TRAUMA SERVICES
AUCKLAND HOSPITAL

BLUNT THORACIC AORTIC INJURY

Current experience

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Thoracic aortic injury

- High prehospital mortality
- Associated with severe multiple injuries
- Traditional surgery associated with risks of bleeding, paraplegia, stroke, pulmonary insufficiency, renal failure etc

Traumatic Aortic Rupture: Twenty-year Metaanalysis of Mortality and Paraplegia.

von Oppell U.O. et al. ATS 1994; 58: 578-84

- Most reported series of operative intervention are small; it is a relatively uncommon operation
- Of the 1742 pts "salvageable" 1972-1992
  - 179 (10.3%) died before operation
  - A further 61 (3.5%) bled out despite emergent operation
  - 117/1492 (6.7%) died intraoperatively
  - 201 (11.5%) died post operatively
  - New paraplegia rate up to 10% depending on technique

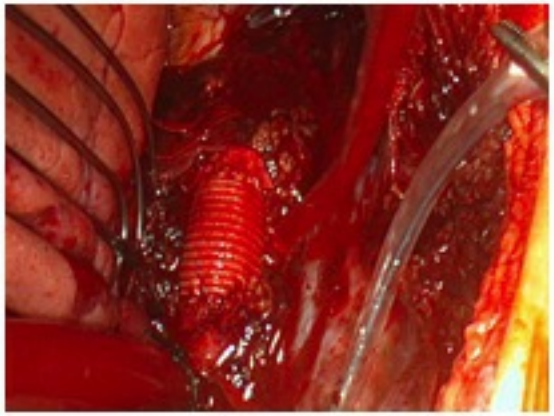
A paradigm shift…

- Few examples in trauma care
  - Non-operative management of solid organ injuries
  - Damage control surgery

What do you see?
By shifting perspective you might see an old woman or a young woman.

So why are alternatives be valuable?

- Open surgery is maximally invasive
- Requires single lung ventilation
- May compromise lung function post-procedure
- Requires heparinisation
- Carries risk of paraplegia
- Carries the risk of recurrent laryngeal and phrenic nerve injuries
- Carries all the other risks of any open procedure



Endoluminal Stent Grafting

- Procedure of choice in repair of AAA with >50% repaired that way
- Appears durable in medium term
- Minimally invasive
- Does not require full heparinisation
- Does not seem to carry significant risk of paraplegia
- Requires no change in ventilation
- Usual risks associated with open surgery minimised

Typical early experience

The Journal of TRAUMA® *Injury, Infection, and Critical Care*

Acute Traumatic Rupture of the Thoracic Aorta Treated with Endoluminal S

Charles S. Thompson, ML
Shoaib Shafique, MD, Da

Background: Endovascul
ogies provide a new therapeut
the treatment for acute traum
of the thoracic aorta. We repo
rience with endoluminal stent
of thoracic aortic ruptures.

Methods: Five patients
repair of the thoracic aorta
doluminal stent graft for acut
rupture. Data from patient
procedure, hospital course, an
were analyzed.

Conclusion: Five cases of successful endograft repair of thoracic aortic rupture have been demonstrated. This should encourage future studies to determine whether endovascular repair of thoracic aortic ruptures is a safe and feasible alternative to conventional open repair.

Key Words: Thoracic aorta, Stent graft, Traumatic aortic rupture, Endovascular.

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J Trauma. 2002;52:1173–1177.

Surgical versus endovascular treatment of traumatic thoracic aortic rupture

Philippe Amabile, MD,[a] Frédéric Collart, MD,[b] Vlad Gariboldi, MD,[b] Gilles Rollet, MD,[a] Jean-Michel Bartoli, MD,[c] and Philippe Piquet, MD,[a] *Marseille, France*

- July 1998 – Jan 2004
- 20 patients
  - 11 had surgical repair
  - 9 stent grafts
- Surgical patients
  - Mean age; 32
  - Direct suture; 6
  - Graft; 5
  - Delay to surgery; 2.6d
- Endoluminal patients
  - Mean age; 32
  - Talent graft; 7
  - Gore Excluder; 2
  - Subclavian covered in only 2 patients
  - Delay to surgery; 17.8d

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- SURGICAL PATIENTS
  - One death
  - Three complications (phrenic nerve; recurrent laryngeal nerve; haemopericarium requiring reoperation)
  - No paraplegia
- ENDOVASCULAR GROUP
  - All deployements successful
  - No conversions to open repair
  - No procedure related complications
  - No post-op endoleaks

