Aggressive endovascular management of ilio-femoral DVT is the “key” in preventing post thrombotic syndrome

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READING HEALTH SYSTEM
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Faculty Disclosure

- Consultant Medtronic, Boston Scientific, Cardinal Health,
Venous Thromboembolism (DVT & PE)

- >2 million Deep vein thrombosis
- >200,000 deaths from pulmonary embolism
- Even after 6 months of anticoagulation following first VTE event, risk of subsequent VTE is increased by 5-12% annually.
Pathophysiology

Deep Vein Thrombosis

- **Hematologist:** view DVT as a disorder of hematology and biology.

- **Vascular Surgeon and Interventional Radiologist:** view DVT from an Anatomical and Functional perspective.
Ilio-Femoral DVT

**Endovascular Specialists:**

- View *ilio-femoral DVT* as fundamentally different from physiologic considerations as well as more severe disease manifestation.

- **BUT** it is rarely distinguished from other forms of DVT by other physicians.
Not All Clots Are Created Equal

Venous Thrombosis ≠ Peripheral Arterial Thrombosis ≠ Coronary Artery Thrombosis
Post thrombotic syndrome

- Most physicians treat all cases of proximal DVT the same.
- MUST differentiate between **iliofemoral** DVT and **infrainguinal** DVT.
- **Iliofemoral DVT** → Virulent post-thrombotic morbidity.

20 -60% of Pts with DVT
800,000/Yr cases of Post-Thrombotic Syndrome

Incidence and cost burden of post-thrombotic syndrome.
AU
Ashrani AA, Heit JA
Post Thrombotic Syndrome

- Chronic leg heaviness
- Leg aching
- Venous claudication
- Edema
- Venous varicosities
- Chronic skin changes
- Ulceration
Iliofemoral DVT

Natural History

Associated with Severe Postthrombotic Morbidity!

O'Donnell T
J Surg Res. 1977

Mavor GE
Br J Surg 1969

Beyth RJ
Arch Int Med 1995
Ilio-Femoral DVT
Long Term Clinical Status and QOL

• **Conclusions**
  - Venous claudication developed in almost 50%
  - Limited ambulation in 15%
  - Marked hemodynamic impairment
  - Markedly reduced QOL

Delis KT et al
*Ann Surg* 2004;239(1):118
Ilio-Femoral DVT

Treatment Objectives

- Minimize or eliminate the Embolic potential of the existing Thrombus
- Prevent further Thrombosis

- Restore Venous Patency (remove obstruction)
- Preserve Venous Valvular function
Anticoagulation

**DOES**

- Minimize or eliminate the Embolic potential of the existing Thrombus
- Prevent further Thrombosis

**DOES NOT**

- Restore Venous Patency (remove obstruction)
- Preserve Venous Valvular function
Post Thrombotic Syndrome (PTS)

- Venous Hypertension
- Venous Capacitance is reduced
- Calf pump ejection fraction is reduced
Ambulatory Venous Hypertension

Components

- Obstruction
- Valve incompetence
Ambulatory Venous Hypertension

Combination of Obstruction + Valvular Incompetence

Highest Venous Pressure and most severe morbidity
Indications for Endovascular Therapy

- Functional patient with ilio-femoral DVT
- No Major risk factors for the use of thrombolytic
- “But” can use Mechanical Thrombectomy
- Need to be anticoagulated with Heparin and Coumadin
- Phleghmasia Cerulea Dolens
Ilio-Femoral DVT
Improved Outcome with Early Resolution

Randomized Trial: Iliofemoral DVT
Venous Thrombectomy vs. Anticoagulation
(Follow-up @ 6 mos, 5 yrs, 10 yrs)

- Patients randomized to thrombectomy showed:
  1. Improved patency \( P < 0.05 \)
  2. Lower venous pressures \( P < 0.05 \)
  3. Less leg swelling \( P < 0.05 \)
  4. Fewer post-thrombotic symptoms \( P < 0.05 \)

Compared to anticoagulation

Plate G, et al. JVS; 1984
Venous Thrombectomy

Femoral Vein Exposure
Management of Ilio-Femoral DVT

- Anticoagulation
- Surgical Thrombectomy
- Catheter Directed Thrombolysis
- Pharmacomechanical Thrombectomy
Combination of Mechanical Thrombectomy and Thrombolysis

