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# Image guided Pleural Biopsy

**BTS Intervention Course**  
31<sup>st</sup> May 2024

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# Overview

- Ultrasound skills
- Evidence for use of image guided biopsy
- Indications
- Technique
- Complications

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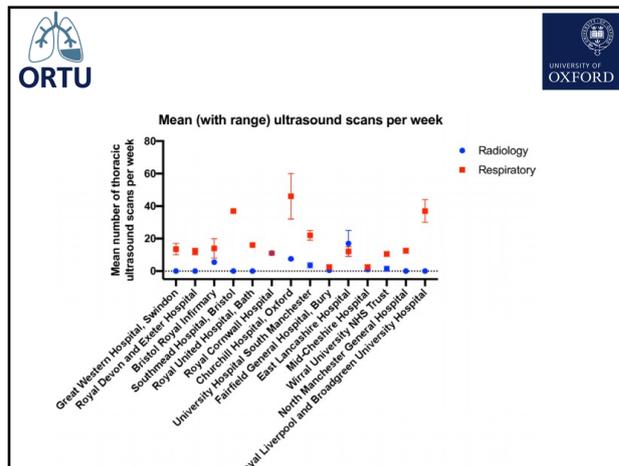
Pleural Disease

BMJ Open Respiratory Research

## Training opportunities in thoracic ultrasound for respiratory trainees: are current guidelines practical?

Andrew E Stanton<sup>1</sup>, Matthew Evison<sup>2,3</sup>, Mark Roberts<sup>4,5</sup>, Jennifer Latham<sup>6</sup>, Amelia O Clive<sup>7</sup>, Elizabeth Batalia-Duran<sup>8</sup>, Rahul Bhattagar<sup>9</sup>, Rachelle Asciak<sup>10</sup>, Ben Diggins<sup>11</sup>, Oliver J Bintcliffe<sup>12</sup>, Diana Lees<sup>13</sup>, Maria Parsonage<sup>14</sup>, Peppa Denny<sup>15</sup>, Kathryn Gow<sup>16</sup>, Cristina Avram<sup>17</sup>, Manish Gautam<sup>18</sup>, Najib M Rahman<sup>19</sup>

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Pleural Disease

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## British Thoracic Society Training Standards for Thoracic Ultrasound (TUS)

Andrew E Stanton<sup>1</sup>, Anthony Edey<sup>2</sup>, Matthew Evison<sup>3,4</sup>, Ian Forrest<sup>5</sup>, Sabine Hippolyte<sup>6</sup>, Jack Kastelik<sup>7</sup>, Jennifer Latham<sup>8</sup>, Lola Loewenthal<sup>9</sup>, Thapas Nagarajan<sup>10</sup>, Mark Roberts<sup>11</sup>, Nicholas Smallwood<sup>12</sup>, John E S Park<sup>13</sup>

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# BTS guidelines

**2a: Emergency TUS operator pathway**

To be able to practice independently in emergency TUS to enable safe intervention in context of an emergency life threatening situation due to large, simple pleural effusion

By the end of training and entrustment at CIP level 4 emergency operators will:

- ▶ Have completed a local introductory TUS session, focusing on:
  - The basics of ultrasound examination
  - Familiarity with the local ultrasound machine(s) including depth, gain and probe orientation
- ▶ Be able to correctly identify normal structures (lung, heart, hemi diaphragm, liver, kidneys, spleen and ribs)
- ▶ Be able to correctly identify a clinically large free flowing pleural effusion of greater than 5 cm on ultrasound
- ▶ Accurately measure depth of any pleural fluid identified
- ▶ Appropriately identify a sonographically safe site for safe aspiration / drainage of fluid in a large effusion
- ▶ Recognise when ultrasound appearances are atypical for large, simple, free flowing pleural effusion and where onward referral to a more expert practitioner is made before any intervention
- ▶ Be aware of own limitations and subsequent onward referral rate
- ▶ Demonstrate annual review and appraisal of practice