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Conclusion: In the treatment of blunt thoracic aortic rupture, the immediate outcome in patients who receive endovascular stent grafts appears to be at least as good as observed after conventional surgical repair. Long term follow-up is necessary to assess long term effectiveness of such management.
(J Vasc Surg 2004;40:873-9)

An outcome analysis of endovascular versus open repair of blunt traumatic aortic injuries

Ali Azizzadeh, MD,[a] Kristofer M. Charlton-Ouw, MD,[a] Zhongxue Chen, PhD,[b] Mohammad H. Rahbar, PhD,[b] Anthony L. Estrera, MD,[a] Hammad Amer, MD,[a] Sheila M. Coogan, MD,[a] and Hazim J. Safi, MD,[a] *Houston, Tex*

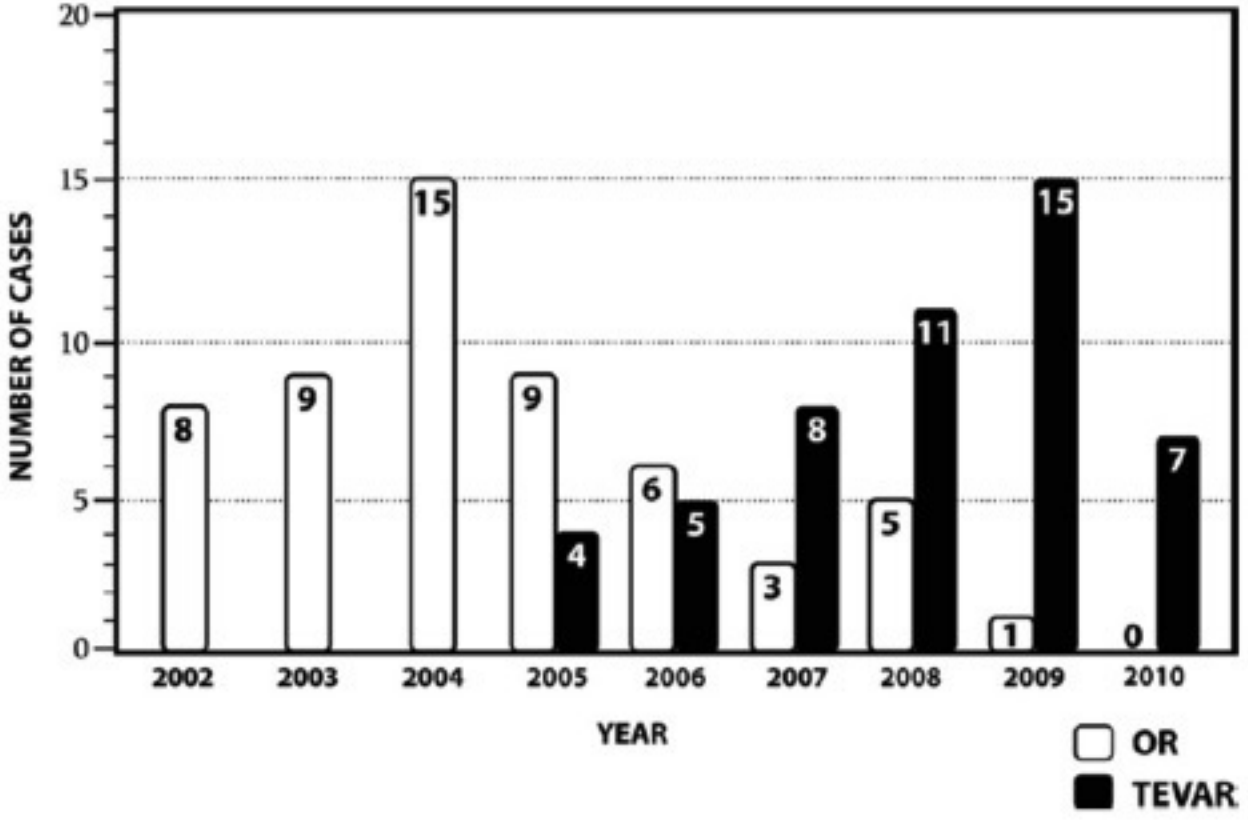
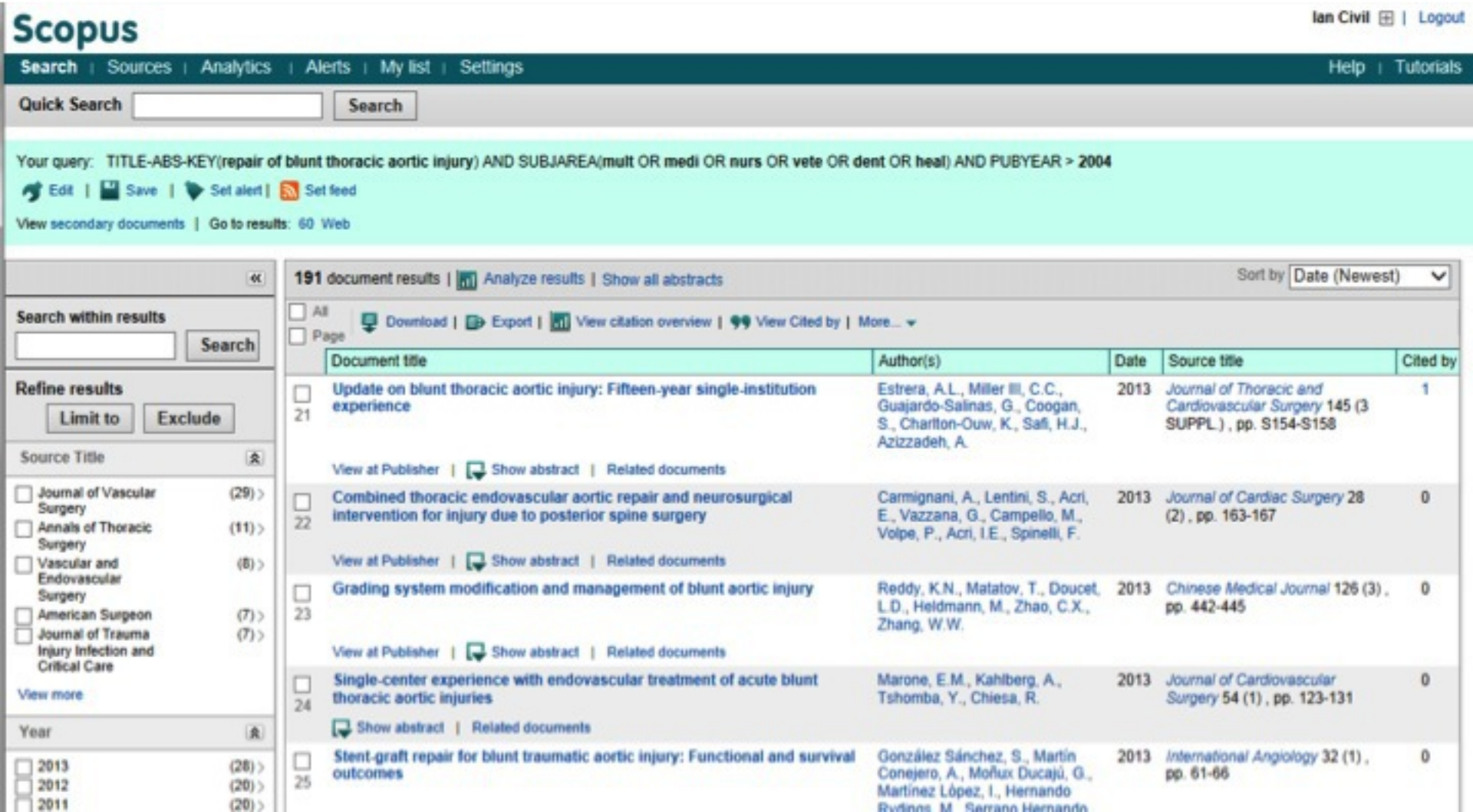


