Vascular Emergencies: Pennington Lecture Series, Sept 2017
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Disclosures

- Paid Consultant Cook Medical- Proctor Advanced Aortic Intervention, Z Fenestrated and P- Branch Fenestrated
- Paid Consultant Medtronic – National Chairman, Physician Screening Committee
- Educational and Research Grant Support – WL Gore, Cook Medical
Vascular Emergencies

- Acute Limb Ischemia
Acute Limb Ischemia

- Trauma
- Iatrogenic
- Embolism
- Acute on Chronic Thrombosis
## Thrombosis vs Embolus

<table>
<thead>
<tr>
<th></th>
<th>Thrombosis:</th>
<th>Embolus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td><strong>Embolic Source</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Onset</strong></td>
<td>Progressive</td>
<td>Abrupt</td>
</tr>
<tr>
<td><strong>Ischemia</strong></td>
<td>Milder</td>
<td>Severe</td>
</tr>
<tr>
<td><strong>PMHx</strong></td>
<td>Claudication</td>
<td>Afib</td>
</tr>
<tr>
<td><strong>Other Leg</strong></td>
<td>Abnormal</td>
<td>Normal</td>
</tr>
</tbody>
</table>
Clinical Presentation

- Acute ischemia affects sensory nerves first
- Motor nerves
- Skin
- Muscle Tissue
- Muscle tenderness is one of the end-stage signs
Duration of Symptoms

- Irreversible muscle necrosis in 6-8 hours
- Reperfusion injury?
- Fasciotomy?
- Primary amputation?
Evaluation

- P’s
- Pain
- Pallor
- Paresis
- Pulse Defecit
- Parasthesia
- Poikilothermy
Initial Management

- Anticoagulation with IV heparin
- O2 by facemask (Improve skin perfusion)
- IVF resuscitation- Foley catheter to monitor U/O
- Analgesia
Clinical Assessment of Severity

- Viable
- Threatened- marginally vs immediately threatened
- Irreversible
Practical Questions

- Is the limb viable, threatened or lost?
- If threatened how long can reperfusion be delayed?
- Is there a need for duplex or angiography?
- Should the patient be immediately heparinised?
Chronic Ischemia

- Lafontaine Classification (Claudication, Rest Pain, Tissue Loss)
- Rutherford Classification
- WiFi
Critical Limb Ischemia

- Presence of Tissue loss
- Rest Pain with ankle pressure <50 mm Hg
- Either for 2 weeks or more
Anatomic Level

Aorti-Iliac
Ileo-femoral
Femoro-popliteal
Tibio-Peroneal
WiFi Classification

Designed to define disease burden and combine the best of previous systems • analogous to the tumor, node, metastasis (TNM) system for cancer staging
• Grades 3 major factors: Wound, Ischemia, and foot Infection (WIfI) • SVS WIfI (2014)
• Ischemic rest pain with confirmed, objective hemodynamic studies (ABI, TP, TcPO2)
• DFU
• Non healing LE wound longer than 2 weeks duration
• Gangrene to any part of LE
* Excludes pure venous wounds, ischemia due to microemboli, trauma, and non atherosclerotic conditions (Buerger’s, neoplasm)
WOUND GRADES

• Scale: 0-3 based on size, depth, severity, and difficulty achieving healing
• 0- No Wound. No gangrene
• 1- small, shallow, no bone exposed, minor tissue loss, salvageable with digital amputation or skin coverage. No gangrene
• 2- deeper, bone, joint, or tendon exposed, major tissue loss, salvageable with multiple digit amputations or a standard TMA (+/- skin coverage). Gangrene to digits only
• 3- extensive wound(s) with gangrene involving forefoot, midfoot, and/or rearfoot. Salvageable with non-traditional midfoot amputation and/or flap coverage.
• ABI < 0.8 (no gradient of severity)
• Patients with ABI > 0.8 are low risk for amputation and wound healing is likely to take place without the need for revascularization
• Patients with ABI < 0.4 are high risk for amputation and wound healing is unlikely to take place without revascularization
• *If ABI is unreliable (or incompressible), TP (toe pressure) or TcPO2
<table>
<thead>
<tr>
<th>Risk of Amputation</th>
<th>Proposed clinical stages</th>
<th>WIfI spectrum score (W, I, fI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low</td>
<td>Stage 1</td>
<td>000, 001, 010, 011, 100, 101, 110</td>
</tr>
<tr>
<td>Low</td>
<td>Stage 2</td>
<td>002, 011, 020, 021, 030, 102, 111, 120, 200, 201</td>
</tr>
<tr>
<td>Moderate</td>
<td>Stage 3</td>
<td>003, 021, 022, 031, 032, 103, 112, 121, 130, 131, 202, 210, 211, 220, 300, 301</td>
</tr>
</tbody>
</table>
WOUND GRADES

