Visceral and Renal Artery Aneurysm
When and How to Repair

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Arterial Aneurysms: General Considerations

- SVS defined aneurysm as “a permanent localized dilation of an artery having at least a 50% increase in diameter compared to expected normal diameter of the artery.”
Aneurysm Classification

- **True VS False Aneurysms**
  - *True aneurysms* – involve all 3 layers of arterial wall
  - *False aneurysms* - presence of blood flow outside the normal layers of the arterial wall
  - Hole in artery wall that allows extravasation of blood into a contained space outside the artery
Visceral/Splanchnic Artery Aneurysms (SAA)

- Intra-abdominal aneurysms that are *not part of the aortoiliac system* and include aneurysms of the celiac, superior and inferior mesenteric arteries and their branches
- Of all intra-abdominal aneurysms, only 5% affect the splanchnic arteries
- Prevalence of SAA in general population ~ 0.1-2%
Frequency and anatomic distribution of SAA

- Splenic 60%
- Hepatic artery 20%
- SMA 6%
- Celiac 4%
- Gastric and gastroepiploic arteries 4%
- Jejunal, ileal, colic arteries 3%
- Pancreaticoduodenal and pancreatic arteries 2%
- Gastroduodenal artery 1.5%
- IMA <1%
Splenic Artery Aneurysms

- MC type of SAA – 60% of reported splanchnic aneurysms
- Rare - prevalence in general pop is low; 0.01%;
  - BUT splenic artery in autopsy study showed incidence of 10%
- MC in W vs M; 4:1
- Usually saccular, <2cm in diameter
  - Located in mid/distal splenic artery or at bifurcation points
SPAA Rupture

• Double Rupture Phenomenon
  – Seen in 20-30% cases; initially contained rupture into lesser sack allowing for diagnosis
    • Rupture can also occur into GI tract, pancreatic ducts or splenic veins

• Splenic PSA can also occur and rupture 2/2 pancreatitis →
  – hemosuccus pancreaticus

• Overall mortality of ruptured SPAA 25%
  – Pregnancy a/w 20-50% of all ruptures
    • Occurs in 3rd trimester
    • Devastating maternal and fetal mortality rates – 80 and 90%

• Risk factors for rupture poorly defined – pregnancy highest risk for rupture
SPAA Indications for Treatment

• **ABSOLUTE**
  - If ruptured or symptomatic – require urgent treatment
  - In pregnant women or those of childbearing age warrant Tx

• **LESS STRINGENT**
  - enlarging or > 2cm in diameter (not absolute criteria)
  - Tx in pts with portal HTN or in candidates for liver transplant

• Also
  - All pseudoaneurysms should be repaired irrespective of size 2/2
    increased risk of rupture
SPAA Therapeutic Options

- **Open Surgery**
  - Aneurysmectomy
  - Exclusion and Ligation – proximal and distal ligation
  - Splenectomy
  - Distal pancreatectomy
  - Laparoscopic ligation

- **Endovascular**
  - Occlusion
    - Coiling
    - Glue injection
    - Thrombin Injection
  - Stenting

Typically reserved for proximal or middle portion lesions

Typically reserved for distal/intrasplenic portion lesions
Technique

• Femoral Artery Access with 5F sheath and .035 inch guidewire
  – Cannalize SMA, Celiac arteries and Renal with shaped catheter
    • Smaller branches using microcatheter (2.5F with .014 wire)

• Transcatheter coil embolization with coils, onyx, etc.

