Current Management of Traumatic Aortic Injury

Javairiah Fatima, MD
Assistant Professor
Division of Vascular Surgery and Endovascular Therapy
University of Florida
Gainesville, Florida

Robert J. Feezor, MD FACS
Assistant Professor
Division of Vascular Surgery and Endovascular Therapy
University of Florida
Gainesville, Florida

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Historically, aortic transection has been the second leading cause of traumatic death, trailing only intracranial injury. Aortic transection occurs typically at the level of the ligamentum arteriosum, and occurs when a mobile part of the aorta is torn away from a fixed portion, causing a violent disruption of the layers of the aortic wall. While it is felt that most of the patients with aortic transection die before reaching the hospital, those who survive are either hemodynamically stable or are hypotensive from associated injuries. With the prevalence, rapidity, and resolution of CT scans, most traumatic aortic pathology is diagnosed incidentally.

The decision to perform or refrain from any surgical intervention balances the risk of action with the risk of inaction. Open surgical repair was, and is, associated with a high morbidity. In a review of 1742 patients who arrived to the hospital alive with thoracic aortic injury, the overall mortality was 32%, and notably one-third of the patients died before surgical repair was attempted.[1] The advent of endovascular technology (TEVAR) has likely increased the incidence of repair of traumatic aortic transections and undoubtedly decreased the repair-associated morbidity. In a pair of publications sponsored by the American Association for the Surgery of Trauma published a decade apart, it was noted that percentage of patients presenting with aortic transection who were repaired via open surgical techniques decreased from 100% in 1997 to 35% in 2008.[2,3] This shift in therapy from open surgery to endovascular therapy was associated with a reduction in mortality from 22% to 13% (p=0.02) and paraplegia from 9% to 2% (p=0.001). A more recent multi-center study from nine American College of Surgeons-verified level I trauma centers examined 453 patients with aortic transection, of whom 198 (52%) underwent TEVAR.[4] Complications included endograft malpositioning (3.0%), endoleak (2.5%), stroke (1.0%) and paralysis (0.5%). Aortic related mortality was 6.5% overall, with a mortality reduction in the subset managed endovascularly as opposed using open surgical techniques (2.5% vs. 13.1%, respectively).

The obvious questions that remain are four: 1) Which injuries need to be repaired? 2) What is the timing of such repair? 3) What are the best devices that can be used? and 4) What adjunctive maneuvers can be utilized to decrease morbidity? Since most patients are asymptomatic from an aortic injury standpoint and the injury is diagnosed radiographically, better imaging and natural history may help answer the first question. Azizzadeh et al. proposed a grading system of aortic injury based on CT findings,[5] and this nomenclature was found to be predictive of aortic mortality in a subsequent study (see **Table 1**).[4] From this data, patients with minimal aortic disruptions, grade I, should not be offered repair.

Grade	Radiographic finding (5)	Mortality (4)
I	Intimal tear	0%
II	Intramural hematoma	2.9%
III	Pseudoaneurysm	5.2%
IV	Rupture	46.4%

Table 1. Correlation between radiographic findings with aortic injuries and mortality

In terms of timing of repair, the clinical practice guidelines published by the Society for Vascular Surgery recommend urgent aortic repair after stabilization of other injuries.[6] At our institution, we tend to agree with above recommendations, and advocate repair as soon as feasible in relation to other injuries. Often, patients present with concomitant intracranial injuries and the repair of the aortic transection may afford the ability of the treating physicians to augment the systolic blood pressure. Additionally, repair of aortic pathology may alleviate the concern for frank aortic disruption if a patient has unexplained hypotension.

At present, there are two FDA-approved devices for repair of blunt thoracic aortic trauma, and most implanting physicians would credit that the devices are safe and effective. What is not known is the long-term natural history as these devices were initially designed for pathologies commonly seen in the elderly, and in most publications the mean age of patients undergoing TEVAR for transections is significantly younger.[7] The ideal characteristics relate to the ability of these devices to conform to the smaller size and peaked aortic arches of the injured trauma patient.

Lastly, any intervention is associated with morbidity. The major morbidities seen with TEVAR, stroke and paraplegia, are fortunately seen with less frequency in patients being treated for transection compared to the other approved indications of aortic aneurysms, dissections, and penetrating ulcers. This may be due to the rather short length of aortic coverage required, the minimal amount of atherosclerotic disease in the aorta, and the general overall health of the typical patient who sustains an aortic injury. Adjunctive maneuvers such as spinal fluid drainage and left subclavian artery revascularization are not routinely implemented at our institution for this select population, a policy that is also supported by the Society for Vascular Surgery.[6]

In summary, TEVAR for aortic transection is an accepted practice in the appropriately selected patient. It is clearly superior to open surgical repair, and is associated with an acceptably low rate of complications. Continued diligence needs to be exercised by implanting physicians to follow these patients up long term to ensure the devices are effective and durable.

References

1. von Oppell UO, Dunne TT, De Groot MK, Zilla P. Traumatic aortic rupture: twenty-year metaanalysis of mortality and risk of paraplegia. The Annals of thoracic surgery. 1994;58(2):585-93. Epub 1994/08/01.Davis PD, Koprowicz MK, Newgard DC et al. The relationship between out-of-hospital airway management and outcome among trauma patients with Glasgow coma scale scores of 8 or less. Prehosp Emerg Care 2011; 15(2): 184-192.
2. Demetriades D, Velmahos GC, Scalea TM, Jurkovich GJ, Karmy-Jones R, Teixeira PG, et al. Diagnosis and treatment of blunt thoracic aortic injuries: changing perspectives. The Journal of trauma. 2008;64(6):1415-8; discussion 8-9. Epub 2008/06/12.
3. Fabian TC, Richardson JD, Croce MA, Smith JS, Jr., Rodman G, Jr., Kearney PA, et al. Prospective study of blunt aortic injury: Multicenter Trial of the American Association for the

Surgery of Trauma. The Journal of trauma. 1997;42(3):374-80; discussion 80-3. Epub 1997/03/01.

4. DuBose JJ, Leake SS, Brenner M, Pasley J, O'Callaghan T, Luo-Owen X, et al. Contemporary management and outcomes of blunt thoracic aortic injury: a multicenter retrospective study. The journal of trauma and acute care surgery. 2015;78(2):360-9. Epub 2015/03/11.
5. Azizzadeh A, Keyhani K, Miller CC, 3rd, Coogan SM, Safi HJ, Estrera AL. Blunt traumatic aortic injury: initial experience with endovascular repair. Journal of vascular surgery : official publication, the Society for Vascular Surgery [and] International Society for Cardiovascular Surgery, North American Chapter. 2009;49(6):1403-8. Epub 2009/06/06.
6. Lee WA, Matsumura JS, Mitchell RS, Farber MA, Greenberg RK, Azizzadeh A, et al. Endovascular repair of traumatic thoracic aortic injury: clinical practice guidelines of the Society for Vascular Surgery. Journal of vascular surgery : official publication, the Society for Vascular Surgery [and] International Society for Cardiovascular Surgery, North American Chapter. 2011;53(1):187-92. Epub 2010/10/27.
7. Tang GL, Tehrani HY, Usman A, Katariya K, Otero C, Perez E, et al. Reduced mortality, paraplegia, and stroke with stent graft repair of blunt aortic transections: a modern meta-analysis. Journal of vascular surgery : official publication, the Society for Vascular Surgery [and] International Society for Cardiovascular Surgery, North American Chapter. 2008;47(3):671-5. Epub 2007/11/06.