Traumatic Thoracic Aortic Injury

Should endovascular repair be considered the standard of treatment?

BY PETER H. LIN, MD, AND ALAN B. LUMSDEN, MD

Traumatic blunt injury to the thoracic aorta is a devastating condition that can lead to immediate death at the time of injury in the majority of cases, due in part to either aortic transection or acute rupture.[1] Although blunt aortic injury accounts for fewer than 1% of all adult level I trauma center admissions, this condition represents the second most common cause of death due to blunt injury, second only to head trauma.[2] With an incidence of 7,500 to 8,000 cases of blunt aortic trauma occurring annually in North America, it is estimated that only 25% of patients who sustain aortic injuries due to blunt thoracic trauma remain alive upon arrival to the hospital.[3] Among these patients who survive the initial injury, the prognosis remains poor—nearly 30% of them will die within the first 6 hours, and 50% of these patients will not live beyond the first 24 hours after the injury.[4] This high mortality rate has previously prompted traditional management of blunt aortic injury to establish early diagnosis and rapid surgical intervention to prevent a catastrophic rupture. This belief has been modified to allow delay of the operative intervention to first manage other serious concomitant injuries and lessen the high surgical mortality rate associated with emergent aortic repair.[5] Despite advances in modern trauma care, emergent operative intervention for blunt aortic injury is associated with significant cardiac, pulmonary, neurologic, and hemodynamic complications.[5,6]

The classic injury mechanism of blunt thoracic aortic trauma is related to the combination of sudden deceleration and traction at the relatively immobile aortic isthmus, which represents the junction between the relatively mobile aortic arch and the fixed descending aorta (Figure 1). The isthmus is the most common location for rupture (50% to 70%), followed by the ascending aorta or aortic arch (18%) and the distal thoracic aorta (14%).[4] The objectives of this article are to (1) examine the role of endovascular repair of traumatic blunt aortic injury, (2) review the current literature of endovascular aortic repair of blunt injury, and (3) analyze the potential challenges of this treatment modality in blunt aortic injury.

ENDOVASCULAR REPAIR OF TRAUMATIC AORTIC INJURY

Endovascular treatment of blunt thoracic aortic disruptions offers many practical benefits and technical advantages compared to conventional open repair in patients with thoracic aortic injuries. Deployment of a stent graft in the descending aorta with a focal traumatic lesion, particularly in patients with an adequate proximal and distal aortic

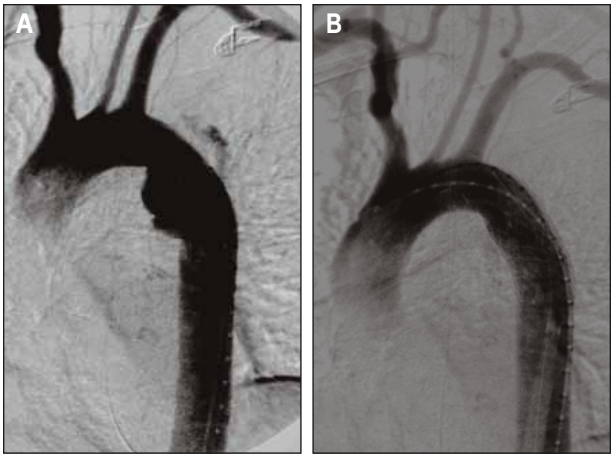

Figure 1. Blunt aortic injury typically occurs in the proximal segment of the descending thoracic aorta, due in part to the sudden disruption of the aortic isthmus (A). Successful repair of a blunt aortic injury can be accomplished using endoluminal treatment approach (B).

neck, can be performed in a straightforward manner. In patients with adequate femoral artery access, this procedure can even be performed under local anesthesia without incurring significant cardiopulmonary stress. Commonly encountered physiologic insults associated with an open repair, such as thoracotomy, aortic cross-clamping, extracorporeal bypass, and single-lung ventilation can all be avoided in the setting of an endovascular thoracic aortic endografting procedure. Exclusion of a descending aortic disruption with an endograft does not necessitate cross-clamping of the thoracic aorta. As a result, the avoidance of aortic cross-clamping minimizes significant blood pressure shifts and coagulopathy. It also reduces operative blood loss as well as ischemic events involving the spinal cord, viscera, and kidneys. Moreover, avoidance of a thoracotomy has obvious convalescent advantages in patients who might be disabled from other multiple-organ injuries.

