Deep Vein Thrombosis
And
Pulmonary Embolism

October 3rd 2017
VTE Epidemiology

- Most common cause of preventable death in hospitalized patients

- 150,000 to 200,000 deaths per year; ~1/3 in perioperative patients


- AHRQ: VTE prevention is number 1 priority to improve safety in hospitals
Annual Incidence Of VTE By Age And Sex

Richard H. White Circulation. 2003;107:I-4-I-8

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Risk Factors: Virchow’s Triad

• Stasis
  – Immobility
  – Congestive heart failure

• Injury
  – Surgery (especially major orthopedic and pelvic)
  – Trauma

• Thrombophilia
  – Cancer
  – Oral contraceptives
  – Hereditary states (factor V Leiden, PT mutations)
Deep Vein Thrombosis

- Very common disorder

- Third most common cause of cardiovascular morbidity and mortality
  - After coronary artery disease and stroke

- Approximately 600,000
  - Inpatient/outpatient visits each year in US
Acute Lower Extremity DVT

• Proximal Lower extremity DVT
  – 80% of these cases
  – Any DVT above the popliteal vein
    • Femoropopliteal
    • Iliofemoral
    • Caval

• Calf DVT – Distal DVT
Recanalization Rates

- Iliofemoral: 19%
- Femoral: 50%
- Tibial/Popliteal: 95%

Elkof and Rutherford Vascular surgery
20 -50% - Proximal LE DVT

Post Thrombotic Syndrome (PTS)

- Pain/heaviness
- Swelling and edema
- Itching/paresthesia
- Hyperpigmentation and stasis dermatitis
- Lipodermatosclerosis
- Ulcers

Schreiber, D. Deep venous thrombosis and thrombophlebitis. www.emedicine.com
Post Thrombotic Syndrome

• Marked impairment in Quality of life
  – Which parallels that of COPD or CHF

• Huge Economic Burden
  – 2.4 billion dollars annually in US
  – 200 million workdays lost annually in US

Vedantham S; Semin Respir Crit Care Med 2008;29:56–65
Anticoagulation

• Prevents - Clot propagation

• Reduces - Risk of pulmonary embolism

• Reduces – Risk of Post Thrombotic Syndrome (PTS)
Duration of Anticoagulation

- Provoked VTE - 3 months
- Unprovoked VTE - Extended
  - After stopping - start aspirin
- Recurrent VTE on anticoagulation
  - LMWH
VTE in Cancer Patients

- LMWH - first three months
- Anticoagulate as long as cancer is active
NOACs versus VKA

Advantages
- Rapid onset of action
- Predictable anticoagulant effect
- No need for routine monitoring
- Specific enzyme target
- Low food/drug interactions

Disadvantages
- No antidote
- Rx Cost
NOACs

- Direct Thrombin Inhibitor
  - Dabigatran
    - 150 mg and 75 mg capsules; Twice a day

- Factor Xa Inhibitors
  - Rivaroxaban
    - 20 mg, 15 mg, and 10 mg tablets; Once daily with dinner
  - Apixaban
    - 5mg and 2.5 mg tablets; Twice a day
  - Edoxaban
    - 60mg and 30 mg tablets; Once daily
NOAC Choice

Choose the OAC drug considering the patient profile and/or preferences

- **Recurrent Stroke/TIA despite well controlled VKA**: Consider agent with superior efficacy for preventing both IS and hemorrhagic stroke.
- **Patient has moderate-severe renal impairment** (e.g., CrCl 15-49 mls/min): Consider also increased risk of bleeding.
- **High risk of GI bleeding**: Consider agent with lowest bleed incidence.
- **GI symptoms or dyspepsia** (HAS-BLED ≥3):
  - D150
  - If CrCl <15 mls/min, VKA

**Apixaban now approved for HD patients**

*Figure 1. Selecting the Optimal Oral Anticoagulant for Stroke Prevention in Atrial Fibrillation: Some Suggestions for Initial Treatment OptionsA = apixaban; CrCl = creatinine clearance; D = dabigatran (D75, 75 mg bid does in United States only;*
# NOAC Reversal Agents

