Interventional treatment for patients with acute pulmonary embolism

I. Petrov, I. Martinov
Cardiology department
Tokuda Hospital Sofia
Treatment and prophylaxis of PE

Treatment of PE:
1.) Systemic thrombolysis “gold standard”
2.) Supraselective thrombolysis
3.) Conventional anticoagulant treatment with heparin

Prophylaxis of PE
1.) Oral anticoagulant treatment
2.) Implantation of Cava Filter

ESC Guidelines on Acute Pulmonary embolism

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticoagulation with UFH should be initiated without delay in patients with high-risk PE</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Systemic hypotension should be corrected to prevent progression of RV failure and death due to PE</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Vasopressive drugs are recommended for hypotensive patients with PE</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Dobutamine and dopamine may be used in patients with PE, low cardiac output and normal blood pressure</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Aggressive fluid challenge is not recommended</td>
<td>III</td>
<td>B</td>
</tr>
<tr>
<td>Oxygen should be administered to patients with hypoxaemia</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Thrombolytic therapy should be used in patients with high-risk PE presenting with cardiogenic shock and/or persistent arterial hypotension</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Surgical pulmonary embolectomy is a recommended therapeutic alternative in patients with high-risk PE in whom thrombolysis is absolutely contraindicated or has failed</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Catheter embolectomy or fragmentation of proximal pulmonary arterial clots may be considered as an alternative to surgical treatment in high-risk patients when thrombolysis is absolutely contraindicated or has failed</td>
<td>IIb</td>
<td>C</td>
</tr>
</tbody>
</table>
Contraindications to fibrinolytic therapy
Guidelines on Acute Pulmonary embolism 2008

Absolute contraindications
• Haemorrhagic stroke or stroke of unknown origin at any time
• Ischaemic stroke in preceding 6 months
• Central nervous system damage or neoplasms
• Recent major trauma/surgery/head injury (within preceding 3 weeks)
• Gastrointestinal bleeding within the last month
• Known bleeding

Relative contraindications
• Transient ischaemic attack in preceding 6 months
• Oral anticoagulant therapy
• Pregnancy or within 1 week post partum
• Non-compressible punctures
• Traumatic resuscitation
• Refractory hypertension (systolic blood pressure > 180 mmHg)
• Advanced liver disease
• Infective endocarditis
• Active peptic ulcer
## Risk stratification

<table>
<thead>
<tr>
<th>PE-related early MORTALITY RISK</th>
<th>RISK MARKERS</th>
<th>Potential treatment implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH</strong> &gt;15%</td>
<td>+</td>
<td>(+)(^a)</td>
</tr>
<tr>
<td></td>
<td>(+)(^a)</td>
<td>(+)(^a)</td>
</tr>
<tr>
<td>Thrombolysis or embolectomy</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NON HIGH</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermediate 3–15%</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hospital admission</td>
</tr>
<tr>
<td>Low &lt;1%</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>–</td>
<td>Early discharge or home treatment</td>
</tr>
</tbody>
</table>

\(^a\) Indicates significant clinical or cardiac involvement.
Risk stratification

The patients with high and intermediate risk groups need aggressive treatment – fibrinolysis, surgical thrombectomy, percutaneous treatments.

For USA the expected number is 4000 annually *

But....

- 1/3 of patients with indications for fibrinolytic therapy are with absolute contraindications*

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**Therapeutic algorithm**

1. **Cardiogenic shock**
   - **YES**
     - Thrombolysis, Catheter intervention or surgical embolectomy ± cava filter
   - **NO**
2. **RV dysfunction +**
3. **RV dysfunction --**
   - UF or LMW heparin ± cava filter

**Oral anticoagulation ≥6 months**

*Grossman’s Cardiac Catheterization, Angiography and Intervention 2006*
The aim of the interventional therapy is to achieve hemodynamic and clinical improvement, and not a perfect angiographic result.

Prolongation of the procedure increases the risk of perforation of pulmonary vessels, pulmonary infarction and blood loss from the puncture site.
PERCUTANEOUS CATHETER EMBOLECTOMY AND FRAGMENTATION

combined with local fibrinolysis and heparin

Even partial restoration of blood flow increases probability for successful fibrinolysis.

When the operator places a catheter in pulmonary artery he can choose exactly the place for application of fibrinolytic.