- Combination therapy is even more Powerful
- Initially reduces more thrombus burden
- Exposes a greater area of the thrombus surface to lytic agent
- **Decrease Dose and Infusion time** for thrombolytic drugs
- One Retrospective study, PMT greatly reduced both time of lysis (40% reduction) and Lytic drug dose (60% reduction).
Endovascular Intervention

1. Access
2. Device/Techniques
Access

- Popliteal Vein
- Small Saphenous vein
- Post Tibial Vein
- Contralateral Femoral vein
- IJ Vein
Popliteal Vein
Small Saphenous Vein
PT Vein Access
Device/ Techniques
Treating DVT with AngioJet

Photo courtesy of Bayer HealthCare

Photo courtesy of Bayer HealthCare 2012
AngioJet® Power Pulse® Delivery System

Power Pulse® Delivery

- Power-infuse lytic solution directly into the clot
- Combination of chemical and mechanical thrombolysis
Solent™ Family
AngioJet® Catheters for Peripheral Vessels

SOLENT Proxi - 90 cm length
SOLENT Omni - 120 cm length

- Thrombectomy power similar to DVX®
- Compatible with 6FR sheath and 0.035” guidewire
- Guidewire swapability
- Contrast injection port
- Power Pulse® Delivery enabled

Photo courtesy of Bayer HealthCare
Treating DVT: Meet the Players

**Trellis- PMT System**

- Thrombus isolated between 2 occluding balloons, reducing embolization risk
- Local delivery of lytic allows minimal dose needed to achieve high concentration
- Sinusoidal wire disperses lytic, mechanically disrupts thrombus
- Aspiration following treatment
- Often requires only single treatment setting
Treating DVT: Meet the Players

EKOS Lysis System
EKOS US-Assisted CDT

>99% of US energy passes through valves

- 3 drug delivery lumens
- US core wire
- thermocouple
- central coolant lumen
CLINICAL STUDY


Mark J. Garcia, MD, MS, Robert Lookstein, MD, Rahul Malhotra, MD, Ali Amin, MD, RVT, Lawrence R. Blitz, MD, Daniel A. Leung, MD, Eugene J. Simoni, MD, and Peter A. Soukas, MD
PEARL Registry

- Prospective, multi-center registry collecting patient history, procedural information, adjunctive treatments, outcomes and adverse events. All pts treated with AngioJet® Thrombectomy catheters.
- Pts divided into arterial, venous & dialysis access
- PEARL I *(January 2007 thru April 2010)*: Followed patients for 3 months with documentation of symptomatic improvement after rheolytic thrombectomy (with mid-length catheters).
- PEARL II *(March 2010 thru June 2013)*: Followed patients outcomes through 12 months after thrombectomy using any AngioJet® Catheter
Registry Objectives

- Determine efficacy of thrombus removal from baseline to final venogram
- Evaluate clinical outcomes of treated patients at defined intervals of 3, 6 & 12 mos.
- Characterize clinical events
- Characterize treatment options used with the AngioJet® System
- Estimate rate of AngioJet Thrombectomy related adverse events
# DVT Age

From Signs/Symptoms Onset

<table>
<thead>
<tr>
<th></th>
<th>≤ 24 Hours</th>
<th>&gt; 24 Hours and ≤ 7 Days</th>
<th>&gt; 7 Days and ≤ 14 Days</th>
<th>&gt; 14 Days and ≤ 30 Days</th>
<th>&gt; 30 days and ≤ 3 Months</th>
<th>&gt; 3 Months and ≤ 6 Months</th>
<th>&gt; 6 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>18 (5%)</td>
<td>158 (43%)</td>
<td>80 (22%)</td>
<td>68 (18%)</td>
<td>33 (9%)</td>
<td>8 (2%)</td>
<td>6 (1%)</td>
</tr>
<tr>
<td>Sub Acute</td>
<td></td>
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<tr>
<td>Chronic</td>
<td></td>
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</tr>
</tbody>
</table>

