Standardisation of multidisciplinary obstetric emergency training nationally.
The Management of Pulmonary Embolism

John R. Higgins
UCC Professor of Obstetrics & Gynaecology,
Head College of Medicine & Health
Purpose and scope

1. Diagnosis

2. Treatment

3. Challenges
   - Massive PE
   - PE before delivery
   - Reversal of anticoagulation
New National Guideline

• Haematology
  Susan O’Shea, Niamh O’Connell, Fionnuala Ni Ainle

• Obstetrics
  Carmen Regan, Brigette Bryne, John Higgins

• Radiology
  Kevin O’Regan

• Respiratory Medicine
  Des Murphy
• 25 maternal deaths
  • Rate 8 per 100,000 maternities

• 6 Direct Deaths

• 3 Deaths due to pulmonary embolism
  • Rate 1 per 100,000 maternities
Figure 1.4. Leading causes of maternal death per 100,000 maternities; UK: 2006–08. Other *Indirect* causes of death are separated into neurological and others, and Other *Direct* includes fatty liver and a direct cancer.
Figure 1.4. Leading causes of maternal death per 100 000 maternities; UK: 2006–08. Other Indirect causes of death are separated into neurological and others, and Other Direct includes fatty liver and a direct cancer.
Figure 2.1. Rates per 100,000 maternities of Direct deaths from thrombosis and thromboembolism; UK: 1985–2008.
The Pyramid of Disease

- Deaths
- Severe Morbidity
- Illness requiring medical care
- Asymptomatic/Self-care
### Table 1: Frequency and corresponding rates, 2011, 19 maternity units

<table>
<thead>
<tr>
<th>Event</th>
<th>Frequency</th>
<th>Rate per 1,000 (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major obstetric haemorrhage</td>
<td>159</td>
<td>2.3 (1.9-2.7)</td>
</tr>
<tr>
<td>ICU/coronary care unit admission</td>
<td>111</td>
<td>1.6 (1.3-1.9)</td>
</tr>
<tr>
<td>Renal or liver dysfunction</td>
<td>26</td>
<td>0.4 (0.2-0.5)</td>
</tr>
<tr>
<td>Peripartum hysterectomy</td>
<td>23</td>
<td>0.3 (0.1-0.3)</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>12</td>
<td>0.2 (1.0-3.1)</td>
</tr>
<tr>
<td>Eclampsia</td>
<td>12</td>
<td>0.2 (1.0-3.1)</td>
</tr>
<tr>
<td>Pulmonary oedema</td>
<td>8</td>
<td>0.1 (0.04-0.22)</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>7</td>
<td>0.1 (0.04-0.20)</td>
</tr>
<tr>
<td>Anaesthetic problem</td>
<td>7</td>
<td>0.1 (0.04-0.20)</td>
</tr>
<tr>
<td>Cerebrovascular event</td>
<td>6</td>
<td>0.09 (0.02-0.16)</td>
</tr>
<tr>
<td>Acute respiratory dysfunction</td>
<td>5</td>
<td>0.07 (0.01-0.10)</td>
</tr>
<tr>
<td>Septicaemic shock</td>
<td>4</td>
<td>0.06 (0.00-0.10)</td>
</tr>
<tr>
<td>Status epilepticus</td>
<td>3</td>
<td>0.04 (0.00-0.09)</td>
</tr>
<tr>
<td>Coma</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Interventional radiology</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Planned</td>
<td>8</td>
<td>0.1 (0.04-0.20)</td>
</tr>
<tr>
<td>Unplanned</td>
<td>6</td>
<td>0.1 (0.04-0.20)</td>
</tr>
<tr>
<td>Total events reported</td>
<td>399</td>
<td>3.8 (3.36-4.30) *</td>
</tr>
</tbody>
</table>

*Total rate is based on the number of women diagnosed with a severe morbidity, not on the number of events.
Antenatal pulmonary embolism: risk factors, management and outcomes

- One of first UKOSS studies
- Feb 2005 – Aug 2006
- All Obstetric units in UK

- 143 antenatal Pulmonary Emboli
- Incidence – 1.3 per 10,000 maternities

- Risk factors identified
  - BMI $\geq$ 30kg/m $^2$ aOR 2.65 (95%CI 1.09-6.45)
  - Multiparity aOR 4.03 (95%CI 1.6-9.84)

Knight et al for UKOSS BJOG 2008;115:453-461
Figure 2. Gestational age at pulmonary embolism (completed weeks). Figures above bars show numbers of women.
Venous thromboembolism in pregnant and puerperal women in Denmark 1995-2005

• A national cohort study
• Women 15-49 years
• 1995-2005 incl.