Because the traumatic force responsible for blunt aortic disruptions frequently results in concomitant injuries involving other organs, prompt endovascular exclusion of a traumatic aortic pseudoaneurysm or aortic transection can be performed without undue delay in surgical interventions of other concomitant injuries. This advantage is in sharp contrast to an open aortic repair, which would require a patient to initially recover from any major operative intervention or intensive therapy of life-threatening complication of blunt trauma. Lastly, the use of systemic anticoagulation with heparin during an endovascular aortic procedure can be reduced to a minimum, which is particularly beneficial in patients with concomitant intracranial or abdominal injuries.

Although endovascular repair has many obvious advantages compared to conventional open repair, keep in mind the potential shortcomings of this treatment strategy. The possibility of persistent endoleak after endovascular exclusion of traumatic aortic pseudoaneurysm has been reported.[7-9] There are still concerns of late complications, such as endograft migration or device infection due to fistula formation.[10] Furthermore, given the limited commercially available endovascular devices, not all patients with traumatic aortic disruptions have adequate aortic morphology to undergo this repair. Critics of this treatment strategy often cite the lack of long-term durability studies to justify the use of an aortic endograft in young trauma victims who may well tolerate the physiologic stress associated with an open repair.

ANATOMICAL CONSIDERATION IN ENDOVASCULAR REPAIR OF TRAUMATIC AORTIC INJURY

There are several fundamental differences in the anatomical morphology between patients with atherosclerotic thoracic aortic aneurysms and traumatic aortic injuries that may impact on the choice of endograft devices and deployment techniques. In patients with descending thoracic aneurysms, adequate proximal and distal aortic neck length is critical to ensure proper device fixation and aneurysm exclusion. The diameter of the aortic neck is similarly important for device selection. Because the diameter of an aortic neck may be subject to continual expansion due in part to aneurysm progression, many stent graft devices have incorporated components such as hooks and proximal bare metal to reinforce device fixation and minimize stent graft migration. Other pertinent factors in treating patients with thoracic aortic aneurysms include proximity to the celiac artery, thrombus in the aneurysm sac, length of aneurysm involving intercostal arteries, and pre-existing thrombus in the aortic landing zones. These considerations may play critical roles in subsequent aneurysm remodeling after endovascular repair, which may result in aneurysm size regression and alter stent graft fixation. Access vessels are also an important consideration. Because the majority of patients with thoracic aneurysms are elderly men with underlying atherosclerotic disease, the insertion of a large thoracic endovascular device using a 21-F introducer sheath may require a retroperitoneal access with the creation of an iliac artery conduit.

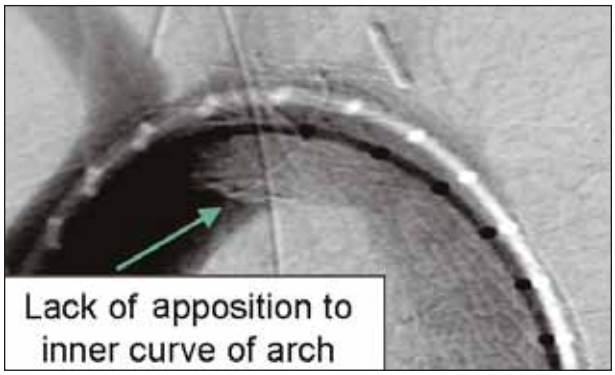

Figure 2. In the clinical situation of an oversized endograft placed in a small aorta with a tight aortic curvature, the device fails to appose the inner curvature (Arrow). Infolding of the lower lip of the graft can occur, with catastrophic consequences. This has not occurred when the device is sized according to the directions for use.

