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Pleural effusion and thickening

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Disclosures

• Nothing to disclose
Overview

• Evidence base for use of thoracic ultrasound
  – diagnostic and interventional

• Pleural effusion
  – Characteristics of effusions
  – Transudates vs exudates
  – Colour fluid sign
  – Formulas for volume estimation

• Malignant pleural effusion
  – US sensitivity on detection

• Empyema
  – US findings

• Pleural thickening
  – Identification, DD with pleural effusion
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Why ultrasound?

- Not all opacification is fluid... 

Why ultrasound?

• **Higher diagnostic sensitivity vs. plain chest radiography**
  – pleural effusion +/- consolidation

• **Accessible to clinician and patient**
  – instant feedback to inform decision-making process

• **Provides additional diagnostic information**
  – echogenicity, septations, pleural thickening, underlying viscera

• **Improves procedural outcomes**
  – eliminates “dry tap”, limits risk of iatrogenic complications
Interventions

• Thoracic ultrasound (TUS)
  – necessary for any pleural intervention for fluid
  – more sensitive than CXR for detection of fluid\(^1\)
  – improves diagnostic accuracy and reduces complications\(^2\)

• BTS Pleural Disease Guidelines\(^3\)
  ▶ Bedside ultrasound guidance significantly increases the likelihood of successful pleural fluid aspiration and reduces the risk of organ puncture. (B)
  ▶ Thoracic ultrasound guidance is strongly recommended for all pleural procedures for pleural fluid. (B)
  ▶ The marking of a site using thoracic ultrasound for subsequent remote aspiration or chest drain insertion is not recommended except for large pleural effusions. (C)

\(^1\) Eibenberger KL et al. Radiology 1994
\(^2\) Diacon AH et al. Chest 2003
\(^3\) BTS Pleural Disease Guidelines. Thorax 2010
The evidence for fluid

• Better than clinical examination
  - 15% of clinically specified puncture sites inaccurate / “at risk”
  - 80% of these successfully aspirated / accessible with TUS
  - If clinical site not identified, TUS achieved in 54%
  - TUS prevented iatrogenic organ puncture in 10% of cases

• Reduces cost / complications in thoracentesis
  - 61,261 thoracenteses, 47% performed without TUS
  - MV modelling and analysis
  - TUS reduced risk of pneumothorax by 19%
  - OR 0.81; 95% CI 0.74-0.90

1 Diacon et al. Chest 2003
2 Mercaldi et al. Chest 2013
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Normal appearances

• Thoracic anatomy
  – ultrasound unable to “see” through air or bony structures
  – recognition of “normal” features and artefacts
  – lung sliding, A-lines and B-lines (comet tails)

• Other organs
  – liver, spleen, heart and vascular structures

• Aerated lung
  – demonstration of lung sliding, B-lines
  – you cannot comment on what is below the interface
  – you cannot “see” the lung, rather artefact caused by lung
Pleural effusion

• Identification
  – echogenicity (“swirling” pattern)
  – assess underlying lung (atelectasis, consolidation)
  – inversion of hemidiaphragm (correlation with symptoms)
  – pleural thickening and nodularity

• Diagnostic features
  – Aid to identify cause (transudates vs exudates)
  – Specific for malignant pleural effusions
  – Particular findings in pleural infection
Characterisation of effusions

Non echogenic

Echogenic
Septations and fluid loculations
Number of septations

Predictor of non symptomatic benefit post fluid drainage

Psallidas I et al, submitted article
Combination of echogenicity and septations

- Complex non-septated
- Anechoic
- Complex septated
- Homogenously echogenic
Size of effusion on US

Size / Volume measurement$^1$: 
- 2cm depth of fluid = 480mls
- 4cm depth of fluid = 960mls

Supine patients$^2$: 
- Size calculation:
  » Visceral – parietal (mm) x 20 = volume (mls)$^1$
  » Distance between posterior chest wall and lung of >50mm predicts >500ml thoracentesis vol$^2$

$^1 = $Balik, ICM 2006  
$^2 = $Roch, Chest 2005
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The “simple” effusion

<table>
<thead>
<tr>
<th></th>
<th>This study</th>
<th>Leung et al (12)</th>
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</thead>
<tbody>
<tr>
<td><strong>Number of patients</strong></td>
<td>52</td>
<td>74</td>
</tr>
<tr>
<td><strong>Study type</strong></td>
<td>US</td>
<td>CT</td>
</tr>
<tr>
<td><strong>Parietal pleural thickening &gt;1cm</strong></td>
<td>42%</td>
<td>56%</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>95%</td>
<td>88%</td>
</tr>
<tr>
<td><strong>Nodular pleural thickening</strong></td>
<td>42%</td>
<td>36%</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>100%</td>
<td>85%</td>
</tr>
<tr>
<td><strong>Visceral pleural thickening</strong></td>
<td>15%</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>100%</td>
<td>85%</td>
</tr>
<tr>
<td><strong>Diaphragmatic thickening &gt;7mm</strong></td>
<td>42%</td>
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<tr>
<td><strong>Sensitivity</strong></td>
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<td>NA</td>
</tr>
<tr>
<td><strong>Diaphragmatic layers resolved</strong></td>
<td>30%</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>95%</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Diaphragmatic nodules</strong></td>
<td>30%</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>100%</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td>79%</td>
<td>72%</td>
</tr>
<tr>
<td><strong>Specificity</strong></td>
<td>100%</td>
<td>83%</td>
</tr>
</tbody>
</table>

NA: Not assessed

**Table 4**: Sensitivities and specificities for ultrasound and CT determined criteria that are suggestive of malignant pleural disease.
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Pleural thickening

• Unechoic on ultrasound

• Due to:
  – Malignancy: e.g. mesothelioma
  – Asbestos exposure
  – Empyema
Use of Doppler pleural thickening
Use of Doppler pleural effusion
Visceral thickening
General points

• **ASK FOR HELP IF YOU NEED IT!**
  – senior, more experienced colleagues for second opinion
  – get a radiologist (more skilled; access to other techniques)

• **Trust your CXR interpretation**
  – does this correlate with what you are seeing on TUS?

• **Know your limits**
  – do not practice outside your competence / experience
  – TUS is safe, but what follows may not be...
Thank you for your attention!

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