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KDIGO Central & Peripheral Arterial Diseases Conference

Aortic Aneurysms and Dissections

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Disclosures

• Co-Owner and Medical Director
Aneurysms

- Definitions and classifications
  - Infrarenal >95% AAA
    - Usually ~1.5-2cm proximal segment of normal aorta below renal arteries
  - Juxtarenal
    - Extend to level Renal Arteries
  - Suprarenal
    - Extend to level SMA or Celiac
Aneurysms: Principles of Management

- Risk is small for diameter $<5\text{cm}$
  - Annual risk of 5% or less
- Risk increases to 10% for 6\text{cm}
- Risk 20% for 7\text{cm}
- 5-year rupture risk of 50% for 6\text{cm}
- 5-year rupture risk of 100% for 7\text{cm}

<table>
<thead>
<tr>
<th>AAA DIAMETER (cm)</th>
<th>RUPTURE RISK (%/y)</th>
</tr>
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<tbody>
<tr>
<td>&lt;4</td>
<td>0</td>
</tr>
<tr>
<td>4-5</td>
<td>0.5-5</td>
</tr>
<tr>
<td>5-6</td>
<td>3-15</td>
</tr>
<tr>
<td>6-7</td>
<td>10-20</td>
</tr>
<tr>
<td>7-8</td>
<td>20-40</td>
</tr>
<tr>
<td>&gt;8</td>
<td>30-50</td>
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AAA, abdominal aortic aneurysm.

Aneurysms: Principles of Management

- Mortality of operative repair
  - Depends on status of aneurysm (symptomatic, asymptomatic, ruptured) and method of repair (open vs endovascular)
  - Mortality of open repair of intact aneurysms in U.S. 4.2%
    - 2.2% age 50-59
    - 9.2% age >80
    - Mortality significantly > in women (6.1 vs 3.7%)
  - Mortality from Endovascular repair significantly lower
    - DREAM Trial 1.2% vs 4.6%
    - EVAR Trial 1.7% vs 4.7%
Aneurysms: Operative Indications

- All patients with symptomatic or ruptured AAA
  - Unless they have underlying medical condition that precludes long-term survival
- Repair of intact/asymptomatic AAA complex and needs to be tailored to individual patient
  - AAA size, life expectancy, comorbidities, preference, and anatomic considerations

<table>
<thead>
<tr>
<th>RISK FACTOR</th>
<th>ODDS RATIO</th>
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<tbody>
<tr>
<td>Creatinine &gt;1.8 mg/dL</td>
<td>3.3</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>2.3</td>
</tr>
<tr>
<td>ECG ischemia</td>
<td>2.2</td>
</tr>
<tr>
<td>Pulmonary dysfunction</td>
<td>1.9</td>
</tr>
<tr>
<td>Older age (per decade)</td>
<td>1.5</td>
</tr>
<tr>
<td>Female gender</td>
<td>1.5</td>
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</tbody>
</table>
Aneurysms: Repair

- Open vs Endovascular
  - Anatomic configuration of aorta, aneurysm, and access vessels
  - Number of available devices and specific characteristics constantly evolving
    - Infrarenal landing zone: >/= ~15mm in length; </= 26-32mm in diameter
    - Proximal neck angle </= 45 degrees
    - Infrarenal neck relatively free of thrombus and calcification
    - Iliac artery should have landing zone >/= 20mm with diameter 7-20mm
      - Facilitates anchoring graft and passing device into aorta
Aneurysms: Open Repair

- Dacron Tube Graft
- Proximal anastomosis
- Aortic Wall: Note Athero
Aneurysms: Endovascular Repair

• Main Device
  – The main body device for the abdominal aorta is usually bifurcated
  – The grafts rely primarily on outward tension in the proximal graft to maintain position
  • Although may include barbs or a suprarenal uncovered extension
Aneurysms: Endovascular Repair

- Device / Limb Extensions
  - One or more extension devices may be required to provide a complete seal
  - Following deployment of main device and any necessary extensions an aortogram is performed
- This ensures that the graft has completely excluded the aneurysm from the circulation
CKD

• One of the risk factors most associated with worse outcomes after repair of both intact and ruptured AAA
• EVAR accounts for majority of intact and will soon be also in rupture
• This makes all open repairs more complicated and more likely to require suprarenal clamp
Current Approach-Intact

• Use combination of anatomy and patient wishes/characteristics to decide on EVAR, FEVAR, PMEG, Open
• Pendulum swinging back to Open in younger patients or those outside IFU
• Still about 70% being done with EVAR
Current Approach-Rupture

