Stenting in Trauma

Injury 2005

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LEFT

Thoracic aortic rupture

- Pre-hospital death rate of 80-90%.
- Usually involves injury at the level of the isthmus causing aortic transection with pseudo-aneurysm
- Standard treatment is open repair
- But, 8-33% mortality and 2-26% paraplegia rates (Jahromi et al. J Vasc Surg. 2001;34:1029-34)
- Stenting is emerging as the primary method to treat blunt aortic injuries

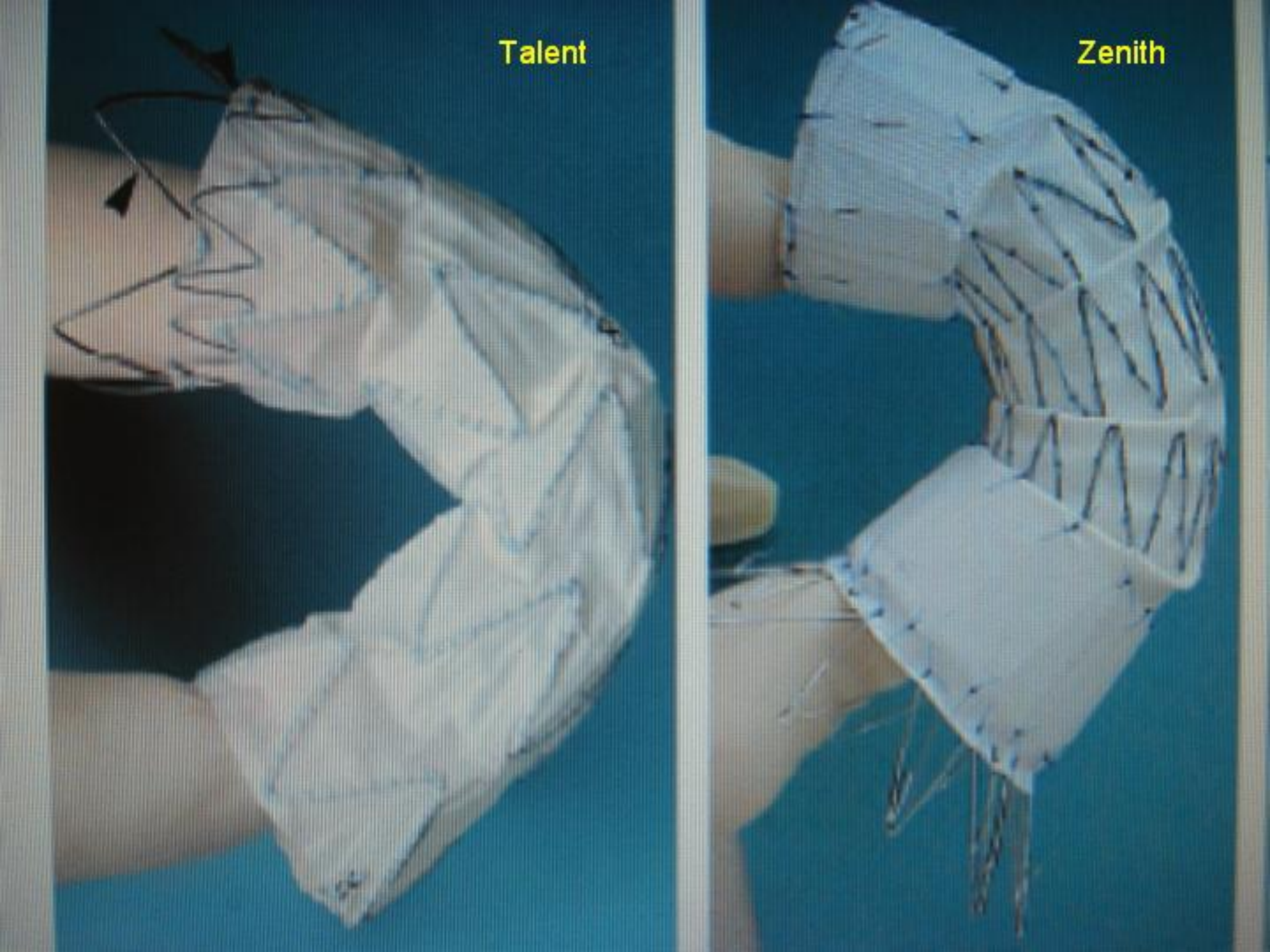
Thoracic aortic stents

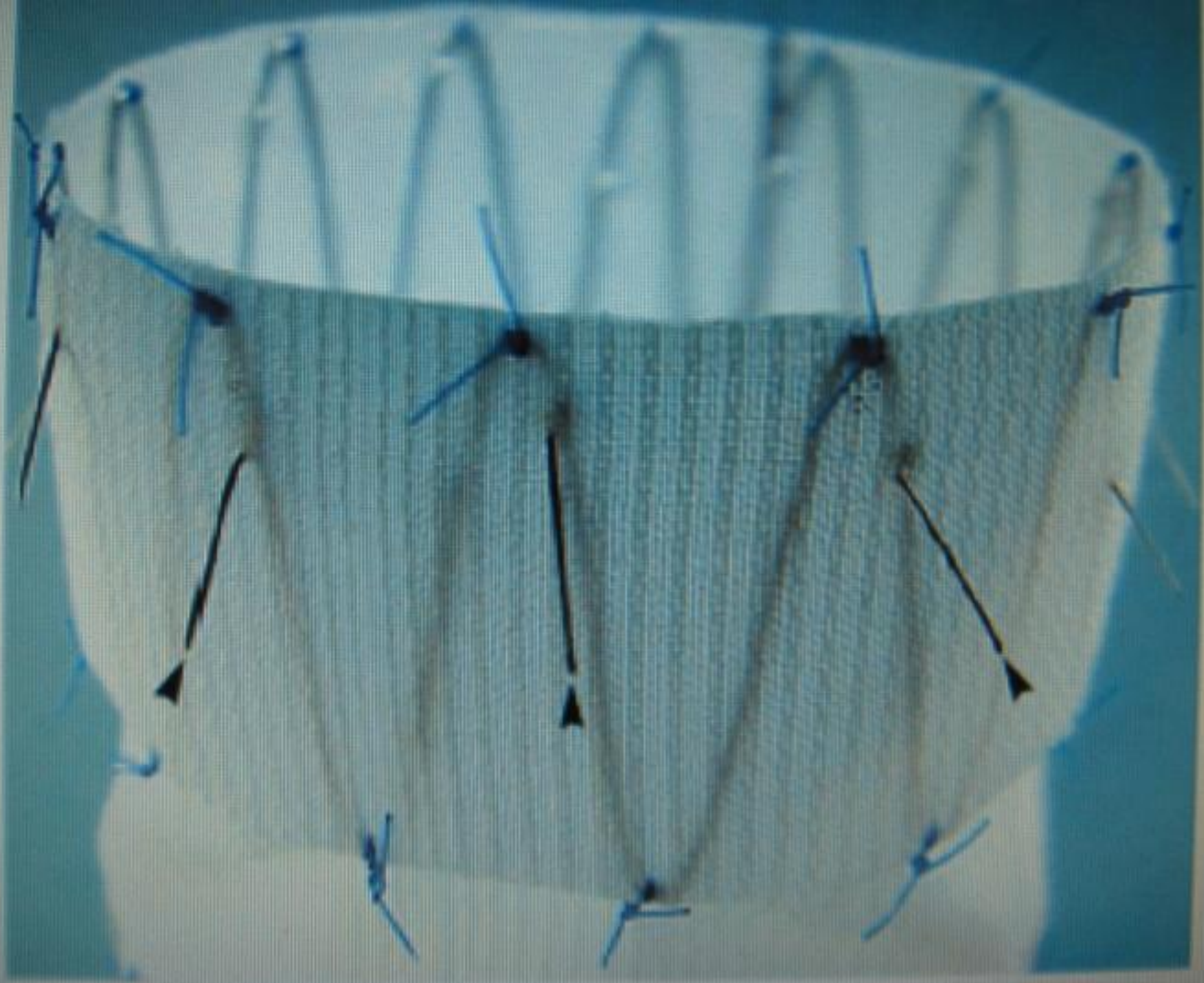
- Avoid the morbidity of open repair, bypass, heparinisation and one-lung anaesthesia
- Good for pseudo-aneurysms and A-V fistulas, and useful in high-risk multi-trauma or co-morbid patients.
- Multiple small series have shown impressive results
- Commercial stents are now available

Successful stenting requires

- Adequate vascular access via iliac artery and aorta
- Minimal aortic tortuosity
- lesion >15 cm above celiac artery and >5mm from left subclavian artery

Therasse et al. Radiographics 2005;25:157-173


Talent
Zenith



Complications

(9 stent studies 1996-2003)

Dunham et al. J Trauma 2004;56(6):1173-78

	Stent	Open
Technical success	98.5%	75-95%
Overall mortality	5.9%	5-28%
Paraplegia	0%	9-26%
Endoleaks	7.4%	
Graft-related death rate	1.5%	

But….

