Imaging of Thoracic Endovascular Stent-Grafts

Tariq Hameed, M.D.
Department of Radiology and Imaging Sciences, Indiana University School of Medicine, Indianapolis, Indiana
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Off label use:
Thoracic aortic Stent-Grafts

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Imaging of Thoracic Endovascular Stent-Grafts

• Objectives
  – Background
  – Computed Tomography (CT) imaging technique
  – Evaluation before Thoracic Endovascular Aortic Repair (TEVAR)
  – Normal CT appearance of TEVAR
  – Imaging findings of complications of TEVAR
Open Surgical Repair for Aortic Pathology

• High morbidity and high mortality rates
  – Complicated by
    • Severity of underlying condition
    • Advanced age
    • Cardiovascular disease
Thoracic Endovascular Stent-Graft Repair (TEVAR)

• An alternative to open surgical management
  – In patients with suitable anatomy of thoracic aorta
Endovascular Stent-Grafts

• 1992  First Used
Thoracic Endovascular Stent-Grafts

• FDA Approval
  – 2005
    ▪ For atherosclerotic aneurysms of descending thoracic aorta

• Four devices are currently FDA approved
Endovascular versus Surgical Repair of Aorta


42 non randomized studies
5888 patients
Endovascular versus Surgical Repair of Aorta. Clinical Outcomes

Endovascular Repair

- Stroke: Overall risk: Similar (reduced in multicenter trials)
- Paraplegia and paraparesis: Decreased
- Intensive care length of stay: Reduced (by 4 days)
- Hospital length of stay: Reduced significantly
- Operative death and 30 day all cause mortality: Reduced

## Endovascular versus Surgical Repair of Aorta. Clinical Outcomes

### Endovascular Repair
- **Stroke: Overall risk**
  - Similar (reduced in multicenter trials)
- **Paraplegia and paraparesis**
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- **Intensive care length of stay**
  - Reduced (by 4 days)
- **Hospital length of stay**
  - Reduced significantly
- **Operative death and 30 day all cause mortality**
  - Reduced
- **Cumulative all cause mortality at 1 and 2-3 years**
  - Similar

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Role of Imaging

• Pre Stent Graft
  – Anatomical screening

• Post Stent Graft
  – Monitoring and detection of complications
Imaging of Aorta for TEVAR

- Computed Tomography (CT)
  - Imaging modality of choice

- Magnetic Resonance Imaging (MRI)
  - In patients with contraindication to the use of iodinated contrast

- Catheter Angiography
  - During the placement of stent-graft
Imaging evaluation before TEVAR

- Delineate Extent of the disease
- Assessment for feasibility of stent-graft
  - Thoracic aorta for stent-graft size and placement
  - Access vessels for introduction of device
CT Angiography of Aorta (CTA)

- **Coverage**
  - Thoracic inlet to common femoral arteries
    - Slice thickness 0.9 mm
    - Increment 0.45 mm

- **Contrast**
  - 100 – 120 ml 370 mg I/dl
  - 4 ml/sec

- **Bolus Triggering**
  - 120 HU at the level of Proximal descending aorta
CT Angiography of Aorta (CTA)

ECG Gated Imaging
  Prospective
  Retrospective gating with Tube current modulation
Prospective ECG gated imaging
Follow up thoracic aortic stent-graft

FOV = 500 mm
Step length = 45 mm
Scan time = 18 sec
Patients with Renal Insufficiency

• CT Angiography
  – with small contrast dose (less than 35 ml) with 80 kVp technique.
Low contrast Dose CT in patients with Renal Insufficiency using Timing Runs and 80 KVp

30 ml Iodinated contrast 370 mg/dl
Post Processing

• MPR
  – Axial 2 mm@2 mm
  – Sagittal 2 mm@2 mm
  – Coronal 2 mm@2 mm
  – Oblique Sagittal ‘Candy cane’ 2 mm@2 mm
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  – Axial 2 mm@2 mm
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• MIP
  – Coronal MIP 10 mm @ 1 mm and/or 40mm @ 1 mm
  – Sagittal MIP 10 mm @ 1 mm and/or 40 mm @ 1 mm
Maximum Intensity Projection
40 mm thick slab Images
Post Processing

- **MPR**
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- **MIP**
  - Coronal slab MIP 10 mm @ 1 mm and/or 40mm @ 1 mm
  - Sagittal slab MIP 10 mm @ 1 mm and/or 40 mm @ 1 mm

