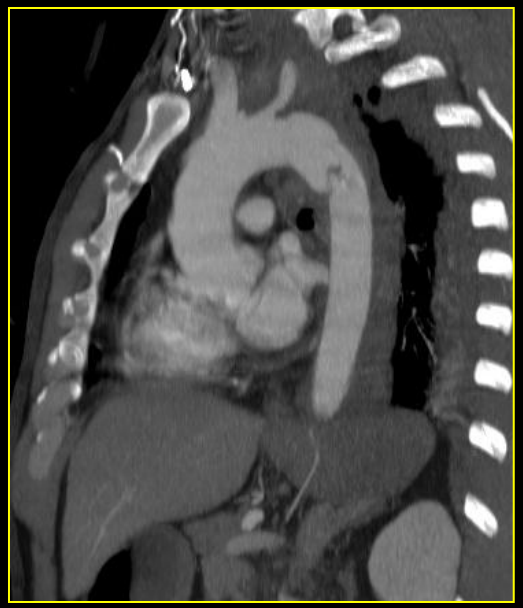
Modern Management of Blunt Aortic Injury

October 4, 2012

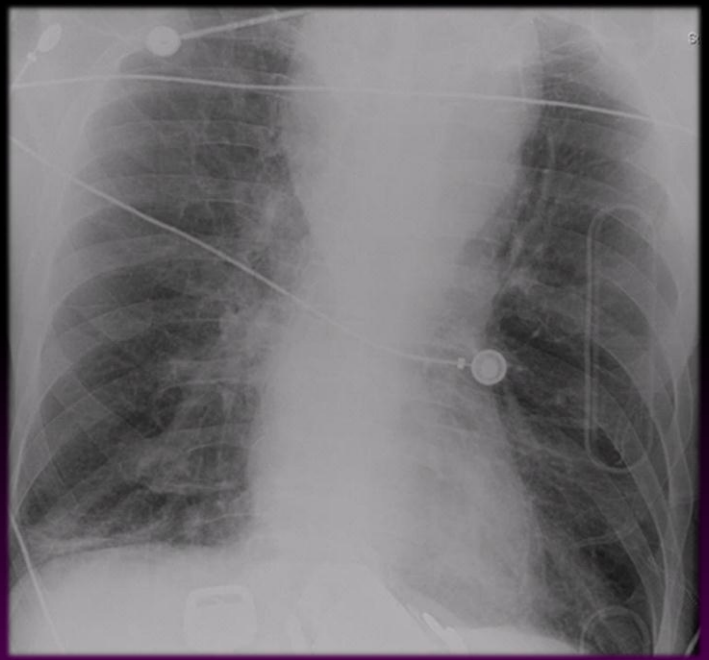


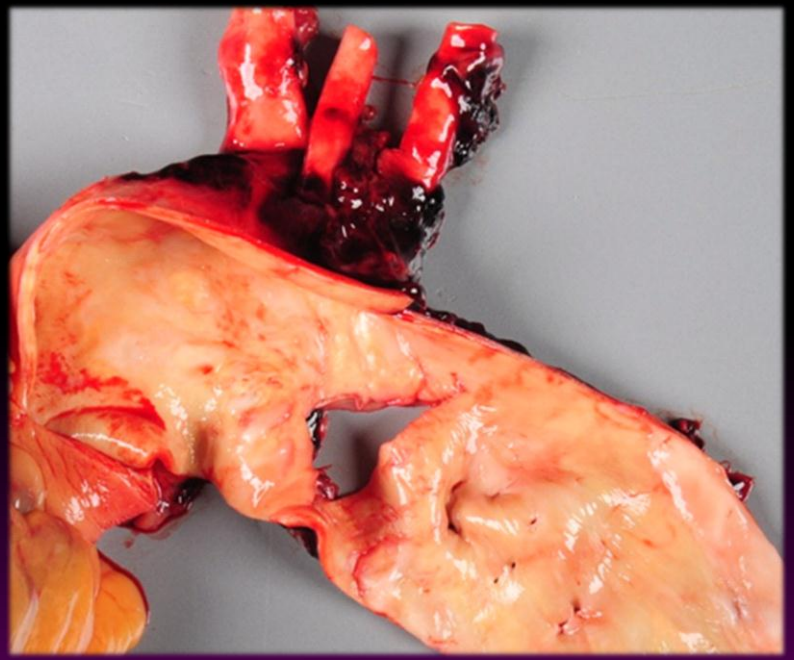
Benjamin W. Starnes MD, FACS
Professor of Surgery
Chief, Division of Vascular Surgery
University of Washington
Seattle, WA

Blunt Aortic Injury (BAI)