<table>
<thead>
<tr>
<th>Company</th>
<th>Agent</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boehringer-Ingelheim Pharmaceuticals, Inc.</td>
<td>Idarucizumab: fully humanized Fab</td>
<td>Dabigatran only</td>
</tr>
<tr>
<td>Portola Pharmaceuticals, Inc.</td>
<td>Andexanet alpha: recombinant, modified human FXa</td>
<td>Factor Xa Inhibitors (rivaroxaban; apixaban; edoxaban)</td>
</tr>
<tr>
<td>Perosphere Inc.</td>
<td>Aripazine (PER977): di-arginine piperazine</td>
<td>All NOACs (dabigatran; rivaroxaban; apixaban; edoxaban)</td>
</tr>
<tr>
<td></td>
<td>Ciraparantag</td>
<td>UFH, LMWH, fondaparinux</td>
</tr>
</tbody>
</table>

NOACs and surgical procedures

- Minor procedures - Hold for 24 hours
- Major procedures - Hold for 48 hours
- Renal Dysfunction - Longer hold times depending on GFR
Question

• What additional treatments can be considered to reduce her risk of post thrombotic syndrome?
  – *Knee high Compression stockings (30-40 mmHg)*
  – *Catheter-based thrombus removal*
Surgical Thrombectomy

Surgical Thrombectomy

- Lack of surgical expertise
- Risks of general anesthesia
- Slightly increased risk of PE
Systemic Thrombolysis - PTS

Cochrane Analysis of trials that reported PTS

PTS – RR 0.7 (95% CI 0.5 – 0.9)

NNT – 3
Systemic Thrombolysis - Safety

![Bar chart showing major bleeding rates with P=0.04. Intravenous tPA has a rate of 14%, and Heparin has a rate of 4%.]

Turpie et al Chest 1990: 172S - 175S
Catheter-directed Thrombolysis (CDT)

- Place a infusion catheter (Multiple sideholes)

- Infuse thrombolytic - 24 to 96 hrs
CDT and PTS – 5 year

NNT 2

78%

30%

p <0.001

0 – 2 CEAP Score

CDT plus anticoagulation
Anticoagulation alone

AbuRahma et al Ann Surgery 2001:233; 752-760
• Sustained benefit at 5 years

• NNT - 4
Pharmacomechanical Thrombolysis

- Reduce the procedure time
- Reduce the dose of thrombolytics
- Even allow single session treatments
40 Year-old female

- Left Leg swelling and pain

- ER – Extensive left lower extremity DVT from iliac to popliteal veins

- Discharged on LMWH and warfarin from ER
Ultrasound guided transpopliteal vein access
May Thurner syndrome

Pre-stent

Post Stent
Pre-Pharmacomechanical thrombectomy  Post Pharmacomechanical thrombectomy
Intravenous lesions (ridges/webs/chords)

Eliahou R et al. Radiographics 2012;32:E33-E49
Intravascular Ultrasound

Proximal Iliac Vein

Iliac Vein Compression
PTS is very common (>50%) after IVC filter placement in DVT patients


Postthrombotic syndrome in relation to vena cava filter placement: a systematic review.
IVC Filters and PTS
IVC Filters and PTS
Inferior Vena Cava Filter Thrombosis and Suprarenal Caval Stenosis

A Double Whammy

Mohamad Alkhouli, MD, Irfan Shafi, MD, Riyaz Bashir, MBBS

Angiovac Thrombectomy

- IVC/RA junction
- Large thrombus
- IVC filter
- Suprarenal IVC
- Right renal vein
- IVC filter
- Left renal vein
- IVC filter

Angiovac Thrombectomy

Creatinine level vs. time

Daily serum creatinine levels
Chronic Lifestyle Limiting Venous Claudication
Upper Extremity
PTS
Acute Pulmonary Embolism

- Estimated 530,000 cases of symptomatic PE annually
- 1% - Cardiopulmonary arrest
- Approximately 300,000 people die every year from acute PE

## Classification

**Acute Pulmonary Embolism**

<table>
<thead>
<tr>
<th>High Risk PE</th>
<th>Massive PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate Risk PE</td>
<td>Submassive PE</td>
</tr>
<tr>
<td>Low Risk PE*</td>
<td>Low Risk PE*</td>
</tr>
</tbody>
</table>

* With or without Saddle or Central Embolism
Interventional Treatment of Pulmonary Embolism

