Overview of Abdominal Aortic Aneurysm

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DEFINITIONS

• Abdominal aortic aneurysm (AAA) definition: abdominal aortic diameter > 3.0cm

• Main risk of aortic aneurysm: rupture

PATHOPHYSIOLOGY & RISK FACTORS

PATHOPHYSIOLOGY

• Normal remodeling requires balance between proteases (that break down tissue) and their inhibitors

• AAA: imbalance between proteases and inhibitors
  • Increase in inflammatory cytokines: IL-1B and TNF-α
  • Cytokines → increase matrix metalloproteinases (MMPs)
  • MMPs take over and destruct collagen and elastin in the ECM → thinning of aortic wall → dilation and aneurysm

• There is a decreased risk of AAA in DM
  • Diabetics have a thicker aorta → decreases wall stress

RISK FACTORS for AAA

- Smoking
- Family history of AAA
- Male sex
- HT N
- Older age
- Other large artery aneurysms (e.g., iliac, femoral, popliteal)
- HT, Atherosclerosis

CLINICAL PRESENTATIONS

• Asymptomatic
  • MOST COMMON
  • Found incidentally on imaging for another cause or preventative maintenance surveillance for smoking history

• Symptomatic
  • Fast expansion → pain
  • Compression/Erosion into surrounding structures - mostly in inflammatory
    • Ureteral compression → hydronephrosis and flank pain
    • Bowel (rare)
      • Aortoenteric fistula → hematemesis or hematochezia
      • Small bowel obstruction
  • Rupture
  • Triad of severe pain, hypotension and pulsatile abdominal mass
  • Diagnosis missed initially up to 30% of the time

● Small aneurysms have a diameter <4.0 cm
● Medium aneurysms have a diameter between 4.0 and 5.5 cm
● Large aneurysms have a diameter >5.5 cm
● Very large aneurysms have a diameter ≥6.0 cm
Diagnosis and management of asymptomatic abdominal aortic aneurysm

AAA identified* and no symptoms are present

Was prior imaging adequate based upon the following?
- Imaging defined the extent of the aneurysm
- Maximal diameter measured orthogonal to flow
- Imaging included iliac arteries

No, imaging is not adequate
Repeat imaging:
- Perform fasting abdominal ultrasound
- Otherwise, perform CT angiogram of abdomen/pelvis

AAA not confirmed
Further surveillance not warranted

AAA confirmed
Diameter ≥5.5 cm in a male?
Diameter ≥5.0 cm in a female?

No

Yes

Box A
Surveillance ultrasound
- At six months for AAA 5.0 to 5.4 cm
- At one year for AAA 4.0 to 4.9 cm
- At three years for AAA 3.0 to 3.9 cm

Are any of the following present on repeat ultrasound?
- Diameter ≥5.5 cm (male) or ≥5.0 cm (female)
- Expansion >0.5 cm in six months or >1 cm in one year

No

Yes

Continue to observe using surveillance ultrasound with intervals described in box A
Manage cardiovascular risk:
- Smoking cessation
- Control hypertension
- Lipid management
- Daily aerobic exercise

Referral for possible repair
MEDICAL MANAGEMENT

- Appropriate for small aneurysms and non-operative candidates

- There is a lack of RCTs and formal guidelines looking at risk reduction for AAAs

- Smoking cessation
  - Reduces all-cause mortality
  - Reduction in aneurysm-related mortality

- Reduction of cardiovascular risk factors
  - Statin therapy recommended in all patients with AAA
    - No RCT data
    - A small study showed Simvastatin reduced MMP levels in aortic wall by 40%
  - Antiplatelet therapy with low-dose aspirin recommended to reduce overall cardiovascular risk

•OVERALL CONCLUSIONS

• EVAR (endovascular aortic repair) associated with lower immediate post-operative morbidity and mortality
• OSR (open surgical repair) associated with decreased long-term morbidity and mortality
• Open repair preferred for good surgical candidates

• 2013 meta-analysis of 25,078 EVAR patients and 27,142 OSR patients
  • Lower 30-day mortality with EVAR
  • Same 2-year all-cause mortality (EVAR, 3586 of 25078 [14.3%]; OSR, 4071 of 27142 [15.2%]; odds ratio, 0.87 [95% CI, 0.72-1.06]; \( P = .17 \))
  • More EVAR patients required re-intervention and had late aneurysm rupture

• DREAM trial (Dutch trial comparing open and endovascular repair)
  • Similar 12-year survival rate (OSR, 41.7%; EVAR, 38.4%; 3.3% difference [95% CI, −7.1% to 13.7%]; \( P = .48 \))
  • Higher freedom from re-intervention for OSR (OSR, 86.4%; EVAR, 65.1%; 21.3% difference [95% CI, 11.2%-31.4%]; \( P = .001 \))

• EVAR 1 trial
  • After 8 years, EVAR associated with higher all-cause mortality (adjusted hazard ratio, 1.25 [95% CI, 1.00-1.56])
  • After 8 years, EVAR associated with aneurysm-associated mortality (adjusted hazard ratio, 5.82 [95% CI, 1.64-20.65])

Surgical Management – When to Repair

Society for Vascular Surgery (SVS) Guidelines for AAA Treatment
(Level of Evidence/Quality of Evidence Rating)

