Classification Of BTAIs In Adults And Pediatric Patients: The Evidence Shows That Grades I And II Lesions Can Be Treated Conservatively Whereas Grades III And IV Should Be Treated Endovascularly: Recommendations For Graft Sizing In Children

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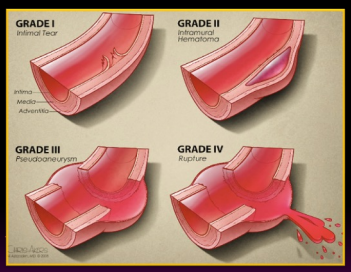
Disclosures:

WL Gore

Boston Scientific

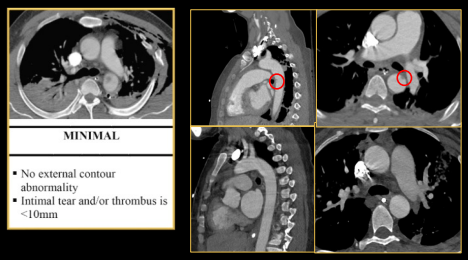
SVS Guidelines



Harborview BTAI Grading System

MINIMAL	MODERATE	SEVERE
▪ No external contour abnormality ▪ Intimal tear and/or thrombus is <10mm	▪ External contour abnormality or intimal tear >10mm	▪ Active extravasation ▪ LSA hematoma >15mm
NO INTERVENTION	**SEMI-ELECTIVE REPAIR**	**IMMEDIATE REPAIR**
▪ Optional follow-up imaging	▪ Stabilization of concomittant injuries ▪ Impulse control	▪ BAI takes first priority

Minimal TBAI



MINIMAL

- No external contour abnormality
- Intimal tear and/or thrombus is <10mm

No intervention
No follow up
Aspirin x 6 weeks*

ORIGINAL ARTICLE

Do patients with minimal blunt thoracic aortic injury require thoracic endovascular repair?

Joseph J. DuBose, MD, Kristofer Charlton-Ouw, MD, Benjamin Starnes, MD, Naveed Saqib, MD, Elina Quiroga, MD, Jonathan Morrison, MD, PhD, Bruce Gewertz, MD, Ali Azizzadeh, MD, and AAST/Aortic Trauma Foundation Study Group, *Baltimore, Maryland*

INTRODUCTION: The optimal management of minimal blunt thoracic aortic injuries (BTAIs) remains controversial, with experienced centers using therapy ranging from medical management (MM) to thoracic endovascular aortic repair (TEVAR).
METHODS: The Aortic Trauma Foundation registry was used to examine demographics, injury characteristics, management, and outcomes of patients with BTAI.
RESULTS: Two hundred ninety-six patients from 28 international centers were analyzed (mean age, 44.5 years [SD, 18 years]; 70% [223/296] male; mean Injury Severity Score, 34 [SD, 14]). Blunt thoracic aortic injury was classified as Grade I, 22.4% (67/296); Grade II, 17.6% (52/296); Grade III, 47.3% (140/296); and Grade IV, 12.5% (37/296). Overall aortic-related mortality (ARM) was 4.7% (14/296). Among all deaths, 33% (14/42) were ARM. Open repair was required for only 2%, with most undergoing TEVAR (58.4%) or MM (20.0%). Thoracic endovascular repair complications occurred in 5.4% (6/173), most commonly Type 1 endoleak (2.3%; 4/173). Among patients with minimal aortic injury (Grades I and II), 69.7% (71/119) received MM, while 46.3% (48/119) underwent TEVAR. Two patients initially managed with MM required subsequent TEVAR for injury progression during initial hospital stay. No significant difference in ARM between MM and TEVAR was noted for Grades I and II injuries.
CONCLUSION: A third of the trauma victims with BTAI succumb to ARM. Thoracic endovascular repair has replaced open repair but remains equivalent in outcomes to MM for minimal injuries. These data support MM of patients with minimal aortic injury. *J Trauma Acute Care Surg.* 2021;90: 384–387. Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved.)
LEVEL OF EVIDENCE: Therapeutic study, level IV.
KEY WORDS: Blunt thoracic aortic injury; TEVAR; outcomes; vascular injury; thoracic.

