What Can We Do For “Intermediate Risk” Pulmonary Embolism

Dr Alex West

Respiratory Consultant
Guy’s and St Thomas’ Hospital
London
Declarations - none
Definitions of PE – “size”

Formally known as...
- massive
- sub-massive
- non-massive
Definitions of PE – “size”

Now know as…
- High Risk
- Intermediate Risk
- Low Risk
Page 1: Investigation for Suspected and Confirmed Acute Pulmonary Embolism (PE) for non-pregnant patients

N.B. If patient hypotensive and PE suspected, see page 3 for management and contact Clinical Response team (CRT)

Assess clinical probability of PE using Wells Score (see table A). Order:
- D-Dimer
- Coagulation screen
- Full Blood Count
- Renal profile and electrolytes
- Oxygen saturations
- Troponin
- ECG
- Chest X-ray.

PE unlikely according to WELLS score (PE score ≤4)

D-dimer NEGATIVE

PE EXCLUDED

Requires no further imaging or anticoagulation. Seek alternative diagnosis

D-dimer POSITIVE

PE likely according to WELLS score (PE score >4)

Perform VQ SPECT/CTPA (see table B)

VQ SPECT /CTPA negative

VQ SPECT /CTPA positive OR scan delayed = TREAT AS PE

PE DIAGNOSED

For management of pregnant patients with PE, refer to Management of thrombosis and thromboprophylaxis in pregnancy and the puerperium guideline

Investigation and management of suspected and confirmed acute PE vs 11 DTC submission 5 September 2018.
“Risk”..... Mortality

C: Pulmonary embolism severity index (PESI) score is a clinical prediction tool to risk stratify patients with PE.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>+ 1 per year</td>
</tr>
<tr>
<td>Male sex</td>
<td>+10 points</td>
</tr>
<tr>
<td>Cancer</td>
<td>+30 points</td>
</tr>
<tr>
<td>Chronic heart failure</td>
<td>+10 points</td>
</tr>
<tr>
<td>Pulse rate ≥ 110 bpm</td>
<td>+20 points</td>
</tr>
<tr>
<td>Systolic blood pressure &lt;100mmHg</td>
<td>+30 points</td>
</tr>
<tr>
<td>Respiration rate &gt;30 breaths/minute</td>
<td>+20 points</td>
</tr>
<tr>
<td>Temperature &lt;36°C</td>
<td>+20 points</td>
</tr>
<tr>
<td>Altered mental state</td>
<td>+60 points</td>
</tr>
<tr>
<td>Arterial oxyhaemoglobin saturation &lt;90%</td>
<td>+20 points</td>
</tr>
</tbody>
</table>

PESI score (ESC guidelines)

<table>
<thead>
<tr>
<th>PESI score</th>
<th>30 day Mortality risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>PESI I ≤ 65</td>
<td>Very low mortality risk</td>
</tr>
<tr>
<td></td>
<td>0-1.6 %</td>
</tr>
<tr>
<td>PESI II 66-85</td>
<td>Low mortality risk</td>
</tr>
<tr>
<td></td>
<td>1.7-3.5 %</td>
</tr>
<tr>
<td>PESI III 86-105</td>
<td>Moderate mortality risk</td>
</tr>
<tr>
<td></td>
<td>3.2-7.1 %</td>
</tr>
<tr>
<td>PESI IV 106-125</td>
<td>High mortality risk</td>
</tr>
<tr>
<td></td>
<td>4.0-11.4 %</td>
</tr>
<tr>
<td>PESI V &gt; 125</td>
<td>Very high mortality risk</td>
</tr>
<tr>
<td></td>
<td>10.0-24.5 %</td>
</tr>
</tbody>
</table>
Page 4: Management of Low risk Pulmonary Embolism in Non-Pregnant Patients

- for cancer-associated thrombosis (CAT), please refer to 'management of cancer-associated thrombosis (CAT) guideline

What is the patient’s renal function? Use the Cockcroft-Gault equation to calculate creatinine clearance

