Thoracic aortic trauma

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Thoracic Aortic Trauma

In USA and CANADA 7500- 8000 die of blunt thoracic aortic trauma
1 in every 6-10 people killed in vehicular accidents sustain this injury
Leading cause of rapid death amongst automative fatalities less than 25% survive pre-hospital setting those who do less than 50% survive 24 hours .[1]
Current data [2] - 4% of patients die during transport and 19% during initial trauma evaluation of the remaining survivors 29% have concomitant abdominal injuries and 31% major head injuries – poses a significant challenge in managing these patients

1.Fabian TC et al. J Trauma 1997;42:374-80
2.Arthurs ZM et al . J Vasc Surg 2009;49:988-994

Thoracic aortic trauma : mechanism of injury

- Aorta inherently weak at isthmus which is at the junction of moveable and fixed portion of aorta
- Mobility of ascending aorta and arch relative to the fixed distal descending aorta
- Displacement of the upper mobile section of the aorta in a caudal direction places isthmus section under tension and leads to rupture
- Essentially combination of mechanisms including shear , torsion and stretching compounded by hydrostatic forces.[1]

- 1.Richens D et al .Eur J Cardiothoracic Surg 2002;21:288-293

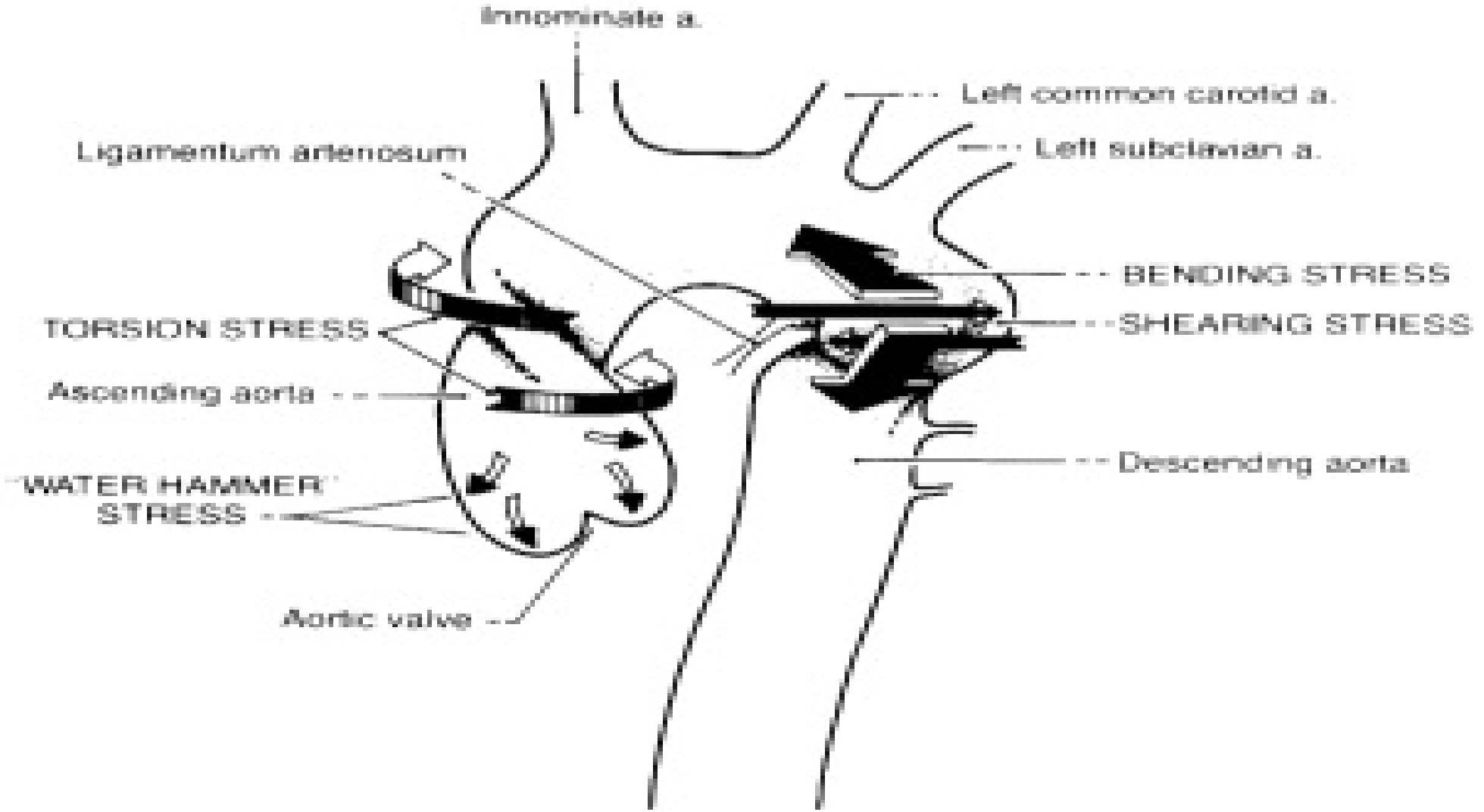
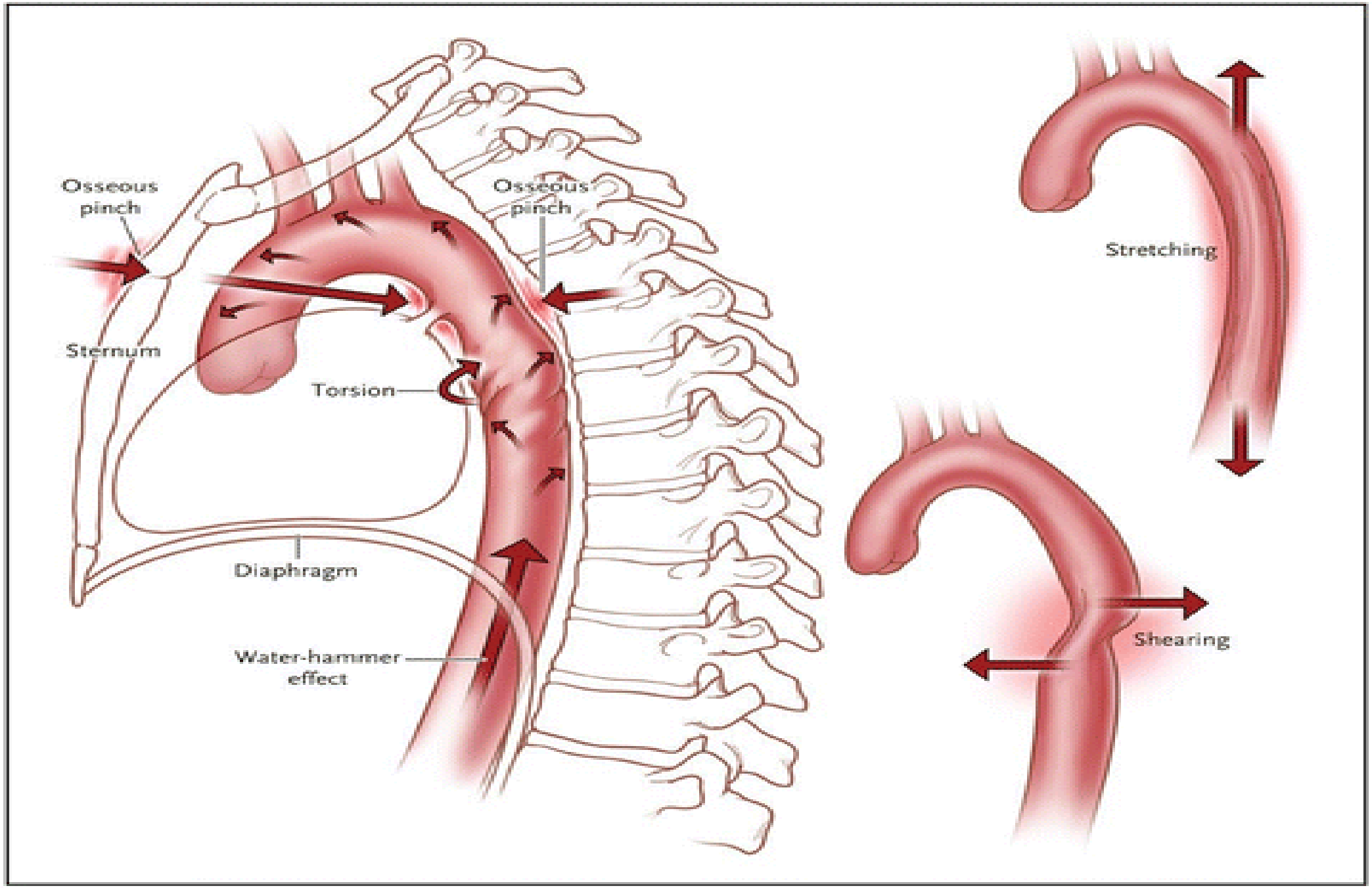


Fig. 1. Demonstration of the putative forces acting through the aorta during blunt traumatic injury (from Ref. [15]).