• 727 VTE from 819,751 pregnant women
Venous thromboembolism in pregnant and puerperal women in Denmark 1995-2005

• Absolute risk antenatally 10.7 per 10,000 pregnancy-years

• Absolute risk in puerperium 17.5 per 10,000 puerperal years
Venous thromboembolism in pregnant and puerperal women in Denmark 1995-2005

Figure 1: Adjusted* incidence rate ratios (IRR) of thromboembolism in pregnant and puerperal women versus non pregnant women not using oral contraceptives.

*Adjusted for age, calendar year and education.
Risk of first venous thromboembolism in and around pregnancy: a population-based cohort study

- UK primary care database
- Women 15-44 years
- 1987-2004
- 207,327 live birth pregnancies
- Overall rate 10.7 per 10,000 person years

Aylshah Abdul Sultan et al. BJH Dec 2011
Risk of first venous thromboembolism in and around pregnancy: a population-based cohort study

Aylshah Abdul Sultan et al. BJH Dec 2011
Conclusion

• Increased risk is in late pregnancy
• Very high relative risk out to three weeks post partum
• Observational data continues to be essential
Clinical practice guidelines

• Venous Thromboprophylaxis in pregnancy  HSE Clinical Care Programme in Obstetrics and Gynaecology, 2013

• The Acute Management of Thrombosis and Embolism during Pregnancy and the Puerperium  RCOG, Greentop guideline No. 37b, 2007

• Pulmonary Embolism in Pregnancy – Diagnosis and Treatment  ACOG 2013
Early detection of PE in pregnancy

- *Clinical diagnosis is difficult – high index of suspicion required*

<table>
<thead>
<tr>
<th>Finding</th>
<th>Occurrence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tachypnoea</td>
<td>89</td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>81</td>
</tr>
<tr>
<td>Pleuritic pain</td>
<td>72</td>
</tr>
<tr>
<td>Apprehension</td>
<td>59</td>
</tr>
<tr>
<td>Cough</td>
<td>54</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>43</td>
</tr>
<tr>
<td>Haemoptysis</td>
<td>34</td>
</tr>
<tr>
<td>Temp &gt; 37 C</td>
<td>34</td>
</tr>
</tbody>
</table>
Initial Management

1. Clinical diagnosis is difficult – high index of suspicion required
2. Consider PE in all women presenting with shortness of breath, chest pain, tachycardia, cardiovascular collapse
3. If unstable immediately
   - involve senior obstetrician, anaesthetist and medical team
   - Assess Airway, Breathing, Circulation – CPR if woman is in cardiac arrest
   - Transfer to HDU for monitoring
4. Initial investigations – FBC, baseline clotting, arterial blood gas, ECG
5. Diagnostic imaging by protocol – Chest X-ray, Lower limb Doppler, Ventilation/perfusion, CTPA
6. Anticoagulate while awaiting outcome
Differential for SOB/respiratory distress in suspected PE in pregnancy

1. Pneumonia

2. Asthma exacerbation

3. Cardiovascular causes
   - Pre-eclampsia
   - Valvular heart disease
   - Cardiomyopathy

4. Amniotic-fluid embolism

Management response

Diagnostic algorithm for suspected PE in pregnancy*

*If PE is suspected and CUS and V/Q scanning services are not readily available, proceed immediately to CTPA to avoid a potentially lethal delay in treatment.
Management Response

Bourjeily et al, Lancet 2010
Investigation dilemma

• CTPA vs V/Q
  - Radiation exposure
  - Test characteristics
  - Availability
### Table 1. Calculation of initial doses of drugs by early pregnancy weight

<table>
<thead>
<tr>
<th>Initial dose</th>
<th>Early pregnancy weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 50</td>
</tr>
<tr>
<td>Enoxaparin</td>
<td>40 mg bd</td>
</tr>
<tr>
<td>Dalteparin</td>
<td>5000 iu bd</td>
</tr>
<tr>
<td>Tinzaparin</td>
<td>175 units/kg once daily (all weights)</td>
</tr>
</tbody>
</table>

bd = twice daily
Challenges – Massive PE

Individualised decision making – senior Obstetrics, Haematology, Respiratory, Radiology, Cardio-thoracic, Midwifery