• Code Aorta
• CTA in ER and direct to room with team in place
• Percutaneous balloon placement under local
• If not at all anatomically feasible- balloon in place for clamp
• Even if borderline- EVAR
• 87 y.o. male transferred with ruptured 10cm AAA
• - h/o low back pain over past 3 months
• - worsened over past 24 hours
• - hypotensive
• PMH: Parkinson’s, HTN, GERD, BPH, Chol
• PSH: neg
• Meds: Norvasc, Losartan, Sinemet, ASA, Simvastatin, Paxil, Omeprazole
- Transported by ambulance directly to Endovascular OR
- Vitals: P 80’s, BP 110/70
- Awake and alert c/o abdominal and back pain
- Abdomen distended, tender in all 4 quadrants
- Hct 35, Creatinine 1.5
Future

• Physician modified
• Cut holes in pre-made graft for viscerals and renals
• Place stent grafts in branch vessels
• Still percutaneous
Future

- Off the shelf branched devices
- Use in ruptures even in “bad” anatomy
Suprarenal Fixation

- Comparison of Endovascular Stent Grafts for Abdominal Aortic Aneurysm Repair in Medicare Beneficiaries.

- Buck DB¹, Soden PA¹, Deery SE¹, Zettervall SL¹, Ultee KHJ¹, Landon BE², O'Malley AJ³, Schermerhorn ML⁴

- The suprarenal fixation patients had higher rates of perioperative mortality (1.7% vs. 1.3%, $P < 0.01$), renal failure (6.0% vs. 4.7%, $P < 0.001$), and mesenteric ischemia (0.7% vs. 0.4%, $P < 0.01$) and longer length of stay (3.4 days vs. 3.0 days, $P < 0.001$) compared with patients with infrarenal fixation.
Is there a way to prevent AKI?

- Clamp Time?
- Mannitol
- Lasix
- Volume
- Cold perfusion
Predictors and Consequence of Renal Dysfunction

- 2635 open juxtarenal repairs, of which 621 (24%) were complicated by AKI. The majority of these (20% of the overall cohort) were AKI alone, but 2.2% required temporary RRT and an additional 1.7% were permanently dialysis dependent.

- Factors independently associated with postoperative renal dysfunction included renal-visceral ischemia time (per minute: odds ratio [OR], 1.01 [1.01-1.02]; P < .001), clamp site (above both renal arteries: OR, 1.4 [1.1-1.8; P = .02]; supraceliac: OR, 1.7 [1.1-2.5; P = .01]), and preoperative renal function (glomerular filtration rate [GFR] of 45-60 mL/min/1.73 m²: OR, 1.8 [1.3-2.5; P < .001]; GFR of 30-45 mL/min/1.73 m²: OR, 1.9 [1.2-2.8; P = .003]; GFR of <30 mL/min/1.73 m²: OR, 6.2 [3.1-12.2; P < .001]).

- Factors associated with postoperative renal dysfunction and the subsequent impact on survival after open juxtarenal abdominal aortic aneurysm repair.

- O'Donnell TF, Boitano LT, Deery SE, Clouse WD, Siracuse JJ, Schermerhorn ML, Green R, Takayama H, Patel VI.
Predictors and Consequence of Renal Dysfunction

• When renal-visceral ischemia time was categorized, there was no difference in risk of postoperative renal dysfunction until >25 minutes, but risk increased stepwise thereafter (25-39 minutes: OR, 1.6 [1.2-2.1; P = .004]; 40+ minutes: OR, 2.6 [1.9-3.5; P < .001]).

• Neither mannitol nor the use of cold renal perfusion was associated with renal complications or mortality in the overall cohort.

• Postoperative renal dysfunction was associated with higher adjusted perioperative mortality (AKI: OR, 2.6 [1.4-5.0; P < .01]; RRT: OR, 10.5 [4.0-27.6; P < .001]) and significantly higher risk of long-term mortality (AKI: hazard ratio, 1.5 [1.0-2.1; P = .049]; RRT: hazard ratio, 5.8 [3.2-10.3; P < .001]).
Aortic Dissection

- Primary event is a tear in the aortic intima.
- Cystic medial degeneration present
- Blood passes into the aortic media through the tear, separating the intima from the media and creating a false lumen.