- Graft durability is unknown over a lifetime of dynamic motion in a thoracic aorta.
- Grafts can migrate.
- 5-20% endoleak rate in proximal lesions.
- Long term effects of covering subclavian origin and vertebral are unknown.
- No large trials have been done validating the technique. (The current AAST Multicentre Trial may solve this.)

Carotid stenting is controversial

Coldwell et al. *J Trauma. 2000 Mar;48(3):470-2*

- 27 pts with extracranial ICA injury
- 0% stroke rate at 2.5 yrs

Clothren et al. *Arch Surg. 2005 May;140(5):480-5*

- 46 pts with extracranial ICA injury
- 23 pts got stents for pseudoaneurysms **after 7-10 days of anticoagulation**
- 45% reocclusion rate
- 10% stroke rate

Joo et al. *J Trauma 2005 June; 58(6):1159*

- 6 pts stented for intra- and extra-cranial ICA injuries
- no vascular or neurologic complications at 20 months

Cohen et al. *Stroke. April 2005;36(4):45-7*

- 10 pts stented ICA injury and high stroke risk (cerebral hypoperfusion or failed anticoagulation)
- mean dissection stenosis 69% -> 8%
- no neurologic complications at 16 months

ICA Injury

Penetrating

Operate if hard signs present, or injury is accessible

Blunt

Standard treatment is anticoagulation

Other options..

(a) Accessible to surgeon (below C2):

Operative repair or temporary balloon occlusion then repair.

(b) Inaccessible:

Embolisation, stenting or combinations.

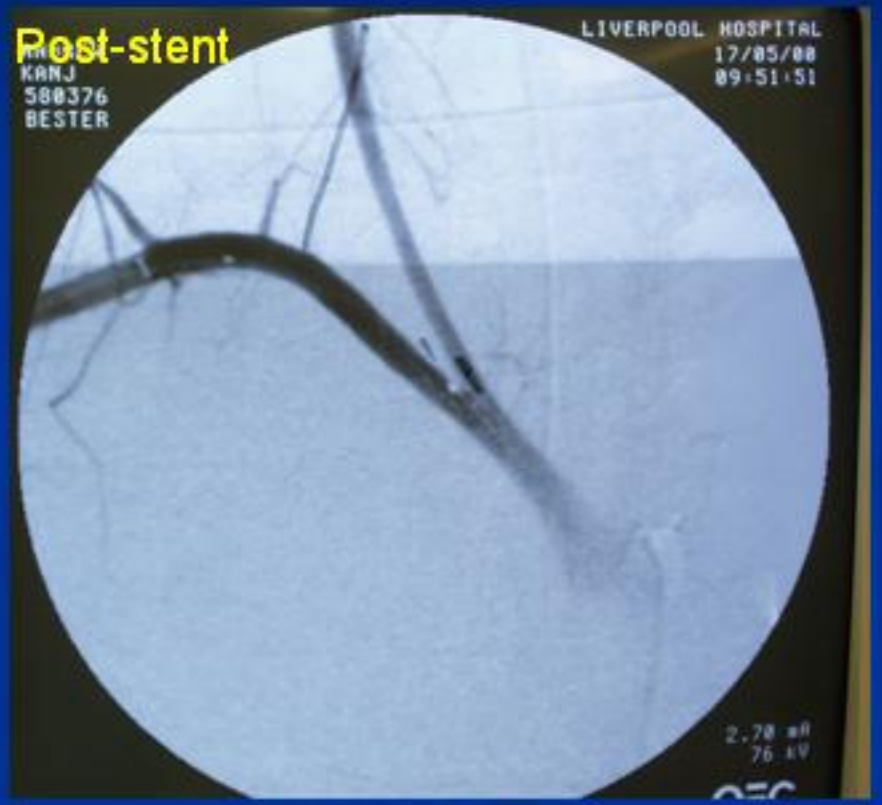
Today

- Vascular stenting
  - Thoracic aorta
  - Carotids
  - Subclavian arteries
  - The rest
- Non-vascular stenting
- The Future

