Course Objectives

- DVT Incidence and Etiology
- Imaging.
- Anticoagulation
- Systemic Thrombolysis
- Catheter Directed Thrombolysis
- To Filter or Not to Filter? That is the question.
- Mechanical Thrombectomy Devices.
- Venous Intervention.
Incidence

- Two million people in the U.S affected by DVT.
- Over 250 thousand new cases per year.
- Iliofemoral DVT represents approximately 20% of new cases.

NIH Consensus Conf JAMA 1986
Pathogenesis

• **Virchow’s Triad:**
  – Endothelial Injury.
  – Abnormal Blood Flow (Stasis).
  – Hypercoagulability.

• **Extension of Calf Vein thrombosis**
  – 10-29%
Risk Factors

• Postoperative patient
• Orthopedic Surgery
• Old Age
• Malignancy
• Pregnancy / Post Partum
• Spinal Injury
• Birth Control Pills
• Obesity
• Intravenous Foreign Body
• Prior DVT
• Cardiac Disease
• Immobilization
• Leg Trauma
• Blood Coagulation Disorder
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- Venous Intervention
DVT Imaging

• Diagnosis
  – Imaging
    • Ultrasound
      – Inexpensive
      – Excellent in the extremities
      – Limited Centrally
      – Difficult in chronic DVT
    – Findings
      Expanded Vein
      Lack color flow
      Non Compressible

• CT

• MRI
• **Diagnosis**
  – Imaging

• **CT**
  – Requires Contrast
  – Excellent Centrally
  – Identifies Extrinsic Compression
  – Evaluate central stent patency
  – Findings
    - Filling defect
    - Expanded vein
    - Extrinsic compressive structure
    - Peri-vascular edema

• **MRI**
• **Diagnosis**
  – Imaging

• **MRI**
  – Expensive
  – Excellent Central and Peripheral
  – Acute vs. Chronic
  – Patient Compliance
  – Limited with metal artifact
  – Findings
    - Filling Defect
    - Absent flow signal
    - Extrinsic structure
    - Peri-vascular edema
DVT Imaging

• Diagnosis
  – Imaging

• MRI
  – Expensive
  – Excellent Central and Peripheral
  – Acute vs. Chronic
  – Patient Compliance
  – Limited with metal artifact
  – Findings
    – Filling Defect
    – Absent flow signal
    – Extrinsic structure
    – Peri-vascular edema
DVT Imaging
Course Objectives

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Venous Thrombosis Treatment Options

- Anticoagulation
- Leg Elevation
- Compression Stockings
- Surgical Thrombectomy
- Catheter Directed Thrombolysis
- Intravenous Thrombolysis

Reduce PTS by 50%
Venous Thrombosis
Anticoagulation Therapy

- **Traditional Therapy:**
  Intravenous Heparin with conversion to oral Warfarin Therapy.

- **Benefits:**
  - Stops propagation of Clot.
  - Relies on body's own fibrinolytic system to reestablish patency.

- **Limits:**
  - Unable to clear clot burden from vessels larger than 8mm.

- **Outpatient Therapy:**
  Low Molecular Weight Heparin (*Enoxaparin*) with conversion to oral Warfarin Therapy.

- **Dosing:**
  1mg/kg q 12 hrs or 1.5mg/kg q 24 hrs

- **Benefits:**
  - Stops propagation of Clot.
  - Relies on body's own fibrinolytic system to reestablish patency.

- **Limits:**
  - Unable to clear clot burden from vessels larger than 8mm.
Venous Thrombosis

Natural History:
Complete Lysis
Organization with venous occlusion
Recanalization with narrowing
Thickening of the walls and Valves

50% of veins demonstrate residual disease after DVT. This will lead to an incompetent valvular system and Venous hypertension

Venous Thrombosis
Post Thrombotic Syndrome

• **Wide Spectrum**
  - Chronic Leg heaviness
  - Leg aching
  - Venous claudication
  - Edema
  - Varicosities
  - Trophic skin changes (lipodermatosclerosis)
  - Venous Ulcer
Venous Thrombosis
Post Thrombotic Syndrome

• Inadequate treatment 20-50%

• With anticoagulation
  – PTS 35 – 70%
  – Severe 7 – 23%
  – Ulcer 4 – 6%
  – Recurrent DVT 5% 6 fold increase in PTS


• Medical cost of post thrombotic syndrome accounts for 40% of total cost of care for DVT.

