Endovascular Options for Complex Aortic Pathology

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Disclosures

- No financial disclosures
- Presentation will discuss off label uses of FDA approved devices.

Objectives

- Approaches to treatment
  - Ascending aorta and Arch aneurysms
  - Acute Type B Aortic dissections
  - Juxtarenal aortic aneurysms
  - Thoracoabdominal aortic aneurysms

Ascending Aorta and Arch Pathology

- Zones of the Arch
  - Complexity increases more proximally
    - Branch vessels
    - Inner curve of arch
    - Hemodynamic forces

Ascending Aorta and Arch Pathology

- Endovascular repair is all about...
  - Creating a proximal landing zone
  - Maintain perfusion of supraaortic vessels

Preoperative suggestions

- Preop CTA Head to groin
  - Know status of cervical carotids and intracerebral circulation
  - Know status of vertebrals.
    - 15% end in PICA
    - Vertebrals off arch?
    - Is there a critical left vertebral?
    - Is there an absent right vertebral?
    - Is there a LIMA graft?
Preoperative suggestions

- For fusiform aneurysms ensure creation of proximal landing zone at least 2cm on inner curve
  - Inner curve is the achilles heel
- Assess quality of landing zone

- Decide on type of extranatomic bypass
  - Zone 0 will require a median sternotomy
  - Zone 1: right to left carotid-carotid bypass with left carotid subclavian bypass
  - Zone 2: +/- left subclavian revascularization

Zone 0 Intraoperative suggestions

- Side biting clamp
- Sew as far proximal as possible
- Lateral placement of proximal anastomosis
- Preserve stent graft landing zone
- Place a radioopaque marker at distal end proximal anastomosis
- 12mmx6mm bifurcated graft
- Avoid “kinking” with closure of sternotomy

Endovascular Technical Tips to the Ascending Aorta and Arch

- Perform debranching and stent graft placement in one stage
- Lower MAP / adenosine / rapid V pacing
- IVUS to assist in placement

More complex configurations

Endovascular Technical tips to the Ascending Aorta and Arch

- Ensure proximal neck is as long as possible and proximal stent graft parallel to axis of blood flow
- Retrograde vs antegrade deployment in ascending aorta
  - Antegrade: less torque, more precision. More bleeding
  - Retrograde: more torque, less precision, most stent grafts designed to deploy
Case

70 yo male with remote history of MVA. Incidental finding on chest ct for chest pain.

Preop

Post deployment

Predeployment

Postoperative scans

Lack of Apposition to inner curve of arch
Postoperative scans

Double barrel technique

- Preserve aortic arch branches
- Avoid the need for sternotomy
- Advantageous in hostile mediastinum or prior sternotomy
- Coaxially aligned stents (Branch vessel and thoracic aorta)
- MUST have some amount of aortic neck distal to double barrel area to prevent endoleak

Double Barrel technique

- Branch vessel stent or stent graft must be reinforced with a wallstent to provide more radial force and reduce compression risk from thoracic stent graft

Future Technology: Branched Endografts
Acute Type B Aortic Dissections

- Endovascular approaches
  - Fenestration – equalize true and false lumen pressures
  - Stent graft – obliterate false lumen
  - Dynamic and static compression

Endovascular Aortic Fenestration

- Why not just stent branch occlusion?
  - Dynamic and static compression
- Why not use stent graft?
  - Aortic diameter too large
  - Tear close to a branch vessel
  - Inadequate seal
  - Not always readily available.
- Indications:
  - End organ ischemia

Case

50 yo male presents with chest pain, left leg ischemia, and acute renal insufficiency

Preop visceral

Preop renals

Preop iliacs
Equipment

- CTA
- IVUS
- Balloons
- Stents
- Snares
- Reentry needles

Intraop
Technical aspects of endovascular fenestration

- Preop imaging essential:
  - CTA
    - extent of dissection
    - branch vessel obstruction
    - relation of branches to dissection
Technical aspects of endovascular fenestration

- IVUS is a necessity
- Bilateral femoral access
- Ideally know where true and false lumen off iliac
- IVUS interrogation of entire aorta
- Aortogram limited to areas needing intervention

- Pressure measurements in true and false lumen
- Plan fenestration before stenting branch vessel compromised

Technical aspects of endovascular fenestration

- Needles for fenestration
  - Colapinto needle (9F guide, 16 gauge needle)
  - Rosch-Uchida needle (10F guide, 14 gauge needle)
  - CTO reentry devices (6F, outback and pioneer)

Technical aspects of endovascular fenestration

- How to fenestrate?
  - Introducer advanced over stiff guide wire
  - Advance needle above puncture area
  - Advance ivus to puncture level in the infrarenal aorta
  - Chose aortic diameter large enough

Technical aspects of endovascular fenestration

- Advance needle stylet and puncture across flap
- Remove stylet and advance wire across fenestration

