Catheter Based Therapies For Acute Deep Venous Thrombosis

Arashk Motiei MD,
Mayo Clinic Health System, Mankato, MN
Mayo Clinic, Rochester, MN
Disclosures

• Consultant for Medtronic
Rationale for Interventional Treatment

• High risk of post thrombotic syndrome (PTS) in conservatively treated patients with iliac, femoral/popliteal DVT
  – Pain, edema, skin changes and ulceration

• Data suggest a reduced risk of PTS with interventional treatment
CaVenT Trial: Study Design

Eligibility (n = 209)

- Age: 18-75 years
- First-time acute iliofemoral DVT
- Objectively verified DVT above midthigh level
- Symptom duration up to 21 days
- No increased risk of bleeding

Conventional treatment only* (n = 108)

CDT + conventional treatment (n = 101)

* Initial low molecular weight heparin (LMWH) and warfarin followed by warfarin alone with target intensity international normalized ratio (INR) of 2.0-3.0

- Randomization was stratified for involvement of the pelvic veins.
- **Primary outcomes:**
  - Frequency of PTS at 24 months, assessed by the Villalta score
  - Iliofemoral patency after 6 months

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Additional CDT (n = 90)</th>
<th>Standard therapy only (n = 99)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>% (95% CI)</td>
<td>n</td>
</tr>
<tr>
<td>PTS after 6 mo</td>
<td>27</td>
<td>30.3 (21.8-40.5)</td>
<td>32</td>
</tr>
<tr>
<td>PTS after 24 mo</td>
<td>37</td>
<td>41.1 (31.5-51.4)</td>
<td>55</td>
</tr>
<tr>
<td>Iliofemoral patency after 6 mo*</td>
<td>58</td>
<td>65.9 (55.5-75.0)</td>
<td>45</td>
</tr>
</tbody>
</table>

- PTS is defined as a Villalta score ≥5.
- p-values stated are from an unadjusted Chi-square test.
- Absolute risk reduction of long-term endpoint PTS at 24 months of follow-up in CDT versus standard therapy: 14.4% (95% CI 4-502).

PTS After 24 Months in Patients with Iliofemoral Patency or Insufficient Recanalization After 6 Months

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Regained iliofemoral patency (n = 103)</th>
<th>Insufficient recanalization (n = 80)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>% (95% CI)</td>
<td>n</td>
</tr>
<tr>
<td>PTS after 24 mo</td>
<td>38</td>
<td><strong>36.9</strong> (28.2-46.5)</td>
<td>49</td>
</tr>
</tbody>
</table>

- Absolute gain in short-term endpoint iliofemoral patency after 6 months in CDT versus standard therapy group: 18.5% (95% CI 4.2–31.8).
- Absolute risk reduction in the frequency of PTS after 24 months in patency versus insufficient recanalization: 24.4% (95% CI 9.8–37.6).

### Adverse Events

<table>
<thead>
<tr>
<th>AEs</th>
<th>Additional CDT (n = 101)</th>
<th>Standard treatment (n = 108)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major bleeding complications</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Clinically relevant bleeding</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deaths</td>
<td>0</td>
<td>NR</td>
</tr>
<tr>
<td>Pulmonary embolisms</td>
<td>0</td>
<td>NR</td>
</tr>
<tr>
<td>Cerebral hemorrhages</td>
<td>0</td>
<td>NR</td>
</tr>
<tr>
<td>Nonbleeding complications</td>
<td>4</td>
<td>NR</td>
</tr>
<tr>
<td>Recurrent VTE at 24 mo</td>
<td>10</td>
<td>18</td>
</tr>
</tbody>
</table>

NR = not reported

During follow-up, 28 patients had recurrent VTE and 11 had cancer; no significant difference between treatment groups ($p > 0.05$).

ATTRACT Trial

- Acute Venous Thrombosis: Thrombus Removal with Adjunctive Catheter-Directed Thrombolysis Trial
- NIH sponsored, phase III RCT
- N=692
- Pharmacomechanical Catheter Directed Thrombolytic Therapy vs Conventional Treatment
- Completed enrollment
Case Selection

- Occlusive Ilio-femoral DVT: Ideally less than 3 weeks duration
- No contraindication to thrombolytic therapy
- Reasonable functional status and expected longevity
Treatment Phases

1. Eliminate or debulk the clot
   – Recanalize the vein
   – Optimize inflow for stenting

2. Correct underlying venous lesions
   – IVUS
   – PTA and Stenting
Access

- Popliteal Vein (most common)
- Posterior Tibial Veins
- Small Saphenous Vein
- Multiple sites can be accessed if needed
Access

• Prone position

• US guidance is necessary
  – Initial Access
  – Confirmation of wire position

• There is no backflow in most cases

• Confirm venous position with venography after placement of micropuncture sheath

• Change-out for appropriate sheath based on treatment plan
After Access

- Determine extent and location of the clot
- Go ahead with selected treatment plan
Techniques