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**2d: Expert TUS operator**

To be able to demonstrate independent practice at an expert level of TUS using more complex adjuncts to imaging and more invasive diagnostic interventions

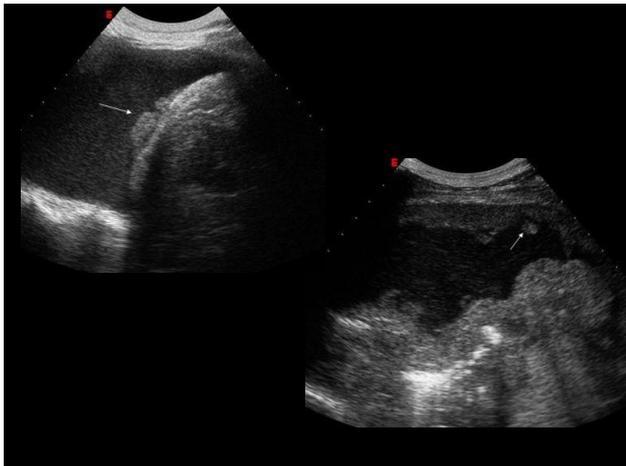
- ▶ Demonstrate they have met all objectives within emergency, primary and advanced pathways
- ▶ Demonstrate ongoing practice of over 70 TUS examinations per year
- ▶ Correctly use and interpret findings using advanced modes, that is, M-mode, colour and Doppler
- ▶ Accurately assess diaphragm function on ultrasound—to identify movement impairment rather than frank paralysis
- ▶ Safely and accurately obtain pleural biopsies under direct ultrasound guidance and demonstrate awareness of the benefits and limitations of TUS guided pleural biopsy versus CT-guided biopsy
- ▶ Use ultrasound to establish if pneumothorax induction at thoracoscopy is possible and safe
- ▶ Be aware of own limitations and subsequent onward referral rate
- ▶ Demonstrate annual review and appraisal of practice including standardised outcome measures

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# Indications

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**Thoracic ultrasound in the diagnosis of malignant pleural effusion**

N R Qureshi,<sup>1</sup> N M Rahman,<sup>2</sup> F V Gleeson<sup>3</sup>

**See Editorial, p 97**

▶ Additional details of the techniques, statistical analysis and figures are published online only at <http://thorax.bmj.com/content/64/iss2>

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Correspondence to: Dr F V Gleeson, Department of Radiology, Oxford Radcliffe Hospital, Headingley, Oxford OX3 7JL, UK; [teresa.gleeson@nds.ox.ac.uk](mailto:teresa.gleeson@nds.ox.ac.uk)

**ABSTRACT**  
**Background:** Malignant pleural effusion (MPE) is a common clinical problem with described investigation pathways. While thoracic ultrasound (TUS) has been shown to be accurate in pleural fluid detection, its use in the diagnosis of malignant pleural disease has not been assessed. A study was undertaken to assess the diagnostic accuracy of TUS in differentiating malignant and benign pleural disease.  
**Methods:** 52 consecutive patients with suspected MPE underwent TUS and contrast-enhanced CT (CECT). TUS was used to assess pleural surfaces using previously published CT imaging criteria for malignancy, diaphragmatic thickness/nodularity, effusion size/nature and presence of hepatic metastasis (in right-sided effusions). A TUS diagnosis of malignant or benign disease was made blind to clinical data/other investigations by a second blinded operator using anonymised TUS video clips. The TUS diagnosis was compared with the definitive clinical diagnosis and in addition to the diagnosis found at CECT.  
**Criteria established in previous studies:** CECT is recommended as the next investigation, with a view to subsequent histological diagnosis (blind, image-guided or thoracoscopic pleural biopsy).<sup>1,4</sup> Thoracic ultrasound (TUS) is a valuable clinical tool which is increasingly being performed by chest physicians. In the UK, guidelines have recently been published with suggested training for physicians with an interest in practising TUS.<sup>5</sup> Hitherto, the role of TUS has been limited to pleural fluid detection (with high sensitivity) and image-guided techniques (thoracocentesis, drain placement, lung biopsy).<sup>6</sup> The sonographic appearance of malignant pleural effusion and the value of ultrasound in determining the nature of pleural effusion have been described in previous studies.<sup>11</sup> However, there are no published studies to our knowledge which have assessed the diagnostic accuracy of ultrasound for malignancy in patients with suspected but undiagnosed malignant pleural effusion.