2nd leading cause of trauma-related death: 8,000 deaths/year

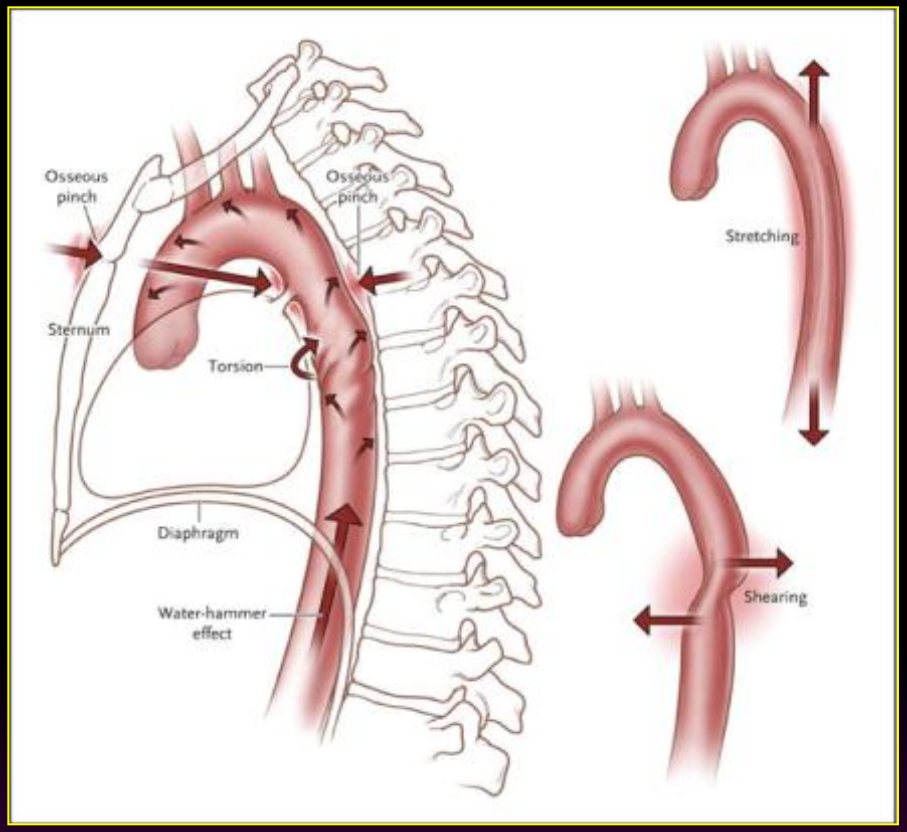
85% die before reaching the hospital

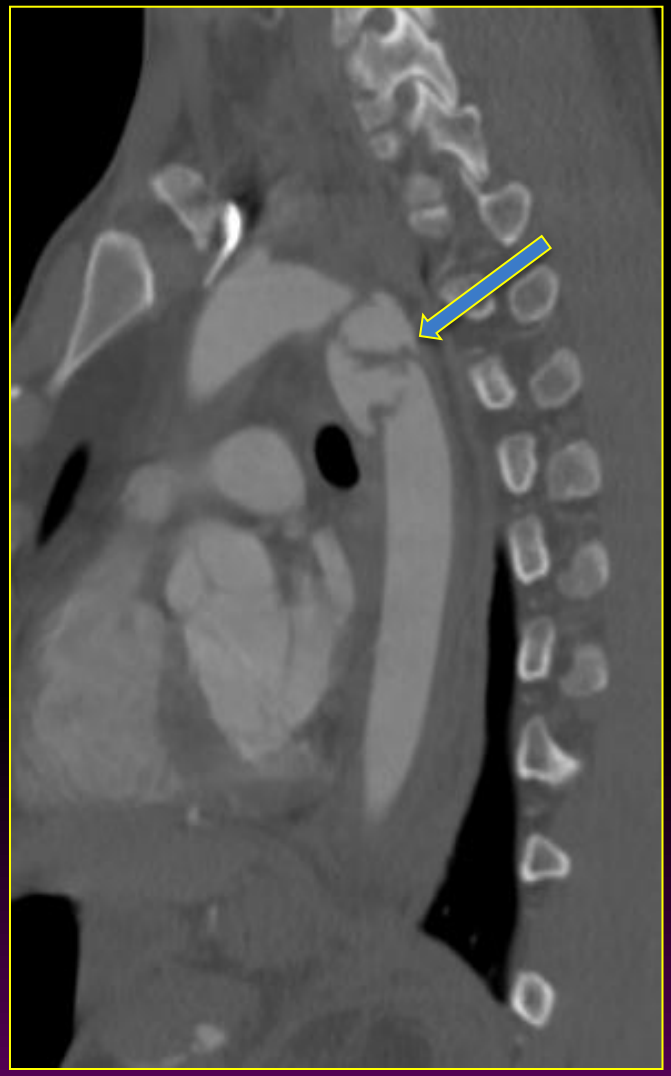




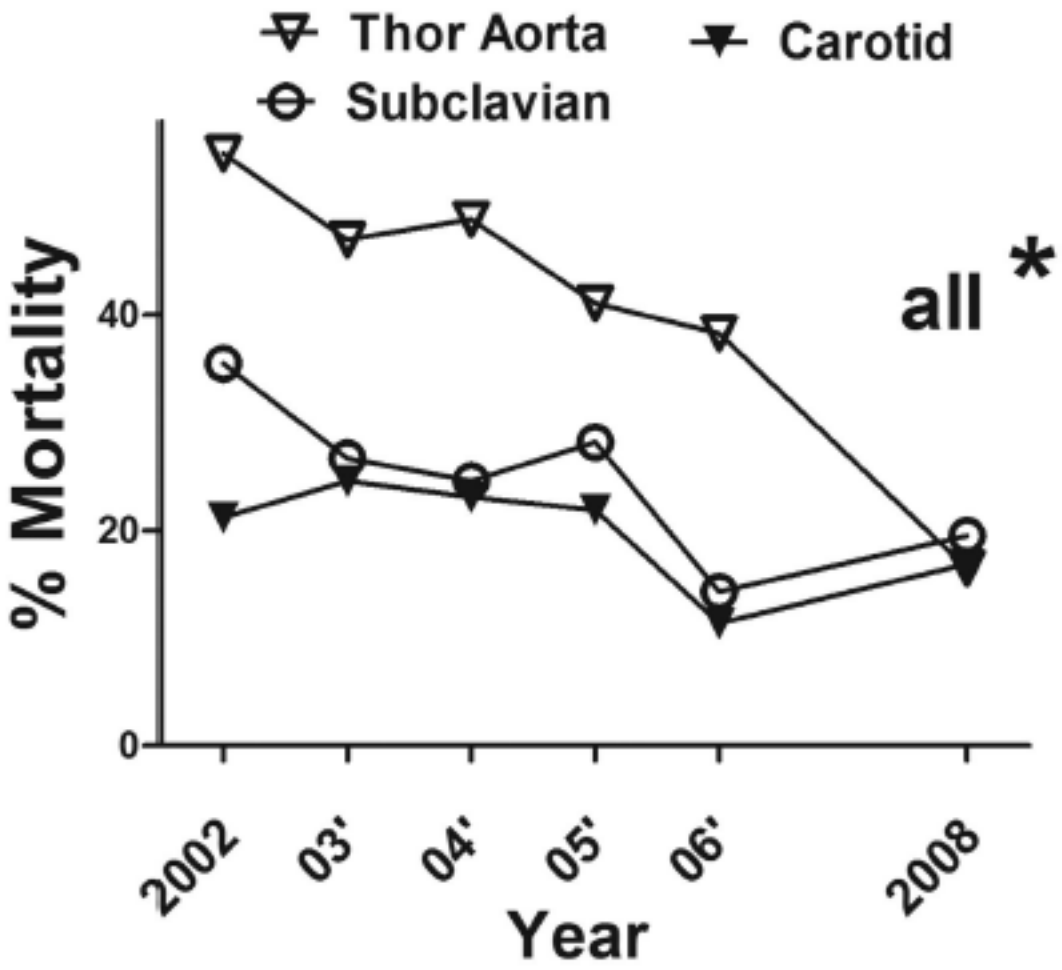
Fabian et al, J Trauma 1997

Blunt Aortic Injury (BAI)



