Introduction

• Common procedure
• Uncommon problem
• Incidence est. 1/6000 cases
• Possible adverse outcome
  – Morbidity
  – Mortality
Case series

- 7 cases
- Ambulatory surgery center
- Hysteroscopic myomectomy
Case series – Methods

• Review of:
• Patient-related factors
  – Pre-operative: ob/gyn, anesthesiological
  – Peri-operative: chart
  – Post-operative: PACU report
• Procedure-related factors
  – Equipment
  – Technique
  – Distention media
Definitions

• Classification of venous air embolism
  – Subclinical
  – Minor
  – Moderate
  – Severe
Definition: Subclinical VAE

- Prevalence 98% (TEE)
- Continuous bubble flow
- “etCO2 drop 2 mmHg”
- NO change in parameters or clinical status
Definition: Minor VAE

- Drop in etCO2 < 5mmHg
- SpO2-reading consistently > 92%
- Hemodynamics STABLE
- Self-limiting clinical problem
Definition: Moderate VAE

- etCO2-drop 5-15mmHg
- etCO2 reading consistently > 20 mmHg
- SpO2 < 92%
- Tachycardia, BP-drop
- ECG: ST-changes, RBBB
- Dyspnea, cough, chest pain
- Neurological symptoms
Definition: Severe VAE

- RVOT occlusion with output failure
- Total cardiovascular collapse
# Case series – Results

<table>
<thead>
<tr>
<th>Location</th>
<th>Volume</th>
<th>Time</th>
<th>Severity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>20.94</td>
<td>End of procedure</td>
<td>2</td>
<td>FiO2 1, Ephedrine 10 mg, swift recovery</td>
</tr>
<tr>
<td>Posterior</td>
<td>21.06</td>
<td>During procedure</td>
<td>2</td>
<td>Stop procedure, FiO2 1, Ephedrine 10 mg, procedure completed after recovery</td>
</tr>
<tr>
<td>Posterior</td>
<td>27.54</td>
<td>During procedure</td>
<td>2</td>
<td>Stop procedure, FiO2 1, Ephedrine 10 mg, procedure completed after recovery</td>
</tr>
<tr>
<td>Anterior</td>
<td>13.99</td>
<td>End of procedure</td>
<td>1</td>
<td>Stop procedure, Fluid overload</td>
</tr>
<tr>
<td>Posterior</td>
<td>12.56</td>
<td>After bag change</td>
<td>1</td>
<td>Abort procedure, FiO2 1, Stop N2O</td>
</tr>
<tr>
<td>Posterior</td>
<td>44.29</td>
<td>End of procedure</td>
<td>2</td>
<td>Abort procedure, FiO2 1, Phenylephrine 0.3mg</td>
</tr>
<tr>
<td>Anterior</td>
<td>19.09</td>
<td>After bag change</td>
<td>2</td>
<td>Stop procedure, FiO2 1, Phenylephrine 0.3mg, Calcium 1g, Conversion to open</td>
</tr>
</tbody>
</table>
Results

- 2 cases of minor VAE
- 5 cases of moderate VAE
- etCO2-drop most frequent sign
- Drop in blood pressure: 3 cases
- Tachycardia, desaturation: 2 cases
- ST-changes: 1 case
Results

• Stop procedure in all cases
• Procedure aborted in 3 cases

• Prolonged PACU stay in all cases
• Uneventful PACU stay: all cases
Results: interventions

- FiO2 → 100%: all cases
- Stop N2O: all of the N2O cases
- Manual ventilation: 2 cases
- Ephedrine 10mg: 3 cases
- Phenylephrine 0,1mg: 2 cases
Pathophysiology

• Risk factors
  – Trendlenburg
  – Air in lines
  – Piston effect of hysteroscope
  – High instillation pressures
  – Traumatic dilation
  – Large lacerations cervix/vagina
Not etiological factors

- (Extensive) coagulation
  - monopolar
  - bipolar
- CO2-emboli
- Distention medium
Preventive measures

- Surgeon
- Anesthesiologist
- OR nurses
Identification of adverse events

- ABC approach useful for any acute clinical event
- Guides classification of venous air emboli (VAE)
  - Subclinical
  - Minor
  - Moderate
  - Severe
Intervention

- Classification guides intervention

Venous Air Embolism

**Minor**
- etCO2-drop < 5
- SpO2 > 92%

**Moderate**
- etCO2-drop 5-15
- etCO2 > 20 mmHg
- SpO2 < 92%
- Tachycardia
- BP-drop < 20% baseline

**Severe**
- Cardiovascular collapse
- Output failure

FiO2 100% and STOP N2O

- Optimize ventilation
- Recruitment + PEEP

- Circulatory support:
  - Ephedrine per 5-10mg
  - Phenylephrine per 0.1mg*

- Manual Ventilation
  - Pre-cordial thump
  - Compressions
  - ALS Protocol

- Surgeon: STOP procedure, drain uterus, occlude cervix & vagina
Intervention – Minor VAE

• Minor emboli
  – Require no intervention
  – Recheck risk factors
  – Communicate with surgeon
Intervention – Moderate VAE

• Airway/Breathing
  – FiO2 → 1
  – Stop N2O

• Circulation
  – Control measurement of NIBP
  – Ephedrin 1\textsuperscript{st} choice
  – Phenylephrine if marked tachycardia
Intervention – Moderate VAE

• Surgeon
  – Communicate with surgeon
  – Drain uterus
  – Pack cervical os and vagina
• Recheck risk factors
• Check ABG
• Continue if stable
Intervention – Severe VAE

• Initiate ALS protocols
• Pre-cordial thump useful to break up or dislodge large bubbles
• Possible benefit of CVC placement
• Percutaneous air aspiration: last resort
• Priority of ALS >>> CVC placement!
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Cardiovascular collapse
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FiO2 100% and STOP N2O

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Recruitment + PEEP

Manual Ventilation
Pre-cordial thump
Compressions
ALS Protocol

Circulatory support:
Ephedrine per 5-10mg
Phenylephrine per 0.1mg*

Surgeon: STOP procedure, drain uterus,
occlude cervix & vagina
Post-operative

• Full clinical examination
  – Check for signs of non-cardiogenic pulmonary edema
  – Neurological examination (paradoxical VAE)
• 12 leads ECG
• CBC + biochemistry + ionogram
• 2nd ABG
• Chest X-ray if signs of NCPE
Post-operative

• Discharge
  – Stable
  – Investigations negative

• Hospitalization
  – Unstable
  – NCPE
  – Inadequate neurological status
Take Home Messages

- Rare but possibly fatal complication
- etCO2 drop +/- hemodynamic instability
- Anesthesiologist AND surgeon take action, communicate!
- Pre-cordial thump potential life-saver
- Thorough clinical examination at PACU
References (1)

References (2)