When treating patients with traumatic aortic disruption, many of these considerations are different. Because the majority of aortic disruptions are located in the proximal descending thoracic aorta, the proximal landing zone is generally in the proximity of the left subclavian artery. The distal landing zone, on the other hand, is usually not a critical factor due to the fact that the long segment of normal descending thoracic aorta is more than sufficient to permit

TABLE 1. ANATOMICAL CONSIDERATION OF BLUNT AORTIC INJURY IN YOUNG TRAUMA PATIENTS

- Smaller radius of aortic curvature, in contrast to older patients with aortic aneurysms who have wider aortic curvature
- Smaller aortic diameter, in contrast to older patients with aortic aneurysms who tend to have a larger aortic diameter
- Small iliac or femoral access vessel diameter
- Aortic disruption typically located immediately distal to the left subclavian artery, in contrast to patients with thoracic aneurysms, which can occur in any segment of the thoracic aorta

proper device fixation. To ensure proper proximal device fixation in traumatic aortic injury, many investigators have raised the concern that the left subclavian artery will be intentionally covered by the endograft in a significant number of patients. Clinical experience has shown that critical limb-threatening ischemia of the left arm rarely occurs and, if necessary, can be reversed by an elective left carotid-to-subclavian artery bypass grafting procedure.[11-13] Because the endograft device is anchored in relatively normal proximal and distal aortic segment, there is very little concern regarding the possibility of subsequent aortic neck enlargement, which is the case in the aneurysm population. The possibility of device migration or late endoleak in the trauma population, although possible, is less likely and worrisome as opposed to the aneurysm cohorts. Important considerations of these anatomical features when performing endovascular thoracic repair in young trauma patients are summarized in Table 1.

The main anatomical challenge of endovascular treatment of traumatic aortic injury is related to the relatively small aortic diameter in these young victims, as opposed to elderly patients with thoracic aortic aneurysms. Although the Gore TAG Thoracic Endoprosthesis is currently the only device that has received Food and Drug Administration (FDA) approval for clinical application, it is designed for patients with thoracic aortic aneurysms who typically have larger aortic diameters. In a recent study by Borsa et al, who analyzed the angiographic morphology of 50 trauma victims with thoracic aortic disruptions, the mean aortic diameter adjacent to the aortic injury was 19.3 mm.[14] The available Gore TAG Thoracic Endoprosthesis has devices ranging from 26 mm to 40 mm in diameter. Because this device was not designed for the treatment of traumatic aortic injuries, placement of even the smallest available Gore TAG device in trauma patients will likely represent a significant and inappropriate device oversize, which might lead to inadequate device fixation. This scenario was highlighted by a recent case report in which a Gore TAG device was used in a 20-year-old trauma victim.[15] Because of the severe device oversize, the Gore TAG device collapsed within the aortic lumen, which was subsequently treated by another stent graft insertion, which unfolded the collapsed endograft.[15] Appropriately sized thoracic endografts with smaller diameters must be made available in order for endovascular therapy to be a viable treatment strategy in patients with traumatic aortic injuries.

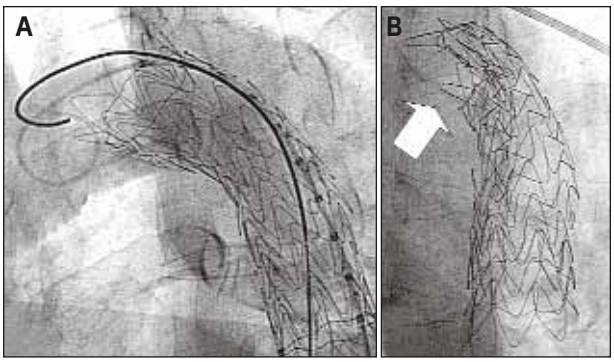

Figure 3. Successful deployment of a Gore TAG (Gore & Associates, Flagstaff, AZ) thoracic device can be achieved when appropriate device selection was made based on the recommended Instructions for Use, as evidenced by the full apposition of the stent graft in the aortic lumen (A). When the device is inappropriately oversized relative to the aortic diameter, it can lead to device collapse in its leading segment (arrow; Image courtesy of Michael Dake, MD, and Gore & Associates) (B).