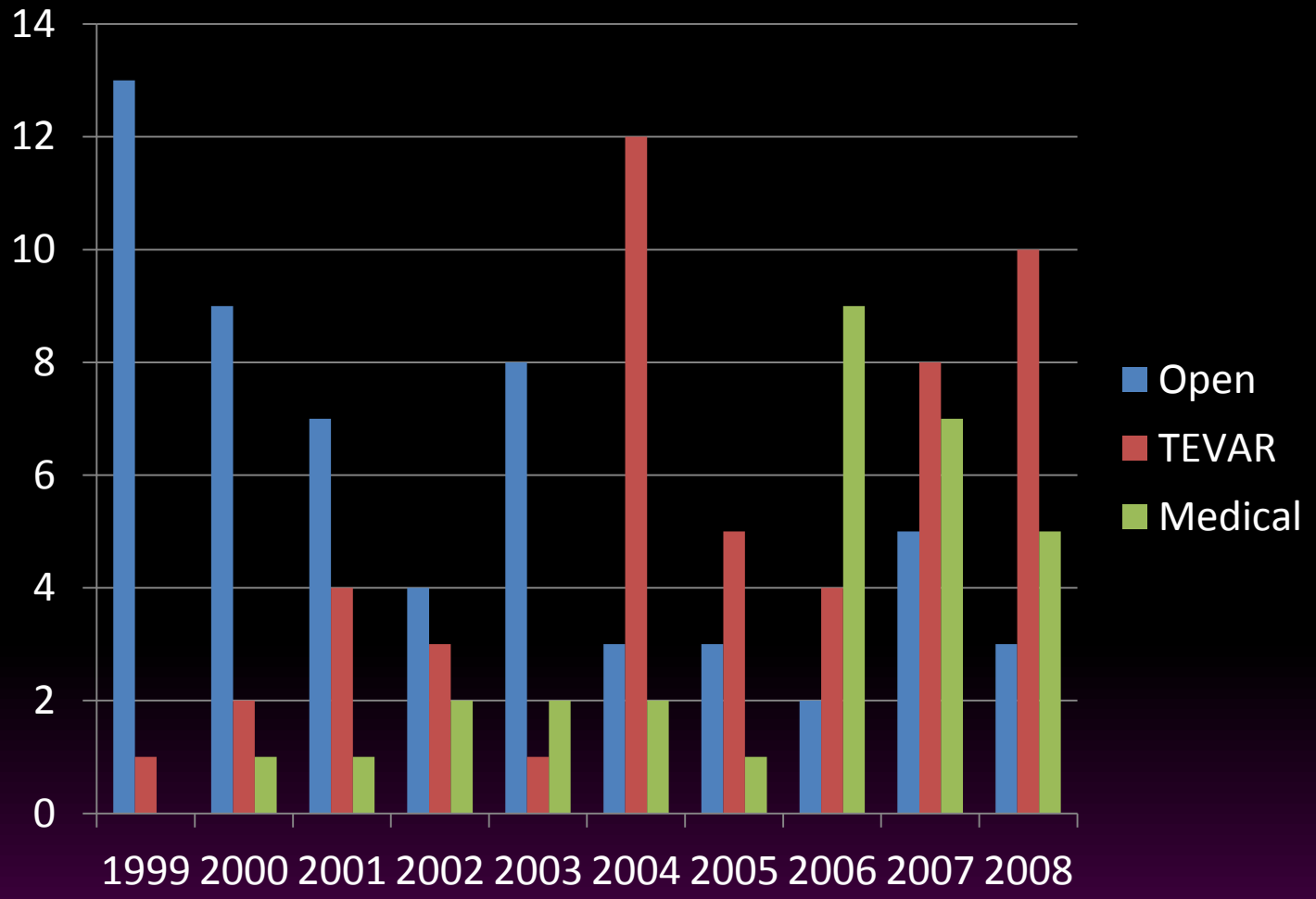


Blunt Aortic Injury (BAI)



Avery et al. J Trauma 2012;72:41-47

Harborview- 10 years, 140 patients



TOTALS	14	12	12	9	11	17	9	15	20	18

The Harborview Experience 1999-2008

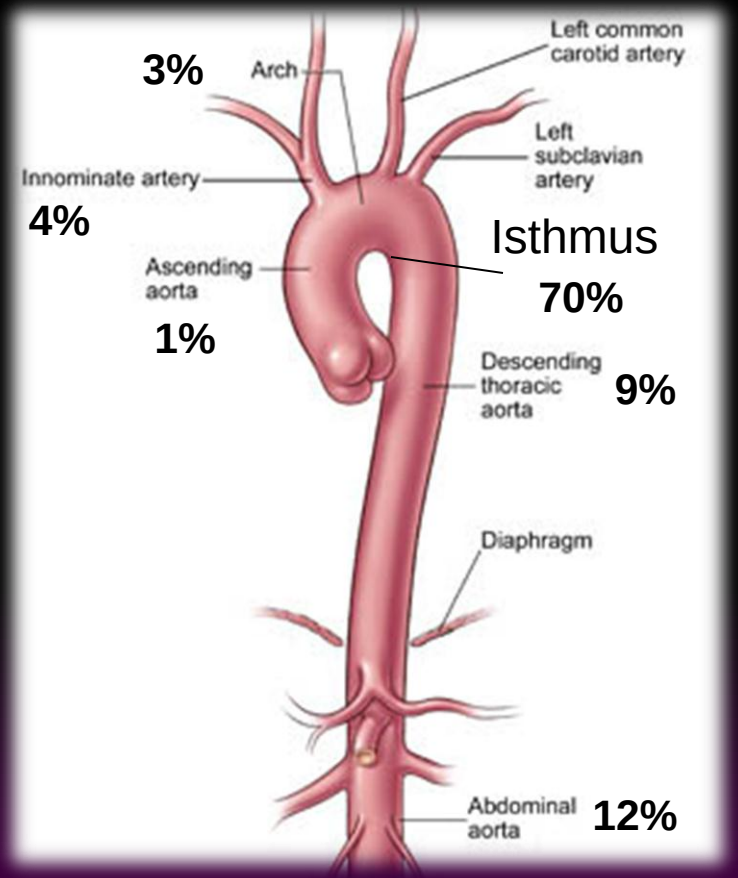
0.5% of all trauma patients who survive to ED presentation

BAI N = 140

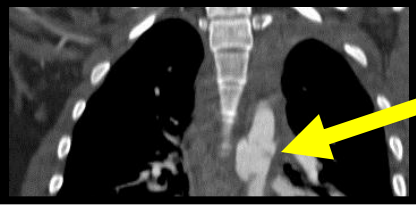
- Mean age: 40 years old (range 10-89)