Ikeda et al. JVS 2008;47:1212-1219
Hepatic Artery Aneurysm

• 2nd most common true VAA
• Indication for treatment include:
  – Symptomatic
  – Nonatherosclerotic aneurysms, multiple aneurysms, and aneurysms >2cm in good risk patient with life expectancy >2 years, pt’s getting OLT

• Txm options depend on location
  – Ligation, Ligation with bypass, hepatectomy/OLT
  – Ligation/coil embolization only if portal vein patent
  – Proper Hepatic Artery requires reconstruction, whereas Common Hepatic Artery does not.
Superior Mesenteric Artery

- 3rd most common
- Indications for repair
  - Symptomatic
  - Size > 2cm, growth
- Options for treatment
  - Bypass, ligation, coiling
Celiac Artery

• Rare
• Concomitant aneurysms
• Similar treatment paradigm as other VAA
Renal Artery Aneurysm

• Rare disease
  – 0.1% prevalence
  – 0.6%-1% of angiograms

• Natural history poorly defined
Diagnostic Evaluation

• Cross-sectional imaging
  – MDCT, MRA
• Diagnostic angiography
• Renal scan
Diagnostic Evaluation

- Cross-sectional imaging
  - MDCT, MRA
- Diagnostic angiography
- Renal scan
Indications for Repair

• Size - >2.0cm
• Women of childbearing age
• Hypertension associated with stenosis or FMD
SURGICAL REPAIR
Surgical Repair

- Vein patch angioplasty
- Surgical bypass
- Ex-vivo reconstruction
- Nephrectomy
Vein Patch Angioplasty

Surgical Bypass
Surgical Bypass
Ex-Vivo Repair

ENDOVASCULAR REPAIR
Endovascular Repair

- Choice of therapy depends on location and comorbidities
- Covered stents
- Embolization coils
- Liquid embolic agents

*Abath, et al. Tech Vasc Interventional Rad 10:299-307*
Covered Stents

- Require proximal and distal seal zone
- Rare to find suitable anatomy

*Abath, et al. Tech Vasc Interventional Rad 10:299-307*
Balloon-Assisted Coiling

Figure 3  Balloon-assisted coil embolization. (A) Selective renal artery angiography showing a type II RAA. (B) Balloon-assisted embolization showing a basket configuration after the first GDC deployment. (C) Dense packing with aneurysm exclusion in the control angiography.

Balloon-Assisted Embolization

Figure 6  Type II RAA. (A) Selective renal angiography. (B) Balloon protection of the aneurysm neck during sealing test, before Onyx injection. (C) Onyx injection showing progressive filling of the aneurysm cavity. (D and E) Complete obliteration of the aneurysm sac by the Onyx casting. (F) Actinic dermatitis due to x-ray exposure. (Color version of figure is available online.)

Abath, et al. Tech Vasc Interventional
Rad 10:299-307
Stent Assisted Coiling

- 68 yo male with COPD, CAD, s/p DES
- Incidentally found 2.5 cm RAA
Conclusions

• RAA is a rare disease, complex anatomy
  – Younger patients, predominantly female, associated FMD/HTN
• Surgical repair is traditional gold standard
• Endovascular therapy safe, feasible
• Choice of therapy needs to be individualized to the patient
Surgical treatment of visceral artery aneurysms: A 25-year experience

Raffaele Pulli, MD, Walter Dorigo, MD, Nicola Troisi, MD, Giovanni Pratesi, MD, Alessandro Alessi Innocenti, MD, and Carlo Pratesi, MD. Florence and Rome, Italy

- Retrospective review from 1982-2007 (N=55)
- Pre-op variables
  - Demographics
  - Risk Factors
  - Comorbidities
  - Clinical/Anatomic Features
- Diagnostic Workup
  - CTA
  - DSA
- Follow Up
  - US @ 1 and 12 months; yearly thereafter
  - At least 1 CT scan following repair
- Outcomes
  - Complications ➔ prolonged hospitalization/complications requiring surgical intervention

- 52/55 found incidentally (as/sx)
- 3/55 “symptomatic”
- 32M and 23W
  - Ages 36-78
- Types
  - 30/55 Splenic
  - 3/55 Renal
  - 7/55 Common Hepatic
  - 4/55 Pancreaticoduodenal
  - 2/55 Celiac
  - 2/55 SMA