Fig 3. Treatment of traumatic aortic injury: the proportion of patients undergoing thoracic endovascular aortic repair (*TEVAR*) increased from 0% to 100% from April 2, 2002 to June 2, 2010. *OR*, Open repair.

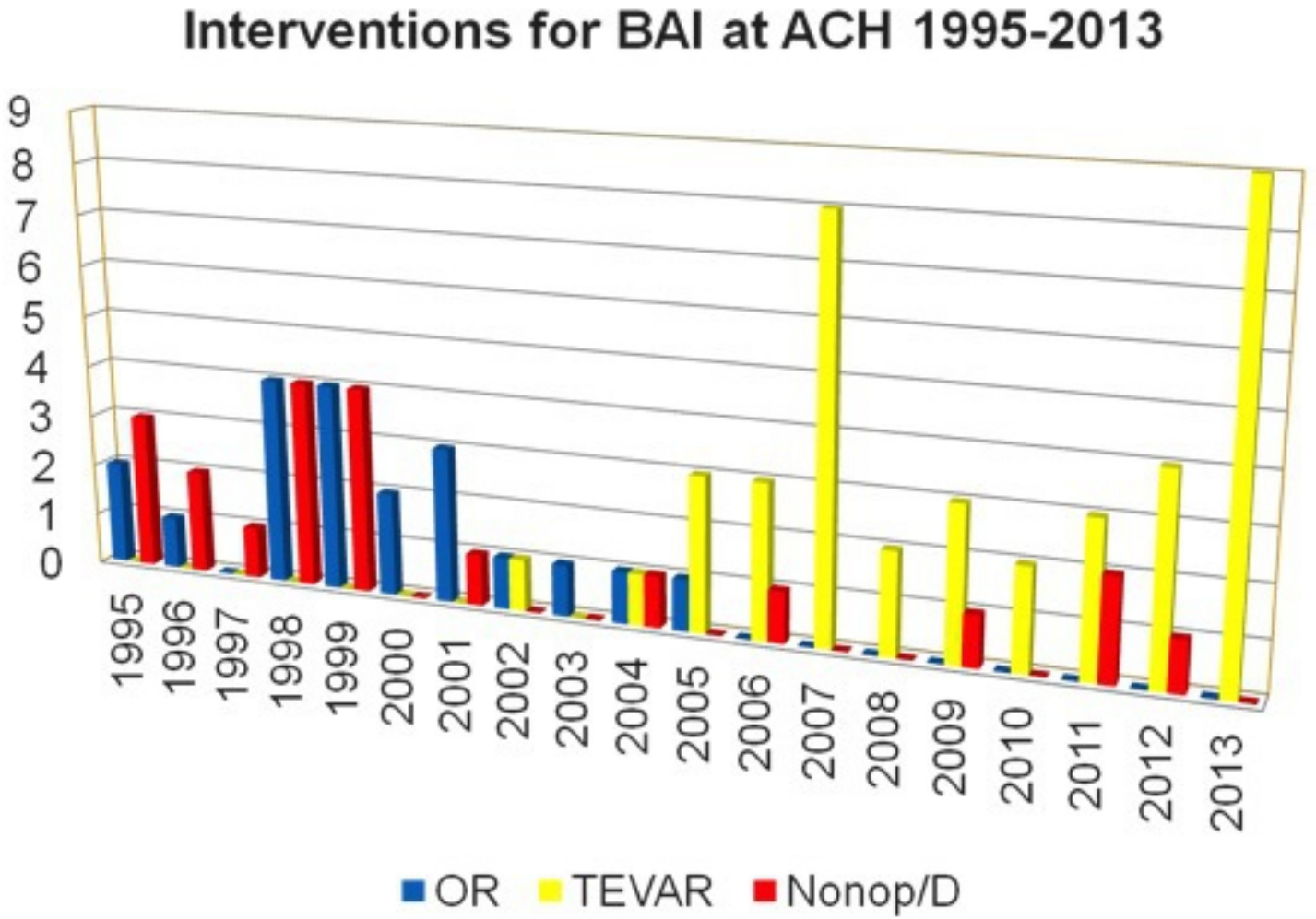
What has happened since 2005?



Auckland City Hospital Experience

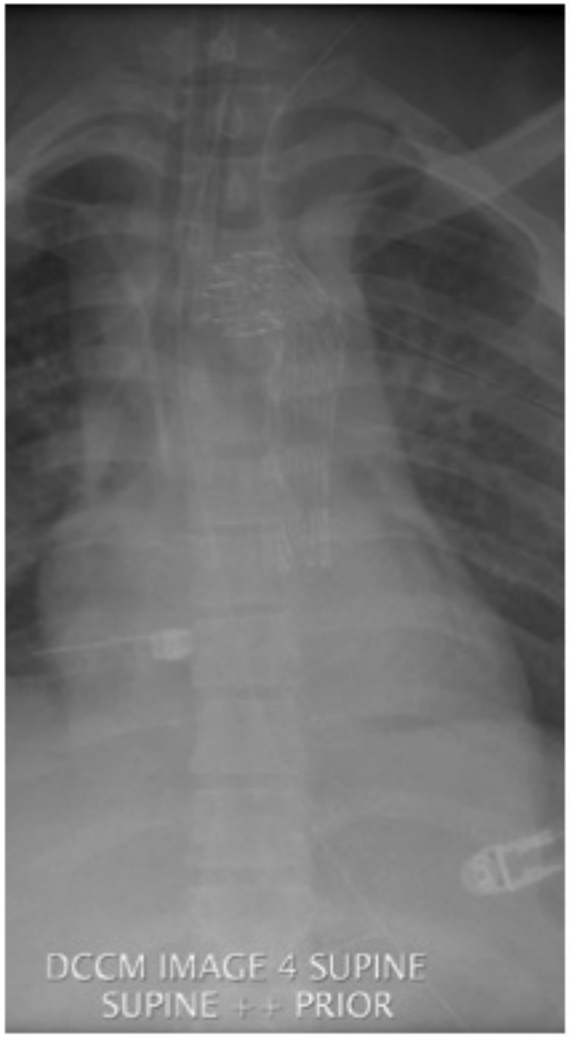
- 39 stent graft repairs mostly with Cook Zenith TX-2 or Medtronic Captiva grafts
- Six deaths, one aortic related
- Eight debranching operations
  - 2 CCXO, 1 arch to CC and L SC, 5 CC-SC
- No major complications
  - One temporary paraparesis
  - Three type 1 leaks, one type 4 leak
  - One hypertension 2^{o} to graft stenosis