Creatinine clearance ≤15ml/minute
Admit and prescribe unfractionated heparin infusion

Refer to ‘Adult unfractionated heparin infusion’ guideline relevant to your clinical area

Creatinine clearance >15ml/minute
If no contra-indication to rivaroxaban (see box A)
Prescribe rivaroxaban, depending on renal function

Creatinine clearance 15-29ml/minute:
If no contraindications (see A)
Prescribe:
Initial dose:
Rivaroxaban 15mg BD orally for 3 weeks
Followed by maintenance dose:
Rivaroxaban 15mg OD thereafter

Creatinine clearance >30ml/minute:
If no contraindications (see A)
Prescribe:
Initial dose:
Rivaroxaban 15mg BD orally for 3 weeks
Followed by maintenance dose:
Rivaroxaban 20mg OD orally thereafter

If contraindications to rivaroxaban (see box A) AND creatinine clearance >15ml/minute:
Prescribe dalteparin 200 units/kg OD according to patient weight for FOUR weeks

<table>
<thead>
<tr>
<th>Weight</th>
<th>Treatment dose Dalteparin 200 units/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;46 kg</td>
<td>7,500 units OD</td>
</tr>
<tr>
<td>46-56 kg</td>
<td>10,000 units OD</td>
</tr>
<tr>
<td>57-68 kg</td>
<td>12,500 units OD</td>
</tr>
<tr>
<td>69-82 kg</td>
<td>15,000 units OD</td>
</tr>
<tr>
<td>83-100 kg</td>
<td>18,000 units OD</td>
</tr>
<tr>
<td>&gt;100 kg</td>
<td>Seek Haematology advice - contact details below</td>
</tr>
</tbody>
</table>

Bleep Thrombosis team for in-patient review and discharge planning with appropriate anticoagulation therapy

Consider if the patient is suitable for ambulatory care – see table B

Yes
Consider admitting to Emergency medical unit for review & monitoring for 4-6 hours (if ambulatory patient)

No
- Admit - duration at discretion of admitting consultant
- Request Thrombosis team in-patient review

On discharge:
- Provide anticoagulation for at least FOUR WEEKS (provide sharps bin for patients on low molecular weight heparin).
- Arrange for outpatient GSTT Thrombosis clinic referral via EPR (type in ‘OP-VTE’ into orders) who will take over ongoing investigation and management within 4 weeks and decide on the duration of anticoagulation
- Provide patient information leaflet on pulmonary embolism
- DO NOT DO A THROMBOPHILIA SCREEN AT THIS TIME (NO VALUE).

A: Contra-indications to rivaroxaban
- Significant liver disease (Child Pugh score B or C)
- Pregnancy/breastfeeding
- Creatinine clearance <15ml/minute
- Concomitant use of cytochrome P-450 3A4 inhibitors: e.g. fluconazole, protease inhibitors
- Concomitant use of cytochrome P-450 3A4 inducers: e.g. rifampicin, carbamazepine or phenytoin
- Currently not recommended in active cancer – patients should receive dalteparin or UFH
- Anticipated compliance problems

B: Exclusion criteria for ambulatory management
- Pregnant
- Age <18 years
- GI/GU/intracranial bleed <4/52 ago
- Heparin sensitivity/history of HIT
- Systolic BP >180 or diastolic BP >115
- Angina or SOB on minimal exertion
- CCI ≤15ml/minute - give unfractionated heparin infusion - refer to ‘Adult unfractionated heparin infusion’ guideline relevant to your clinical area
- Platelets <50 x 10^9/L

How to contact the Thrombosis NR:
During routine hours - bleep 0122;
Out of hours and at weekends - bleep 0284
Massive PE
“High Risk PE”

• SBP < 90 mmHg or drop of >40 mmHg
• >15 mins
• with no other cause
• Up to 5-10% of patients
• Mortality – high (15-58%)
High Risk PE - Treatment