Richens D et al Eur j Cardioth Surg 2002;21:288-293


Osseous pinch
Osseous pinch
Sternum
Torsion
Diaphragm
Water-hammer effect
Stretching
Shearing

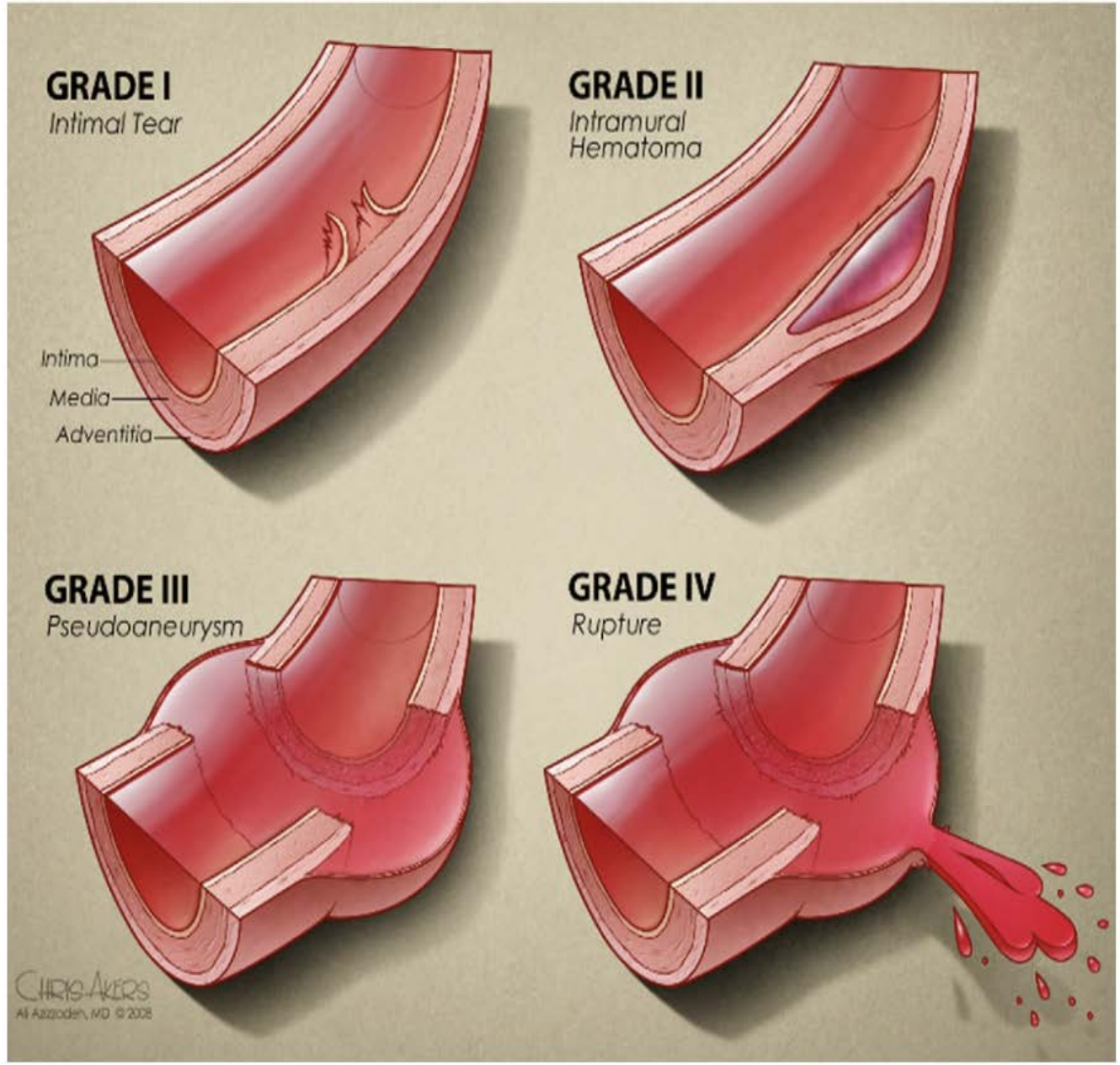


Fig. Classifications of traumatic aortic injury.[12]

Thoracic aortic injury : Diagnosis

- Chest xray → rib fractures ,widened mediastinum
- Ct scan with contrast[1,2,3] → most accurate sensitivity , specificity , and accuracy are 96%,99%,99% respectively the negative predictive value is 100% and CT helpful in planning Endovascular therapy
- MRI
- Angiography

- 1. Mirvis SE et al Radiology 1996 413-422
- 2.Scaglione M et al EurRadiol,11(2001):2444-2448
- 3.Ellis JD et al Can Assoc Radiol J 2007:58:22-26