Unclear whether the initiating event is a primary rupture of the intima with secondary dissection of the media, or hemorrhage within the media and subsequent rupture of the intima.
Mechanism

• Propagation of the dissection can occur both distally and proximally to the initial tear

• Complications of dissection:
  – ischemia (coronary, cerebral, spinal, or visceral)
  – aortic regurgitation
  – Pericardial effusion/cardiac tamponade
### Classification of aortic dissection

<table>
<thead>
<tr>
<th>Percentage</th>
<th>60%</th>
<th>10-15%</th>
<th>25-30%</th>
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<tbody>
<tr>
<td>Type</td>
<td>DeBakey I</td>
<td>DeBakey II</td>
<td>DeBakey III</td>
</tr>
<tr>
<td></td>
<td>Stanford A</td>
<td>Stanford B</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Proximal</td>
<td></td>
<td>Distal</td>
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Incidence

- Ranges from 2-10 per 100,000 person-years
- Evidence of dissection is found in 1-3% of all autopsies
Who’s affected?

• International Registry of Acute Aortic Dissection (IRAD)
  – 65% men
  – Mean age 63 yrs
  – Women tend to present at older ages
• Highest incidence in patients 50 to 70 years old.
• Male-to-female ratio 2:1
• Half of dissections in females before age 40 occur during pregnancy
Mortality

- When left untreated...
  - 33% of patients die within the first 24 hours
  - 50% die within 48 hours
  - ~75% die within 2-weeks
AKI in Dissection

- This can occur through several mechanisms
- Significant decrease in size of true lumen causing decreased perfusion of all visceral vessels as well as lower extremity
- Fenestration with direct change in lumen of renal arteries, can be false or true
- LE ischemia and CPK elevation
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Treating AKI in Dissection (past)

- Fenestration – scary
- Basically intentionally creating hole between false and true and than using balloon or “scissor” to tear
- Stents into renal but can make worse
Treating AKI in Dissection (Current)

• Stent graft at tear
• Risk of paralysis based on how much Aorta is “covered”
• Use of adjunctive bare metal stents
• Idea is to preserve and expand the true lumen
Decreasing Malperfusion

- STABLE II clinical trial on endovascular treatment of acute, complicated type B aortic dissection with a composite device design.
- Lombardi JV¹, Gleason TG², Panneton JM³, Starnes BW⁴, Dake MD⁵, Haulon S⁶, Mossop PJ⁷, Seale MM⁸, Zhou Q⁸; STABLE II Investigators.

In patients with acute type B aortic dissection in the setting of branch vessel malperfusion, the use of a composite device with proximal stent grafts and distal bare aortic stent appeared to result in lower malperfusion-related mortality than the use of stent grafts alone. The 30-day rates of morbidity and secondary interventions were similar between the groups.
Admission, ER, Initial ICU

- 61 M transfer with chest, back pain and Type B
  - Arrived on esmolol and nicardipine gtt, SBP <120, HR 78 sinus

- PMH: HTN
- Meds: Denies any medication
- SocHx: Smokes 1 PPD. Drinks 1-2 beers daily. History of crack cocaine.
- FamHx: No aneurysm or dissection. Father HTN, DM2. Brother CABG
- Cr 1.1, Lactate 2.5.

- Admitted to ICU, BP <120. Severe EtOH withdrawal. Developed pneumonia, intubated for respiratory failure, eventually extubated.
- Uncomplicated from aneurysm perspective. Cr rose to 1.9, By HD 19, still requiring IV BP medicine to keep SBP <140, in addition to Lasix, PO Carvedilol, Amlodipine, Dilt, Captopril & Hydralazine
Post op

- Palpable left radial pulse post-op
- Off vasoactive drips by POD 3
- POD 6, CTA then discharged home
  - ASA/Plavix for innominate shutter
  - Amlodipine, Clonidine, Isosohide, Labetalol, Lisinopril
- Cr 0.8
Lessons from IRAD

- Patients with renal insufficiency (18%) were at increased risk for drug-resistant hypertension and aortic branch vessel compromise (OR, 5.2). This complication was associated with a significant increase in hospital mortality, both in type A (50% versus 25%, $P<0.001$) and type B (27% versus 9%, $P<0.001$).
Lessons from IRAD

• In the 20 years since the IRAD was established, overall mortality in patients with type A AAD has declined. It is notable that surgical mortality in patients with type A AAD and type B AAD has fallen significantly. Improvements in AAD outcomes may be attributable to a number of factors: earlier detection, improved diagnostic imaging, and advances in surgical and endovascular techniques and perioperative and long-term management.
Imaging in AKI

- Prehydrate and CTA
- Vessel navigator
- CO2 angio
- IVUS
- DUS
- MRA
Questions to the group

• What is the best measure of adequate pre-hydration (CVP, MAP, TEE)
• Does hydration post op help or just prevent second hit?
• Does lasix help?
• IS early CRT helpful or harmful related to long term renal recovery?