- **Centerline reconstruction through the aorta for true axial measurements**
  - Pre endograft workup
  - Complex post endograft cases
Centerline Reconstruction for Aortic Diameter
Post Processing

• MPR
  – Axial 2 mm@2 mm
  – Sagittal 2 mm@2 mm
  – Coronal 2 mm@2 mm
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• MIP
  – Coronal slab MIP 10 mm @ 1 mm and/or 40mm @ 1 mm
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• Centerline reconstruction through the aorta for true axial measurements
  – Pre endograft workup
  – Complex post endograft cases

• 3D Volume rendering
3 D Volume Rendering
Evaluation of Aorta for Endovascular Repair
Stent-Graft Length of Landing Zone

>15 – 22 mm

>15 – 22 mm
Landing Zone Aortic Diameter

18 – 42 mm

18 – 42 mm
Aortic Arch Debranching

Surgical and endovascular repair
Stent-Graft Diameter for Fusiform Aneurysm
Stent-Graft Diameter for Aortic Dissection
Stent-Graft Diameter for Aortic Trauma
Pre Stent-Graft Evaluation

Special Consideration

• Young Patients
  – Small aortic diameter
    • Potential for under-sizing and stent graft collapse or stress on aortic wall
  – Small Aortic arch curvature
    • Potential for Bird beak configuration
  – Long term follow up
    • Enlargement of aorta and potential for stent graft migration
Pre Stent- Graft CT Evaluation

- **Access vessels** (Common femoral artery, iliac arteries, aorta)
  - Size
    - Variable with device type
    - > 8 mm
  - Tortuosity
Access vessels modified by synthetic conduits
Evaluation of Aorta after TEVAR
Always “Pre- and post” contrast media for endovascular stent-graft follow-up.
CTA Aorta

- Delayed Images (for detection of endoleak)
  60 – 90 sec
Post Stent Graft Evaluation

• 1 Month
• 3 Month
• 6 Month
• 12 Month
• Annual
Aortic Pathology

- Aneurysm
- Dissection
- Intramural hematoma
- Penetrating aortic ulcer
- Acute traumatic aortic injury
- Aortic rupture
67-year-old male with 5.8 cm Fusiform Descending Aortic Aneurysm
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Endograft repair of descending thoracic fusiform aortic aneurysm.
Saccular Aneurysm

Pre Stent- Graft

Post Stent- Graft
Aortic Aneurysm

Pre Stent- Graft
Surgical Graft in Descending Aorta with a Pseudoaneurysm

71-year-old male with hemoptysis
Surgical Graft in Descending Aorta with a Pseudoaneurysm

Pre Stent- Graft  

Post Stent- Graft
Aortic Dissection
Pre Stent-Graft
Stent-Graft Repair for Aortic Dissection
Acute Traumatic Aortic Injury

Pre Stent- Graft

Post Stent- Graft
Aortic Rupture

Pre Stent- Graft

Post Stent- Graft
Combined Surgical and Endovascular Repair
Hybrid Surgical and Endovascular Repair
For Ascending and Descending Aortic Pathology
Hybrid Surgical and Endovascular repair

Elephant Trunk Technique
Stage 1
Hybrid Surgical and Endovascular repair

Elephant Trunk Technique
Stage 2
Hybrid Surgical and Endovascular repair
Imaging of Complications of TEVAR

• Potential Vascular Complications
  – Complication of Placement
  – Vascular access
• Endoleak
• Device Migration
  – Proximal Migration of distal end
  – Distal migration
• Endovascular Stent Graft Failure
  – Collapse
  – Kink or narrowing
Complications of TEVAR

Endoleak

Persistence of blood flow within the aneurysm sac surrounding the stent-graft.
Endoleak Types
Endoleak Types
Endoleak Type I
Endoleak Type II
Endoleak Type II in Aortic Dissection
Value of Delayed Images
Endoleak Type II in Aortic Dissection
Value of Delayed Images
Endoleak in Aortic Dissection
Value of Delayed Images
Collapse of Stent-Graft
Summary

• Thoracic endovascular aortic repair is utilized as an alternative to open surgical repair.
• CT imaging is the modality of choice for evaluation of patients before and after endovascular repair.
THANK YOU