Venous Thrombosis
Post Thrombotic Syndrome

• Valvular Insufficiency
  • Two years 23%
  • Five years 25%
  • Eight Years 29%

24% patency of Iliofemoral veins treated with heparin at 1 year.

Course Objectives

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Venous Thrombosis
Thrombolysis

- **Systemic Thrombolytic**

64 patients with DVT randomized

- rt-PA alone, n=36
- rt-PA plus heparin, n=17
- heparin alone, n=12

0.05mg/kg/hr rt-PA

Complete or Greater than 50% Lysis

Thrombolysis 66% with systemic tPA
Thrombolysis 17% with systemic Heparin

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Venous Thrombosis Thrombolysis

- **Flow Directed Thrombolytic**

  Associated with longer infusion times and higher lytic doses

  67.8 hrs vs. 48 hrs

  9.95 million units vs. 6.77 million units

Mewissen, MD, et. al. Radiology; 211:39-49
Venous Thrombosis Thrombolysis

- Flow Directed / Catheter Directed Thrombolytic Therapy

  10 patients 12 legs
  - 50mg rt-PA per leg per day
  - Up to 4 days
  - 9 of 10 >75% lysis
  - 1 of 10 50-75% lysis
  - No major bleeding

Venous Thrombosis
Thrombolysis

- Catheter Directed Thrombolytic
Venous Thrombosis
Thrombolysis

• Catheter Directed Thrombolytic

• I have done this once
Interruption pneumatic compression of the foot and calf improves the outcome of catheter-directed thrombolysis using low-dose urokinase in patients with acute proximal venous thrombosis of the leg

Tomohiro Ogawa, MD, PhD, Shunichi Hoshino, MD, PhD, Hirofumi Midorikawa, MD, PhD, and Kouichi Sato, MD, PhD, Fukushima, Japan

Objective: Catheter-directed thrombolysis (CDT) is a promising treatment of acute proximal deep vein thrombosis (DVT) to prevent the postthrombotic syndrome by early removal of thrombus. During CDT for DVT patients, the calf muscle pump is compromised because of immobility. Intermittent pneumatic compression (IPC) can be used to increase venous flow during bed rest. The CDT with IPC may lyse venous thrombus better than CDT alone. The purpose of this study was to evaluate the efficiency and safety of IPC during CDT for DVT using low-dose urokinase.

Methods: Twenty-four patients with proximal DVT confirmed by duplex ultrasonography underwent CDT alone (10 cases) and CDT with IPC and a temporary inferior vena cava filter (14 cases) for 3 to 6 days. Pulmonary emboli (PEs) were assessed by pretreatment and posttreatment pulmonary angiogram or spiral computed tomography of the chest, and in the CDT/IPC patients, a posttreatment inferior vena cavaogram was performed. The initial results were evaluated by venogram immediately after CDT, and the late results were evaluated by venous disability score and duplex ultrasonography 6 to 36 months after treatment.