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## US Dx of MPE

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

	This study (n = 52)		Leung <i>et al</i> <sup>11</sup> (n = 74)	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
Parietal pleural thickening >1 cm	42	95	56	88
Nodular pleural thickening	42	100	36	85
Visceral pleural thickening	15	100	NA	NA
Diaphragmatic thickening >7 mm	42	95	NA	NA
Diaphragmatic layers resolved	30	95	NA	NA
Diaphragmatic nodules	30	100	NA	NA
Overall	79	100	72	83

NA, not assessed.

**Qureshi et al, Thorax 2008**

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**“Realtime Guidance”**

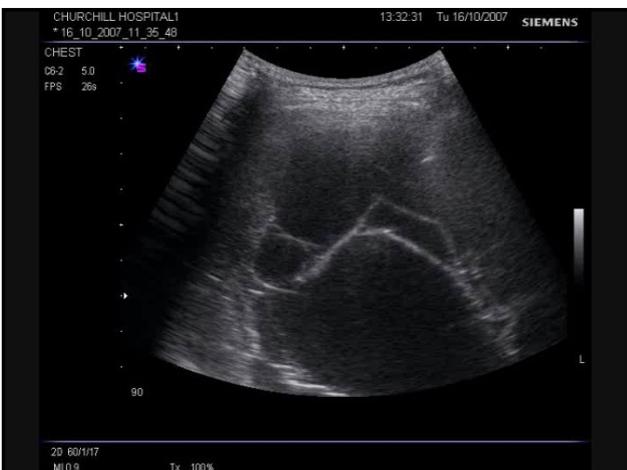
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## Image Guided Biopsy

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## Image guided Biopsy

### Indications

- **Pleural thickening**
  - Malignancy
  - TB
- **Failed thoracoscopy**
  - Pleurodesed space
  - Unable to induce pneumothorax
- **Unfit for thoracoscopy**



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## Image guided or thoracoscopy?

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## Evidence<sup>1</sup>

### Use of thoracic US in:

1. Predicting feasibility of pneumothorax induction
2. Safe PTx induction using real-time US guidance



<sup>1</sup>Corcoran et al, Thorax 2015 70:906

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## Evidence<sup>1</sup>

### 207 thoracoscopies:

- 76 (37.2%) required pneumothorax induction
- 10 (13.0%) could not be induced

### Prediction:

- 67/70 (95.7%) with lung sliding successful pneumothorax
- 7/7 with poor lung slide failed pneumothorax induction
- 6/7 converted to image guided Bx

<sup>1</sup>Corcoran et al, Thorax 2015 70:906

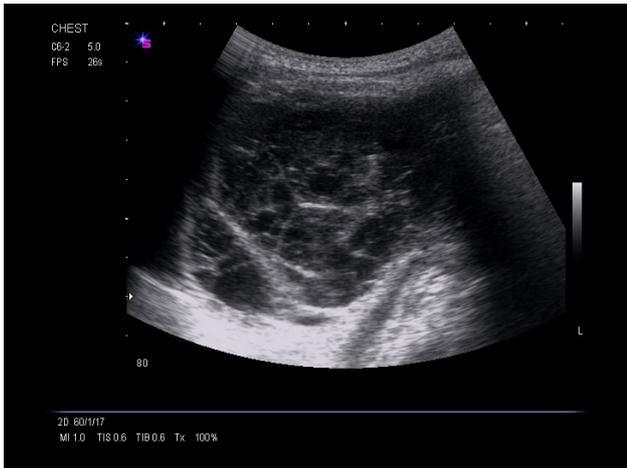
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## Evidence<sup>1</sup>