AORTIC TRAUMA FOUNDATION

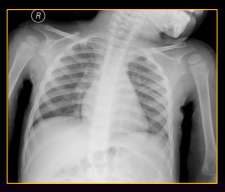
TABLE 1. Treatment and Survival Outcomes Blunt Thoracic Aortic Injuries, All SVS Grades

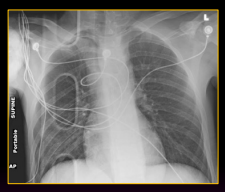
SVS Grade	Aortic-Related Death Before Opportunity for Repair	MM Alone	Open Repair	TEVAR
I (n = 67)	0% (0/67)	91.0% (61/67)	0% (0/67)	9.0% (6/67)
II (n = 52)	0% (0/52)	61.5% (32/52)	0% (0/52)	38.5% (20/52)
III (n = 140)	0.7 (1/140)	11.4% (16/140)	1.4% (2/140)	86.4% (121/140)
IV (n = 37)	16.2% (6/37)	2.7% (1/37)	10.8% (4/37)	70.3% (26/37)
All BTAI (N = 296)	2.4% (7/296)	28.0% (83/296)	2.0% (6/296)	58.4% (173/296)

Minimal aortic injuries (SVS Grade 1 and 2) undergo TEVAR in 40% of patients. When compared with those patients managed medically, however, there appear to be no difference in subsequent outcomes except an increase in complications related to the conduct of TEVAR itself.

These findings suggest that the current SVS guidelines for BTAI management warrant revision and greater emphasis should be used to highlight the safety of an MM first strategy for MAIs.

BTAI In Pediatric Patients





BTAI In Pediatric Patients

Lower rates of BTAI in kids compared to adults*

BTAI In Pediatric Patients

Lower rates of BTAI in kids compared to adults*

- **CT of the chest** — In children, the frequency of cardiac and great vessel injury is low [23], and the risk of missing such an injury may be less than the risk of radiation exposure from CT [24-26]. For these reasons, the routine use of chest CT in children with major trauma but a normal anteroposterior CXR is not indicated and may be harmful. For example, in a children's hospital database study of over 120,000 pediatric trauma patients who received chest CTs (40 percent of admitted trauma patients), there were 2 thoracic aortic injuries found per 10,000 chest CTs [26].

  For children with major thoracic injury, contrast chest CT rarely changes management compared with CXR alone [27]. For example, in two large observational studies, chest CT in addition to CXR altered management in <1 percent of pediatric patients with blunt chest injury [28,29].

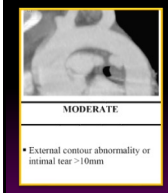
Minimal TBAI may be underdiagnosed in pediatric population

BTAI In Pediatric Patients

When should they undergo invasive treatment?

BTAI In Pediatric Patients

When should they undergo invasive treatment?



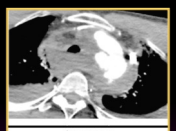
MODERATE

- External contour abnormality or intimal tear >10mm

Semi elective repair
Stabilization of concomitant injuries
Impulse control

BTAI In Pediatric Patients

When should they undergo invasive treatment?



SEVERE

- Active extravasation
- LSA hematoma >15mm

Immediate repair
BTAI takes priority over all other injuries

BTAI In Pediatric Patients

When endo?
When open?

SOCIETY FOR VASCULAR SURGERY® DOCUMENTS

Endovascular repair of traumatic thoracic aortic injury: Clinical practice for Vascular Surgery

W. Anthony Lee, MD,[a] Jon S. Matsumura, MD,[b] Roy K. Greenberg, MD,[c] Ali Azizzadeh, MD,[d] M Ronald M. Fairman, MD,[e] *Ben Xavier, Hu; Houston, Tex; Rochester, Minn; and Philadelphia, Pa*

The Society for Vascular Surgery® pursued development thoracic aortic injuries with thoracic endovascular aortic r a panel of experts and conducted a systematic review Recommendations Assessment, Development and Evalua tions. The systematic review included 7768 patients from who underwent endovascular repair, followed by open rep $P < .01$). Based on the overall very low quality of evidence infectious compared with open repair or nonoperative ma a variety of issues that were not specifically addressed by the committee suggest urgent repair following stabilization o routine) revascularization in cases of left subclavian artery cases. (J Vasc Surg 2021;[73:187-92.)

Issue 3: Choice of repair in the young—TEVAR vs open. There was near unanimity of opinion that anatomic suitability is important for TEVAR but age should not be a factor in deciding the type of repair. The risks of death and spinal cord ischemia are significantly lower in all age groups after endovascular repair compared with open surgery,[13-15] and these early benefits outweigh the concerns of potential late complications. However, in surgically fit patients with poor anatomy for endovascular repair, conventional open repair should be considered.

