Treatment of embolic complications in vascular interventions

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Prevention

• Heparinization during procedure
• Pre-treatment with thrombolysis/OAC for acute and acute-on-chronic lesions
• Use of filter devices
  – Not always possible
    • Unexpected hypercoagulability
    • Aorto-iliac procedures/EVAR etc.
Embolic complications

• Thrombo-embolic
• Plaque embolism
Treatment options

• Catheter directed thrombolysis (urokinase/rtPA)
• Aspiration thrombectomy
  – Diagnostic catheter/guiding catheter
  – Aspiration catheters
• Mechanical thrombectomy
  – Aspirex
  – Indigo
• Pharmacomechanical
  – Angiojet, EKOS, etc.
• Open surgery
  – Fogarty embolectomy
Choice of treatment modality

- Depending on severity of ischemia (Rutherford classification)

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Findings</th>
<th>Doppler signals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sensory loss</td>
<td>Arterial</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muscle weakness</td>
<td>Venous</td>
</tr>
<tr>
<td>I</td>
<td>Viable</td>
<td>None</td>
<td>Audible</td>
</tr>
<tr>
<td></td>
<td>Not immediately threatened</td>
<td>None</td>
<td>Audible</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>IIa</td>
<td>Marginally salvageable if promptly treated</td>
<td>Minimal/none</td>
<td>Inaudible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>None</td>
<td>Audible</td>
</tr>
<tr>
<td>IIb</td>
<td>Immediately salvageable with immediate</td>
<td>More, rest</td>
<td>Inaudible</td>
</tr>
<tr>
<td></td>
<td>vascularization</td>
<td>pain</td>
<td>Audible</td>
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<tr>
<td>III</td>
<td>Irreversible</td>
<td>Anesthesia</td>
<td>Inaudible</td>
</tr>
</tbody>
</table>
Thrombolysis

- Catheter size depending on vessel segment involved
- On-the-table
  - Bolus followed by slow infusion (250-500K urokinase)
- Overnight
  - Intermediate dose protocol (90-120K/hr urokinase)
- Caveat: contraindications
Thrombolysis

Guidewire-test
Aspiration thrombectomy/suction thrombo-embolectomy

- Change introducer for sheath with detachable valve/Touhy (avoid loss of thrombus that protrudes beyond the tip of the catheter)
- Vac-Lock syringe
- Large vessels (iliac/femoral/popliteal)
  - Guiding catheter (5-9F)
  - Telescoping technique (avoid dissection)
  - NB positioning with guidewire, suction without guidewire
- Small vessels (distal popliteal/BTK)
  - Single-end hole diagnostic catheter (4-5F)
  - Aspiration catheters (coronary)
Aspiration thrombectomy
Aspiration thrombectomy
Aspiration thrombectomy
Aspiration thrombectomy
Aspiration thrombectomy
Aspiration thrombectomy
Aspiration thrombectomy
Aspiration catheters

- Placed over guidewire
- Guidewire can be left in place (Rx system)
- Lower risk of dissection
- Volume that can be aspirated is limited (BTK only)
- Various devices available
  - Pronto (Vascular Solutions; Minneapolis, MN)
  - Export (Medtronic; Minneapolis, MN)
  - Eliminate (Terumo; Tokyo, Japan)
  - QuickCat (Spectranetics; Colorado Springs, CO)
  - Etc.
Eliminate
Eliminate
Mechanical thrombectomy

- Aspirex system (Straub Medical AG; Wangs, CH)
  - Catheter generated negative pressure that provides continuous aspiration of fresh thrombotic material
  - Aspirated material is fragmented and removed (Archimedes screw principle)
- Indigo (Penumbra; Alameda, CA)
  - Vacuum aspiration created by an external vacuum pump
  - Flexible catheter (range 3, 5, 6, 8F)
  - Aspiration is directly applied to the lesion
  - Separator to maintain lumen patency (breaks up clot)
Aspirex
Indigo-Penumbra
Indigo-Penumbra

Images courtesy J. Benenati/C. Schonholz
Indigo-Penumbra

Images courtesy J. Benenati/C. Schonholz
Hydrodynamic thrombolysis

• Angiojet (Boston Scientific; Marlborough, MA)
  – High-velocity saline flow that causes a negative pressure at the tip of the multi-lumen catheter
  – Venturi effect used for microfragmentation, capture and removal of the thrombus
  – Can be combined with lytics
Surgical embolectomy

- Indicated in Class IIB or higher and when other techniques fail
- Fogarty balloon embolectomy
- Preferably with fluoroscopic guidance
- N.B. potential vessel wall damage (dissection, AV-fistula)
Conclusions

• Various treatment modalities are available from low-end to very high-end
• Clinical status dictates treatment of choice
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