David M. Dudzinski, MD, JD; Jay Giri, MD, MPH; Kenneth Rosenfield, MD, MHCDS

High Risk Acute Pulmonary Embolism

• Shock or hemodynamic compromise
• 5%
• Mortality:
  – Cardiopulmonary arrest - ~ 70%
  – Hypotension requiring pressors - 30%
• Treatment
  – Systemic thrombolysis
  – Catheter-based or surgical thrombectomy

Intermediate Risk (Sub Massive) Acute Pulmonary Embolism

- Signs of Right Ventricular dysfunction with or without elevations in Troponin or BNP.
- 30%
A Spectrum of Short Term Risks

32% In-Hospital Mortality

Unstable

3.4% In-Hospital Mortality

Stable

Becattini C, et al. CHEST 2013;144: 1539
Long Term Risk - Chronic Thromboembolic Pulmonary Hypertension
Intermediate Risk (Sub Massive) Acute Pulmonary Embolism

- Advanced Treatment Options
  - Systemic thrombolysis
  - Catheter-based Thrombus Removal
  - Surgical thrombectomy
Clinical Evidence

Systemic Thrombolysis
Fibrinolysis for Patients with Intermediate-Risk Pulmonary Embolism

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Tenecteplase (N = 506)</th>
<th>Placebo (N = 499)</th>
<th>Odds Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome — no. (%)</td>
<td>13 (2.6)</td>
<td>28 (5.6)</td>
<td>0.44 (0.23–0.87)</td>
<td>0.02</td>
</tr>
<tr>
<td>Death from any cause</td>
<td>6 (1.2)</td>
<td>9 (1.8)</td>
<td>0.65 (0.23–1.85)</td>
<td>0.42</td>
</tr>
<tr>
<td>Hemodynamic decompensation</td>
<td>8 (1.6)</td>
<td>25 (5.0)</td>
<td>0.30 (0.14–0.68)</td>
<td>0.002</td>
</tr>
</tbody>
</table>
## Safety

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Tenecteplase (N = 506)</th>
<th>Placebo (N = 499)</th>
<th>Odds Ratio (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bleeding between randomization and day 7</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major extracranial bleeding</td>
<td>32 (6.3)</td>
<td>6 (1.2)</td>
<td>5.55 (2.3–13.39)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Minor bleeding</td>
<td>165 (32.6)</td>
<td>43 (8.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Major bleeding†</strong></td>
<td>58 (11.5)</td>
<td>12 (2.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke between randomization and day 7</td>
<td>12 (2.4)</td>
<td>1 (0.2)</td>
<td>12.10 (1.57–93.39)</td>
<td>0.003</td>
</tr>
<tr>
<td>Ischemic stroke</td>
<td>2 (0.4)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hemorrhagic stroke‡</strong></td>
<td>10 (2.0)</td>
<td>1 (0.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serious adverse events between randomization and day 30</td>
<td>55 (10.9)</td>
<td>59 (11.8)</td>
<td>0.91 (0.62–1.34)</td>
<td>0.63</td>
</tr>
</tbody>
</table>

*Table 4. Safety Outcomes in the Intention-to-Treat Population.*

† Includes intracranial hemorrhage.

‡ Includes intracranial hemorrhage and subarachnoid hemorrhage.
Reduction in Mortality Thrombolysis

### Odds of Mortality in Patients With Intermediate-Risk Pulmonary Embolism Treated With Thrombolytic Therapy vs Anticoagulation