Results: There was no symptomatic PE in either group. In CDT with IPC, one new asymptomatic PE was found, but there was no large thrombus in the inferior vena cava. The initial thrombolytic results of CDT with IPC were better than those of CDT alone (five cases of complete lysis in the CDT/IPC group and none in the CDT alone group). In the follow-up, the deep veins were patent and competent in 43% (6/14) in the CDT/IPC group, compared with 17% (1/6) in the CDT-alone group. The venous disability score showed that the CDT/IPC group had less disability than the CDT-alone group.
Catheter Directed Thrombolysis

Thrombus Less than 4 weeks old.(10 days)

Contraindications

• **Absolute:**
  – Recent Bleed
  – Recent CVA
  – CNS Tumor
  – Recent Neurosurgery

• **Relative:**
  – Recent Surgery 10-14 days
  – Pregnancy
  – Uncontrolled HTN
  – Endocarditis
  – Organ Failure
  – Elderly
Peripheral Vascular Disease
Endovascular Treatment of DVT

• Catheter Directed Thrombolysis Protocol
  – tPA Dosed at 0.5 to 1.0 mg/hr.
  – Heparin 500 Units IV/hr.
  – PT, PTT, Fibrinogen, PLT, H/H every 4 hrs.
  – Patient is admitted to Unit for close monitoring.
  – Infusion usually 12-24 hours.

Venous Registry
Infusion time averaged 53.4 hours
Urokinase
Venous Registry

• 287 Patients
• Iliofemoral and Femoral-Popliteal DVT
• Mean treatment time was 53.4 hrs (Urokinase)
• Lysis Achieved
  – Grade III (Complete)  96 patients (31%)
  – Grade II (50-99%)  162 patients (52%)
  – Grade I (<50%)  54 patients (19%)
• Complications
  – Major Bleeding 54 patients (11%) most often at the puncture site.
  – Symptomatic Pulmonary Embolism in 6 patients (1%) One fatal.
  – Two Intracranial Hemorrhages with one being fatal.
• Venous Intervention
  – 99 Iliac and 5 Femoral Veins
• 1 yr Primary Patency of 60%
  – Lysis Grade predictive of 1 yr patency
    • Grade III:  79%
    • Grade II:  58%
    • Grade I:  32%
Catheter-directed Thrombolysis for Iliofemoral DVT improves health-related quality of life

- 98 Retrospective patients from a Venous registry filled out an 80 question HRQOL questionnaire.
- All 98 treated no less than 6 months prior.
- 68 patients in Thrombolysis arm.
  - 53 yo +/- 17 yrs.
- 30 patients in Anticoagulation arm
  - 61 yo +/- 6 yrs.
  - Treated with Heparin with conversion to Coumadin therapy.
Catheter-directed Thrombolysis for Iliofemoral DVT improves health-related quality of life

• Results:
  – In the two groups there was no difference in quality of life prior to onset of DVT.
  – Patients treated with catheter directed Thrombolysis
    • Better physical function: \((p= .046)\)
    • Less stigma: \((p= .033)\)
    • Less health distress: \((p= .022)\)
    • Fewer post-Thrombotic symptoms: \((p= .006)\)
  – Less stigma, health effects and fewer symptoms remained significant at 22 months.
  – Patients who failed lysis scored the same as those in the anticoagulation arm.
A clinical trial of vena caval filters in the prevention of pulmonary embolism in patients with proximal deep-vein thrombosis

PREPIC Study Group

400 patients with proximal DVT randomly assigned
vena caval filter (200)
o no filter (200)

all pts were anticoagulated
(unfractionated heparin 205, LMWH 195)

## Table 3. Principal End Points during the Two-Year Follow-up Period in the Filter and No-Filter Groups.*

<table>
<thead>
<tr>
<th>Event and Time of Occurrence</th>
<th>Filter</th>
<th>No Filter</th>
<th>Odds Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomatic pulmonary embolism†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrollment—3 mo</td>
<td>2</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;3 mo—1 yr</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;1—2 yr</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>6 (3.4)</td>
<td>12 (6.3)</td>
<td>0.50 (0.19–1.33)</td>
<td>0.16</td>
</tr>
<tr>
<td>Recurrent deep-vein thrombosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrollment—3 mo</td>
<td>9</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;3 mo—1 yr</td>
<td>8</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;1—2 yr</td>
<td>20</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>37 (20.8)</td>
<td>21 (11.6)</td>
<td>1.87 (1.10–3.20)</td>
<td>0.02</td>
</tr>
<tr>
<td>Major bleeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrollment—3 mo</td>
<td>11</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;3 mo—1 yr</td>
<td>5</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;1—2 yr</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>17 (8.8)</td>
<td>22 (11.8)</td>
<td>0.77 (0.41–1.45)</td>
<td>0.41</td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrollment—3 mo</td>
<td>15</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;3 mo—1 yr</td>
<td>12</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;1—2 yr</td>
<td>16</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>43 (21.6)</td>
<td>40 (20.1)</td>
<td>1.10 (0.72–1.70)</td>
<td>0.65</td>
</tr>
</tbody>
</table>
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- Complications
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  - Two Intracranial Hemorrhages with one being fatal.