The changing approach to blunt aortic injury at ACH



Patients

- 39 patients; 12 female, 27 male
- Average age 36 (median 26)
- 2 falls, 1 hit by train, 36 MVC
- Median ISS 38
- ICU LOS 7 days
- Hosp LOS 14 days



Anatomy, location of rupture

- All but 3 injuries involved the aorta at or just distal to left subclavian artery (furthest 9cm distal to LSA)
- 1 injury at innominate
- 2 injuries adjacent to left carotid

Landing zones and debranching

- One Zone 0 with debranching of innominate, LCA and LSA
- Two Zone 1with C-C bypass
- 26 Zone 2 with 5 left carotid-subclavian bypasses
- 10 Zone 3 with no debranching

Grafts used

- 2 Talent
- 26 Cook Zenith TX-2
- 7 Medtronic Valiant (5 Captiva)
- 4 Gore
- 22-36mm x 77-157mm

Subclavian coverage

- SCA covered 29/39
- 5 SCA revascularisations (all prior to TEVAR)
- 1 posterior circulation CVA, one temporary spinal cord ischaemia (both in patients with C-SC bypass)

Overall outcome (short term)

- One conversion to open surgery and associated mortality
- One posterior circulation stroke
- One transient spinal cord ischaemia
- 3 Type 1 and 1 Type 4 endoleaks
- One short term reintervention for distal stenosis

Distal stenosis

Outcome (medium term)

- Only two survivors lost to follow-up to the extent that they have not been seen in the last 24 months.
- All other 31 patients seen in the last 2 years.
- Longest follow-up 9.81 years –free from intervention
- Mean follow-up only 3.76 years
- No late mortality or reintervention

Results

- So does this experience compare with international trends
- Does the subclavian artery matter?

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Table III. Descriptive results: proportion of individual complications and in-hospital death by study group

Variable[a]	*OR* (*n* = 56) No. (%)	*TEVAR* (*n* = 50) No. (%)
Complication + death	39 (69.64)	24 (48.00)
Complication + death, mean	1.29	0.94
Death	5 (8.9)	2 (4.0)
Cardiac	5 (8.93)	3 (6.00)
Respiratory	32 (57.14)	18 (36.00)
Gastrointestinal	4 (7.14)	2 (4.00)
Stroke	2 (3.57)	1 (2.00)
Paraplegia	0	0
Other neurologic	4 (7.14)	1 (2.00)
All neurologic	6 (10.71)	2 (4)
Hematologic	7 (12.7)	5 (10.00)
Peripheral vascular	2 (3.57)	0
Infectious	6 (10.71)	6 (12.00)
Renal	10 (17.86)	4 (8.00)
Other	6 (10.71)	5 (10.00)

OR, Open repair; *TEVAR*, thoracic endovascular aortic repair.
[a]Data are shown as number (%) except where indicated.