Management of thoracic aortic trauma

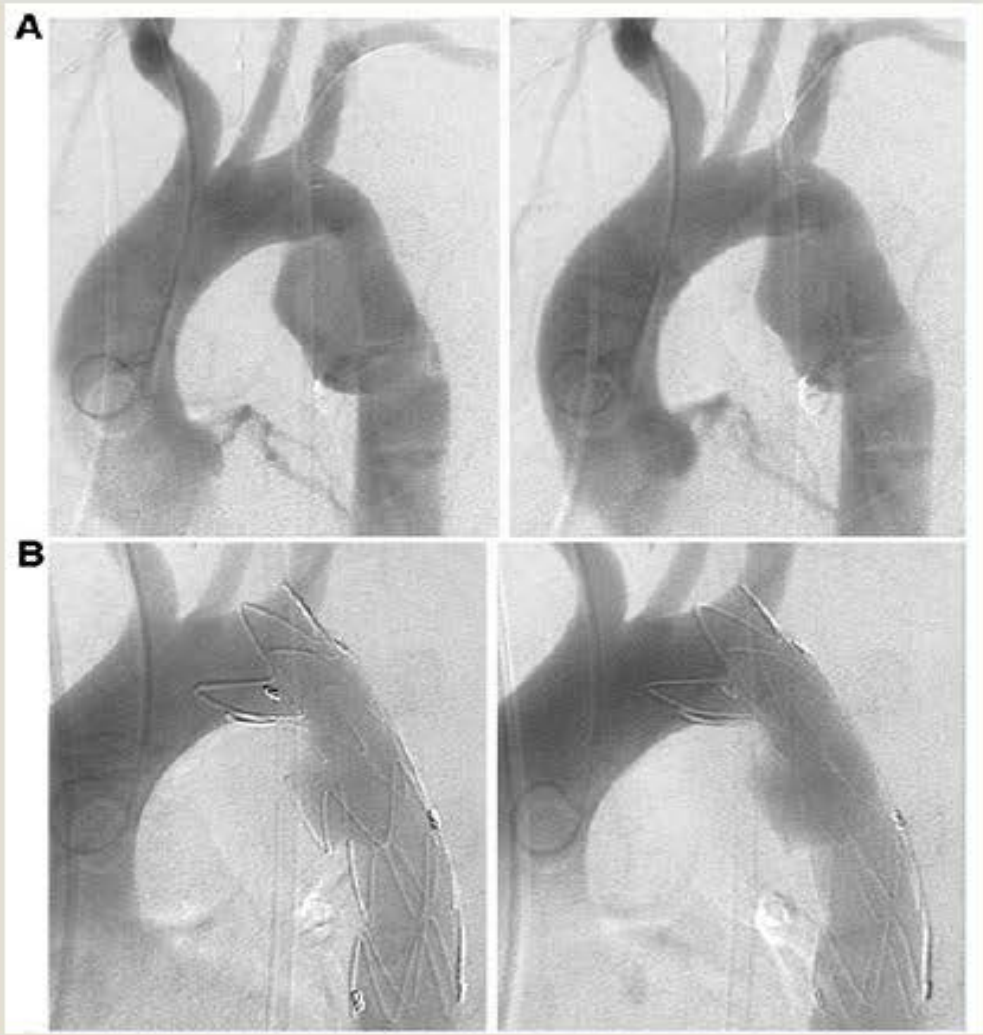
- In USA the first thoracic aortic device in 2005 – treatment was off-label
- Prior to 2005 Open Surgical repair was standard therapy
- Thoracic Endovascular Aortic Repair (TEVAR) outcomes have improved significantly with better morbidity , mortality and paraplegia rates
- Some unresolved issues with TEVAR