Carotid Stenting Summary

- Indications for carotid stenting in trauma are unclear
- Useful in inaccessible lesions, esp at the skull base
- Medium term results encouraging but no long term outcome studies to date

Subclavian artery stent




Viabahn

A wave of vascular stents

- Axillary artery

  Papaconstantinou et al. J Trauma 2004;57:180-83
- Axillary vein

  Kumar J. Vasc Surg Dec 2004;40(6):1243-4
- Subclavian artery

  Xenos et al. J Vasc SurgSep 2003 38(3):451-4
- Subclavian vein

  Jeroukhimov et al. J Trauma 2004;57:1329-30
- Renal artery

  Inoue et al. J Urol. 2004; 171:347-8
- IVC

  De Naeyer et al. J Vasc surg 2005 Mar;41(3):552-4

More vascular stents

- Cervicothoracic arteriovenous fistulas
  DuTiot et al. BJS. Dec 2003 90(12):1516-21
- Brachial artery
  Maynar et al. J Trauma 2004; 56:1336-41
- Iliac Arteries
  Shah et al. J Trauma 2003;55:383-5
- Bilateral iliac occlusion
  Sternbergh et al. J Vasc Surg. Sept 2003;38(3):589-92
- Iliac veins
  Kataoka et al. J Trauma 2005 Apr; 58(4):704-8
- SMA
  Appel et al. J Vasc Intervent. Radiol. 2003;14:917-22

Non-vascular stenting

- Ureters
  - Commonly used. Mandatory adjunct to operative and non-operative treatment
- Pancreas
  - Early open surgery is standard.
  - Stents useful for fistulas. Beware late strictures.
  - Emerging primary role in children

    Canty et al J Trauma 2001;50:1001-7
- Biliary
  - Surgery standard if extrahepatic
  - Stents useful if intrahepatic

    Nathan et al. Surg Laparosc Percut Tech Oct 2003;13(5):350-2

    D'amours et al. J Trauma 2001;51:159-61
- Larynx
  - Soft, sutured stents for comminuted fractures and mucosal damage. Remove 2-3/52

    Hwang SY et al. J Laryngol Otol. 2004 May;118(5):325-8.
- Bronchus
  - Early surgery is best. Consider stents for delayed diagnoses.

    Sim et al. Sing Med J 1999; 40(6)

The Future

- Exciting and expanding field
- Improvement in techniques, imaging and stent technology and delivery systems
- Success requires combined skills of surgeons and interventionists
- New systems and protocols will develop as the data matures

The Last Word

"The long-term consequences of endovascular stents in trauma are not yet defined"


Thankyou

Progress

- First proposed by Dotter in 1969
- Reported in humans in 1983
- To date..
  - Most vital vessels have been stented
  - Covered stents developed
  - Open arteriotomy or percutaneous routes
- Technical skills, stent technology and delivery systems continue to evolve

Aims of Vascular stenting

- Occlude injury to walls of vital arteries without compromising flow
- Exclude pseudo-aneurysms or fistulas
- Prevent backflow of embolic materials into vital arteries after branch embolisation

Advantages

- Endovascular approach is from a distant non-injured site
- Avoids morbidity from surgical access and difficult surgical dissection and repair in injured tissue
- Most beneficial in the critically ill where anaesthesia or vascular reconstruction may be hazardous
- Useful for delayed diagnosis or rupture if surgical access is limited (hostile abdomen)

Advances

- Reduced patient transport, time to repair, and time to haemostasis.
- Effective and minimally invasive.
- Commercial stents replace 'homemade" ones.
- Young trauma victims have good vessels
- We are getting better at it.

Short term outcomes are promising

Arterial stenting - multiple series
axillary/subclavian/aorta/iliac/femoral

[Rich NM et al. Vascular Trauma 2nd ed 2004]

- Technical success 94-100%
- Complication rate 0-7%
- Primary patency 85-100%
- Mean follow-up 10-18 months

But….

- Operator dependent and resource intensive
- Rare complications include rupture, dissection, immediate or late occlusion
- Lack of long term follow-up
- Still need to operate if unstable, multi-traumatised, or wounds contaminated.