- **"Blind" Abrams biopsy:**
  - Very poor yield in MPE (40-60%)
  - Moderate to good in TB pleuritis (~80%)
- **RCTs of blind versus image guided biopsy**
  - 2 RCTs demonstrate superiority of CT guided<sup>2,3</sup>
- **US versus CT biopsies (lung and pleura):**
  - Successfully Bx in 97.1% (US) and 96.5% (CT)<sup>4</sup>

<sup>1</sup>Sibby and Maskell, *Curr Op Pulm Med*, 2016 22:392  
<sup>2</sup>Maskell et al, *Lancet* 2003; 361:1326  
<sup>3</sup>Rezk NAS et al, *Egyptian J Chest Dis Tub* 2015; 64:405  
<sup>4</sup>Scorlenza et al, *Radiology* 2013; 266:930-935.

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## Realtime Ultrasound Bx by Pulmonary Physicians



- **High diagnostic yield<sup>1</sup>:**
  - 47/50 (94%) sufficient material
  - 13 in failed thoracoscopy – 11/13 (85%) sufficient
  - Sensitivity 46/50 (92%)

<sup>1</sup>Hallifax et al, *Chest* 2014; 146:1001-1006.

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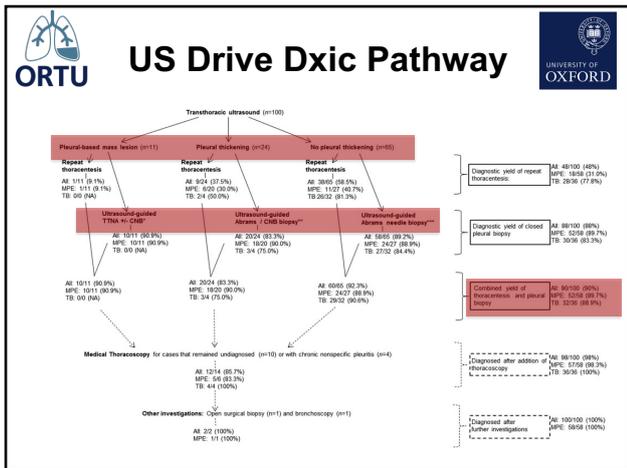
## Realtime Ultrasound Bx by Pulmonary Physicians



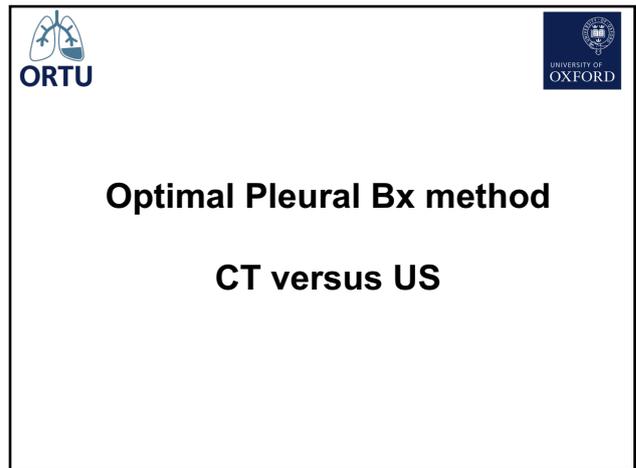
- **Assists in selecting Bx technique / pathway<sup>2</sup>:**
  - Prospective 100 patient study
  - For malignancy altered diagnostic yield from 31% to 90%
  - For all diagnoses, yield 90%