Thoracic aortic injury

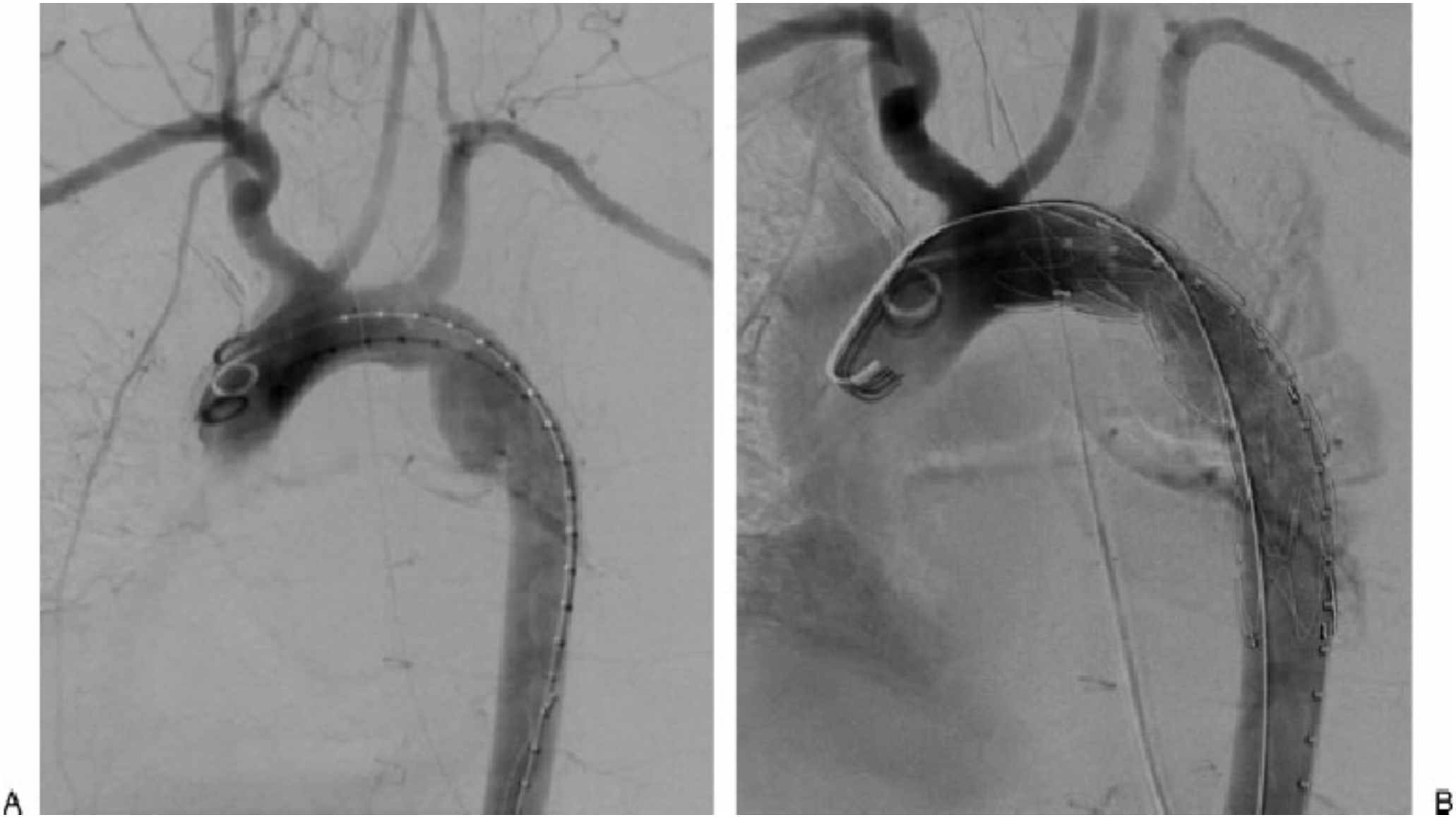
- Evidence for TEVAR
- **No Randomized control trials on TEVAR vs OPEN Repair**
- Meta-analysis of retrospective cohort studies [1] → lower procedure related and overall mortality with TEVAR
- Systematic review [2] commissioned by SVS of 7768 pts →mortality rates significantly lower for TEVAR (9%), OPEN(19%) Non-Operative(46%).
- Spinal cord ischemia TEVAR (3%) vs OPEN (9%) but at 2 years increased risk of secondary procedures wit TEVAR
- Based on this low quality of evidence (grade 2 c) the SVS recommended TEVAR be considered instead of open surgery for thoracic aortic injury but stated there were unresolved issues

- 1. Xenos ES et al J Vasc Surg 2008;48:1343-51
- 2. Lee WA et al J Vasc Surg 2011;53:187-92