<table>
<thead>
<tr>
<th>Source</th>
<th>Thrombolytics</th>
<th>Anticoagulants</th>
<th>OR (95% CI)</th>
<th>Favors Thrombolitics</th>
<th>Favors Anticoagulants</th>
<th>Weight, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldhaber et al, 1993</td>
<td>0</td>
<td>2</td>
<td>0.16 (0.01-2.57)</td>
<td></td>
<td></td>
<td>5.3</td>
</tr>
<tr>
<td>Konstantinides et al, 2002</td>
<td>4</td>
<td>3</td>
<td>1.58 (0.35-7.09)</td>
<td></td>
<td></td>
<td>18.4</td>
</tr>
<tr>
<td>IPES, 2010</td>
<td>0</td>
<td>1</td>
<td>0.14 (0.00-7.31)</td>
<td></td>
<td></td>
<td>2.7</td>
</tr>
<tr>
<td>Basu et al, 2011</td>
<td>0</td>
<td>1</td>
<td>0.11 (0.02-0.58)</td>
<td></td>
<td></td>
<td>15.1</td>
</tr>
<tr>
<td>MOPETT, 2012</td>
<td>1</td>
<td>3</td>
<td>0.35 (0.05-2.57)</td>
<td></td>
<td></td>
<td>10.5</td>
</tr>
<tr>
<td>JLTMA, 2013</td>
<td>0</td>
<td>1</td>
<td>0.13 (0.00-6.59)</td>
<td></td>
<td></td>
<td>2.7</td>
</tr>
<tr>
<td>POPCOAT, 2014</td>
<td>1</td>
<td>1</td>
<td>1.08 (0.07-17.53)</td>
<td></td>
<td></td>
<td>5.3</td>
</tr>
<tr>
<td>PEITHO, 2014</td>
<td>6</td>
<td>9</td>
<td>0.66 (0.24-1.82)</td>
<td></td>
<td></td>
<td>40.0</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>26</td>
<td>0.48 (0.25-0.92)</td>
<td></td>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2 = 7.63; P = .37; I^2 = 8\%$

Overall effect: $z = 2.22; P = .03$
## Bleeding Outcomes

<table>
<thead>
<tr>
<th>Outcome of Interest (No. of Studies Reporting)</th>
<th>Thrombolytic Group</th>
<th>Anticoagulant Group</th>
<th>No. Needed to Treat or Harm</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause mortality (16)</td>
<td>23/1061 (2.17)</td>
<td>41/1054 (3.89)</td>
<td>NNT = 59</td>
<td>.01</td>
</tr>
<tr>
<td>Major bleeding (16)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>98/1061 (9.24)</td>
<td>36/1054 (3.42)</td>
<td>NNH = 18</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>ICH (15)</td>
<td>15/1024 (1.46)</td>
<td>2/1019 (0.19)</td>
<td>NNH = 78</td>
<td>.002</td>
</tr>
<tr>
<td>Recurrent PE (15)</td>
<td>12/1024 (1.17)</td>
<td>31/1019 (3.04)</td>
<td>NNT = 54</td>
<td>.003</td>
</tr>
<tr>
<td>Age &gt;65 y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All-cause mortality (5)</td>
<td>14/673 (2.08)</td>
<td>24/658 (3.65)</td>
<td>NNT = 64</td>
<td>.07</td>
</tr>
<tr>
<td>Major bleeding (5)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>87/673 (12.93)</td>
<td>27/658 (4.10)</td>
<td>NNH = 11</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age ≤65 y</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All-cause mortality (11)</td>
<td>9/388 (2.32)</td>
<td>17/396 (4.29)</td>
<td>NNT = 51</td>
<td>.09</td>
</tr>
<tr>
<td>Major bleeding (11)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11/388 (2.84)</td>
<td>9/396 (2.27)</td>
<td>NNH = 176</td>
<td>.89</td>
</tr>
<tr>
<td>Intermediate-risk PE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All-cause mortality (8)</td>
<td>12/866 (1.39)</td>
<td>26/889 (2.92)</td>
<td>NNT = 65</td>
<td>.03</td>
</tr>
<tr>
<td>Major bleeding (8)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>67/866 (7.74)</td>
<td>20/889 (2.25)</td>
<td>NNH = 18</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Rationale for Endovascular Thrombus Removal

• 20 – 30% patients
  • Contraindications for systemic thrombolysis

• Major bleeding rates – 10 - 22%
  – Even after using it in low bleeding risk patients

• Failure of systemic thrombolysis
Devices Available

- Pigtail Catheters (Rotatable – Cook Europe)
- EKOS – Ultrasound Enhanced CDT
- Angioplasty Balloon
- Angiovac – Venovenous Bypass
- Rheolytic thrombectomy –
  - Angiojet
- Aspirex (Straub Medical)
- Amplatz thrombectomy device (Ev3)
Clinical Evidence
Catheter-Directed Thrombolysis
SEATTLE II Study