<sup>2</sup>Koegelenberg CFN et al, *Thorax* 2015; 70:995-997

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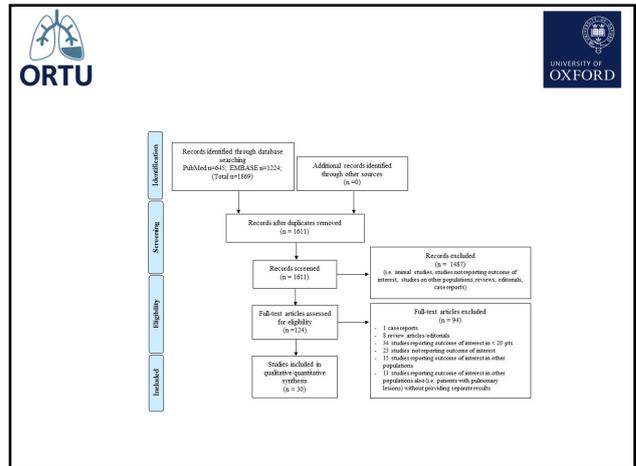


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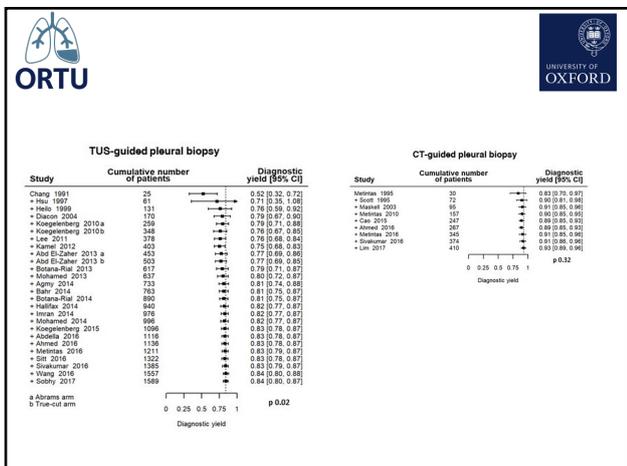


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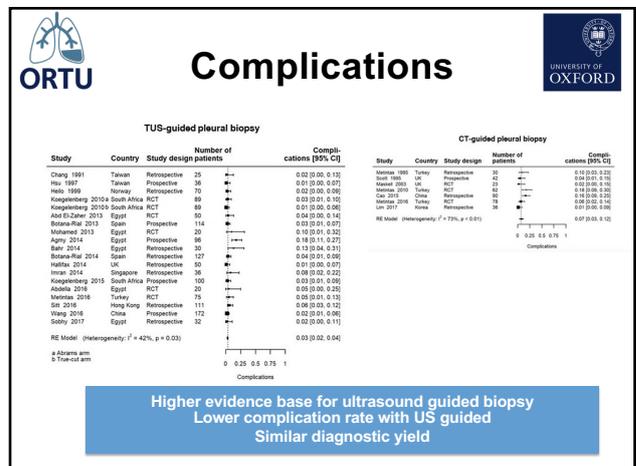
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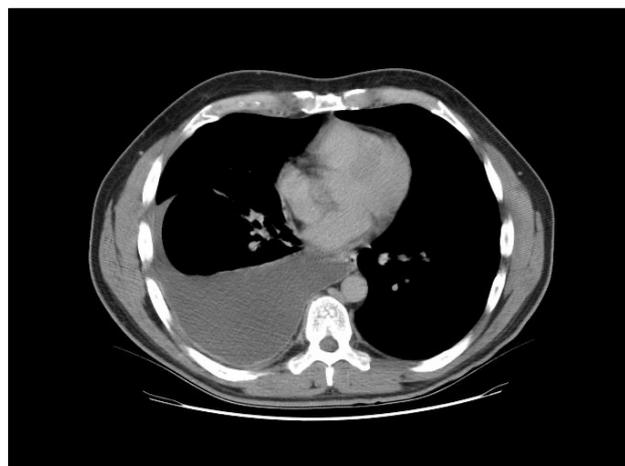