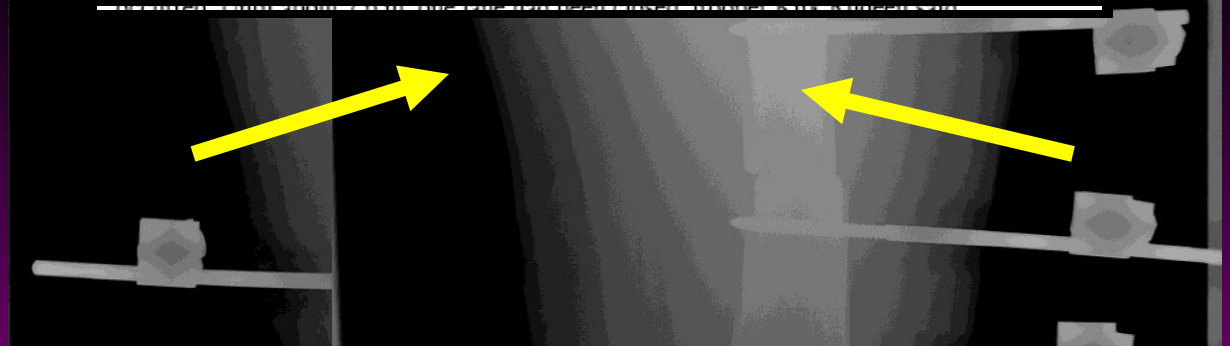
Endovascular repair n = 49

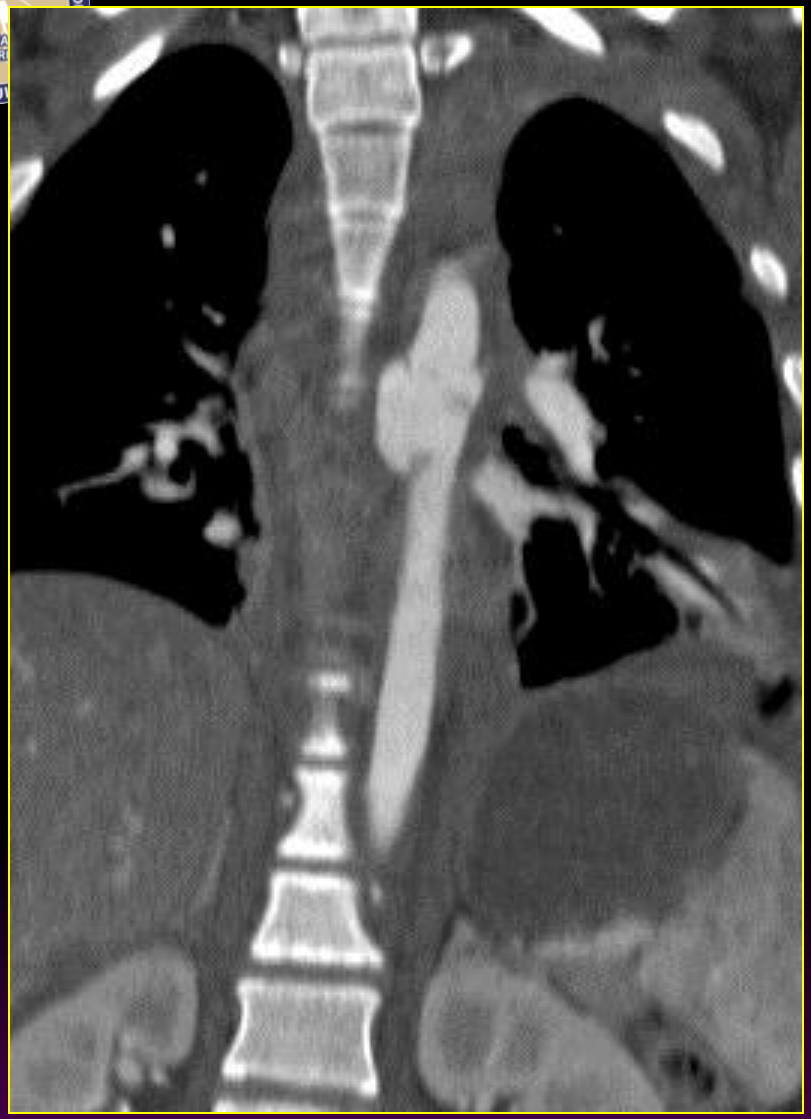
- Patients with multiple injuries

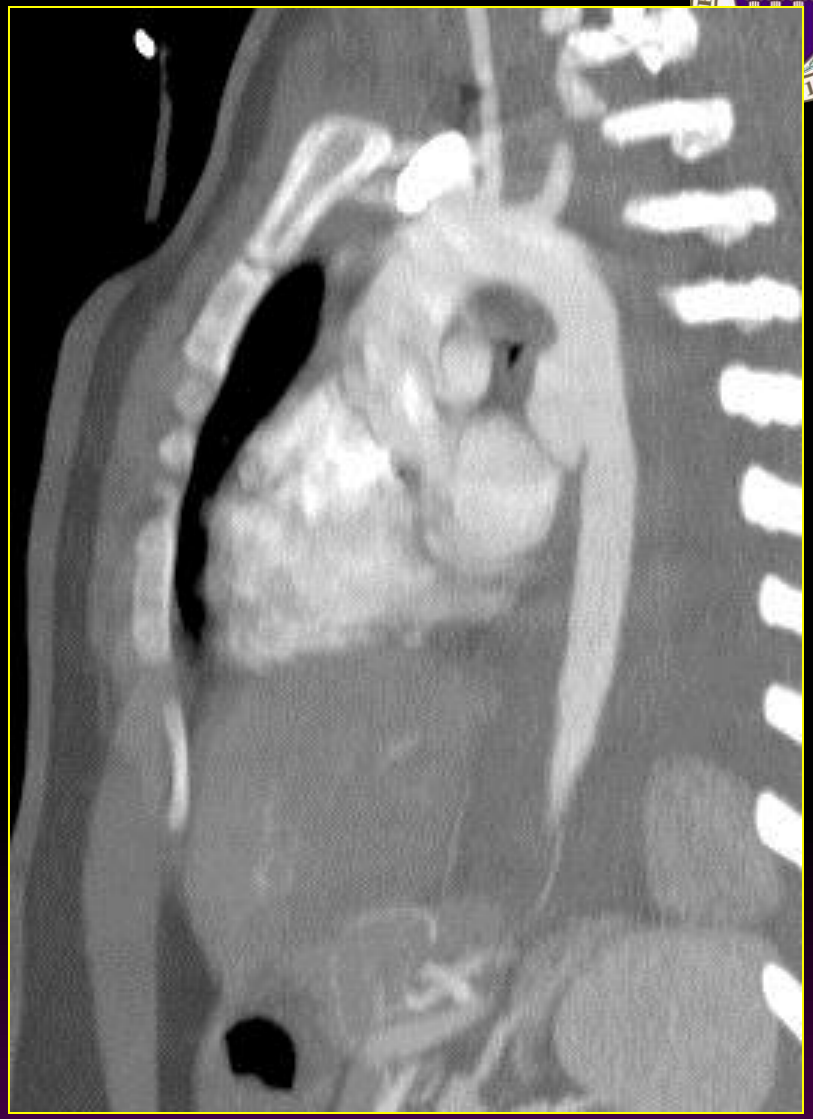


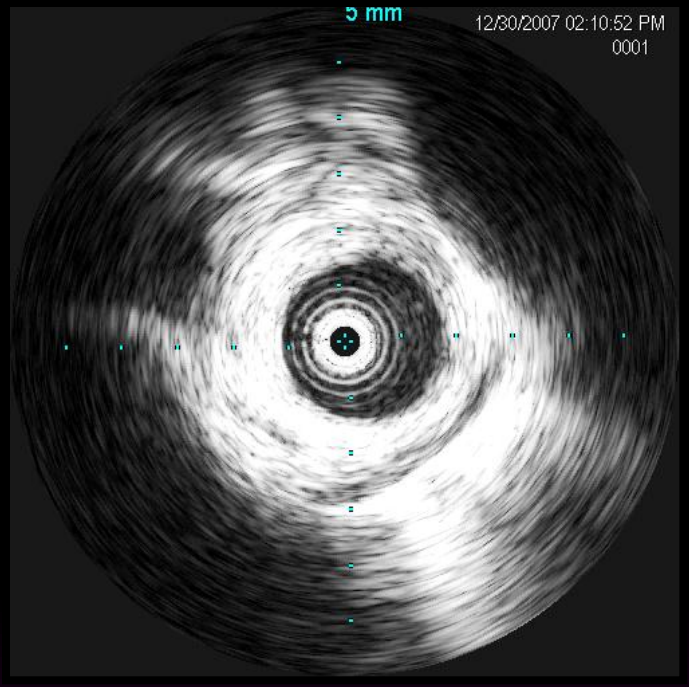
BAI presented at the 64th Society for Vascular Surgery annual meeting