Left subclavian artery coverage during thoracic endovascular aortic aneurysm repair does not mandate revascularization

Thomas S. Maldonado, MD,[a] David Dexter, MD,[a] Caron B. Rockman, MD,[a] Frank J. Veith, MD,[a] Karan Garg, MD,[a] Frank Arko, MD,[b] Hernan Bertoni, MD,[c] Sharif Ellozy, MD,[d] William Jordan, MD,[e] and Edward Woo, MD,[f] *New York, NY; Dallas, Tex; Buenos Aires, Argentina; Birmingham, Ala; and Philadelphia, Pa*

- *1189 consecutive patients who underwent TEVAR at 6 high volume centres from 2000-2010*
- *Selective LSA revascularisation was practiced in all centres, before or at the time of TEVAR*
- *Indications included*
  - *Long aortic coverage*
  - *Prior abdominal surgery*
  - *Dominant left vertebral*
  - *LIMA-coronary bypass*
  - *Isolated left cerebral hemisphere*
  - *Left upper extremity AVF*

- *AUCKLAND indications selective and include*
  - *Dominant left vertebral*
  - *LIMA-coronary bypass*
  - *Left upper extremity AVF*

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Table II. Indications for thoracic endovascular aortic aneurysm repair (TEVAR)

Indication	*No. (%)*
Aneurysm	823 (69.2)
Dissection	155 (13.0)
Ulcer	61 (5.1)
Trauma	75 (6.3)
Coarctation	75 (6.3)

Table III. C, Major adverse events (*MAEs*), including paraplegia, stroke, and death after thoracic endovascular aortic aneurysm repair (TEVAR) for all thoracic aortic aneurysms (*TAA*) (n = 823) comparing group B (left subclavian artery [LSA] covered without revascularization) and C (LSA covered and revascularized)

	All TAA repairs, No. (%)		
Event	*Group B*	*Group C*	P
Paraplegia	5/111 (4.5)	6/136 (4.2)	.914
Stroke	5/106 (4.5)	11/132 (7.7)	.3
Mortality at 30 days	14/111 (12.6)	9/143 (6.3)	.08
Total MAEs	21/111 (18.9)	22/143 (15.3)	.456

Table IX. A, Risk of spinal cord ischemia (SCI) at 30 days in patients undergoing thoracic endovascular aortic aneurysm repair (TEVAR) with coverage of left subclavian artery (LSA) with (group C) and without (group B) revascularization according to urgency, indication, use of spinal drain, and gender

Variable	*Group B No. (%)*	P	*Group C No. (%)*	P
Urgency				
Emergency	14/123 (11.4)	.015	2/43 (4.7)	.831
Elective	8/86 (2.3)		5/128 (3.9)	
Indication				
Aneurysm	5/109 (4.6)	.22	6/143 (4.2)	.92
Dissection	7/67 (10.4)		1/19 (5.3)	
Ulcer	2/10 (20)		0/5 (0)	
Trauma	2/23 (8.7)		0/5 (0)	
Spinal drain			4/42 (9.5)	
Yes	6/139 (15)	.021	2/99 (2)	.44
No	4/99 (4)			
Gender				
Female	6/76 (7.9)	.89	4/67 (6.0)	.31
Male	10/136 (7.4)		3/105 (2.9)	

Table IX. B, Risk of stroke (CVA) at 30 days in patients undergoing thoracic endovascular aortic aneurysm repair (TEVAR) with coverage of left subclavian artery (LSA) with (group C) and without (group B) revascularization according to urgency, indication, and gender[a]

Variable	*Group B*	P	*Group C*	P
Urgency				
Emergency	9/123 (7.3)	.432	4/44 (9.1)	.4
Elective	4/86 (4.7)		7/128 (5.5)	
Indication				
Aneurysm	5/109 (4.6)	.52	11/144 (7.6)	.5
Dissection	6/67 (9.0)		0/19 (0)	
Ulcer	0/10 (0)		0/5 (0)	
Trauma	1/23 (4.3)		0/5 (0)	
Gender				
Female	4/76 (5.3)	.9	8/67 (11.9)	.03
Male	9/136 (6.6)		3/106 (2.8)	

[a]Only female gender differed between groups, with an increased risk of stroke in female patients undergoing left subclavian artery revascularization

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- *Conclusions:*

  LSA coverage does not appear to result in an increased incidence of SCI or CVA event when a strategy of selective revascularisation is adopted. Selective revascularisation results in similar outcomes among the three cohorts studied. Revascularisation in women carries and increased risk of a CVA event and should be reserved for select cases


Spin -90
Tilt 0

Summary

- Paradigm shift in practice pattern towards stent-graft repair of TAI
- Incidence of paraplegia lower than with open surgery (<=1%)
- Debranching needed in some – indications still unclear
- Some minor device related complications
- Good early and mid-term (up to 10 years) result

Ongoing questions

- What is the best graft
- Who needs subclavian revascularisation
- What followup is appropriate (and achieveable) in this largely young and geographically mobile group