Thrombaspiration reduces the thrombotic mass in the main pulmonary vessels.
The main goal of fragmentation is desobstruction of main pulmonary vessels.
Rotation of pigtail catheter
Thrombasapiration with 8F catheter
### TABLE 3. Interventional Catheter Devices for Massive PE

<table>
<thead>
<tr>
<th>Device</th>
<th>Company</th>
<th>Size, F</th>
<th>Guidewire Compatible</th>
<th>Thrombus Fragmentation</th>
<th>Time, s, and Completeness of Thrombus Removal, % complete*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenfield suction catheter</td>
<td>Medi-Tech/Boston Scientific, US</td>
<td>10</td>
<td>No</td>
<td>No</td>
<td>...</td>
</tr>
<tr>
<td>Pigtail rotational catheter</td>
<td>Cook Europe, the Netherlands</td>
<td>6</td>
<td>Yes</td>
<td>Yes</td>
<td>...</td>
</tr>
<tr>
<td>Amplatz thrombectomy device</td>
<td>BARD-Microvena, US</td>
<td>7</td>
<td>No</td>
<td>Yes</td>
<td>83, 66</td>
</tr>
<tr>
<td>Angiojet Xpeedior</td>
<td>Possis Medical, US</td>
<td>6</td>
<td>Yes</td>
<td>Yes</td>
<td>118, 67</td>
</tr>
<tr>
<td>Hydrolyser</td>
<td>Cordis Europe, the Netherlands</td>
<td>6</td>
<td>Yes</td>
<td>Yes</td>
<td>124, 32</td>
</tr>
<tr>
<td>Oasis</td>
<td>Medi-Tech/Boston Scientific, US</td>
<td>6</td>
<td>Yes</td>
<td>Yes</td>
<td>185, 43</td>
</tr>
<tr>
<td>Aspirex</td>
<td>Straub Medical, Switzerland</td>
<td>11</td>
<td>Yes</td>
<td>Yes</td>
<td>69, ≈100</td>
</tr>
</tbody>
</table>

*Measurements obtained from flow models with 16.3 to 16.5 g of in vitro–generated thrombus in test tubes with 20-mm internal diameter and 66% stenosis (Amplatz thrombectomy device, Angiojet Xpeedior, Hydrolyser, and Oasis)\(^0\) and in test tubes with 14-mm internal diameter without stenosis (Aspirex).\(^{24}\)
According LJ Greenfield and M Fava the advantages of supraselective fibrinolysis vs. systemic are:

- Selective fibrinolysis lyses the thrombus at site with rapid restoration of the blood flow
- The operator can titrate the dose of the fibrinolytic agent.
- The risk of bleeding is significantly lower than systemic due to a local application and lower dose.

Fava M, Loyola S, Flores P, Huete I. Mechanical fragmentation and pharmacologic thrombolysis in massive pulmonary embolism. J Vasc Interv Radiol 1997;8:261–266
Several small trials for application of local fibrinolysis at low doses rTPA 10 – 20mg or urokinase 250k – 500k E including patients with contraindication for systemic thrombolysis

- **Tapson and colleagues** *(ARRD 1992 145 A719)* – dramatic improvement in 6 cases with PE after intraarterial fibrinolysis without any hemorrhagic complication (5 of the patient with contraindication for systemic fibrinolysis)

- **Molina et al** *(AJS 1992 163.4 375-0)* – complete lysis of the thrombi without any complications after application of Urocinase in 13 patients with documented PE after surgical operations.

- **Fava et al** *(J Vasc Interv Radiol 1997 8 261-6)* dramatic improvement after selective infusion of fibrinolytic combined with mechanical fragmentation of the thrombus in 16 patients with PE, in 14 were with complete restoration.
Our experience in interventional treatment of massive PE

10 patients with massive PE for period 12.2006г. – 01.2009г.:
- In 8 cases was implanted Cava Filter
- In 2 cases is was performed supraselective fibrinolysis combined with thrombuspiration and followed implantation of permanent Cava Filter
- 1 death - the patient was in cardiogenic shock with massive bilateral PE and serious comorbidity.
Pulmoangiography
Patient with massive PE after operation in the small pelvic area
Fragmentation of the thrombus + CPR
Thromb aspiration with Thrombuster 7F
Patient with massive PE after vascular surgery – implantation of cava filter.
Conclusion

- Interventional methods are taking place in selected patients with submassive and massive PE in presence of contraindications for fibrinolysis, failed fibrinolysis and contraindications for surgical treatment.
- At present methods based on PCI equipment are efficacious.
- The goal of intervention is hemodynamic improvement.
- They can be combined with local fibrinolysis at low doses.
- In case of indication, they can be combined with implantation of cava filter at the end of the procedure.
Emergency surgical treatment – indications:

- Large embolus in the main trunk or the large branch of pulmonary artery or occluding 50% of the pulmonary three leading to cardiogenic shock.

- Persisting hemodynamic instability Персистираща хемодинамична нестабилност, въпреки Heparin и други ресуситивни мерки

- Contraindications for thrombolysis

- Failed thrombolysis
Emergency surgical treatment

- An aggressive approach to large pulmonary embolus, including rapid diagnosis and prompt surgical intervention, has improved results with surgical embolectomy with perioperative mortality 6%.


With an incision of the PA trunk and usually an additional arteriotomy of the right pulmonary artery, clots can be removed from both pulmonary arteries using blunt grasping instruments under direct vision.
Emergency surgical treatment

Transportable extracorporeal assist systems with percutaneous femoral cannulation can be helpful in critical situations, providing circulation and oxygenation and thus time for definitive diagnosis.

Thank you!