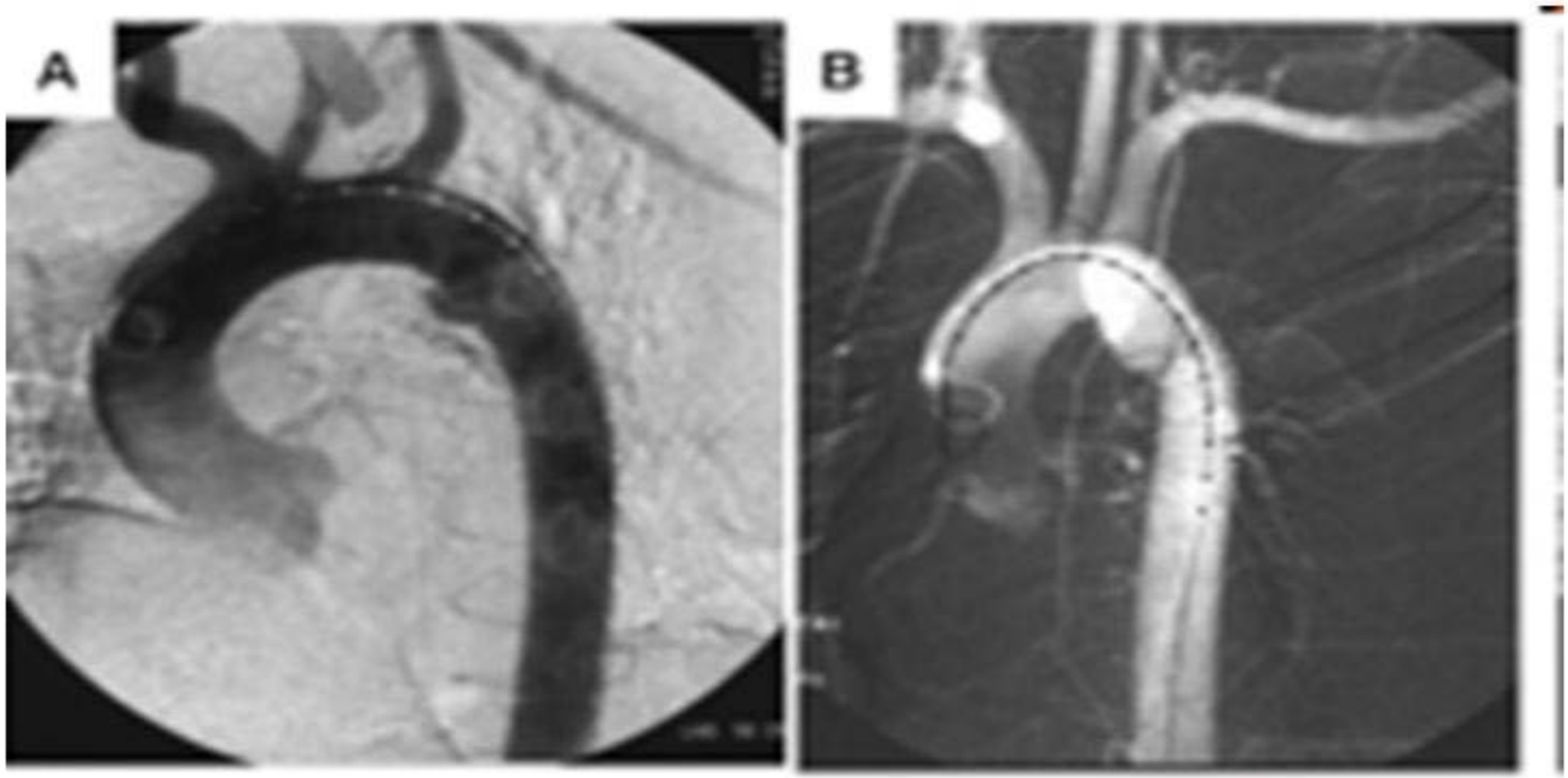
TEVAR - Thoracic Endovascular Aortic Repair



Jahromi AS, Kazemi K, Safar HA, Doobay B, Cina CS (2001) Traumatic rupture of the thoracic aorta: Cohort study and systematic review. J Vasc Surg 34(6):1029–1034


A
B

A wide aortic arch curvature is seen in a 65-year-old patient who sustained a blunt aortic transaction injury. (B) Angiogram of a 17-year-old traffic accident victim showing injury to the descending thoracic aorta. Note the acute sharp curvature of the aortic arch.