Study Performed prior to removable filters and broad use of mechanical devices.
• G2 and G2X
  – 28mm cava
  – Jugular removal
  – Removal 1 to 161 days
  – Animal study 12 weeks
- OptEase
  - 30mm Cava
  - Femoral Retrieval
  - 18 days
Indication for IVC Filter Placement
To Quote Tony Smith

Where are all the Bodies?

VASCULAR IMAGES

Fatal pulmonary embolus associated with asymptomatic popliteal venous aneurysm
Fatal pulmonary embolus associated with asymptomatic popliteal venous aneurysm

Mitchell Wayne Cox, MD, Shyam Krishnan, MD, and Gilbert Aidinian, MD, Bethesda, Md

A 64 year-old male presented with chronic pain of the right knee and initial plain films revealed a soft tissue mass in the popliteal fossa (Fig A). Subsequent MRI demonstrated a torn medial meniscus as well as an incidental 5cm popliteal venous aneurysm (Fig B). Duplex ultrasound showed femoral and popliteal vein reflux on the affected side, but no thrombus or obstruction in the deep veins of either leg (Fig C). He reported only occasional symptoms of venous insufficiency, and to exam, the leg was without varicosities, edema, or ulceration.

An ascending venogram was obtained to further characterize the aneurysm’s morphology and confirm patency of the outflow in order to plan the operative approach (cover). This study depicted a saccular aneurysm of an otherwise normal femoral/popliteal vein which would be amenable to simple resection and lateral venorrhaphy. Given an incidentally discovered popliteal aneurysm which was without thrombus, we scheduled the repair electively. Unfortunately, ten days following venogram the patient had a sudden arrest at his residence and could not be revived. Autopsy revealed multiple bilateral subsegmental pulmonary emboli which were identified as the cause of death.

Popliteal venous aneurysms are a rare entity, with slightly more than 100 cases documented in the world literature. Approximately 75% of
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Devices

- AngioJet
- Trellis
- Trerotola
- Clearway
- Guiding Sheath
- EKOS
- Balloon

Issues:
- 1. Cost?
- 2. Time?
- 3. Effective?
- 4. Complications?
- 5. Cost?
Arrow-Trerotola Percutaneous Thrombolytic Device (PTD)

- Self-expanding 9 mm SS basket
- Spins at ~3000 rpm
- Particles 3 mm in diameter
- Newer over-the-wire version
- Endothelial denudation
Pharmacological and Mechanical Thrombolysis
Rheolytic Thrombectomy Catheters

- These devices induce forces to produce thrombus fragmentation, with or without removal of clot, with AngioJet as the market leader.
- The AngioJet is the only device currently approved for peripheral vascular arterial applications.
- Tested in canine vascular segments:
  - AngioJet (15), Fogarty (4), controls (10)
  - Results: Less endothelial denudation with AJ than with Fogarty (12% vs 42%); no difference from control segments.
  - Embolization: 12% of clot volume; 99.8% <100 μm (none >1000 μm)
In Vitro Analysis of Downstream Particulates with Mechanical Thrombectomy Devices: Comparison of 20-kHz Sonothrombolytic and Rotating Dispersion Wire Systems

Gloria M. Salazar, MD, Salomao Faintuch, MD, Steve R. Gladstone, MS, and Elvira V. Lang, MD

PURPOSE: To assess the potential of macroembolization, the authors compared the downstream particulate profile generated with use of two thrombectomy devices, a 20-kHz ultrasound-based sonothrombolytic (ST) device and a rotating dispersion wire (RDW).