CHALLENGES OF ENDOVASCULAR REPAIR OF TRAUMATIC AORTIC INJURY IN YOUNG PATIENTS

Potential Aortic Growth in Young Trauma Victims

Endovascular treatment of traumatic aortic injuries involves certain challenges. Traumatic aortic injuries tend to affect younger populations, in contrast to the aneurysm population. It is not uncommon that adolescent or pediatric patients may present with this injury. Because of potential vessel expansion as a result of normal aortic growth, placement of a stent graft in young patients must be viewed with extreme caution. The possibility of stent graft migration may occur as the aorta enlarges due to expected growth in young patients. Endovascular repair in selected pediatric patients may be considered as a tempo-

TABLE 2. DELIVERY SYSTEM LENGTHS AND DIAMETERS OF AORTIC EXTENDER CUFFS CURRENTLY APPROVED FOR INFRARENAL ANEURYSM REPAIR

Device	Delivery System Shaft Length (cm)	Maximum Stent Graft Diameter (mm)	Stent Graft Length (cm)
Medtronic AneuRx	55	28	3.75
Gore Excluder	61	28.5	3.3
Cook Zenith	55	32	3.6
Endologix PowerLink	63	28	5.5-7.5

rary bridge to a more definitive operative repair at a later stage. In pediatric patients with life-threatening aortic disruption who have other concomitant injuries, it may be appropriate to perform endovascular repair to exclude the aortic injury until the patients fully recover from other injuries and can undergo an elective definitive open repair with proven long-term durability.

Challenges Related to Femoral Artery Access in Young Trauma Patients

Femoral arterial access represents a potential challenge when considering endovascular thoracic aortic repair, particularly in young trauma patients. Currently available thoracic endograft devices require a minimum 20-F introducer sheath. Placement of such a large introducer sheath in a diseased artery or in ileofemoral vessels smaller than 8 mm in diameter can result in severe iatrogenic injuries, including arterial dissection and rupture.[16] If significant resistance is encountered during the insertion of an introducer sheath, one should stop the insertion process and carefully withdraw the introducer sheath. A retroperitoneal access with the creation of an iliac or aortic conduit should be considered to limit the risk of iatrogenic rupture associated with small femoral artery access. These conduits can be converted to an ileofemoral or aortofemoral bypass graft to improve the inflow of an ischemic extremity, if necessary. The potential of iatrogenic femoral artery injury in endovascular thoracic repair is highlighted in a study by White et al, who noted a 27% increase of access complication.[16] However, as endovascular devices undergo continual refinement and miniaturization with smaller introducer sheaths, the incidence of iatrogenic access complication will likely be decreased or possibly be eliminated.

Limitation in Utilizing Aortic Endograft Cuffs Treating Descending Aortic Injury

Another important challenge in endovascular repair of traumatic aortic injuries is the limited availability of stent graft devices. Although several investigators have reported successful use of infrarenal aortic endograft cuffs in excluding thoracic aortic injuries, it is not an ideal endovascular solution.[8,17] Current FDA-approved endovascular devices for infrarenal aortic aneurysms, such as the AneuRx (Medtronic, Santa Rosa, CA), Zenith (Cook Incorporated, Bloomington, IN), Endologix (Irvine, CA), and Gore Excluder endograft all have aortic extension cuffs that are designed for delivery to the infrarenal aorta. The lengths of these delivery devices range from 55 cm to 65 cm, which may not be sufficient for juxtasubclavian artery deployment, which may be a particular concern in tall patients (Table 2). Although a retroperitoneal iliac artery conduit may provide an added advantage of delivering an endograft device to a more proximal location, these cuffs are generally short in length and will likely require placement of multiple aortic cuffs to adequately exclude an aortic disruption. Without clear evidence to demonstrate the efficacy of placing multiple aortic cuffs as an effective treatment in traumatic aortic disruptions, this treatment strategy represents an off-label device application and should not be widely encouraged.