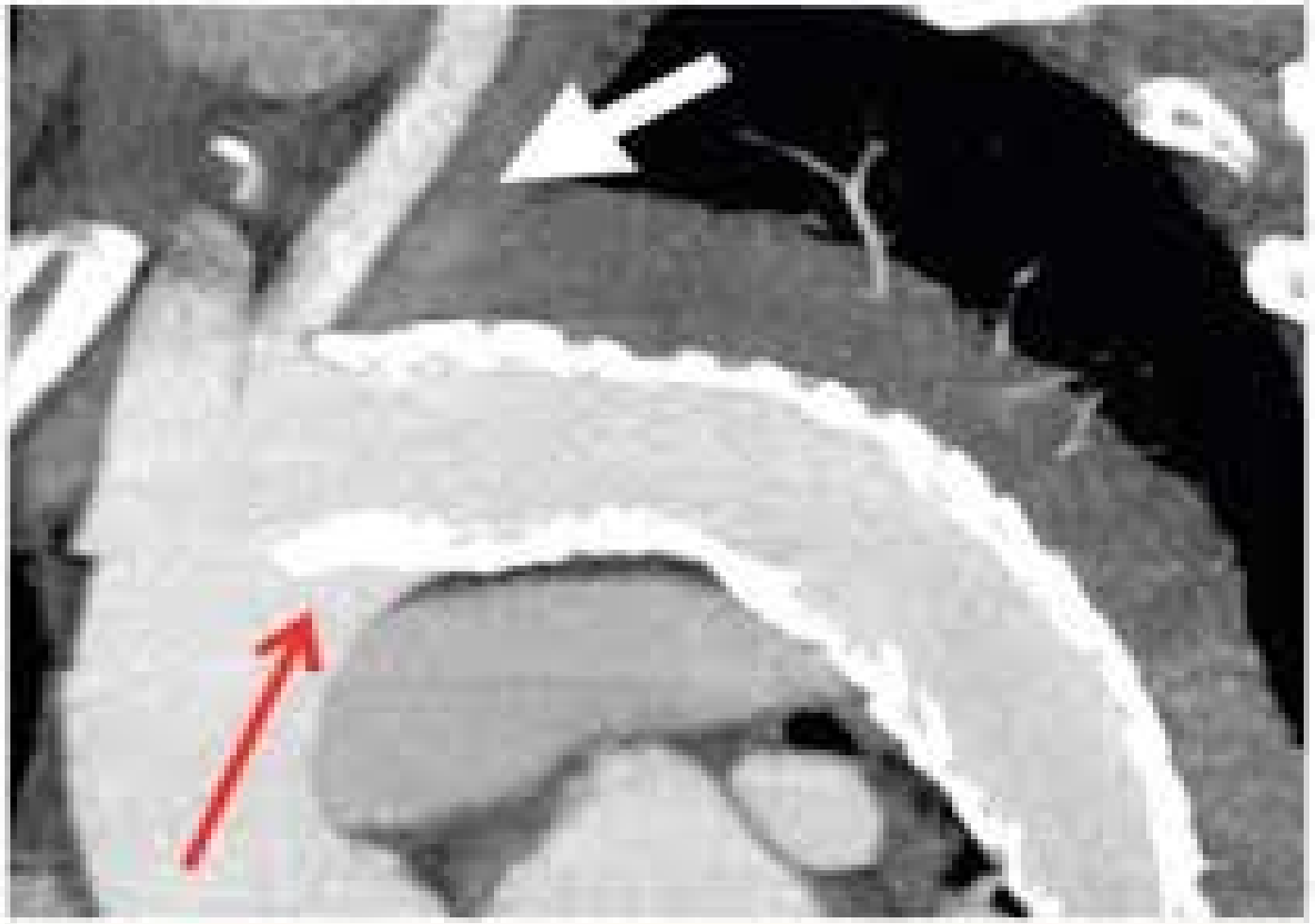
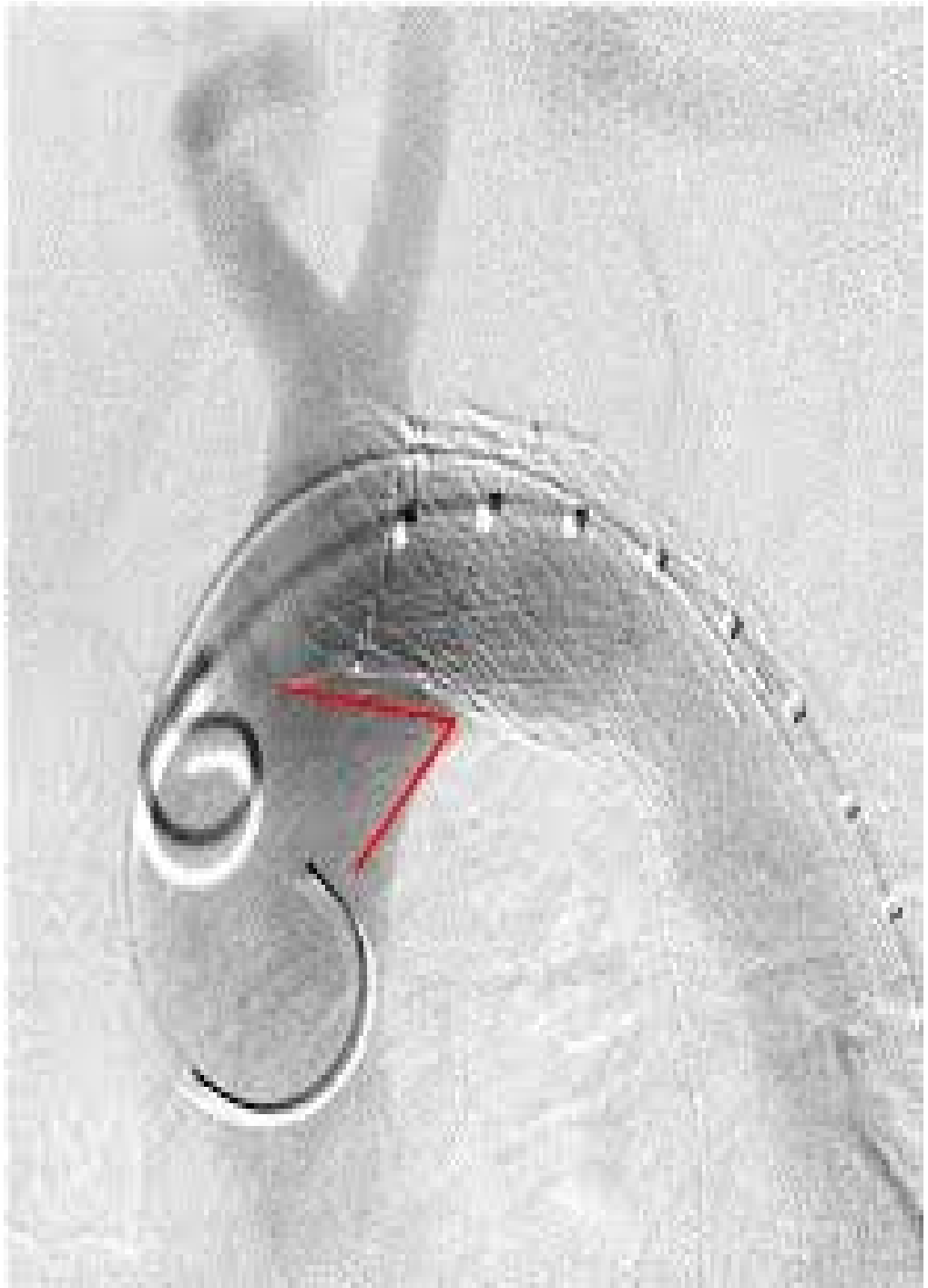