- Resuscitation
- "Full Dose" systemic thrombolysis
  - tPA – 10mg bolus, 90mg / 2 hours
- Risk of major bleeding (6-20%)
- Intracranial Haemorrhage (2-6%)
- ....But outweighs risk of death from PE
Sub-massive PE
“Intermediate Risk PE”

• Not hypotensive but...
• Evidence of right heart dysfunction (CT or ECHO)
• Evidence of myocardial injury/strain
  – elevated biomarkers - Troponin & BNP
• Confirmed large clot burden – CTPA (V:Q)

• Mortality or “Adverse Events” 3-25%?
So why not thrombolysie “intermediate risk PE” too?

Much “pro/con” debate on going....
Fibrinolysis for Patients with Intermediate-Risk Pulmonary Embolism

Guy Meyer, M.D., Eric Vicaut, M.D., Thierry Danays, M.D., Giancarlo Agnelli, M.D., Cecilia Becattini, M.D., Jan Beyer-Westendorf, M.D., Erich Bluhmki, M.D., Ph.D., Helene Bouvaist, M.D., Benjamin Brenner, M.D., Francis Couturaud, M.D., Ph.D., Claudia Dellas, M.D., Klaus Empen, M.D., Ana Franca, M.D., Nazzareno Galiè, M.D., Annette Geibel, M.D., Samuel Z. Goldhaber, M.D., David Jimenez, M.D., Ph.D., Matija Kozak, M.D., Christian Kupatt, M.D., Nils Kucher, M.D., Irene M. Lang, M.D., Mareike Lankeit, M.D., Nicolas Meneveau, M.D., Ph.D., Gerard Pacouret, M.D., Massimiliano Palazzini, M.D., Antoni Petris, M.D., Ph.D., Piotr Pruszczynk, M.D., Matteo Rugolotto, M.D., Aldo Salvi, M.D., Sebastian Schellong, M.D., Mustapha Sebbane, M.D., Bozena Sobkowicz, M.D., Branislav S. Stefanovic, M.D., Ph.D., Holger Thiele, M.D., Adam Torbicki, M.D., Franck Verschuren, M.D., Ph.D., and Stavros V. Konstantinides, M.D., for the PEITHO Investigators*
PEITHO: Overview of study design

Confirmed acute symptomatic PE

Absence of hemodynamic collapse

Confirmed RV dysfunction + myocardial injury

DOUBLE BLIND

UFH bolus i.v.

UFH infusion

VKA

Primary Outcome, Secondary Outcomes

Day 2

TNK

UFH, LMWH or Fondaparinux

Day 7

Placebo

Secondary Outcomes, SAE

Day 30

S Konstantinides for the PEITHO Steering Committee. Am Heart J 2012;163:33-38.e1
## PEITHO: Causes of death (within 30 days of randomization)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Tenecteplase (n=506)</th>
<th>Placebo (n=499)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause mortality</td>
<td>12 (2.4)</td>
<td>16 (3.2)</td>
<td>0.42</td>
</tr>
<tr>
<td>From hemodynamic collapse</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>From recurrent PE</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>From respiratory failure</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>From stroke</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>From bleeding</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Other cause</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
PEITHO: Primary end point according to age

Age ≤ 75 years

0.12 0.33 0.85

Odds ratio

Age > 75 years

0.23 0.63 1.66

Odds ratio

ITT population

The PEITHO Investigators
“Adverse Events” from Intermediate Risk PE

(This group can be very well!)
PEITHO: Analysis of primary efficacy outcome

<table>
<thead>
<tr>
<th>Event</th>
<th>Tenecteplase (n=506)</th>
<th>Placebo (n=499)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause mortality within 7 days</td>
<td>6 (1.2)</td>
<td>9 (1.8)</td>
<td>0.43</td>
</tr>
<tr>
<td>Hemodynamic collapse within 7 days</td>
<td>8 (1.6)</td>
<td>25 (5.0)</td>
<td>0.002</td>
</tr>
<tr>
<td>Need for CPR</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Hypotension / blood pressure drop</td>
<td>8</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Catecholamines</td>
<td>3</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Resulted in death</td>
<td>1</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