Procedure-Related Complications Due to Device Deployment

Delivering and deploying thoracic endovascular devices may pose certain technical challenges in young trauma victims with aortic injuries. Because younger patients with relatively normal aortas frequently have a sharp aortic angulation just distal to the left subclavian artery, it may be difficult to accurately position and deploy a thoracic stent graft in a juxtasubclavian artery location, particularly if the endograft has a rigid or relatively nonflexible device shaft. In some thoracic endovascular devices, such as the Talent endografts (Medtronic), the proximal bare stents need to be deployed higher in the aortic arch. The stent graft portion of the device is then slowly pulled back in the descending thoracic aorta to allow accurate deployment. Manipulation of the endograft in the vicinity of the ascending aorta not only is technically difficult, but also carries a higher risk of stroke complications. Numerous complica-

TABLE 3. EXAMPLES OF INAPPROPRIATE DEVICE OVERSIZE WHEN USING A GORE TAG THORACIC DEVICE IN PATIENTS WITH RELATIVELY SMALL AORTIC DIAMETERS

The Gore TAG thoracic device should not be oversized more than 18% based on the aortic diameter, as indicated by the device Instructions for Use. Given the smallest Gore TAG device has a diameter of 26 mm, placement of such a device can result in varying degrees of oversize in various aortic diameters. The following description summarizes varying degrees of device oversize in various scenarios of aortic diameters.

- Placement of a 26-mm thoracic endograft in a 20-mm aortic diameter would result in a 30% oversize
- Placement of a 26-mm thoracic endograft in an 18-mm aortic diameter would result in a 44% oversize
- Placement of a 26-mm thoracic endograft in a 16-mm aortic diameter would result in a 63% oversize
- Placement of a 26-mm thoracic endograft in a 14-mm aortic diameter would result in an 86% oversize

tions related to manipulating bulky devices in the aortic arch have been reported, which include cardiac perforation, aortic valve injury, arch perforation, branch vessel rupture, and cerebral embolization.[18-28] Significant device refinement, such as a more flexible shaft to accommodate aortic curvature, will be necessary before this technology can be widely adapted in young patients with traumatic aortic injuries.

Hemodynamic and Anatomical Features Related to the Aorta in Young Trauma Patients

An important anatomical consideration in endovascular treatment of traumatic aortic injuries in young patients relates to their tapering luminal diameter of the descending thoracic aorta. Moreover, younger patients typically have higher aortic pulsatile compliance and flow velocity when compared to elderly patients, which represents a hemodynamic factor that may destabilize aortic endograft fixation.[29,30] Implantation of currently available, nontapered thoracic endografts in young trauma victims who have relatively narrow aortic lumens will likely lead to diameter mismatch, as well as endograft oversize. Gross oversizing in a relatively small-diameter aorta, in combination with a short radius of aortic arch curvature, can result in suboptimal conformability along the inner curve of the aortic arch, which can lead to problems including device fracture, endoleak, migration, and infolding (Figure 2). It is estimated that these types of device-related complications, such as stent fracture, stent graft compression, rate of reintervention, device explantation, or endoleak, occurred in approximately 3% when used in traumatic aortic disruptions.[12,18,21,31-37] Moreover, a semirigid stent graft in a tightly curved arch may tend to lift the inferior wall of the lesser curve (Figure 2). The force of cardiac pulsations pushing the stent graft against the outer curvature could further tend to push the inferior wall off the inner curvature. Some stent grafts may also adopt a fishmouth configuration, with the superior-inferior diameter of the proximal graft shortening and the lateral diameter widening, thus decreasing graft-wall apposition superiorly and inferiorly.

Endograft Collapse Due to Significant Endograft Oversize in Young Trauma Patients