BTAI In Pediatric Patients

National Trends of Thoracic Endovascular Aortic Repair versus Open Thoracic Aortic Repair in Pediatric Blunt Thoracic Aortic Injury

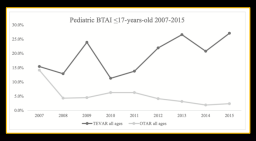
Rima J. Hajjar,[1] Areg Grigorian,[1] Cristobal Barrios Jr.,[2] Sebastian Schubl,[1] Jeffry Nahmias,[2] Viktor Gabriel,[1] Dean Spencer,[1] and Carlos Donayre,[1] Orange, California

Background: Blunt thoracic aortic injury (BTAI) occurs in <1% of all trauma admissions. Thoracic endovascular aortic repair (TEVAR) has become the preferred treatment modality in adult patients with BTAI, but its use in pediatrics is currently not supported by device manufacturers and lacks United States Food and Drug Administration approval. We hypothesized that there would also be an increased use of TEVAR in the pediatric population, thus conferring a lower risk of mortality compared with open thoracic aortic repair (OTAR).

Methods: The National Trauma Data Bank (2007-2015) was queried for patients ≤17 years with BTAI. The primary outcomes were the incidences of TEVAR and OTAR. Secondary outcome was risk of mortality in those undergoing intervention. A multivariable logistic regression model was used to determine the risk of mortality in OTAR versus TEVAR.

Results: We identified 650 pediatric BTAI patients with 159 (24.5%) undergoing intervention. Of these, 124 underwent TEVAR (78.0%) and 35 (22.0%) underwent OTAR. The rate of TEVAR steadily increased from 2007 to 2015 (15.4% vs. 27.1%, $P < 0.001$). Patients receiving OTAR and TEVAR had a similar injury severity score and rate of hypotension on admission ($P > 0.05$). Compared with OTAR, TEVAR patients had a higher rate of any traumatic brain injury (TBI) (83.7% vs. 37.1%, $P < 0.005$) and shorter hospital and intensive care unit length of stay (LOS) (16.4 vs. 21.4 days, $P = 0.02$; 10.1 vs. 12.2 days, $P = 0.01$). TEVAR and OTAR, even when stratified by ≤14 years and 15-17 years, had no difference in risk for mortality (odds ratio 1.20, confidence interval 0.39-5.01, $P = 0.80$).

Conclusions: The rate of TEVAR in pediatric BTAI has doubled from 2007 to 2015. Compared with OTAR, TEVAR was associated with a shorter hospital LOS despite a higher rate of TBI. There was no difference in risk for mortality between TEVAR and OTAR. Longitudinal studies to determine the long-term efficacy and complication rates, including reintervention, development of endoleak, and/or need for further operations, are needed as this technology is being rapidly adopted for pediatric trauma patients.



BTAI In Pediatric Patients

> Ann Surg. 2021 Dec 1;274(6):1089-1098. doi: 10.1097/SLA.0000000000003768.

Endovascular Repair of Blunt Thoracic Aortic Trauma is Associated With Increased Left Ventricular Mass, Hypertension, and Off-target Aortic Remodeling

Alexey Kamenskiy [1 2], Paul Aylward [1], Anastasia Desyatova [1 2], Matthew DeVries [3], Christopher Wichman [4], Jason MacTaggart [1]

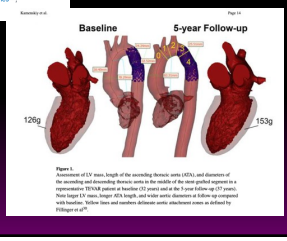


Figure 1.
Assessment of LV mass, length of the ascending thoracic aorta (ATA), and diameters of the ascending and descending thoracic aorta in the middle of the stent-grafted segment in a representative TEVAR patient at baseline (32 years) and at the 5-year follow-up (37 years). Note larger LV mass, longer ATA length, and wider aortic diameters at follow-up compared with baseline. Yellow lines and numbers delineate aortic attachment zones as defined by Fillinger et al[30].