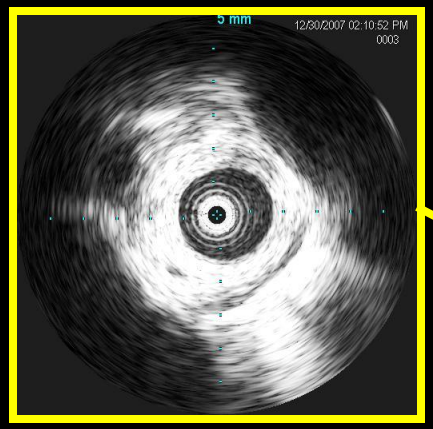


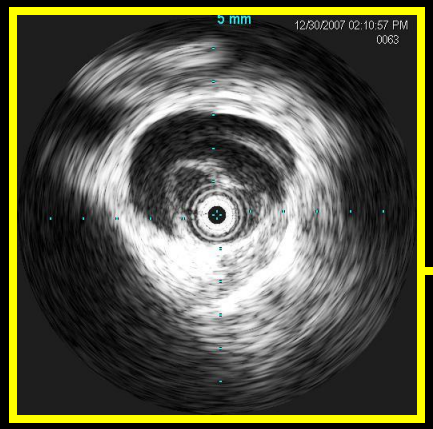


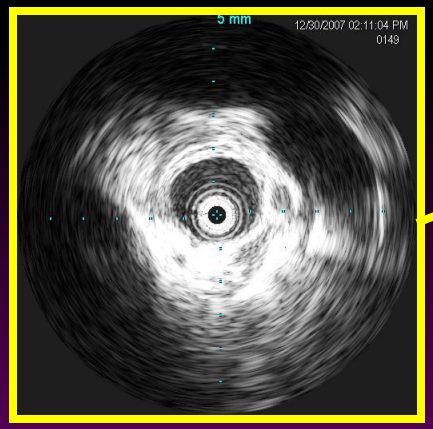


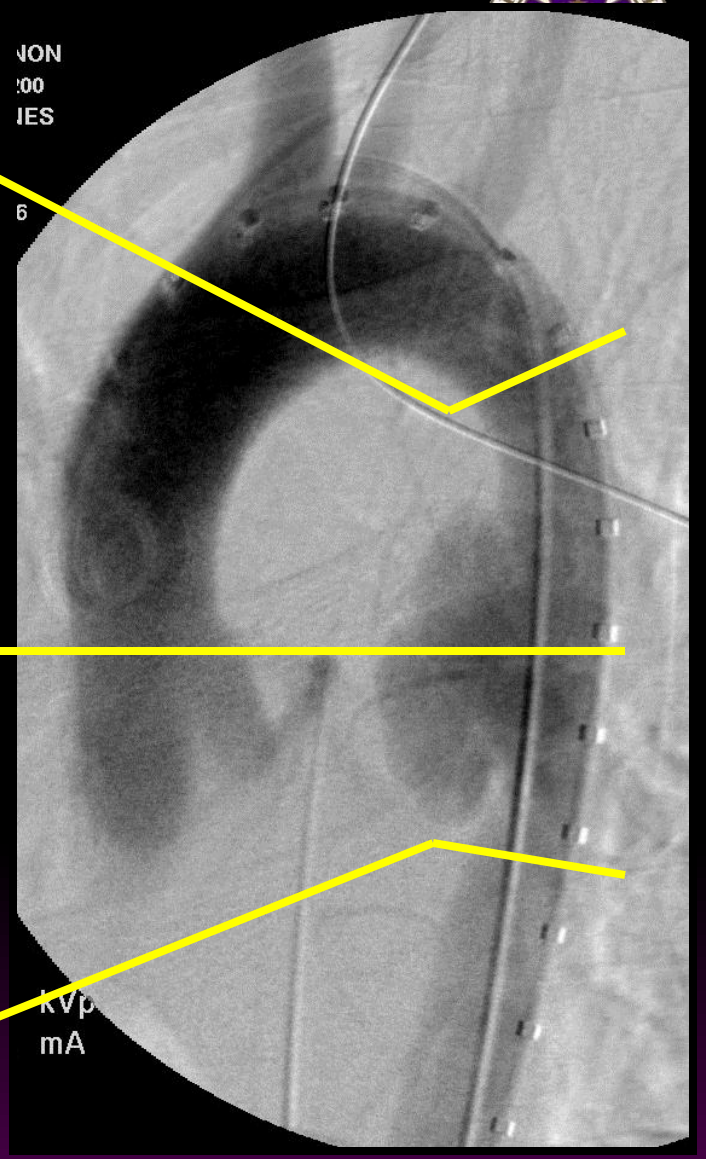



5 mm
12/30/2007 02:10:52 PM
0001


5 mm
12/30/2007 02:10:52 PM
0003


5 mm
12/30/2007 02:10:57 PM
0063

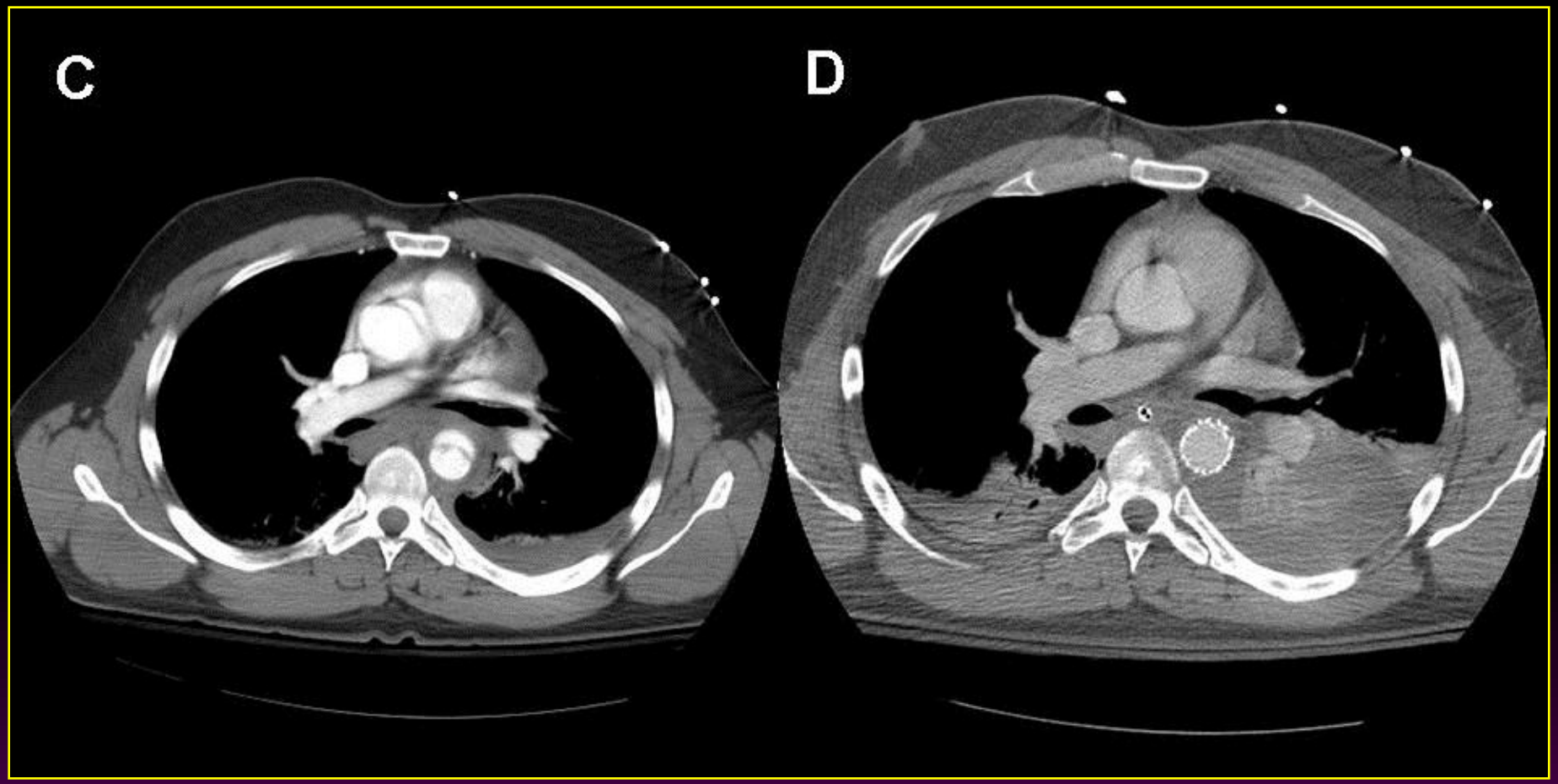

5 mm
12/30/2007 02:11:04 PM
0149

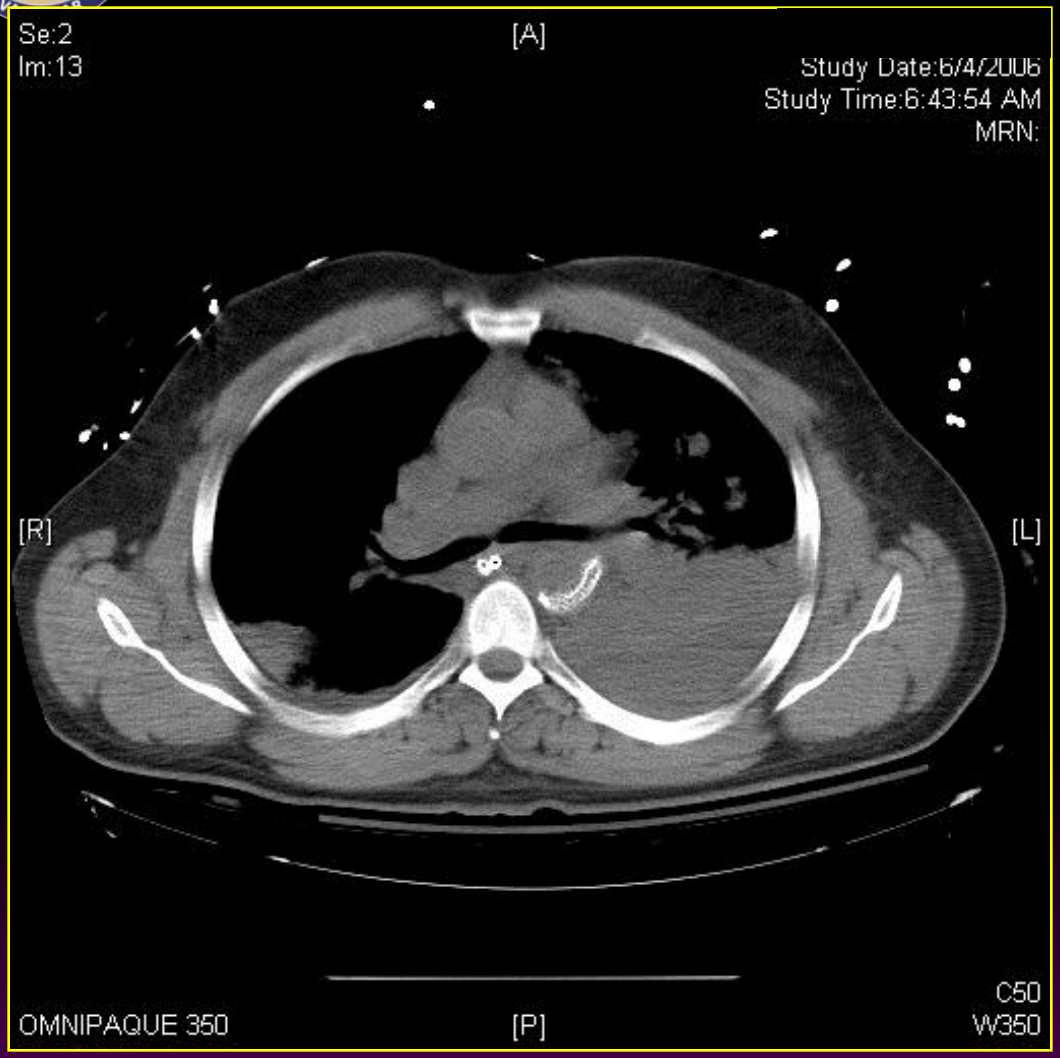

mA


HARBORVIEW
12/30/2007
2:52:08 PM
H2565200
STARNES
TAG
RT
3101986
97 kVp
16.24 mA
30
55
64
OEC

Jan 08

May 09


C
D


Se:2
Im:13
[A]
Study Date:6/4/2006
Study Time:6:43:54 AM
MRN:
[R]
[L]
OMNIPAQUE 350
[P]
C50
W350

Thoracic Vascular Trauma

From the Society for Vascular Surgery

Reduced mortality, paraplegia, and stroke with stent graft repair of blunt aortic transections: A modern meta-analysis

Gale L. Tang, MD,[a] Hassan Y. Tehrani, MD, ChB,[b] Asad Usman, BS,[a] Kushagra Katariya, MD,[b] Chris Otero, MD,[c] Eduardo Perez, MD,[c] and Mark K. Eskandari, MD,[a] *Chicago, Ill; Gurgaon, Haryana, India; and Miami, Fla*

Objective: Stent grafting has become the first-line approach to traumatic thoracic aortic transections (TTAT) in some trauma centers due to a perceived decrease in morbidity and mortality compared with standard open repair. We reviewed contemporary outcomes of patients undergoing endovascular repair of TTAT (endoTTAT) and those undergoing open repair (openTTAT) to determine if current reported results support first-line use of endoTTAT.

Method: Retrospective, nonrandomized studies published in English (>5 cases/report) involving TTAT listed in PubMed between 2001 and 2006 were systematically reviewed. Periprocedural outcomes between endoTTAT and openTTAT were analyzed. Mean follow-up was 22.9 months for endoTTAT (reported for 22 of 28 studies) and 48.6 months for openTTAT (reported for 5 of 12 studies). For statistical analysis, *t* tests were used.

Results: We analyzed 33 articles reporting 699 procedures in which 370 patients treated with endoTTAT and 329 patients managed with openTTAT. No statistical differences were found between patient groups in mean age (41.3 vs 38.8 years, $P < .10$), injury severity score (39.8 vs 36.0, $P < .10$), or technical success rates of the procedure (96.5% vs 98.5%, $P =$

Table I. Articles reporting endovascular repair for traumatic thoracic aortic transections