69% of patients report symptom onset of < 14 days
# PEARL Results

Duration of treatment

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\leq 6 \text{ Hrs})</td>
<td>133 (38%)</td>
</tr>
<tr>
<td>(&gt; 6 \text{ Hrs} &amp; \leq 12 \text{ Hrs})</td>
<td>37 (10%)</td>
</tr>
<tr>
<td>(&gt; 12 \text{ Hrs} &amp; \leq 24 \text{ Hrs})</td>
<td>97 (27%)</td>
</tr>
<tr>
<td>(&gt; 24 \text{ Hrs})</td>
<td>88 (25%)</td>
</tr>
</tbody>
</table>

(355/371 had times recorded)

- 38% completed in \(\leq 6 \text{ hrs}\)
- 75% completed in \(\leq 24 \text{ hrs}\)
### PEARL Results

#### # of sessions

<table>
<thead>
<tr>
<th># of Sessions</th>
<th>N(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>123 (34%)</td>
</tr>
<tr>
<td>2</td>
<td>189 (53%)</td>
</tr>
<tr>
<td>3</td>
<td>40 (11%)</td>
</tr>
<tr>
<td>&gt;3</td>
<td>7 (2%)</td>
</tr>
</tbody>
</table>

(359/371 had # sessions recorded)

87% had 2 or less sessions
## PEARL Results

### Lab Test Comparisons

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Pre-procedure Mean</th>
<th>Post-procedure Mean</th>
<th>Mean Difference*</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin (N=266)</td>
<td>12.4</td>
<td>11.2</td>
<td>-1.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>BUN (N=235)</td>
<td>16.8</td>
<td>16.4</td>
<td>-0.4</td>
<td>0.1030</td>
</tr>
<tr>
<td>Creatinine (N=239)</td>
<td>1.1</td>
<td>1.2</td>
<td>0.1</td>
<td>0.0848</td>
</tr>
</tbody>
</table>

*Wilcoxon Signed Rank Test
*Paired analysis
PEARL Results

Venographic Results

\( N = 1295 \) vessels treated (\( p < 0.0001 \))
Venographic Results
clot age by Sx Onset (p<0.0001)

ACUTE DVT

- <=24 Hrs
  - Improved: 100%
  - Unchanged: 0%
  - Worsened: 0%
  - N=64

- 1-7 Days
  - Improved: 97%
  - Unchanged: 3%
  - Worsened: <1%
  - N=533

- 7-14 Days
  - Improved: 97%
  - Unchanged: 3%
  - Worsened: 0%
  - N=306
Venographic Results
clot age by Sx Onset (p<0.0001)

SUBACUTE
14-30 Days
N=226
97%
Improved
2%
Unchanged
1%
Worsened

30-90 Days
N=126
93%
Improved
7%
Unchanged
0%
Worsened

>3 Mons
N=40
100%
Improved
0%
Unchanged
0%
Worsened

CHRONIC
Freedom from Rethrombosis*

- 94% at 90 Days
- 88% at 180 Days
- 84% at 365 Days

* Estimated by Kaplan Meier
Maintained Clinical Benefit*

* Estimated by Kaplan Meier
There are statistically significant improvements measured by the physical (p<0.0001) and mental (p<0.0001) components. The pretreatment physical scores differ significantly from the 3, 6 & 12 month follow ups.
# PEARL Comparison