BTAI In Pediatric Patients

Impact of thoracic endovascular aortic repair following blunt traumatic thoracic aortic injury on blood pressure

TABLE 1. Demographic and clinical data for healthy controls and BTAI patients

Characteristic	BTAI patients (N = 26)
Age, y, mean ± SD	43.5 ± 12.9
Sex, % female	11.5
BSA, m^2, mean ± SD	1.95 ± 0.23
Smoking, %	46
Dyslipidemia, %, mean ± SD	31
Chronic kidney disease, %, mean ± SD	0
TEVAR characteristics, mean ± SD	
TEVAR proximal diameter, mm	25.4 ± 3.5
Proximal oversizing at surgery, %	20.9 ± 9.5
Proximal oversizing at discharge, %	20.6 ± 8.8
TEVAR distal diameter, mm	25.0 ± 3.4
Distal oversizing at surgery, %	42.8 ± 21.8
Distal oversizing at discharge, %	26.6 ± 17.5
TEVAR length, mm	126.7 ± 24.9
TEVAR exposure, mo	120.2 ± 69.7
Proximal ending, n plane	10.6 ± 2.8
Distal ending, n plane	22.1 ± 1.2

> J Thorac Cardiovasc Surg. 2023 Jul 23:S0022-5223(23)00623-2. doi: 10.1016/j.jtcvs.2023.07.018. Online ahead of print.

BTAI In Pediatric Patients

Impact of thoracic endovascular aortic repair following blunt traumatic thoracic aortic injury on blood pressure

TABLE 2. Demographic and clinical data of BTAI patients with or without HT after surgery

Characteristic	No HT (N = 9)	HT (N = 17)	*P* value
Age, y, mean ± SD	46.3 ± 11.4	42.0 ± 13.8	.339
Sex, % female	22.2	5.9	.268
BSA, m^2, mean ± SD	1.87 ± 0.18	1.99 ± 0.24	.241
Smoking, %	44.4	47.1	.613
Dyslipidemia, %	33.3	29	.587
Chronic kidney disease, %	0	0	-
Time of HT diagnosis, mo, mean ± SD	59.3 ± 47.5	-	-
TEVAR characteristics, mean ± SD			
TEVAR proximal diameter, mm	25.4 ± 4.0	25.4 ± 3.4	1.000
Proximal oversizing at surgery [%]	18.3 ± 11.3	22.4 ± 8.5	.312
Proximal oversizing at discharge, %	21.1 ± 11.1	20.4 ± 7.8	.860
TEVAR distal diameter, mm	24.4 ± 3.3	25.3 ± 3.5	.597
Distal oversizing at surgery, %	31.2 ± 14.3	48.9 ± 22.9	.046*
Distal oversizing at discharge, %	21.4 ± 16.9	29.2 ± 17.8	.316
TEVAR length, mm	134.3 ± 29.0	128.0 ± 23.3	.525
TEVAR exposure, mo	112.5 ± 76.6	124.2 ± 67.9	.833
Proximal ending, n plane	12.2 ± 4.1	9.7 ± 1.2	.025*
Distal ending, n plane	22.3 ± 1.5	21.9 ± 1.1	.597

> J Thorac Cardiovasc Surg. 2023 Jul 23:S0022-5223(23)00623-2. doi: 10.1016/j.jtcvs.2023.07.018. Online ahead of print.

BTAI In Pediatric Patients

Gouda et al — Thoracic

Impact of thoracic endovascular aortic repair following blunt traumatic thoracic aortic injury on blood pressure

RESULTS

Compared to healthy subjects, BTAI patients have

- ↑ proximal aorta diameter, native aorta stiffness
- = cardiac function, peripheral resistance

- more proximal TEVAR landing zone
- larger TEVAR distal oversizing

65% of patients had hypertension

J Thorac Cardiovasc Surg. 2023 Jul 23:S0022-5223(23)00623-2. doi: 10.1016/j.jtcvs.2023.07.018. Online ahead of print.

BTAI In Pediatric Patients

Technical tips and precautions

Place graft as distally as possible-ideally, distal to left subclavian

Consider tapered grafts

Access vessels: be prepared for iliac injuries

BTAI In Pediatric Patients

Even as there is limited data regarding management of TBAI in pediatric patients, TEVAR is a safe option for patients with moderate and severe BTAI

Consider placing stent graft as distally as possible

Adhesion to follow up protocols in pediatric patients is imperative- what are the long-term implications of TEVAR in pediatric patients?

BTAI In Pediatric Patients

Minimal blunt aortic injuries do no need surgical repair- there is no role for TEVAR in pediatric patients with minimal injuries