First author (y)	*No.*	*Age, mean y*	*ISS, mean*	*Technical success, %*	*Mortality, No.*	*Paraplegia, No.*	*Stroke, No.*	*Complications, No.*	*Follow-up, mean mon*
Agostinelli (2006)[16]	15	42.3	NR	100	2	0	0	0	29
Amabile (2004)[17]	9	30.9	NR	100	0	0	0	0	15.1
Andrassy (2006)[18]	15	39.1	44.5*	80	2	0	0	6 (1 endoleak, 3 open conversions, 2 delayed LSC transpositions)	36
Bortone (2004)[19]	14	30.8	NR	100	0	0	0	0	14
Broux (2006)[20]	13	46	46	100	2	0	0	0	31
Daenen (2003)[21]	7	46.9	40.7*	100	1	0	0	0	9
Dunham (2004)[22]	16	33.7	36.9	100	1	0	1	0	10.7
Fattori (2002)[23]	19	39.4	NR	100	0	0	0	1 (endoleak)	20
Fujikawa (2001)[24]	6	49.2	35.8	100	1	0	0	0	NR
Hoornweg (2006)[25]	28	40.9	37.1	100	4	0	0	2 (graft collapse, CFA dissection)	26.5
Karmy-Jones (2003)[26]	11	33	NR	81.8	3	0	0	2 (1 endoleak, 1 open conversion for persistent endoleak)	NR
Kasirajan (2003)[27]	5	38	42	100	1	0	0	1 (proximal stenosis)	10.3
Lawlor (2005)[28]	7	42.3	36.3	100	0	0	0	0	18
Lebl (2006)[7]	7	59	35.1	100	1	0	0	1 ascending rupture	NR
Marchiex (2006)[29]	33	38.2	40.2	90.9	0	0	0	9 (3 endoleaks, 1 brachial artery thrombosis, 2 brachial pseudo-aneurysms, 1 transient paraparesis, 1 external iliac rupture, 1 L main bronchus atelectasis requiring stent)	32.4
Marty-Ane (2003)[30]	9	52.3	33.8*	100	0	0	0	1 (endoleak)	NR
Melnitchouk (2004)[31]	15	44.9	37.6*	100	1	0	0	2 (1 endoleak->death, 1 transient paraparesis)	34.1
Orend (2002)[8]	11	33.2	46.7*	82	1	0	0	4 (2 endoleak, 1 iliac rupture, 1 delayed LSC transposition)	14
Orford (2003)[32]	9	50.9	NR	100	1	0	1	1 (brachial artery thrombosis)	21
Ott (2004)[9]	6	44.5	46	100	0	0	0	0	NR
Pacini (2005)[33]	15	NR	NR	100	0	0	0	0	NR
Pratesi (2006)[34]	11	48	NR	100	1	0	0	0	18.2
Reed (2006)[35]	13	54.8	40	100	3	0	0	3 (1 endoleak, 1 iliac rupture, 1 thoracotomy for access)	12
Scheinert (2004)[36]	10	38.6	25.4	100	0	0	0	1 (ARF)	15
Steingruber (2006)[37]	22	39.1	NR	86.3	0	0	0	4 (3 early endoleak->2 open conversion, 1 late endoleak)	31.7
Tehrani (2006)[38]	30	43	42	100	2	0	1	2 (1 iliac rupture, 1 partial stent collapse)	11.6
Thompson (2002)[39]	5	58	51.8	100	0	0	0	1 (arrhythmia requiring pacemaker)	21.2
Wellons (2004)[40]	9	25.4	40.3*	100	1	0	0	3 (1 endoleak, 1 iliac artery injury, 1 femoral artery injury)	NR
Totals	370	41.3	39.8	96.5	28	0	3	44	22.9

ARF, Acute renal failure; *CFA*, common femoral artery; *ISS*, Injury Severity Score; *LSC*, left subclavian artery; *NR*, not reported.
*Mean ISS estimated from description of injuries.

699 procedures
-370 Endo
-329 Open

Mortality
-7.6% Endo
-15.2% Open p=.0076

Paraplegia
-0% Endo
-5.6% Open p<.001

Stroke
-0.85% Endo
-5.3% Open p=.0028

AAST2 Trial

- Multicenter (18 institutions) prospective database to evaluate BAI outcomes
- 193 patients (2 years)
  - 125 received a stent graft
  - 68 had an open repair

	ENDO	OPEN
Mortality	13.5%	23.5%
ISS	43	31
Systemic Comp	42%	50%

- 20% of endovascular repairs had a device-related complication (18/32 endoleaks, 4/32 access vessel injuries, 1/32 paralysis)

AAST

- Conclusions: “Most surgeons select stent grafts for traumatic thoracic aortic ruptures, irrespective of associated injuries, injury severity, and age. Stent Grafts are associated with significantly lower mortality and fewer blood transfusions, but there is a considerable risk of serious device-related complications. *There is a major and urgent need for improvement of the available endovascular devices*.”

Demetriades et al, J Trauma.2008 Mar;64(3):561-70

Current Endovascular Challenges "Small Aorta Diameter"

There is now an FDA approved endovascular graft to treat BTAI (cTAG)

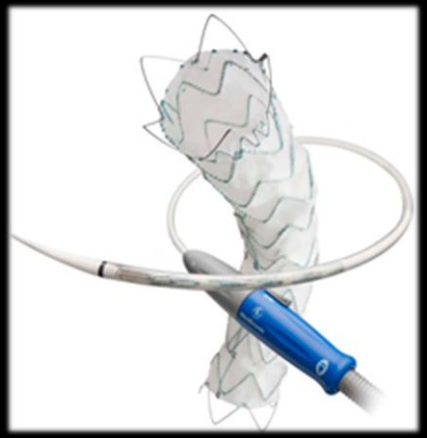
The smallest commercially available grafts for DTA

22 mm (Talent; Medtronic, Santa Rosa, CA)

21 mm (cTAG; W.L.Gore, Flagstaff, AZ)

28 mm (Zenith TX2; COOK, Bloomington, IN)

Infrarenal "cuffs" and limb extensions with off-label device modification



Current Endovascular Challenges
"The Tight Gothic Arch"

Bird Beak Phe

– Acute ar sition of graft to inner pse


Harborview Medical Center
09/09/2011
6:31:06 PM
TEVAR
H3164003
STARNES
4848109
07/29/1964
49
85
3C
OEC

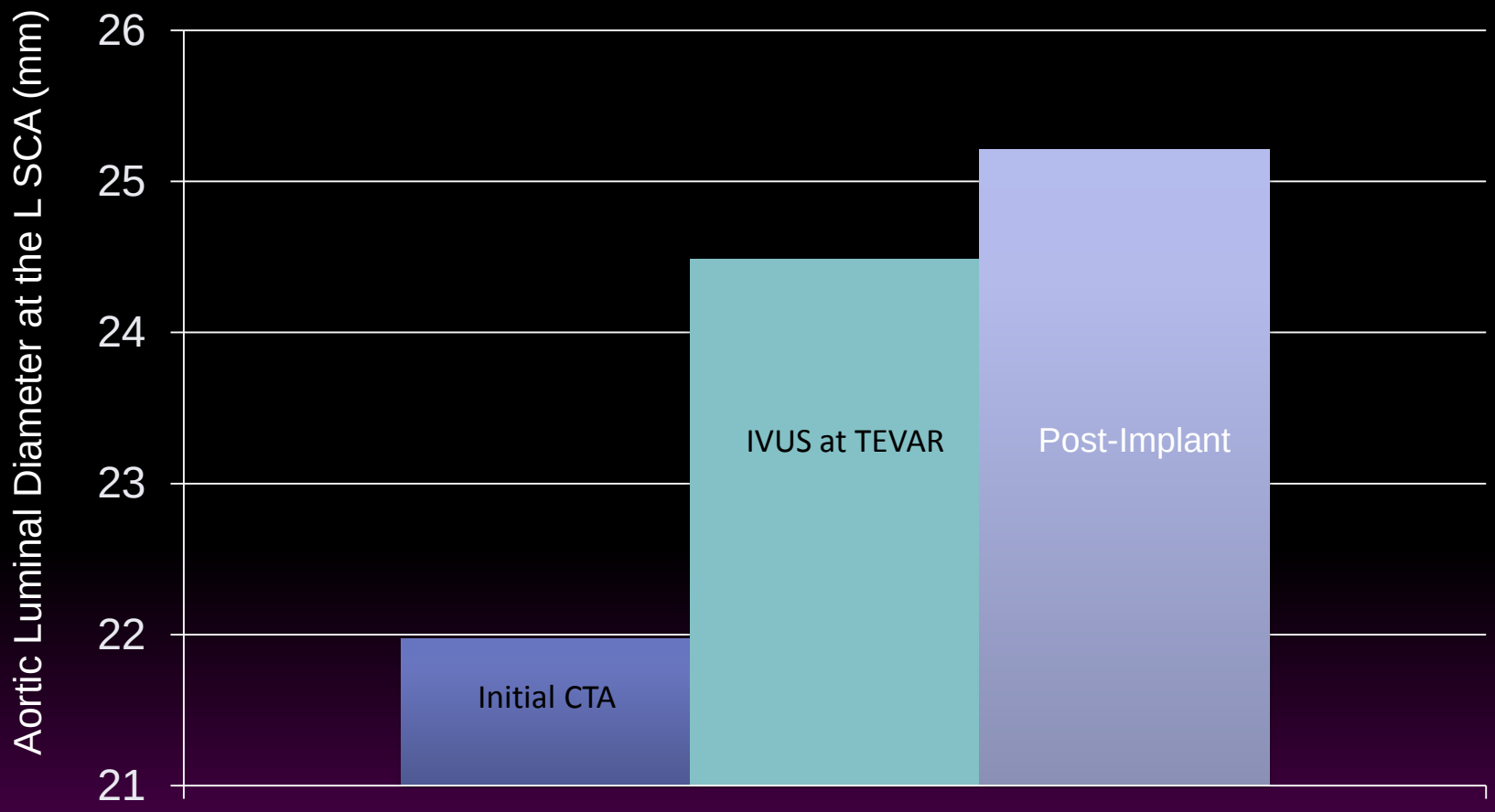
Conformable GORE TAG® Thoracic Endoprosthesis