MATERIALS AND METHODS: An arterial flow model was pressurized to 100 mm Hg and perfused with 1,000 mL/min normal saline. Tubing containing 7-mm × 30-cm bovine thrombus proximal to a 75% stenosis was inserted distal to a nonstenosed bypass. The effluent was passed successively through 1,000-, 500-, and 200-μm filters and a particle analyzer. The ST device and RDW were activated for 10 and 15 minutes, respectively, in randomized sequences of experimental sets with and without the use of 10-mg tissue-type plasminogen activator (tPA). Results are expressed as means and standard deviations of fraction of lysed clot in each category.

RESULTS: The ST device produced significantly fewer particulates larger than 1,000 μm (1.3% ± 1.4) than did the RDW (12.1% ± 8.9) (P < 0.01). A similar effect was also noted with 500-μm particulate size (P < 0.01) and at 200-μm particulate size (P < 0.01).

CONCLUSIONS: In this in vitro model, the use of the ST device resulted in fewer large particulates than did the use of the RDW, with more clots being reduced to less than 10 μm.
Clinical Experience: Mechanical Thrombectomy for DVT

- Experience as reported by K. Kasirajan, MD
  - 17 patients with extensive DVT treated with AngioJet
    - 7 of 17 patients had <50% thrombus removal
    - 9 patients thrombolytics used achieving <90% thrombus removal
    - 4 & 11 month recurrent-free survival rate, 81.6% & 51.8%
    - No complications relating to use of the AngioJet system

- Conclusion: PMT with adjunctive thrombolytic is less invasive, low risk option in patients with extensive DVT
Clinical Experience: Mechanical Thrombectomy for DVT

- 44 patient retrospective study
  - Patients with DVT using AngioJet mechanical thrombectomy

- Key Findings
  - Mean AngioJet run time was 191 seconds
  - 54.5% of patients received thrombolysis administered pre-AngioJet
  - 56.8% of patients received adjunctive thrombolysis
  - No major complications were related to the use of AngioJet

Clinical Experience: Mechanical Thrombectomy for DVT

- Response to AngioJet Treatment

<table>
<thead>
<tr>
<th>Response to Treatment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete (&gt; 90% of initial thrombus removed)</td>
<td>50%</td>
</tr>
<tr>
<td>Substantial (50% -- 90% of initial thrombus removed)</td>
<td>16%</td>
</tr>
<tr>
<td>Partial (&gt; 50% of initial thrombus removed)</td>
<td>25%</td>
</tr>
<tr>
<td>No Response</td>
<td>9%</td>
</tr>
</tbody>
</table>
Conclusions: Addition of lytic agent to PMT facilitates thrombus extraction, decreases overall interventional treatment time, and improves patient outcomes.
Pharmacomechanical thrombectomy for treatment of symptomatic lower extremity deep venous thrombosis: Safety and feasibility study

Ruth L. Bush, MD, Peter H. Lin, MD, Jeffrey T. Bates, MD, Leila Mureebe, MD, Wei Zhou, MD, and Alan B. Lumsden, MD, Houston, TX; and New York, NY

Purpose: The current standard of care for deep venous thromboembolism (DVT) is anticoagulation; however, this treatment method does not rapidly relieve clot burden or clinical symptoms. We describe a rapid and effective method of thrombus removal, with simultaneous percutaneous mechanical thrombectomy (PMT) and thrombolysis.

Methods: Over 26 months 20 patients (22 men, 2 women; mean age, 52 ± 6 years [range, 38-79 years]) with extensive lower extremity DVT were treated with PMT with the AngioJet thrombectomy device in combination with lytic agent (urokinase, tissue plasminogen activator, or reteplase) added to the infusion. Three patients underwent treatment twice, because of recurrent DVT. The primary end point was angiographic evidence of restoration of venous patency at completion of the procedure. Complications, recurrent ipsilateral DVT, and improvement in clinical symptoms were evaluated.