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Compartment Syndrome

- Strong fascia encases the limb to aid muscle function and return of venous blood
- Injury results in swelling
- Swelling raises pressure
- Pressure occludes lymphatic return, then venous return, then arterial inflow
- Result: Dead or severely damaged tissue due to pressure and ischemia
Compartment Syndrome Dx

- Strong clinical suspicion—nature of injury, duration of ischemia
- Clinical manifestations: Nerve and muscle dysfunction, decreased perfusion, tense compartment
- May measure compartment pressure as adjunct to treatment >40 mm Hg
Compartment Syndrome-Tx
Intramural Hematoma

Events leading to intramural hematoma. Rupture of vasa vasorum feeding aortic media to creation of intramedial hematoma with intact intimal layer.
Penetrating Aortic Ulcer

Events leading to penetrating aortic ulcer – Formation of extensive aortic atheroma confined to intimal layer, though lesion progression to deep ulceration of plaque with penetration into media, to entrance of blood from aortic lumen into media and splitting of media with intramural hematoma. Hematoma formation may extend along media, resulting in long segment intramural hematoma.
Penetrating Aortic Ulcer
Type B Aortic Dissection

Events leading to aortic dissection: Formation of entrance tear and exit tear of intima to splitting of aortic media and formation of intimomedial flap. Blood under pressure dissects media longitudinally, and double channel aorta is formed with blood filling both true and false lumens.
Dissection aortique type B

Classic intimomedial flap (arrow) dividing true and false lumens in descending aorta. Intramural hematoma (arrowhead).
Type B Aortic Dissection

Right Renal artery originates from false lumen. Left renal artery originates from true lumen.
Classification

- Stanford
  - A
  - B

- DeBakey
  - I-III
Type A vs Type B
Epidemiology

- Peak 60-70 yo
- Hypertension
- Marfan’s syndrome (cystic media degeneration)
- 3rd Trimester Pregnancy
- Blunt Trauma
- Prior cardiac surgery
- IABP (Intra-aortic balloon pump)
Presentation

- Classic: Severe tearing-interscapular pain (sudden onset)
- CHF
- CVA
- Peripheral Ischemia
- Paraplegia
- Cardiac Arrest
- Sudden Death
Signs (End Organ)

- Hypertension
- Asymmetric Upper Extremity arterial exam
- Acute renal failure
- Acute Mesenteric Ischemia
- Acute lower limb ischemia
Early vs Late Complications

- **Early** – Any kind of malperfusion syndrome or rupture.
- **Late** – Continued false lumen expansion with the risk of late rupture.
Uncomplicated Type B Dissection

- Pain resolves with medication (anti-hypertensives and pain medication)
- No end organ complications
- 90% survival
- Monitor in ICU or CCU until BP controlled on oral medication and pain free.
Complicated Type B Aortic Dissection

- Acute Critical Ischemia from Branch Vessel Involvement
- Aortic Rupture
- Impending rupture, extension of process, early aortic dilatation
- Unrelenting pain, uncontrolled hypertension, aneurysm formation
Critical Ischemia from Branch Vessel Involvement

- Carotid - Stroke
- Renal – Renal failure
- Mesenteric – Mesenteric Ischemia
- Peripheral - Acute Limb Ischemia
# Imaging Modalities

<table>
<thead>
<tr>
<th>Imaging study</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortography</td>
<td>80–90%</td>
<td>88–93%</td>
</tr>
<tr>
<td>Computed tomography</td>
<td>90–100%</td>
<td>90–100%</td>
</tr>
<tr>
<td>Intravascular ultrasound</td>
<td>94–100%</td>
<td>97–100%</td>
</tr>
<tr>
<td>Echocardiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transthoracic</td>
<td>60–80%</td>
<td>80–96%</td>
</tr>
<tr>
<td>Transesophageal</td>
<td>90–99%</td>
<td>85–98%</td>
</tr>
<tr>
<td>Magnetic resonance imaging</td>
<td>98–100%</td>
<td>98–100%</td>
</tr>
</tbody>
</table>
Mortality

- Natural history
  - Type A
    - 50% mortality within 48 hours
    - 1% per hour
    - High Risk—Medical management
      - 58% mortality
  - Type B
    - 50% mortality for untreated
    - 9% in-hospital
Mortality

- Type B--OR
  - 5 year survival
    - 48%
  - 10 year survival
    - 29%
Malperfusion

- Expansion of false lumen and true lumen compression
- Branch obstruction
- Exacerbated by hypertension
- Stroke 5.5%
- Arm Ischemia 2%
- Paralysis 1%
- Renal Failure 4.5%
- Mesenteric Ischemia 1%
- Lower Extremity Ischemia 12%
Malperfusion

- No Obstruction
Malperfusion

- Dynamic Obstruction (80%)
Type B Aortic Dissection

Right Renal artery originates from false lumen. Left renal artery originates from true lumen.
Malperfusion

- Static Obstruction
Acute vs Chronic

- Once patient survives 2 weeks after the dissection occurs, it is defined as a chronic dissection.