Because the Gore TAG device remains the only FDA-approved thoracic endograft, available literature demonstrates that approximately 9% of its reported applications occur in trauma patients.[12,18,21,31-37] This is the scenario when significant device oversize is most likely to occur due in part to the lack of small-diameter endografts to be placed in young trauma patients with relatively narrow thoracic aortic lumen. It is noteworthy that the recommended Instructions for Use of the Gore TAG device, as approved by the FDA, indicates that the device should be oversized in the range of 7% to 18% in reference to the patient's aortic diameter. Because the smallest diameter of the Gore TAG device is 26 mm, the device should be used in treating aortas sized equal to or larger than 23 mm in diameter. Deployment of a 26-mm-diameter Gore TAG device in patients whose aortic diameter is less than 23 mm in diameter represents a device oversize beyond the manufacturer's recommendation, which may result in suboptimal device performance (Figure 3, Table 3). All adverse events reported to date with the use of the Gore TAG device were largely due to device oversize beyond the recommended Instructions for Use, as approved by the FDA (Table 4). Idu et al recently reported a case of Gore TAG device collapse 3 months after endovascular repair.[15] In their reported case, a 26-mm-diameter Gore TAG device was implanted in a young trauma patient whose aortic diameter was only 19 mm, which represented a 37% device oversize. This significant degree of device oversize resulted in the wrinkling of the proximal segment of the thoracic endograft. Although the initial aortogram revealed no gross radiograph abnormality after device deployment, the wrinkling of the proximal Gore TAG

TABLE 4. GORE TAG THORACIC ENDOPROSTHESIS INSTRUCTIONS FOR USE AS APPROVED BY THE FDA

- Healthy neck length minimum of 2 cm; may cover left subclavian artery if necessary
- The Gore TAG device has been designed to be oversized from 7% to 18%, which has been incorporated into the sizing guide (do not oversize and follow sizing chart)
- Measure flow lumen, do not include adventitia or calcium but include thrombus, if present
- Use case-planning forms
- Neck taper must be within device sizing range, especially important around the arch transition
- Neck angles <60° recommend more than 2 cm of neck engagement

device eventually led to device collapse, due in part to the high aortic pulsatile force. This condition was ultimately remedied by the placement of another device, a Talent thoracic endograft, to expand the collapsed Gore TAG device.[15]

RESULTS FROM CLINICAL SERIES IN ACUTE TRAUMATIC AORTIC INJURIES

Available literature on endovascular treatment of traumatic aortic injuries remains relatively scarce, in contrast to the vast body of literature on endovascular abdominal aortic aneurysm repair. Nonetheless, nearly all reported series underscored significant advantages of endovascular treatment of blunt aortic trauma, which include excellent technical success and low mortality rates (Table 5).[7-9,17,21,26,33,36,38-48]

Taylor et al were the first to report the clinical benefit of using commercially available thoracic endografts in the management of blunt aortic injury.[38] Thompson et al reported encouraging outcomes after endovascular thoracic aortic repair for acute traumatic rupture in five patients. The technical success rate was 100%; no procedure-related complication or death was observed during an average follow-up of 20 months.[49] Fattori et al described 11 patients with acute thoracic traumatic injury and eight patients with chronic thoracic traumatic injury located at the aortic isthmus treated by endovascular stent grafting.[36] All procedures resulted in successful outcome without signs of endoleaks. No death, paraplegia, or other complications were observed. The study group detected one type III endoleak during a mean follow-up period of 20 months, which showed spontaneous thrombosis within 2 months.[36]

Lachat et al reported 12 patients with acute traumatic aortic rupture treated by self-expanding stent grafts and reported a complete technical success.[44] The in-hospital mortality rate was 8% due to an undetected residual type I endoleak. During the mean follow-up time of 17 months, one patient experienced a perigraft leakage that was treated by additional stent graft placement 12 months postoperatively.[44] Wellons et al reported nine patients with traumatic aortic injuries who underwent endovascular repair using infrarenal aortic cuff extenders.[17] There was no procedure-related mortality, and technical success was achieved in all patients. Two recent studies compared the treatment outcome of traumatic thoracic aortic disruption between conventional open repair versus endovascular therapy. Ott et al reported their experience of 18 patients with blunt thoracic aortic injuries during an 11-year period.[7] The investigators noted that the open surgical group had a 17% early mortality rate, a paraplegic rate of 16%, and an 8.3% incidence of recurrent laryngeal nerve injury. This is in sharp contrast to the endovascular patient cohorts, who did not experience any perioperative mortality, paraplegia, or recurrent laryngeal nerve injury.[7] Similar findings regarding the benefits of endovascular treatment over open surgical repair were highlighted in another study by Kasirajan et al,[42] who noted that patients who underwent endovascular repair had significantly lower perioperative mortality rates compared to those who underwent open repair. The mean procedural time and length of hospital stay were all significantly less in the endovascular group compared to the open repair cohort.[42]

