Endovascular Repair of Abdominal Aortic Aneurysms: Preoperative Evaluation

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Our Patient

- 74 yr old female with known AAA since 1992.
- Most recent US showed AAA with diameter of 4.8 cm.
- Referred from OSH to evaluate for possible endovascular repair of AAA.

Pertinent history include:
- Type II DM
- HTN
- S/P LCEA
- FHx of MI
- Smoker
Definition

- Diameter exceeding the expected normal caliber by at least 50%.
- Normal diameter of abdominal aorta = 2.0 cm (1.4-3.0 cm).
- Abdominal aorta is the most common site of arterial aneurysm.
- 95% of AAA are infrarenal.
Epidemiology

- Incidence of ~36 per 100,000.
- Up to 9% of persons > 65 yo.
- Natural history of AAA is progressive expansion and eventual rupture.
- Overall mortality rate after rupture 78-94%.
- Ruptured AAA results in 15,000 deaths per year in the US.
Risk of Rupture

- **Size of the aneurysm**
  - Increased in women, patients with HTN and COPD.

- When to offer AAA repair based on
  1) Rupture risk
     - < 4 cm – follow w/ US q 6 mo
     - 4-5.5 cm – additional info needed
     - > 5.5 cm or expands > 0.5 cm in 6 mo – repair indicated
  2) Life expectancy
  3) Operative Risk

*Hallett J 2000*
Endovascular Surgery

- First introduced by Parodi and associates in 1991.
- Less invasive than open surgery.
  - Shorter hospital stay
  - Shorter ICU stay
  - Less blood loss
  - Earlier return to function
- Technical success of 98-99%.
- 30-day mortality rate (~3%) comparable to open surgery.
Endovascular Surgery (con’t)

AneuRx stent-graft

Ancure endograft

hooks of the proximal attachment system

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Endovascular Surgery (con’t)

(a) 
(b) 
(c) 
(d) 
(e) 

Yusuf 2000
Role of Radiologic Imaging in Endovascular Surgery

- Preoperative evaluation
- Intraoperative imaging
  - Proper endograft placement
  - A road map for orientation during procedure
- Postoperative follow up
  - Immediate post op check
  - At 1, 6, and 12 mo post op, then q 1 yr thereafter
  - Endoleak, graft migration, stenosis, and kinking
Preoperative Evaluation

- Determine the feasibility of an endograft.
  - Anatomy
  - Quality of the vessel wall

- Determine the dimensions of endograft
  - Accurate measurements important to avoid complications (e.g., endoleak, graft migration, graft kinking)
Preoperative Evaluation (con’t)

Proximal neck may be too short.

Distal attachment site may not be suitable.

Yusuf 2000
Preoperative Imaging

- CT with 3-D Reconstruction
- Angiography
- MRA
- IVUS
Spiral CT with 3-D Reconstruction

- Primary imaging modality today to
  - Measure
  - Assess extent and complexity of the aneurysm
  - Assess quality of aorta proximal and distal attachment sites
  - Evaluate occlusive disease
Spiral CT with 3-D Reconstruction (con’t)

- 3D reconstruction allows accurate length and diameter measurements.

slice reformatted perpendicular to the vessel

a conventional axial CT slice

Fillinger 1999
Spiral CT with 3-D Reconstruction (con’t)

- Specialized measurement software allows additional features.

*Fillinger 1999*  
*Yusuf 2000*
Our Patient: CT

CT without contrast  CT with contrast

calcification
Our Patient: CT (con’t)

right renal artery
SMA
left renal artery

at the level of the right renal artery

15mm below the right renal artery

s/p cholecystectomy

BIDMC PACS
Our Patient: CT (con’t)

Maximum diameter = 52 x 54.2 mm

Bifurcation of the aorta
Our Patient: CT
3-D Reconstruction (MIP)

- Maximum intensity projection
- 3-D imaging technique that permits separation of the enhanced lumen from high attenuation structures within the vessel wall
- Can readily detect calcification in the vessel wall
- Poor depiction of vessels that overlap each other
  - Circumvent this problem by generating multiple MIPs that rotate about an imaginary axis
Our Patient: CT
3-D Reconstruction (MIP)

- Poor depiction of vessels that overlap
- Calcifications
Our Patient: CT
3-D Reconstruction (MIP)
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Angiography

- Used as part of preoperative evaluation
- Sensitive for evaluating occlusive disease
- Only the inner lumen is imaged
  - Cannot evaluate the true lumen diameter, extent of thrombus, plaque and calcification
- 2-D projection of a 3-D structure
- Invasive
Angiography (con’t)

• Angiography may underestimate the true diameter of the aneurysm.
Calibrated catheter may underestimate the length of the aneurysm.

*Fillinger 1999*
Our Patient: Angiogram

- Frontal view
- Calibrated catheter
- Lateral view
MRA

- Poorer resolution compared to CT
- Patient discomfort, contraindications
- Cost
- Reserved for patients with severe renal insufficiency

IVUS

- Operator dependent
- Invasive
- Excellent for post op completion studies to evaluate
  - graft approximation
  - graft stenosis
Our Patient: Preoperative Evaluation Summary

- “Fusiform infrarenal abdominal aortic aneurysm with diameter of 52 x 52mm and length of 12.5cm”
- “Moderate calcification of the aorta”
- “Good length of infrarenal abdominal aortic neck”
- “Without evidence of iliac or aortic stenotic disease”

Our patient underwent endovascular repair of AAA…
Our Patient: Endovascular Repair

preoperative angiogram

postoperative angiogram

proximal graft attachment site

distal graft attachment sites
Our Patient: Postoperative CT

- Thrombus within the aneurysm sac
- IV contrast within the endograft

Axial view
Our Patient: Postoperative CT

3D reconstruction

proximal attachment site

thrombus within the aneurysm sac
In Summary

- Radiologic imaging plays an important role in preoperative, intraoperative, and postoperative evaluation for endovascular repair.
- Preoperatively, CT with 3-D reconstruction and angiography are used to
  - assess suitability for endovascular repair and
  - measure endograft dimensions
- Accurate assessment is essential in order to avoid any complications.
References

- www.uptodate.com
- www.yoursurgery.com
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