ITT population

The PEITHO Investigators
## PEITHO: Other clinical outcomes (within 7 days)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Tenecteplase (n=506)</th>
<th>Placebo (n=499)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE recurrence</td>
<td>1 (0.2)</td>
<td>5 (1.0)</td>
<td>0.12</td>
</tr>
<tr>
<td>Intubation / mechanical ventilation</td>
<td>8 (1.6)</td>
<td>15 (3.0)</td>
<td>0.13</td>
</tr>
<tr>
<td>Open-label thrombolysis</td>
<td>4 (0.8)</td>
<td>23 (4.6)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

ITT population

The PEITHO Investigators
American Guidelines – Chest 2016

• Intermediate risk PE
23. In selected patients with acute PE who deteriorate after starting anticoagulant therapy but have yet to develop hypotension and who have a low bleeding risk, we suggest systemically administered thrombolytic therapy over no such therapy (Grade 2C).
*23. In **selected patients** with acute PE who deteriorate after starting anticoagulant therapy but have **yet to develop hypotension** and who have a **low bleeding risk**, we suggest systemically administered thrombolytic therapy over no such therapy (Grade 2C).

....Dose not suggested
Moderate Pulmonary Embolism Treated With Thrombolysis (from the “MOPETT” Trial)

Mohsen Sharifi, MD\textsuperscript{a,b,\dagger}, Curt Bay, PhD\textsuperscript{b}, Laura Skrocki, DO\textsuperscript{a}, Farnoosh Rahimi, MD\textsuperscript{a},
and Mahshid Mehdipour, DMD\textsuperscript{a,b}, “MOPETT” Investigators

The role of low-dose thrombolysis in the reduction of pulmonary artery pressure in moderate pulmonary embolism (PE) has not been investigated. Because the lungs are very sensitive to thrombolysis, we postulated that effective and safe thrombolysis might be achieved by a lower dose of tissue plasminogen activator. The purpose of the present study was to evaluate the role of this “safe dose” thrombolysis in the reduction of pulmonary artery pressure in moderate PE. During a 22-month period, 121 patients with moderate PE were randomized to receive a “safe dose” of tissue plasminogen activator plus anticoagulation (thrombolysis group [TG], \(n = 61\) patients) or anticoagulation alone (control group [CG], \(n = 60\)). The primary end points consisted of pulmonary hypertension and the composite end point of pulmonary hypertension and recurrent PE at 28 months. Pulmonary hypertension and the composite end point developed in 9 of 58 patients (16\%) in the TG and 32 of 56 patients (57\%) in the CG (\(p < 0.001\)) and 9 of 58 patients (16\%) in the TG and 35 of 56 patients (63\%) in the CG (\(p < 0.001\)), respectively. The secondary end points were total mortality, the duration of hospital stay, bleeding at the index hospitalization, recurrent PE, and the combination of mortality and recurrent PE. The duration of hospitalization was 2.2 ± 0.5 days in the TG and 4.9 ± 0.8 days in the CG (\(p < 0.001\)). The combination of death plus recurrent PE was 1 (1.6\%) in TG and 6 (10\%) in the CG (\(p = 0.0489\)). No bleeding occurred in any group, and despite a positive trend in favor of a “safe dose” thrombolysis, no significant difference was noted in the rate of individual outcomes of death and recurrent PE when assessed independently. In conclusion, the results from the present prospective randomized trial suggest that “safe dose” thrombolysis is safe and effective in the treatment of moderate PE, with a significant immediate reduction in the pulmonary artery pressure that was maintained at 28 months. © 2012 Elsevier Inc. All rights reserved. (Am J Cardiol 2012;\(\text{---}\))
MOPETT Trial

• Concept of “Safe Dose Thrombolysis”?
  • Cardiac output – Brain 15%, Heart 5%, Pulmonary 100%