Paraplegia undoubtedly remains the most feared complication after repair of a traumatic aortic injury, which has a reported incidence as high as 18% in patients after open repair for blunt aortic trauma.[3] A postulated mechanism of this complication relates to aortic cross-clamp times in excess of 30 minutes. An overview of all available endovascular studies on traumatic aortic injuries showed that the paraplegic complication does not occur. Table 5 summarizes the treatment outcome of these studies. One possible explanation of this low paraplegic incidence after endovascular treatment is the avoidance of aortic cross-clamping and less blood pressure variation or hemodynamic instability after endovascular repair.

CONCLUSION

Should Endovascular Repair Be Considered the New Standard of Treatment in Traumatic Aortic Injury?

Because of the rarity of traumatic aortic injury, successful

TABLE 5. CLINICAL SERIES OF ENDOVASCULAR TREATMENT OF ACUTE TRAUMATIC AORTIC INJURIES

Investigator	Year	Patient No.	Technical Success	Endograft Type	Paraplegia	Follow-Up (Months)
Fujikawa[39]	2001	6	100%	Homemade	None	8
Taylor[38]	2001	5	100%	Gore, Talent	None	6
Bortone[50]	2002	10	100%	Gore	None	14
Orend[47]	2002	11	92%	Gore, Talent	None	14
Thompson[37]	2002	5	100%	Gore, Homemade	None	20
Fattori[36]	2002	11	100%	Gore, Talent	None	20
Lachat[44]	2002	12	100%	Gore, Talent	None	9
Kasirajan[42]	2003	5	100%	Gore, Talent, Home-made	None	10
Karmy-Jones[8]	2003	11	100%	AneuRx cuff, Ancure, Talent, Homemade	None	16
Iannelli[21]	2004	3	100%	Gore	None	13
Wellons[17]	2004	9	100%	AneuRx cuff, Excluder cuff	None	6
Kato[43]	2004	6	100%	Homemade	None	6
Scheinert[48]	2004	10	100%	Gore, Talent	None	17
Czermak[40]	2004	12	92%	Gore, Talent	None	9
Morishita[45]	2004	7	100%	Homemade	None	12
Neuhauser[46]	2004	10	100%	Gore, Talent, Vanguard	None	26
Ott[7]	2004	6	100%	Talent	None	16
Uzieblo[9]	2004	4	100%	Talent	None	8
Bortone[33]	2004	14	100%	Talent, Gore, Zenith, Endofit	None	14

endovascular treatment will likely be confined to large trauma centers with a dedicated trauma team working jointly with experienced endovascular surgeons. Moreover, achieving an optimal outcome of this treatment strategy will depend on proper imaging equipment and full arrays of readily available endovascular devices. It is our belief that emergent stent grafting is more technically demanding and conceptually challenging when compared to an elective endovascular procedure. In an elective aneurysm stent grafting procedure, for instance, careful consideration regarding device sizing and device selection can be done in a timely fashion. In contrast, urgent endovascular repair of a traumatic aortic injury will require an experienced team of trauma surgeons, vascular surgeons, anesthesiologists, and operating room nurses ready to perform this procedure in critically injured trauma patients in an around-the-clock fashion.

Physicians must rely on their expertise and skills to make critical decisions relating to device selection or arterial access, both promptly and accurately. Although all available clinical studies on endovascular treatment of traumatic aortic disruptions showed promising results with excellent technical success and lower mortality rates compared to conventional open repair, long-term studies will be necessary to prove the treatment efficacy of this minimally invasive therapy.

Presently, the Achilles' heel of endovascular treatment of traumatic aortic disruption relates to the limited availability of thoracic endografts in all sizes (Table 4). Utilizing currently approved thoracic devices in young trauma victims with aortic injuries will likely result in significant device oversize and potentially lead to late device-related complications (Table 4). Until further studies validate the durability of this treatment, and until the full array of appropriately sized devices becomes available, physicians must take precautions when performing endovascular repair of traumatic aortic injuries because this therapy should only be offered in appropriately selected patients. ■

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