## Treatment of LE DVT

<table>
<thead>
<tr>
<th></th>
<th>PEARL</th>
<th>Venous Registry*</th>
<th>CaVenT**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>CDT</td>
</tr>
<tr>
<td># of Patients</td>
<td>329</td>
<td>287</td>
<td>90</td>
</tr>
<tr>
<td># of Sites</td>
<td>35</td>
<td>63</td>
<td>20</td>
</tr>
<tr>
<td>Prior DVT</td>
<td>40%</td>
<td>31%</td>
<td>10%</td>
</tr>
<tr>
<td>Primary Treatment</td>
<td>AngioJet Thrombectomy With or Without PPS/RL</td>
<td>CDT</td>
<td>CDT</td>
</tr>
<tr>
<td>Stent Placement</td>
<td>35%</td>
<td>33%</td>
<td>17%</td>
</tr>
<tr>
<td>Primary access</td>
<td>Popliteal</td>
<td>Popliteal</td>
<td>Popliteal</td>
</tr>
<tr>
<td>Gender</td>
<td>Male=57%; Female=43%</td>
<td>Male=48%; Female=52%</td>
<td>Male=64%; Female=36%</td>
</tr>
<tr>
<td>Age (mean)</td>
<td>52.2 yrs</td>
<td>47.5 yrs</td>
<td>53.3 yrs</td>
</tr>
<tr>
<td>Treatment Location</td>
<td>Iliofemoral – femoral pop</td>
<td>Iliofemoral – femoral pop</td>
<td>CFV or iliofemoral</td>
</tr>
<tr>
<td>Limbs Involved</td>
<td>Left=62%; Right=38%</td>
<td>Left=61%; Right=39%</td>
<td>Left=60%; Right=40%</td>
</tr>
</tbody>
</table>

## PEARL Comparison

### Treatment of LE DVT

<table>
<thead>
<tr>
<th>Onset of DVT Symptoms</th>
<th>PEARL</th>
<th>Venous Registry*</th>
<th>CaVenT**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>CDT</td>
</tr>
<tr>
<td><strong>Acute</strong></td>
<td>67% (≤14 days)</td>
<td>66% (≤10 Days)</td>
<td>100% ≤21 days</td>
</tr>
<tr>
<td><strong>Chronic</strong></td>
<td>33% (&gt;14 days)</td>
<td>16% (&gt;10 Days)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Acute &amp; Chronic</strong></td>
<td>NA</td>
<td>19%</td>
<td>NA</td>
</tr>
</tbody>
</table>

| Primary Lytic         | TPA   | Urokinase        | TPA      | NA      |
|-----------------------|-------|------------------|----------|
| **CDT Drip Times (mean)** | 17 hrs | 48 hrs           | 57.6 hrs (2.4 days) | NA |

<table>
<thead>
<tr>
<th>Procedure Times</th>
<th>CDT (N=29)</th>
<th>CDT+PPS/RL (N=172)</th>
<th>PPS/RL (N=115)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CDT</strong></td>
<td>40.9 hrs</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td><strong>CDT+PPS/RL</strong></td>
<td>22.0 hrs</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td><strong>PPS/RL</strong></td>
<td>2.0 hrs</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bleeding Complications</th>
<th>PEARL</th>
<th>Venous Registry*</th>
<th>CaVenT**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5% (major &amp; minor combined)</td>
<td>11% (major); 16% (minor)</td>
<td>22% (major &amp; minor combined)</td>
</tr>
</tbody>
</table>

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## PEARL Comparison
### Treatment of LE DVT

<table>
<thead>
<tr>
<th></th>
<th>PEARL</th>
<th>Venous Registry*</th>
<th>CaVenT**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>CDT</td>
</tr>
<tr>
<td>Overall % Thrombus Removal</td>
<td>96%</td>
<td>83%</td>
<td>89%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>By Lytic Groups: % thrombus Removal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDT (N=28)</td>
<td>93%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>CDT+PPS/RL (N=167)</td>
<td>97%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>PPS/RL (N=113)</td>
<td>95%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute: % Thrombus Removal</td>
<td>97%</td>
<td>86%</td>
<td>89%</td>
</tr>
<tr>
<td>Chronic: % Thrombus Removal</td>
<td>95%</td>
<td>68%</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute &amp; Chronic: % Thrombus Removal</td>
<td>NA</td>
<td>76%</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Patency</td>
<td>NA</td>
<td>6 Mon=65%; 12 Mon=60%</td>
<td>6 Mon = 65.9%</td>
</tr>
<tr>
<td>Freedom from Rethrombosis</td>
<td>6 Mon= 87%; 12 Mon=83%</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Summary: Acute Ilio-Femoral DVT

- Medical management is associated with higher PTS compared to endovascular management.
- There is increasing evidence that early thrombus resolution with endovascular intervention is associated with improved outcome.
- Pharmacomechanical decreases procedure time, decrease amount of thrombolytic used.
“Pull out, Betty! Pull out!...You’ve hit an artery!”