The Challenge of Complicated Acute Aortic Dissections

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Background

- Incidence of type B dissection
  - 2-3.5 cases/100,000 person-years
  - 9000 new cases reported in US each year
  - Approx 1/3 are complicated at initial presentation
- Risk factors: older age, hypertension, structural abnormalities in aortic wall, cocaine abuse

Treatment Challenges

- Early
  - Rupture, malperfusion
  - Unremitting pain, refractory hypertension, early expansion
- Late
  - Persistent false lumen perfusion and aneurysmal expansion

Disclosures

- Research support and royalties from Cook, Inc.
Malperfusion Syndromes

- Associated with early mortality
- Occurs when there is end organ ischemia secondary to aortic branch compromise from dissection
- Can involve one or more vascular beds simultaneously
- Early symptoms can be subtle

Malperfusion Syndrome: Dynamic vs Static Obstruction

- Dynamic obstruction
  - Secondary to motion of intimal flap within aortic lumen, which may obstruct orifice of branch vessel to a vital organ
  - Compressed true lumen unable to provide adequate volume flow, or
  - Dissection flap may prolapse into vessel ostium, which remains anatomically intact
  - Responsible (at least in part) for approx 80% of malperfusion cases
  - Malperfusion may vary depending on changes in blood pressure and hemodynamic forces

- Static obstruction
  - Dissecting process extends into branch vessel, causing narrowing
  - Unlikely to resolve with restoration of aortic true lumen flow alone
  - Intervention to vessel typically required
Static Obstruction

Malperfusion Syndrome

- Pure dynamic obstruction of visceral vessels
  - Would be expected to respond to exclusion of entry tear or aortic fenestration
- Static obstruction of visceral vessels
  - Needs to be re-assessed after stent-graft placement/fenestration
  - May require branch vessel stenting

Treatment Strategy

- Stent-graft repair
  - Advantages: restore true lumen flow; prevent late aneurysm formation; favorable aortic remodeling with lower risk of aortic rupture
  - Disadvantages: paraplegia; retrograde dissection
- Fenestration
  - Advantages: restore true lumen flow; minimal risk of paraplegia
  - Disadvantages: promotes blood flow through false lumen, potentially leading to progressive dilation/aneurysmal degeneration

Malperfusion: Goals of Treatment

- Focus on most minimal/expedient intervention to restore perfusion as soon as possible
- Primary goal: Expansion of true lumen with restoration of flow to visceral vessels/lower extremity
  - Stent-graft repair with coverage of proximal entry tear
  - Fenestration (convert complicated into uncomplicated dissection)
- Secondary goal: obliteration of false lumen flow with subsequent complete thrombosis
Treatment: Stent-Graft Repair

- Goal: seal thoracic tears and close communication points
- Pre-operative imaging study
  - CT angiography
  - Assess vertebral circulation
- Angiography/IVUS
  - Verify preoperative anatomy
  - Verify true lumen passage of guidewire
  - Avoid inadvertent deployment in false lumen
- Consider transesophageal echo

Intravascular Ultrasound

Sfyroeras GS, et al; JEVT 2011

Angiography

- Long sheath inserted into aortic arch
- Angiography at different levels to verify true lumen position
- "Viscera on a stick"

Subsequent angiography at different levels
**Treatment: Stent-graft repair**

- Minimize aortic coverage (<20 cm) to reduce risk of spinal ischemia
- Coverage of left subclavian artery (approximately 50% of the time)
- Re-assess distal perfusion after deployment of stent-graft
- May still have inadequate true lumen flow
  - Consider placement of uncovered distal stent: support true lumen and stabilize dissection flap
  - Largest wallstent 24 mm
- Additional stent placement for visceral branch vessel obstruction

**Considerations: Stent-graft Repair**

- Avoid aggressive oversizing
- Avoid ballooning of seal zones
- Young patient with tight aortic arch, narrow aortic diameter
- ? Uncovered stent over entry tear
- ? Proximal barbs
GORE TAG Device

Conformable TAG Device

Zenith TX2 ProForm
- Better apposition to inner curve

Medtronic Talent Device
Petticoat

- Provisional extension to induce complete attachment after stent-graft placement in type B aortic dissection
- Obliterate sustained abdominal false lumen flow and pressurization