CT-confirmed PE
- Symptoms ≤ 14 days
- Massive or submassive
- Meets all inclusion and no exclusion criteria

RV enlargement as documented by initial CT
- RV:LV ratio ≥ 0.9

Ultrasound-facilitated fibrinolysis
- t-PA 1 mg/hr for 24 hours (1 device)
- t-PA 1 mg/hr for 12 hours (2 devices)
- TOTAL t-PA Dose = 24 mg

Follow-up at 48 ± 6 hours after start of the procedure
- CT measurement of RV:LV ratio
- Echocardiogram to estimate PA systolic pressure

- Single Arm Study
- Sites = 21
- Total Trial Population = 150

Reduction: RV/LV Ratio

- **Pre-Procedure**: RV/LV Ratio = 1.55, with \( p < 0.0001 \)
- **48 Hours**: RV/LV Ratio = 1.13

Reduction: PA Systolic Pressure

p < 0.0001

Mean PA Systolic Pressure (mmHg)

Pre-Procedure: 51.4
Post-Procedure: 37.5
48 Hours: 36.9

Reduction: Pulmonary Artery Obstruction index

\[ p < 0.0001 \]

Modified Miller Score

Pre-Procedure: 22.5
48 Hours: 15.8

# Clinical Outcomes

<table>
<thead>
<tr>
<th>Clinical outcomes*</th>
<th>N = 150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean length of stay ± SD, days</td>
<td>8.8 ± 5</td>
</tr>
<tr>
<td>In-hospital death, n (%)</td>
<td>3 (2)</td>
</tr>
<tr>
<td>30-day mortality**, n (%)</td>
<td>4 (2.7)</td>
</tr>
<tr>
<td>Serious adverse events due to t-PA, n (%)</td>
<td>2 (1.3)</td>
</tr>
<tr>
<td>IVC filter placed, n (%)</td>
<td>24 (16)</td>
</tr>
<tr>
<td>Intracranial hemorrhage, n (%)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

*All death, serious adverse, and bleeding events were adjudicated by an independent safety monitor.
**N = 149 (1 patient lost to follow-up)
• ULTIMA Trial
  59 patients
  30 – EKOS CDT
    rt-PA dose 20.7 ± 2.5 mg
  29 - Heparin
Reduction in RV/LV ratio (echo)

- **Baseline to 24 hrs**: EKOS+Heparin (0.30) vs. Heparin (0.03, P<0.0001)
- **Baseline to 90 days**: EKOS+Heparin (0.38) vs. Heparin (0.22, P=0.03)
## Secondary endpoint analysis

<table>
<thead>
<tr>
<th>Clinical outcomes at 90 days</th>
<th>EKOS + Heparin (N = 30)</th>
<th>Heparin (N = 29)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>0</td>
<td>1*</td>
<td>3%</td>
</tr>
<tr>
<td>Recurrent venous thromboembolism</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Major bleeding</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Minor bleeding</td>
<td>3**</td>
<td>1§</td>
<td>3%</td>
</tr>
</tbody>
</table>

*rehospitalization and death from advanced pancreatic cancer

**two patients with transient mild hemoptysis without medical intervention, one patient with groin hematoma requiring manual compression

§one patient with transient anal bleeding following endoscopic removal of colon polyp
# Overcoming Intracranial Hemorrhage

<table>
<thead>
<tr>
<th>Study</th>
<th>Intracranial Hemorrhage (Fibrinolysis Group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICOPER (IV Fibrinolysis)</td>
<td>9/304 (3%)</td>
</tr>
<tr>
<td>(Goldhaber SZ, et al. 1999)</td>
<td></td>
</tr>
<tr>
<td>PEITHO (IV Fibrinolysis)</td>
<td>10/506 (2%)</td>
</tr>
<tr>
<td>(Meyer G, et al. 2014)</td>
<td></td>
</tr>
<tr>
<td>SEATTLE II (CDT-EKOS)</td>
<td>0/150 (0%)</td>
</tr>
<tr>
<td>ULTIMA (CDT – EKOS)</td>
<td>0/30 (0%)</td>
</tr>
<tr>
<td>Kucher, et al. 2014</td>
<td></td>
</tr>
</tbody>
</table>
Temple Experience

Catheter-directed Thrombolysis
69 Year old man with sudden onset Shortness of Breath

