Stenting in Trauma

Injury 2005
Grant Christey
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
- 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

Complications
(9 stent studies 1996-2003)
Dunham et al. J Trauma 2004;56(6):1173-78

<table>
<thead>
<tr>
<th>Complication</th>
<th>Stent</th>
<th>Open</th>
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<tbody>
<tr>
<td>Technical success</td>
<td>98.5%</td>
<td>75-95%</td>
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<tr>
<td>Overall mortality</td>
<td>5.9%</td>
<td>5-28%</td>
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<tr>
<td>Paraplegia</td>
<td>0%</td>
<td>9-26%</td>
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<tr>
<td>Endoleaks</td>
<td>7.4%</td>
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<tr>
<td>Graft-related death rate</td>
<td>1.5%</td>
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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

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

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

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

- 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:
Emboliisation, 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

Pre-stent

Post-stent
A wave of vascular stents

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

- **Axillary vein**

- **Subclavian artery**

- **Subclavian vein**

- **Renal artery**

- **IVC**
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

- Bilateral iliac occlusion

- Iliac veins

- SMA
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
    - D'amours et al. J Trauma 2001; 51: 159-61

- Larynx
  - Soft, sutured stents for comminuted fractures and mucosal damage.
    - Remove 2-3/52

- 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”
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.