Figure 1. Bird-beaking occurs from malapposition to the lesser curve when a stent graft is placed at or across the knuckle of the aortic arch.



Thoracic Aortic trauma : unresolved issues

- Lack of arch confirmation of devices – tight radius of the curvature in younger patients → lack of wall apposition → endoleaks and endograft collapse → recent stent grafts have overcome this problem
- Conservative management of grade 1 and 11 injuries [1] – 5% progression of grade 1 to grade 111 – early within 16 days.
- Conservative treatment is recommended with appropriate observation and BP control with follow-up imaging at 7 days at 1 month and 6 months up to 1 year until lesion resolves.

- 1. Osgood MJ et al J Vasc Surg 2014;59:334-342

Thoracic aortic trauma

- Timing of TEVAR in the injured patient [1]
- Stable aortic injury -- grade111 →timing of TEVAR is dictated by the severity of associated injuries
- Life threatening non-aortic injuries -- delayed treatment of thoracic aortic injury safe and beneficial
- Minimal invasive nature of TEVAR --Possibly earlier repair of aorta in stable patient, emergent treatment of unstable patient and concomitant management of both aortic and non-aortic injuries
- 1. Lee WA et al. J Vasc Surg 2011;53:187-192

Thoracic aortic trauma

- Patients without other serious injuries grade 11 or 111 within 24 hours of admission
- Grade 1V injuries -->priority
- Paediatric and Adolescent patients – current devices are 21-22mm configuration can treat down to 16-18 mm aorta but device lengths are long 10-11,2 cm coverage of aorta too long
- Paediatric population need to take into account somatic growth which may cause future problems with device – balloon expandable stents may overcome this problem, stents not widely available

Thoracic aortic trauma

- Revascularization of left subclavian artery – Selective
- Short proximal landing zone is acceptable to overcome left subclavian coverage
- Access in our unit has been open not percutaneous
- Optimum follow-up strategy → CT SCAN at 1 month, 3 and 12 months after 12 months if no Endoleak , graft collapse or stent migration then repeat imaging at 3-5 years [1]

- 1. Adams J ,Kern JA Endovascular Today Sept 2014:38-42

Thoracic aortic trauma

- TEVAR --- **Treatment of choice for thoracic aortic injury**
- Shorter length devices with smaller introducer sheaths and more conformable devices to account for acute angle of thoracic aorta
- Pediatric population more conformable stent grafts which will allow future balloon dilation as child grows
- Long term outcomes with TEVAR not known and therefore in young patients a caution