Results: Complete thrombus removal was obtained in 15 procedures (65%), and partial resolution in the remaining 8 procedures (35%). Inciting occlusive lesions responsible for acute DVT were revealed in 14 patients (61%), and angioplasty with or without stenting was performed when necessary. In the 8 procedures with partial resolution additional catheter-directed thrombolysis was carried out on average for 5.7 hours, with further thrombus reduction. Overall, immediate (<24 hours) improvement in clinical symptoms was noted in 17 patients (74%). There were no complications related to either PMT or the short duration of lytic agent infusion. At average follow-up of 10.2 ± 0.3 months (range, 3-26 months), 3 patients had recurrent ipsilateral DVT, and underwent repeat treatment.

Conclusions: Addition of lytic agent to PMT facilitates thrombus extraction, decreases overall interventional treatment time, and improves patient outcomes. In addition, definitive management of underlying anatomic lesions can be performed in the same setting. Further outcome measures are necessary to study the long-term efficacy of this treatment method on preservation of valve function, reduction of chronic venous insufficiency, and improved quality of life. (J Vasc Surg 2004;40:965-70.)
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>XMI* 104287-001 pump set 102184-001</td>
<td>OTW</td>
<td>2mm</td>
<td>135cm</td>
<td>4F</td>
<td>0.014&quot;</td>
<td>6F ≥ .068&quot;</td>
<td>40mL/min</td>
<td>5 min/200mL</td>
<td>10 min/400mL</td>
<td>2.5-3.5mm</td>
<td></td>
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<tr>
<td>SpiroFlex* 106439-001 pump set 102184-001</td>
<td>OTW</td>
<td>3mm</td>
<td>35cm</td>
<td>5F</td>
<td>0.014&quot;</td>
<td>7F ≥ .076&quot;</td>
<td>60mL/min</td>
<td>5 min/300mL</td>
<td>10 min/600mL</td>
<td>3-6mm</td>
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<tr>
<td>XVG* 103813-001 pump set 102184-001</td>
<td>RX</td>
<td>3mm</td>
<td>135cm</td>
<td>5F</td>
<td>0.014&quot;</td>
<td>7F ≥ .076&quot;</td>
<td>60mL/min</td>
<td>5 min/300mL</td>
<td>10 min/600mL</td>
<td>3-6mm</td>
<td></td>
</tr>
<tr>
<td>XPEDEIOR® 104307-001 pump set 102184-001</td>
<td>OTW</td>
<td>3mm</td>
<td>120cm</td>
<td>6F</td>
<td>0.035&quot;</td>
<td>8F ≥ .086&quot;</td>
<td>60mL/min</td>
<td>5 min/600mL</td>
<td>10 min/600mL</td>
<td>4-12mm</td>
<td></td>
</tr>
<tr>
<td>DVX® 105420-001 pump set 102184-001</td>
<td>OTW</td>
<td>3mm</td>
<td>90cm</td>
<td>6F</td>
<td>0.035&quot;</td>
<td>8F ≥ .086&quot;</td>
<td>60mL/min</td>
<td>4 min/240mL</td>
<td>8 min/480mL</td>
<td>4-12mm</td>
<td></td>
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<tr>
<td>AVX® 105429-001 pump set 102184-001</td>
<td>OTW</td>
<td>3mm</td>
<td>50cm</td>
<td>6F</td>
<td>0.035&quot;</td>
<td>8F ≥ .086&quot;</td>
<td>60mL/min</td>
<td>5 min/600mL</td>
<td>10 min/600mL</td>
<td>4-12mm</td>
<td></td>
</tr>
</tbody>
</table>

* Series 3000 Catheters require pump set (Order Number 102184-001), sold separately. DO NOT ATTEMPT to install a Series 3000 pump set into the Ultra console as it will damage the pump drawer.