Pulli et al. JVS 2008;48:334-42
Recommendations

• **SPAA**
  - Aneurysmectomy with end-end anastomosis
    - SPLenic PRESERVATION
  - Ligation of splenic artery given collateral perfusion
  - If in hilar location – impossible to perform arterial reconstruction – splenectomy

• **RAA**
  - If saccular and proximal – aneurysmectomy with end to end anastomosis
  - Mid distal – prosthetic bypass graft
  - If intraparenchymal – ex vivo repair; do not do nephrectomy unless RAA rupture, irreparable renal ischemia, or failure at attempted renal artery reconstruction

• **HAA**
  - Ligate proximal and distal CHA
    - Examine liver parenchyma for color change – may require splenohepatic bypass after ligation
  - If distal/parenchymal lesion – may require hepatic parenchymal resection

Pulli et al. JVS 2008;48:334-42
Management of aneurysms involving branches of the celiac and superior mesenteric arteries: A comparison of surgical and endovascular therapy

Ulka Sachdev, MD, Donald T. Baril, MD, Sharif H. Ellozy, MD, Robert A. Lookstein, MD, Daniel Silverberg, MD, Tikva S. Jacobs, MD, Alfio Carroccio, MD, Victoria J. Teodorescu, MD, and Michael L. Marin, MD, New York, NY

• Retrospective review 1991-2005 (N=59)
  – Surgical VS endo
    • Endo – 35 pts
    • Open – 24 pts
  – Mean age, gender, number of patients w/ previous abdominal surgery did not differ between 2 groups
  – Size Average
    • Endo – 3.28 ±1.6cm
    • Open 4.35 ± 1.98cm

Sachdev et al. JVS 2006;44:718-724
Open Surgery VS Endovascular

- Endo Candidacy if
  - inflow and outflow vessels accessible via catheter based system and collateral flow provided adequate perfusion based on CT or MRI

- Ultimately decision to use endovascular VS surgical mgmt at discretion of surgeon

Sachdev et al., JVS 2006;44:718-724
Open Surgery VS Endovascular Results

- Presentation s/sx between two groups similar (but not statistically significant)
- Aneurysm incidental finding in 46% of pts
- Endovascular tx associated with decreased length of stay
  - Endo: 2.4±1.6 days
  - Open 6.6±4.7 days (P<.001)
- Primary treatment success 89% in endovascular group
  - All 2nd attempts were successfully embolized
- Post operative mortality between open and endo findings similar; but not statistically significant

Table IV. Initial presentation of patients treated either with endovascular techniques or surgery for aneurysms of the celiac and superior mesenteric arteries*

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Endovascular</th>
<th>Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidental</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Symptomatic</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Pain</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Rupture</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Gastrointestinal bleeding</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hemobilia</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Infected pseudocyst</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*The P values for these data are not significant.

Table V. Complications, reinterventions, and 30-day mortality after open or endovascular repair of aneurysms involving branches of the celiac and superior mesenteric arteries*

<table>
<thead>
<tr>
<th></th>
<th>Endovascular (n = 35)</th>
<th>Open (n = 24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complications</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Reinterventions</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Deaths ≤30 days</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*The P values for these data are not significant.
Recommendations

- Endovascular intervention is effective in treating VAAs
  - Associated with decreased length of stay
  - Primary failure may also be successfully managed with repeat endovascular intervention
  - Particularly useful in patients with multiple comorbidities, particularly malignancy

Sachdev et al. JVS 2006;44:718-724
Key Planning

- Review detailed imagining to delineate anatomy and location of aneurysms
  - Know collateral circulation to prevent end organ ischemia
- Be aware of precipitating factors of medical/surgical conditions that may complicate repair
  - Pancreatitis/infection/collagen disease
- Be aware of alternative inflow sources for revascularization if technical issues arise
Surveillance

- Mandatory, particularly in endovascular cases
  - Baseline, 6 months, yearly thereafter
- Duplex after open repair
  - Restenosis
- MR Angiography after coiling and Onyx
  - Continued exclusion