• Catheter Directed Thrombolysis
• Ultrasound Enhanced Catheter Directed Thrombolysis (EKOS)
• Pharmacomechanical Thrombectomy
  – Rheolytic Thrombectomy (Angiojet)
• Percutaneous Thrombectomy
  – Aspiration
  – Penumbra-Indigo System
Catheter Directed Thrombolysis

• Multi-hole infusion catheter
  – Wide variety of treatment lengths, many manufacturers e.g Cragg McNamara, Unifuse, Cook etc
• Thrombolytic infusion: usually 1mg/hr of t-PA
• Low intensity heparin protocol
• Relook venography in 24 hours
• Usually need approximately 48 hours of treatment
Power Pulse Spray and Rheolytic Thrombectomy

- Angiojet Solent Omni and Proxa: 6F minimum vessel diameter of 3 mm
- Angiojet Zelante: 8F, minimum vessel diameter of 6 mm, directional control
- Spray saline and thrombolytic into the clot
- Rheolytic thrombectomy after dwell time of 30 minutes or variable period of thrombolytic infusion
Angiojet – PEARL registry

<table>
<thead>
<tr>
<th>Technique</th>
<th>Cases (%); N=329</th>
<th>Median Procedure Time (in hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rheolytic Thrombectomy</td>
<td>13(4)</td>
<td>1.4</td>
</tr>
<tr>
<td>Pharmacomechanical Thrombolysis</td>
<td>115(35)</td>
<td>2</td>
</tr>
<tr>
<td>Pharmacomechanical Thrombolysis and catheter Directed Thrombolysis</td>
<td>172(52)</td>
<td>22</td>
</tr>
<tr>
<td>Rheolytic Thrombectomy and Catheter Directed Thrombolysis</td>
<td>29(9)</td>
<td>41</td>
</tr>
</tbody>
</table>

36% Procedures completed within 6 hrs
73% procedures completed in less than 24 hours
One case of renal failure
Angiojet – PEARL Registry

Duration of Treatment

- ≤ 6 hours: 36%
- 6 hr - 12 hrs: 9%
- 12 hr - 24 hrs: 28%
- > 24 hours: 27%
EKOS Acoustic Pulse Thrombolysis
Percutaneous Thrombectomy

• Best used after adequate thrombolysis
• Options
  – Catheter/Syringe
  – Angiojet
  – Penumbra-Indigo System
Penumbra Indigo System

CAT3, 6 and 8

CAT 8 Xtorq: 8F Angled tip
Identification and Treatment of Underlying Iliac Vein Lesions

• Venography: multiple views needed
  – Stenosis, venous collaterals

• IVUS: Mandatory!
  – Stenosis, webs, spurs, chronic scar/thrombus, compression
  – Area and diameter assessment
  – Lesion length assessment
  – Obviates need for detailed venographic assessment
Venous Intervention

- PTA alone is not enough: recoil is the rule
- Stenting is mandatory
- For most May-Thurner cases, stent needs to be extended into the IVC across the other iliac vein
- Ok to extend the stent below the inguinal ligament
Case

- 55 M, no history of venous thromboembolism
- No prior significant medical history
- No obvious risk factors for DVT
- Left flank/back pain one week prior to presentation
- Worsening flank pain and left lower extremity swelling and pain on the day of presentation
Case

- Ultrasound in the emergency department notable for DVT

Reason For Exam
left leg swelling and discoloration, no injury

Report
EXAM: US Venous Doppler Lower Ext Left
INDICATION: left leg swelling and discoloration, no injury
COMPARISON: None.
PROCEDURE: Multiple real-time grayscale echograms of the left lower extremity were obtained along with Doppler imaging.

FINDINGS: There is extensive occlusive deep venous boluses from the left common femoral vein throughout nearly all of the venous structures into the calf. There is some sparing of the anterior tibial vein but it is also not well seen. There is diffuse edema of the left lower extremity. There is a 4.3 x 1.4 x 3.5 cm Baker's cyst behind the left knee.

IMPRESSION: Extensive occlusive deep venous thrombosis throughout the left lower extremity from common femoral vein to the calf.
Case

After 24 hours of t-PA
Case 1

Day 3
Chronic Scar/thrombus

LCIV

LCIA
Technical Pearls

• Stent well into the IVC (3-5cm) to avoid missing the site of compression
• Variable jailing of the contralateral iliac vein is unavoidable
• Missing the lesion has adverse consequences
38F with PTS and ulceration, prior stenting of left common iliac vein and ablation of left GSV
Missed lesion with unrelieved compression and stenosis
Right Iliocaval Junction Post Stenting

Right Common Iliac Vein Post Stenting
Technical Pearls

- Acute contralateral iliac vein occlusion is rare
- Roughly 20% risk of requiring a contralateral iliac vein intervention in the long term: many of these have contralateral iliac vein lesions
Right Common Iliac Vein Compression In a Case With Prior Left Common Iliac Vein Compression Treated with Wallstent
Z-Stent Technique To Reduce The Risk of Contralateral Iliac Vein Occlusion