The AngioJet System includes several catheter models that are marketed for thrombectomy of coronary arteries and bypass grafts, A.V. access, cardiac, and peripheral arteries and veins. See product Information for Use for specific and complete prescribing information.

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Medrad/Possis Angiojet
HPI

• 42 yo female
• Developed PE s/p hysterectomy for fibroids
• Heparin started
• Patient developed pelvic hematoma
• Bard G2 filter placed
Clinical Course

• Patient presented 2 wks later with SOB, abd pain, and leg weakness
Clinical Course

- Transferred to Duke for thrombolysis
Lysis Check #1
Lysis Check #4
Follow up CT
3 weeks later
1 Year
Iliac Stenting
Course Objectives

- DVT Incidence and Etiology
- Imaging.
- Anticoagulation
- Systemic Thrombolysis
- Catheter Directed Thrombolysis
- To Filter or Not to Filter? That is the question.
- Mechanical Thrombectomy Devices.
- Venous Intervention.
Initial Presentation

HPI: 48 yo male with no significant medical history presents with 3 day history of low back pain. Patient initially noticed a pop and onset of pain while hanging a tire 3 days prior. Pain was better following day, but became night before admission. Additionally, pain in the medial right thigh. Used tramadol and aleve with some relief. Noticed swelling in both legs day of admission, worse on sitting.

PMH: obesity.

Surgeries: none.

FH: non contributory

SH: no tobacco, no alcohol, no drugs.
Presentation #2

HPI: Presented to ED again 2 days later. Swelling on L leg had increased significantly with increased pain. No fevers, chills, or redness. Able to ambulate.

PHYSICAL EXAM:
GENERAL APPEARANCE: No acute distress, obvious mild discomfort from pain.
VITALS: 95% on RA, BP 160/76, HR 94, RR 20, 36.3 C
EXTREMITIES: good pulses in all extremities, swelling and tenderness in the extremities, with no edema.
SKIN: warm, dry, good color, no rashes.
NEURO: motor intact, sensory intact.
Bedside U/S: Bilateral femoral and popliteal veins contained thrombus
Ultrasound

Bilateral lower extremity duplex

Indication: Left leg swelling. Rule out deep vein thrombosis

Technique: Gray-scale ultrasound with and without compression and color Doppler evaluation were performed of the deep veins of bilateral lower extremities from the level of the common femoral veins to the level of the popliteal veins.

Findings/ Impression:
Occlusive thrombus is present throughout the common femoral, superficial femoral, popliteal, greater saphenous veins bilaterally. No flow is visible throughout the deep venous system. The proximal extent of thrombus is not visible bilaterally.
49 y.o Male 2 weeks onset Bilateral lower extremity Swelling
49 y.o Male 2 weeks onset Bilateral lower extremity Swelling
Trellis Catheter
12 mm gradient across the stenosis in the IVC just below the renal veins. Narrowing confirmed with intravascular ultrasound.
14 mm Stent angioplastied to 14 mm.
Celect Filter replaced and scheduled for removal after surgery or biopsies complete.
This is his cavagram on 12/1/2008. He is symptom free.

Ultrasound of the legs is recommended prior to stopping Coumadin.
Case Summary

- **Bilateral Popliteal Access**
  - 8 French Sheaths
  - May Consider Lesser Saphenous
- **Right Jugular Access**
  - 8 French for Filter Placement
  - 11 French for Caval Stenting
  - 8 French for Filter Retrieval
SVC Interventions

- 40 YO
- Head and Neck Swelling
- Cannot tie shoes.
- Sleeps in chair
Dynamic Twist MRA-V
Rt Basilic Vein 8 French Raabe
Right Femoral Vein 7 French Sheath
Stiff Glide through Occlusion from below. 20 mm Snare from Rt Arm for through and through wire access
Stenting of SVC
Summary

- Rt Arm 8 French Raabe
- Right groin 8 French Raabe
- 9 x 58 mm iCast
- 12 x 40 Atlas Balloon
Ideal Patient Selection