Even after successful thoracic stent-graft placement, unresolved problem is fate of distal abdominal segment
- In presence of larger distal reentry points, thoracoabdominal segment of false lumen has tendency not to thrombose and remodel completely
  - setting stage for late complications
- Placement of bare stent scaffold extension into implanted stent-graft
  - Abolish distal true lumen collapse
  - Enhance remodeling process of entire dissected aorta by fixation of distal lamella

Treatment: Fenestration

- Relieve dynamic obstruction by creating flap fenestration to generate large reentry tear
- Flow ensured within false lumen, precluding thrombosis
- Branch vessel compromise (malperfusion) is treated, but not the aorta
- If static obstruction exists, perform branch vessel stent placement

Fenestration: Technique

- Smaller (true) to larger (false) lumen
- Rosch-Uchida needle, Colopinto needle, or back end of 0.014 wire to create fenestration close to compromised aortic branch
- After needle and stiff wire advanced from true to false lumen, catheter advanced and confirmation by angiography
- Large angioplasty balloon used to create fenestration tear
Fenestration: Re-entry Catheter

- Membrane puncture with needle-based re-entry catheter through transfemoral approach
- Guidewire passed through re-entry catheter and across membrane
- Guidewire snared through contralateral transfemoral access (through and through wire access)
- Cheese-wire maneuver
- Portions of fenestrated membrane can occlude iliac artery – be prepared to stent

Kos S et al; Cardiovasc Intervent Radiol 2010
Outcomes: Stent-Graft Repair

- Arizona Heart 10 year experience:
  - 85 patients with acute type B dissection, 23 with malperfusion
  - All patients had stent-graft coverage of proximal entry tear
  - Successful correction of malperfusion in 21 (91%) patients
  - 30 day mortality 9% (2/23); postoperative stroke 17% (4/23); paraplegia 9% (2/23)

Sfyroeras GS et al; JEVT 2011

University of Florida, Gainesville:

- 33 acute, complicated type B dissections from 2005-2007
- All patients underwent repair using TAG device
  - Malperfusion in 11 (33%) patients, 8 of whom required branch vessel stenting
  - 30 day mortality 21% (7/33); paraplegia 15% (5/33), stroke 12% (4/33)
  - 76% (25/33) experienced some type of major complication

Feezor RJ et al; JVS 2009

Multidisciplinary subcommittee of the SVS Outcomes Committee

- Clinical data from 5 physician-sponsored IDE clinical trials between 2000-2008
- Establish performance benchmark for future single-armed trials
- 85 patients with acute, complicated type B dissection (32% rupture, 72% malperfusion)
- 30 day mortality (10.6%); stroke (9.4%); renal failure (9.4%); paralysis (9.4%)

White RA et al; JVS 2011

University of Michigan experience

- 69 patients with acute type B dissection & malperfusion from 1997-2008
- All treated with flap fenestration, true lumen, or branch vessel stenting
- 30 day mortality 17.4% (12/69); renal failure 15.9% (11/69); stroke 4.3% (3/69); paralysis 2.9% (2/69)
- Freedom from aortic rupture or open repair at 1.5,8 years was 80.2%,67.7%, and 54.2%

Patel HJ et al; J Thorac Cardiovasc Surg 2009
Stent-graft or Fenestration?

- Endograft therapy first line of treatment
  - Aims to restore native aortic anatomy by closure of primary tear

- Percutaneous fenestration
  - Aims to increase true lumen perfusion by equalizing pressures in true/false lumens
  - Does not address underlying abnormality of dissection itself
  - Limit to patients who lack suitable proximal landing zone or complex multilumen dissections not easily corrected by closure of primary tear

How Much to Stent?

- Coverage of primary entry tear only
  - May have continued false lumen perfusion
  - Lower risk of paraplegia

- Coverage of entire thoracic aorta
  - Treats primary entry tear as well as distal reentry sites
  - Reduced potential for continued false lumen perfusion
  - Higher risk of paraplegia
  - Need carotid subclavian bypass, spinal drain

Spinal Drain?

- Extensive aortic coverage with coverage of left subclavian
  - >15-20 cm thoracic aortic coverage
  - Coverage of last 5 cm of distal thoracic aorta

- Paraplegia not as well correlated with length of prosthesis as in aneurysm repair
  - Persistent false lumen perfusion

- If choose not to place pre-operatively, be ready for prompt placement of spinal drain

Carotid Subclavian Bypass?

- Dominant left vertebral artery
- Left internal mammary to LAD bypass graft
- Extensive aortic coverage