• tPA - 10mg bolus
• tPA - 40mg/2 hours (0.5mg/kg if <50kg)
MOPETT Trail

<table>
<thead>
<tr>
<th>Variable</th>
<th>TG</th>
<th>CG</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary hypertension*</td>
<td>9 (16%)</td>
<td>32 (57%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pulmonary hypertension plus recurrent pulmonary embolism</td>
<td>9 (16%)</td>
<td>35 (63%)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* Pulmonary artery systolic pressure ≥40 mm Hg.
Table 3
Secondary end points

<table>
<thead>
<tr>
<th>Variable</th>
<th>TG (n = 61; 100%)</th>
<th>CG (n = 60; 100%)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrent pulmonary embolism</td>
<td>0</td>
<td>3 (5%)</td>
<td>0.08</td>
</tr>
<tr>
<td>Total mortality</td>
<td>1 (1.6%)</td>
<td>3 (5%)</td>
<td>0.30</td>
</tr>
<tr>
<td>Total mortality plus recurrent pulmonary embolism</td>
<td>1 (1.6%)</td>
<td>6 (10%)</td>
<td>0.049</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>2.2 ± 0.5</td>
<td>4.9 ± 0.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Bleeding</td>
<td>0</td>
<td>0</td>
<td>—</td>
</tr>
</tbody>
</table>

Data are presented as mean ± SD or n (%).
Acute Pulmonary Embolism Network and Multidisciplinary Response Team Approach to Treatment

Tyler L. Bloomer, MD, Eric J. Thomassee, MD, and Pete P. Fong, MD
A Pragmatic British Alternative…

And applicable to DGH as teaching hospitals alike…
PE Lysis Team- “PELT”

- Chest Physicians
- Critical Care
- Haematologists
- Interventional Radiology
- (Obstetric Physician)
PE Lysis Team- “PELT”

- Chest Physicians
- Critical Care
- Haematologists
- **Interventional Radiology (pt bleeding risk)**
- (Obstetric Physician)
Intermediate Risk PE

- Not shocked but…
- Evidence of right heart dysfunction
- Evidence of myocardial injury
  - elevated Troponin, BNP
- Confirmed large clot burden – CTPA (V:Q)

- Mortality or “Adverse Events” 3-15%?
Intermediate Risk PE

- Not shocked but...
- Evidence of right heart dysfunction*
- Evidence of myocardial injury
  - elevated Troponin*, BNP*
- Confirmed large clot burden* - CTPA (V:Q)

- Mortality or “Adverse Events” 3-15%....
- Predictors* – both +ve and -ve
European Guidelines - 2014
PE Lysis Team- “PELT”

- Initial Clinical Assessment
- ECHO
- Bilateral leg Dopplers
- Bleeding risk (NB age, Pulmonary infarction)
PE Lysis Team- “PELT”

• Initial Clinical Assessment
• ECHO
• Bilateral leg Dopplers
• Bleeding risk (NB age, Pulmonary infarction)
• Serial Assessment – review progress
• Patient involvement in decisions/consent
• …..then you make a TEAM judgement
Key “Take Home” Message

Is your patient...

**Intermediate-High Risk (Lysis)***

**Or**

**Intermediate-Low Risk (Lysis unlikely)**

(but can change groups with time and treatment)
Classification of confirmed acute PE including management of intermediate risk PE

Classification based on early mortality risk (from European Cardiology Society guidelines 2014): Assess using following table

The management of intermediate risk PE with initial low-dose thrombolysis is not recommended in any international guidance because current evidence shows no improvement in mortality at 6 months.