Aortic diameters: 16-42 mm

cTAG 08-02
Device Characteristics

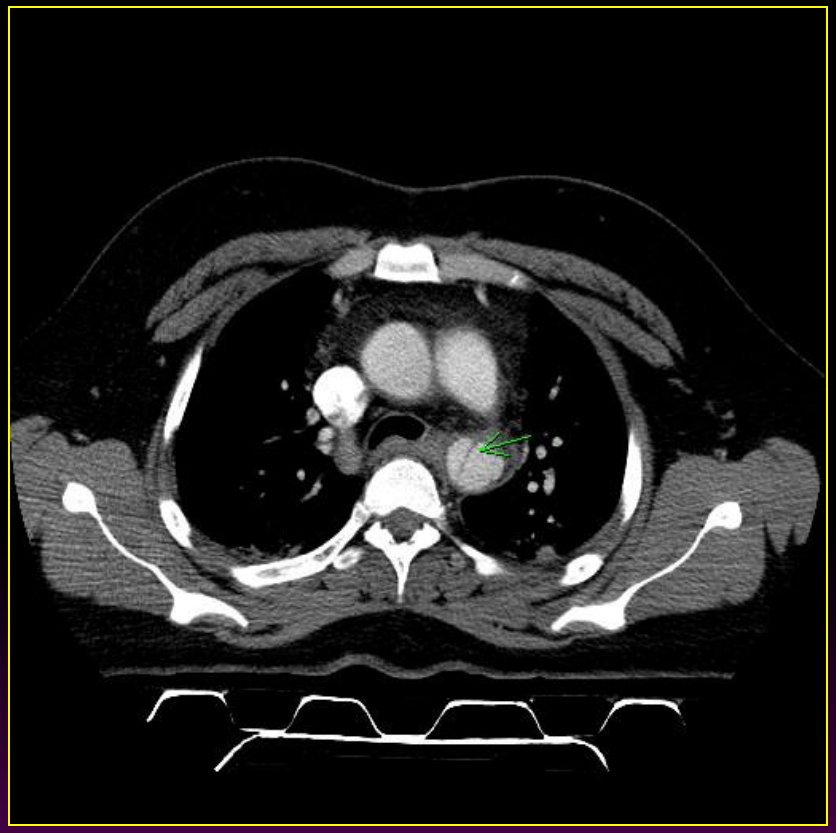
			Initial Procedure	
Proximal Diameter (mm)	Distal Diameter (mm)	Length (cm)	Subject (n = 51) n (%)	Devices (n = 57) n (%)
21	21	10	5 (9.8%)	5 (9.8%)
26	21	10	10 (19.6%)	11 (19.3%)
26	26	10	11 (21.6%)	12 (21.1%)
28	28	10	8 (15.7%)	10 (17.5%)
31	26	10	8 (15.5%)	8 (14.0%)
31	31	10	4 (7.8%)	5 (8.8%)
34	34	10	4 (7.8%)	4 (7.0%)
37	37	10	1 (2.0%)	2 (3.5%)

Diameter Changes



Are we finding more?

- “Minimal Aortic Injury”



Nonpenetrating Traumatic Injury of the Aorta

By Loren F. Parmley, Lt. Colonel, MC, Thomas W. Mattingly, Brig. Gen., MC, William C. Manion, M.D., and Edward J. Jahnke, Jr., Maj., MC

our series the extent of involvement of the aortic wall varied from a simple subintimal hemorrhage to complete laceration of the aorta. The lesions may be classified as follows: (1) intimal hemorrhage; (2) intimal hemorrhage with laceration; (3) medial laceration; (4) complete laceration of the aorta; (5) false aneurysm formation; (6) periaortic hemorrhage.

An evaluation of the gross and histopathologic features of trauma to the aorta requires

Circulation 1958;17;1086-1101

Minimal Aortic Injury

UW BAAI Classification

Absent External Contour Abnormality

Present External Contour Abnormality

Type of Aortic Injury	*Definition*	*Example*	*Type of Aortic Injury*	*Definition*	*Example*
Intimal Tear	No aortic external contour abnormality: tear and/or associated thrombus is <10mm		**Pseudoaneurysm**	Aortic external contour abnormality: contained	
Large Intimal Flap	No aortic external contour abnormality: tear and/or associated thrombus is >10mm		**Rupture**	Aortic external contour abnormality: not contained, free rupture	

Harborview- 10 years, 140 patients

Table 3	Total	Open Repair	TEVAR	Non-operative Treatment	Dead	Non-BAI Death	BAI-related Death
Intimal tear	23	1	2	20	3	3	0
Large Intimal Flap	8	2	4	2	0	0	0
Pseudoaneurysm	100	43	43	14	24	15	9
Rupture	9	9	0	0	8	2	6
Total	**140**	55	49	36	35	20	15

Timing of Intervention

- AAST 1997: mean time from injury to surgical repair
  16.5 hrs

- AAST 2008: mean time from injury to surgical repair
  54.6 hrs

Fabian et al. J Trauma 1997;42:374-80.
Demetriades et al. J Trauma. 2008;64:561–571.

Conclusions

- The use of TEVAR for BAI has become standard in most modern aortic centers
- More BAI is being diagnosed with modern imaging techniques
- Minimal Aortic Injury (-EACA) requires observation only
- Newer devices show promise for treating BAI with less device-related complications


UNIVERSITY OF WASHINGTON VAPS HARBORVIEW
CONSTANTIA COMES VICTORIAE
VASCULAR
HARBORVIEW MEDICAL CENTER
UW Medicine
UNIVERSITY OF WASHINGTON
LVX SIT
1861