Decision to treat with elective repairs
- Fusiform aneurysms of 5.5 cm or larger (1/A)
- All saccular aneurysms (2/C)
- Aneurysms of 5 cm or larger in women (2/B)

Operative approach
- Preserve at least 1 hypogastric artery (1/A)
- Endovascular aneurysm repair recommended for ruptured AAA (1/C)

• Treatment
  • Asymptomatic aneurysms should be treated with the approach above
  • Treatment can be endovascular or open (see following slides)
  • Saccular aneurysms higher risk for rupture → treated at lower sizes
  • All symptomatic aneurysms should be treated urgently

OPEN REPAIR

- Can use transperitoneal or retroperitoneal approach
- Approach depends on exposure needed for repair and previous surgeries
  - Better view of right iliac and femorals
  - Higher rates of ileus
- Transperitoneal
  - Retroperitoneal approach
    - Better for more proximal aneurysms
    - Lower risk of ileus and pneumonia

• EVAR depends on seal in normal, non-aneurysmal, aorta and iliacs

• Need sufficient infrarenal neck or placement of stents into visceral arteries to be able to bring graft proximally into normal aorta

• Can coil hypogastric or perform a bifurcated stent graft in iliacs if needed to bring graft into normal external iliac if common iliac aneurysmal

• Need sufficient iliac and femoral diameters to deliver graft
  • Iliac conduits (cutdown on iliac arteries) can be used if small iliacs to allow graft to be delivered if more distal arteries too small

Fenestrated endograft (aka graft with holes created for placement of stents through them) with stents in the renal arteries to bring graft seal into normal aorta proximally
Endovascular Aneurysm Repair (EVAR)
a) Aortic neck diameter
b) Diameter of the aortic neck 15 mm away from the renal artery closer to the aneurysmAort boyun uzunluğu
c) Aneurysm neck length diameter
d) Aneurysm diameter
e) Aortic bifurcation diameter
f) Right common iliac artery diameter
g) Right common iliac artery diameter
h) Right external iliac artery diameter
i) Left external iliac artery diameter
j) Anevrizmaya daha yakın olan renal arter ile sağ internal arter arasındaki mesafe
k) Anevrizmaya daha yakın olan renal arter ile sol internal arter arasındaki mesafe
l) Right iliac artery sealing length
m) Left iliac artery sealing length
ANATOMİCAL CHARACTERISTIC

<table>
<thead>
<tr>
<th>Favorable characteristics</th>
<th>Hostile characteristics</th>
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<tbody>
<tr>
<td>Aortic neck diameter &lt; 30 mm</td>
<td>Aortic neck diameter &gt; 30 mm</td>
</tr>
<tr>
<td>Aortic neck length &gt; 15 mm</td>
<td>Aortic neck length &lt; 15 mm</td>
</tr>
<tr>
<td>Aortic angulation &lt; 60 degrees</td>
<td>Aortic angulation &gt; 60 degrees</td>
</tr>
<tr>
<td>Aortic calcification &lt; 50% total circumference</td>
<td>Aortic calcification &gt; 50% total circumference</td>
</tr>
<tr>
<td>Absence of reverse taper morphology</td>
<td>Reverse taper morphology</td>
</tr>
<tr>
<td>&lt;50% circumferential thrombus</td>
<td>&gt;50% circumferential thrombus</td>
</tr>
<tr>
<td>Endovascular device</td>
<td>Year of FDA approval</td>
</tr>
<tr>
<td>--------------------------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Ancure™ (EndoVascular Technologies, Inc., USA)*</td>
<td>1999</td>
</tr>
<tr>
<td>AneuRx® (Medtronic Vascular, Inc., USA)</td>
<td>1999</td>
</tr>
<tr>
<td>Excluder® (W. L. Gore &amp; Associates, Inc., USA)</td>
<td>2002</td>
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<tr>
<td>Zenith® (Cook Medical Technologies, USA)</td>
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<tr>
<td>Low-permeability Excluder® (W. L. Gore &amp; Associates, Inc., USA)</td>
<td>2004</td>
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<tr>
<td>Powerlink® (Endologix, Inc., USA)</td>
<td>2004</td>
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<tr>
<td>Enlarged-neck Zenith® (Cook Medical Technologies, USA)</td>
<td>2006</td>
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<tr>
<td>Talent® (Medtronic Vascular, Inc., USA)</td>
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<td>Enlarged-neck Powerlink® (Endologix Inc., USA)</td>
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<tr>
<td>Enlarged-neck Excluder® (W. L. Gore &amp; Associates, Inc., USA)</td>
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<td>Endurant® (Medtronic Vascular, Inc., USA)</td>
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<td>Ovation® (Trivascular, Inc, USA)</td>
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<tr>
<td>Fenestrated Zenith® (Cook Medical Technologies, USA)</td>
<td>2012</td>
</tr>
<tr>
<td>Aorfix® (Lombard Medical, UK)</td>
<td>2013</td>
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</tbody>
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*Device discontinued in 2003. ‡Changed to ≥15 mm in 2003. Abbreviations: AAA, abdominal aortic aneurysm; NS, not specified.
Teşekkürler