<table>
<thead>
<tr>
<th>Risk parameters and scores</th>
<th>Low</th>
<th>Intermediate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock or hypotension</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>PESI SCORE ≥ 5%</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>RV dysfunction on imaging</td>
<td>-</td>
<td>Intermediate high: Both positive</td>
<td>-</td>
</tr>
<tr>
<td>Assessment optional; if assessed, both negative</td>
<td>Intermediate low: Either one (or none) positive</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Low risk PE

Management of Intermediate risk PE

Anticoagulation:
Give 5000 units IV BOLUS unfractionated heparin, followed by unfractionated heparin IV infusion – (Refer to the adult unfractionated heparin infusion guideline relevant to your clinical area).
Avoid DOACs or LMWH as it will increase the bleeding risk with potential thrombolysis. If patient already on an anticoagulant - discuss with Haem, (S)PCC 0122/0294 out of hours

Patient stable/improving: continue IV heparin for up to 48 hours

If patient clinically deteriorates – consider thrombolysis

If there is low bleeding risk, consider systemic thrombolysis
Prescribe alteplase infusion, according to weight
Patient’s informed consent is required as alteplase is unlicensed for low dose thrombolysis

<table>
<thead>
<tr>
<th>Weight &lt; 50kg</th>
<th>Weight ≥ 50kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total dose = 0.5mg/kg, Give as a 10mg IV BOLUS over 1 minute followed by the remainder of the dose as an IV INFUSION over 2 hours</td>
<td>10mg IV BOLUS over 1 minute followed by 40mg IV INFUSION over 2 hours</td>
</tr>
</tbody>
</table>

If there is an increased bleeding risk, consider catheter-directed thrombolysis under direction of IR consultant (contact via switchboard)

If patient significantly deteriorates, then go to page 3 - management of high risk PE

Management of intravenous heparin infusion when on thrombolysis:
- Maintain heparin infusion rate at 5 units/kg/hour whilst alteplase is infused.
- At the end of thrombolysis: Monitor fibrinogen levels with Clauss fibrinogen – order as ‘coagulation special’.
- If BLEEDING, only give cryoprecipitate if fibrinogen <1.5g/L. If NOT BLEEDING, only give cryoprecipitate if fibrinogen <1g/L. Note that 2 pools of cryoprecipitate increases fibrinogen by 1gram

1 hour after alteplase infusion stopped: INCREASE heparin infusion rate, titrating to a target APTT ratio 2.0-2.5. (Refer to the adult unfractionated heparin infusion guideline relevant to your clinical area). Continue for 24-48 hours.

24-48 hours post thrombolysis: If no major bleeding, consider switch to DOAC/dalteparin or continue unfractionated heparin. Follow advice on page 4 and discuss with the Thrombosis team if necessary (bleep 0122/0294 out of hours/weekends)
Local Protocol for Intermediate Risk PE

- Team decision
- Done in level 2 or 3
- Systemic “half dose” first line
- Catheter direct Thrombolysis for
  - bleeding risk (eg post surgery)
  - Second line (post systemic, including massive PE)
  - “Older Clot”? 

- (Local outcome very good… thus far)
Catheter Directed Thrombolysis

- Interventional Radiology
- Time is situ 12-24 hours
- Infuse tPA 0.5-1mg per hour
- Lower total dose
- Mostly bilateral (and each side “adjusted”)

- Still risk of bleeding and arrhythmia
24. In patients with acute PE who are treated with a thrombolytic agent, we suggest systemic thrombolytic therapy using a peripheral vein over CDT (Grade 2C).

Remarks: Patients who have a higher risk of bleeding with systemic thrombolytic therapy and who have access to the expertise and resources required to do CDT are likely to choose CDT over systemic thrombolytic therapy.
EKOS™ Endovascular System Features

- 5.4 F catheter
- 106 and 135 cm working length
- 6, 12, 18, 24, 30, 40 and 50 cm treatment zones
Acoustic Pulse Thrombolysis™
Mechanism of action

**Fibrin Separation**
Ultrasound separates fibrin without fragmentation of emboli

**Active Drug Delivery**
Drug is actively driven into clot by “Acoustic Streaming”

Acoustic streaming drives lytic into clot

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Summary

• Ongoing clinical assessment in “place of safety”
• Intermediate-high or intermediate-low risk
• Advances in TEAM decisions for the more severe PEs to enable improved morbidity and mortality