- Acute (Less than 10 days)
- Iliofemoral DVT
- Patient less than 60 y.o.
- No HTN
- Image confirmation of extent
- Symptomatic
- Phlegmasia Cerulea Dolens
Course Objectives

- DVT Incidence and Etiology
- Imaging
- Anticoagulation
- Systemic Thrombolysis
- Catheter Directed Thrombolysis
- To Filter or Not to Filter? That is the question.
- Mechanical Thrombectomy Devices.
- Venous Intervention.
HISTORY OF PRESENT ILLNESS: The patient is a 79-year-old female who felt low back pain and hematuria in 6/03. Reportedly, laboratory studies and urine examination were negative by her primary care physician and her symptoms resolved spontaneously. In early 7/03, she developed new left lower extremity edema which was initially evaluated with ultrasound, which was negative for DVT. Later in 7/03, she developed left lower quadrant pain which was initially evaluated with KUB, which reportedly showed LS spine degenerative changes; however, a follow-up abdominal CT scan showed a left lower quadrant mass measuring 8.5 x 6 cm encasing the left ureter and causing blockage as well as encasing the left common iliac artery and vein. She underwent fine needle aspiration of the retroperitoneal mass in Virginia, 7/25/03, with the subsequent diagnosis of high grade malignant neuroendocrine neoplasm. On 8/1/03, she underwent placement of a left ureteral stent. She was found to have exacerbation of left lower extremity swelling and on US demonstrated Iliofemoral DVT.
Venous Thrombosis
Thrombolysis

• Future
  – Combination Mechanical and Chemical
    • TNK
    • 24 hour floor based therapy
    • Outpatient management of anticoagulation
    • Need for randomized studies
    • Direct Thrombin Inhibitors
Course Objectives
“Tying is Like Kissing Your Sister”
Catheter Directed Thrombolysis

Abraham Thomas, MSIV

10/8/2008

Basic Radiology Clerkship
24 yo male with 1 day history of right arm swelling. Works as a chef and a lifeguard. Swelling increased during the day.
Symptoms improved then worsened 2 days later.
Returns 2 days later (4 days post initial Rx) with ↑ symptoms
Arm abducted
3 weeks post, mild ↑ symptoms
Case Presentation:
Deep Venous Thrombolysis

Jason Harris, MD
Presentation

• 50 year old female w/o sig PMH presents with pain and swelling from LLE DVT after EVLT for varicose veins.
May-Thurner Syndrome

- In 1957, May and Thurner found in 22% of 430 autopsy patients (1)

- DVT from chronic vein compression by overlying CIA
  - 2 mechanisms:
    - Anatomic physical entrapment
    - Intimal hyperplasia from chronic pulsatility

- True prevalence unknown and US may underestimate (3)
May-Thurner Syndrome

• Symptoms:
  – Acute: leg swelling, DVT, phlegmasia cerulea dolens, PE
  – Chronic: post-thrombotic syndrome - varicosities, chronic venous stasis ulcers (3,4)
May-Thurner Syndrome

- **Treatment:**
  - Historically anticogulation
  - **Surgical options:**
    - vein-patch angioplasty with excision of intraluminal bands
    - division of the RCIA and relocation behind the LCIV or IVC
    - contralateral SVBG to ipsilateral CFV with creation of a temp AVF (Palma crossover) (5,7).
    - Long term patency 40%–88% (5)
May-Thurner Syndrome

• Treatment:
  – EV treatment options supported by growing literature
  • Mechanical thrombectomy
    – Aspiration/Fragmentation
    – Rheolytic therapy
  • Chemical thrombolysis
  • Angioplasty/stent
    – re-thrombosis in 13% of patients who had stents and 73% in those who did not.
    – 5 year patency rates > 60% in recent studies
References

6. Ehrich WE, Krumbhaar EB. A frequent obstructive anomaly of the mouth of the left common iliac vein. Am Heart J 1943; 26:737-750.