 17:1086–1101
6. Brooks SW, Young JC, Cmolik B, Townsend RN, Diamond DL et al (1992) The use of transesophageal echocardiography in the evaluation of chest trauma. J Trauma 32(6):761–765; discussion 765–768
7. Fabian TC, Richardson JD, Croce MA et al (1997) Prospective study of blunt aortic injury: Multicenter Trial of the American Association for the Surgery of Trauma. J Trauma 42(3):374–380; discussion 380–383
8. Kieny R, Charpentier A (1991) Traumatic lesions of the thoracic aorta. A report of 73 cases. J Cardiovasc Surg 32 (5):613–619
9. Woodring JH (1990) The normal mediastinum in blunt traumatic rupture of the thoracic aorta and brachiocephalic arteries. J Emerg Med 8(4):467–476
10. Sparks MB, Burchard KW, Marrin CA et al (1991) Transesophageal echocardiography. Preliminary results in patients with traumatic aortic rupture. Arch Surg 126(6):711–713; discussion 713–714
11. Morse SS, Glickman MG, Greenwood LH et al (1988) Traumatic aortic rupture: false-positive aortographic diagnosis due to atypical ductus diverticulum. AJR Am J Roentgenol 150 (4):793–796
12. Goodman PC, Jeffrey RB, Minagi H et al (1982) Angiographic evaluation of the ductus diverticulum. Cardiovasc Intervent Radiol 5(1):1–4
13. Cardarelli MG, McLaughlin JS, Downing SW et al (2002) Management of traumatic aortic rupture: a 30-year experience. Ann Surg 236(4):465–469; discussion 469–470
14. Parker MS, Matheson TL, Rao AV et al (2001) Making the transition: the role of helical CT in the evaluation of potentially acute thoracic aortic injuries. AJR Am J Roentgenol 176 (5):1267–1272 (May)
15. Fabian TC, Davis KA, Gavant ML et al (1998) Prospective study of blunt aortic injury: helical CT is diagnostic and antihypertensive therapy reduces rupture. Ann Surg 227 (5):666–676; discussion 676–677
16. Vilacosta I, San Roman JA, Ferreiros J et al (1997) Natural history and serial morphology of aortic intramural hematoma: a novel variant of aortic dissection. Am Heart J 134(3):495–507
17. Karalis DG, Victor MF, Davis GA et al (1994) The role of echocardiography in blunt chest trauma: a transthoracic and transesophageal echocardiographic study. J Trauma 36(1):53–58
18. Smith MD, Cassidy JM, Souther S et al (1995) Transesophageal echocardiography in the diagnosis of traumatic rupture of the aorta. N Engl J Med 332(6):356–362
19. Saletta S, Lederman E, Fein S et al (1995) Transoesophageal echocardiography for the initial evaluation of the widened mediastinum in trauma patients. J Trauma 39:137–142; discussion 141–142