- Normotensive
- Enlarged Right Ventricle with Hypokinesis
- Elevated Troponin
Bilateral EKOS catheter placement
Repeat CTA

- Pulmonary Obstruction index; 100 to 46
- Cardiac Index; 2.6 to 3.6
- PA systolic pressure; 60 – 50.
- RV/LV Ratio; 1.1 to 0.9
Cardiac Effects

Pre EKOS CDT  Post EKOS CDT
CTA – 3 Months
Saddle Embolus

Pre EKOS CDT

Post EKOS CDT
Temple Experience – 50 patients

Pulmonary Artery Systolic pressures

Pre-Thrombolysis

Post Thrombolysis

P=0.002

Pre-Thrombolysis

Post Thrombolysis
Temple Experience
Improvement in Cardiac Index

Cardiac Index

Pre-Thrombolysis

Post-Thrombolysis

$P=0.001$
Temple Experience

RV:LV Ratio Echocardiogram

P=0.002
Temple Experience

Pulmonary Occlusion Index

P = 0.00004

Pre-Thrombolysis
Post-Thrombolysis

Pulmonary Occlusion Index
Temple Experience – 50 patients

Complications

• One Groin Hematoma – requiring blood transfusion

• No Intracranial Hemorrhage
Pulmonary Artery Balloon Angioplasty
Pressure wire guided BPA

PRE BPA

POST BPA
Interventional Management of Venous Thromboembolism: State of the Art

Harish Jarrett¹
Riyaz Bashir²

OBJECTIVE. The purpose of this article is to describe the indications for and approach to catheter-based treatment of acute venous thromboembolism (VTE).

CONCLUSION. Catheter-based treatment of VTE is a viable adjunct to anticoagulant therapy and is being rapidly adopted around the United States. Early data suggest that these therapies reduce postthrombotic sequelae and improve quality of life, but bleeding events are still frequent, particularly at low-volume centers. Protocols need to be standardized to improve patient care.

Harish Jarrett, Riyaz Bashir AJR 2017; 208:1–16
3rd Annual Meeting of the PERT Consortium

June 22, 2017 | Royal Sonesta Boston

REGISTRATION NOW OPEN!
3rd Annual Symposium
PULMONARY EMBOLISM
What Is Known, and What We Need to Know
State-of-the-Art and Scientific Update
June 23–24, 2017
Royal Sonesta Boston
40 Edwin H. Land Boulevard
Cambridge, MA

For Members and Potential Members of the PERT Consortium

Sponsored by: The National PERT Consortium & the Massachusetts General Hospital Pulmonary Embolism Response Team
Conclusion

• In massive PE - Thrombolysis first line treatment

– Patients who have a contraindication for fibrinolysis or are unstable despite fibrinolysis.
  • Catheter embolectomy/fragmentation or
  • Surgical embolectomy should be considered
Do We Have Enough Evidence Now? CDT and Sub-Massive PE

- We do have enough evidence to offer Catheter-Directed thrombolysis in carefully selected patients

What about Level I Evidence – None PE-TRACT Trial
Temple Venous Thromboembolism Program
Temple Venous Thromboembolism Program
Multi-disciplinary Temple Acute PE Team

- **Pulmonary**
  - Sheila Weaver MD
  - Nathaniel Marchetti MD

- **Cardiology**
  - Paul Forfia MD
  - Anjali Vaidya MD
  - Vikas Aggarwal MD
  - Riyaz Bashir MD

- **CT Surgery**
  - Yoshi Toyoda MD

- **Radiology**
  - Chandra Dass MD
  - Gary Cohen MD

- **Emergency Medicine**
  - Manish Garg MD
PE-TRACT Study

- Randomized Multicenter nationwide Study of Sub-massive Pulmonary Embolism randomizing to Catheter-based Thrombus Removal versus Anticoagulation Alone.

Under NIH Review
Conclusions (I)

• In massive PE - Thrombolysis first line treatment

  – Patients who have a contraindication for fibrinolysis or are unstable despite fibrinolysis.

  • Catheter embolectomy/fragmentation or

  • surgical embolectomy should be considered
Conclusions

• In submassive PE patients

  – consider catheter-directed thrombolysis particularly ultrasound enhanced thrombolysis.