1. IV unfractionated heparin

2. Thrombolysis (rare)

3. Thoracotomy/surgical embolectomy (V. Rare)
Challenges – Massive PE

IV unfractionated Heparin
1. Loading dose 80 units/kg
2. Maintenance 18 units/kg/hr
3. Adjust to APTT – target 1.5 to 2.5
Challenges – Massive PE

IV unfractionated Heparin
1. Loading dose 80 units/kg
2. Maintenance 18 units/kg/hr
3. Adjust to APTT – target 1.5 to 2.5

<table>
<thead>
<tr>
<th>APTT ratio</th>
<th>Dose change (units/kg/hour)</th>
<th>Additional action</th>
<th>Next APTT (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1.2</td>
<td>+ 4</td>
<td>Re-bolus 80 units/kg</td>
<td>6</td>
</tr>
<tr>
<td>1.2–1.5</td>
<td>+ 2</td>
<td>Re-bolus 40 units/kg</td>
<td>6</td>
</tr>
<tr>
<td>1.5–2.5</td>
<td>No change</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>2.5–3.0</td>
<td>− 2</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>&gt; 3.0</td>
<td>− 3</td>
<td>Stop infusion 1 hour</td>
<td>6</td>
</tr>
</tbody>
</table>

RCOG greentop guideline 37b, 2010
Challenges – PE before delivery

Individualised decision making – Obstetrics, Haematology, Radiology

1. Peripartum anticoagulation – Unfractionated heparin?

2. Retrieval inferior vena cava filter
Challenges – Reversal of anticoagulation

Individualised decision making – Obstetrics, Haematology,

Panel 2: Suggested protamine dose for reversal of UFH and LMWH

Intravenous heparin
- Immediately after dose: 1.0–1.5 mg per 100 U heparin
- 30–60 min after infusion stopped: 0.5–0.75 mg per 100 U heparin
- More than 2 h after infusion stopped: 0.25–0.375 mg per 100 U heparin

Subcutaneous heparin
- Dose needed for reversal: 1.0–1.5 mg per 100 U heparin
- 25–50 mg given slowly intravenously, followed by the remaining portion of the dose given as a continuous infusion over 8–16 h

Enoxaparin
- 1 mg for each 1 mg of enoxaparin
- Additional 0.5 mg per 1 mg enoxaparin if antifactor-Xa concentration more than 0.2 IU/mL 2–4 h after first dose

Dalteparin or tinzaparin
- 1 mg per 100 IU antifactor-Xa
- Additional 0.5 mg per 100 IU antifactor Xa if antifactor-Xa concentration is more than 0.2 IU/mL 2–4 h after first dose

*Excessive protamine doses might exacerbate the risk of bleeding.

Bourjeily et al Lancet 2010
Practical skills & drills elements

• Non-massive PE
  - Desktop scenario training

• Massive PE – haemodynamically unstable
  - Clinical drill

• Massive PE – cardiac arrest
  - CPR drill
Clinical Drill

• Patient - late pregnancy, new onset SOB, pleuritic chest pain, hypotensive

• Setting – Emergency room maternity hospital

• Response 1 – Call for senior help – obstetrics, anaesthetics, haematology midwifery

• Response 2 – ABC, IV access,

• Response 3 – FBC, Coag studies, ABG, ECG
Clinical Drill

• Response 4 – consider treatment – LMWH or UFH or Thrombolysis
  • If good patient recovery

• Response 5 – Complete investigations – CTPA, V/Q, Doppler
  • If Cardiac arrest

• Response 6 – CPR and Delivery,
Summary

1. Diagnosis of PE in pregnancy requires high index of suspicion
Summary

2. Once suspected PE must be treated while awaiting investigations
Summary

3. If investigations negative and still clinically suspicious continue to treat
Summary

4. Massive PE – haemodynamically unstable - requires immediate complex individualised care with input from senior Obstetric, Haematology, Anaesthetic, Radiology, Surgical and Midwifery
Summary

5. PE at term poses particular risk of delivery when therapeutically anticoagulated and requires individualised care with input from senior Obstetrics, Haematology, Anaesthetics and Midwifery
Quality standards and improvement

1. Risk assessment of all pregnant women performed

2. Appropriate treatment for all suspected and confirmed PE

3. Delivery management plan documented for all women on treatment for PE
Looking forward

• Complete new Irish Guideline on Management of VTE in pregnancy

• If you do only one thing when you return to your unit......

  Highlight the importance of shortness of breath in pregnancy