Technical aspects of endovascular fenestration

- Remove needle and exchange for a catheter to confirm placement and then balloon
- Check pressures and upsize balloon if continued gradient
- Balloon max is 20mm diameter
- If still persistent gradient then perform second fenestration
Technical aspects of endovascular fenestration

• Repeat angio to check branches
  • may need to stent branches or aorta/iliacs
  • Stent through the true lumen
  • Favor self expanding stents
• Poor man ivus: balloon in false lumen as target
• Technical success 90%
• Largest series 100 cases with 0% in hospital mortality

Stent graft repair of Acute Type B Aortic Dissection

• Close entry site and decompress false lumen
• Thrombosis of false lumen with aortic remodeling
• Prevent further extension

Stanford Type B Dissection Classifications

Acute
Subject diagnosed within 14 days of symptom onset
  • Dissection flap is flexible (not fibrosed) and will remodel with stent graft therapy

Chronic
Subject diagnosed beyond 14 days of symptom onset
  • Dissection flap may not be flexible (fibrosed) resulting in a less predictable response to stent graft therapy

Management of Type B Dissection

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<th>Acute (&lt;14d)</th>
<th>Chronic (&gt;14d)</th>
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<tr>
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<td>Medical therapy + Stent Graft or Open Surgery</td>
<td>Medical therapy + Stent Graft or Open Surgery</td>
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<td>Uncomplicated</td>
<td>Medical therapy +/- Stent Graft</td>
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Dissection Endovascular Treatment Strategy

Goal of therapy is to depressurize the false lumen by sealing the proximal entry tear(s) with the stent graft.
  • Promotes thrombosis of the false lumen
    • Thrombosis prevents aneurysmal formation and decreases risk of aortic rupture
  • Promotes remodeling of the entire aorta.
    • Decreases the total aortic diameter
    • May result in re-establishment of side-branch flow

Endovascular Treatment of Type B Dissection
Endovascular Treatment of Type B Dissection

Anatomic criteria
- Preop imaging essential:
  - CTA
  - extent of dissection
  - branch vessel obstruction
  - relation of branches to dissection
  - Need for subclavian revascularization
- IVUS is a necessity.
  - Interrogate entire aorta
  - Ensure you are in true lumen at all times

Technical tips
- Minimal oversizing of stent graft
- Only need about 10cm length.
  - Goal is to cover entry tear only
- Minimal to NO postdeployment ballooning
- Remember to reimage paravisceral aorta after stent graft placement
  - Stent if needed
Future directions

- Current devices not ideal for dissections
  - too large
  - designed for aneurysm repair
- Petticoat concept

INSTEAD trial

- Elective stent graft in uncomplicated stable type B dissections
- 140 patients >2 weeks after dissections
- Randomized to medical therapy vs TEVAR + medical therapy
- Primary endpoint all cause death @ 2 years

INSTEAD trial

- Tevar fail improve 2 year survival and adverse events despite favorable aortic remodeling (future aneurysm formation)
- Trial underpowered
- Aortic remodeling occurred in 91% with stent graft and 19% with medical therapy
- Aortic expansion more frequent with medical therapy

Juxtarenal Aortic aneurysms

- Snorkel procedure
  - Method to increase proximal fixation length
  - Can perform with current available devices
- Fenestrated devices
  - Custom device for true juxtarenal aneurysms

Snorkel procedure

- 75 yo male s/p EVAR for infrarenal AAA,
- Prior right nephrectomy
- Type Ia endoleak
Snorkel procedure technical tips

- Ideal for juxtarenal aneurysms with short necks
- Must have normal neck above and below both renal arteries
- Attempt only on one renal artery
  - one renal should be lower than the other
- Two operator technique for simultaneous deployment and balloon angioplasty

Fenestrated devices

- Currently in trials
- Aneurysm with short proximal neck
- Custom made
- Excellent preop imaging needed
- 3 pieces
  - Fenestrated segment
  - Bifurcated segment
  - Iliac segment
Fenestrated devices

- Fenestrated stent graft partially constrained and deployed.
- Branches selected out
- Unconstrain fenestrated stent graft
- Deploy renal stents
- Formal Evar deployment
- Branch vessel patency 90% @ 2 years

Thoracoabdominal Aortic aneurysms

- Visceral debranching
- Branched endograft

Visceral debranching case

60 yo female ESRD, left AKA, type IV thoracoabdominal aortic aneurysm
Branched endograft

- Custom made based on patient anatomy
- Not currently in multiinstitutional trials
- Axially placed cuffs in the paravisceral aortic stent graft which are bridged with separate stent grafts
  - Requires femoral and brachial access
- Evidence that this could be an "off the shelf" device
  - Requires less precision than fenestrated devices

Branched endograft deployment

Conclusions

- Reasonable endovascular options currently exist for complex aortic pathology utilizing currently available technology
- Short term results appear adequate
- Long term durability is unknown
- Future device development will address some of the difficulties and limitations of currently available devices
- Eventually, the entire aorta will be able to be addressed in a complete endovascular fashion
References