- Recently- Sub-Acute Dissection 15-90 Days
Treatment
Uncomplicated Type B Dissection

- Pain resolves with medication (anti-hypertensives and pain medication)
- No end organ complications
- 90% survival
- Monitor in ICU or CCU until BP controlled on oral medication and pain free.
Objective of Surgical Repair

- Depressurization of the false lumen
- Reconstruction of the true channel
- Bypass for end-organ ischemia
Early Surgical Repair

- Mortality 20% at day 2
- Mortality 25-50% at 1 month
Type B Aortic Dissection

Right Renal artery originates from false lumen. Left renal artery originates from true lumen.
Best Medical Therapy

- BP Control
- Surveillance
- Who follows these patients for BP control?
- BP goals?
The Natural History of Medically Managed Acute Type B Aortic Dissection (Durham et al), JVS 2015, May 61 (5)

- 298 pts
- Mean Follow up 4.2 years
- Kaplan-Meier – Intervention Free Survival was 41% at 6 years
- K-M- Survival after 6 years was higher in patients who underwent interventions (76% vs 58%)
- Aneurysmal degeneration was the indication for intervention in 24%
- Conclusion: The majority of patients with Acute Type B dissection will fail medical therapy over time.
Long term outcome and prognostic predictors of medically treated acute Type B Aortic Dissection - Lancet 2015 Feb 28(385)- Onitsuka et al.

- 76 patients, Medically treated

- Patent false lumen and maximum aortic diameter greater than 40 mm upon admission were most strongly associated factors for developing new events.
- In-hospital mortality:
  - 10% BMT
  - 11% Endovascular
  - 33% Open Surgery
- Fattori et al JACCCI; 1: 4, 2008, 395-402
- Endovascular treated more likely to be complicated dissection 61.7% vs 37.2%
- In-hospital mortality similar p=0.273 (10.9% vs. 8.7%)
- 5 year mortality after discharge of 15.5%
Endovascular vs 29% BMT (p=0.0018)
Randomized Comparison of Strategies for Type B Aortic Dissection

The INvestigation of STEnt Grafts in Aortic Dissection (INSTEAD) Trial

Christoph A. Nienaber, MD, PhD; Hervé Rousseau, MD, PhD; Holger Eggebrecht, MD; Stephan Kische, MD; Rossella Fattori, MD, PhD; Tim C. Rehders, MD; Günther Kundt, PhD; Dierk Scheinert, MD, PhD; Martin Czerny, MD, PhD; Tilo Kleinfeldt, MD; Burkhart Zipfel, MD; Louis Labrousse, MD, PhD; Hüseyin Ince, MD, PhD;
for the INSTEAD Trial

- Trial of Medtronic TALENT graft for uncomplicated Type B Aortic Dissections
- 140 patients randomized at 7 European Centers for pts with Type B dissection >14 days.
  - 72 TEVAR vs 68 OMT
- Primary endpoint all-cause mortality
- Secondary endpoints aorta-related death, progression, and aortic remodeling


- No difference in mortality, aorta related death or freedom from progressive disease at 2 yrs
- Significant difference in aortic remodeling at 2 years in patients treated with TEVAR
• INSTEAD XL - 5 year outcomes of INSTEAD trial data

• TALENT graft (Medtronic) for use in uncomplicated Type B dissections treated >14 days after initial symptoms

INSTEAD XL Nienaber et al.
Circ Cardiovasc Interv.
2013;6:407-416
All-Cause Mortality (11.1 +/- 3.7% vs 19.3 +/- 4.8%) and Aorta-Specific Mortality (6.9 +/- 3.0% vs 19.3 +/- 4.8%) at 5 years.
Complications of TEVAR

- Complications of Surgery
- Paraplegia (Low risk)
- Retrograde Type A Dissection
Looked at MOTHER Registry

Incidence of Retrograde Aortic Type A Dissection was 8.4% (OR 10.0 vs aneurysm) in Acute versus 3% (OR 3.4 vs aneurysm) in chronic aortic dissections

Oversizing more than 9% was also found to contribute

• Close follow-up is needed following acute Type B Dissections in patients managed medically and with TEVAR as they may need secondary interventions
• Further data needed to delineate:
  • Optimal timing of repair in uncomplicated dissections to reduce risk
  • Are there subsets of uncomplicated dissections more likely to have aorta related complications in future
Thank you
Thank You