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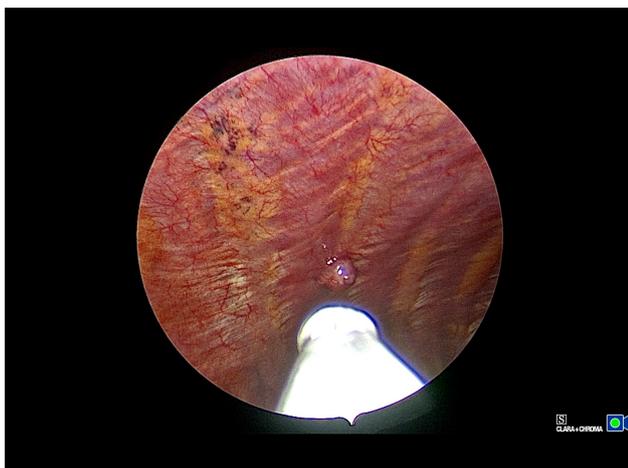



# Case Selection

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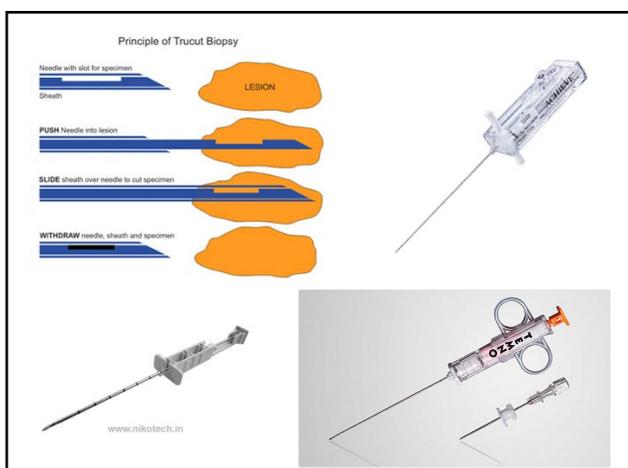


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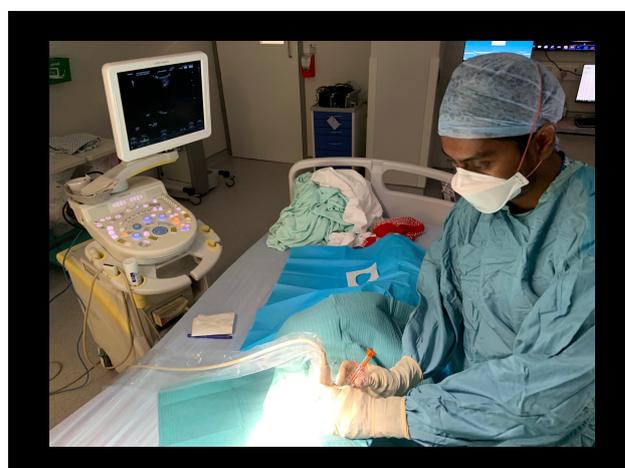



# How to do it

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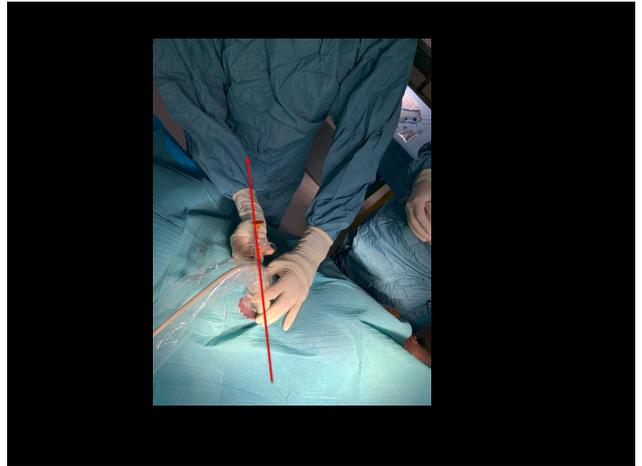
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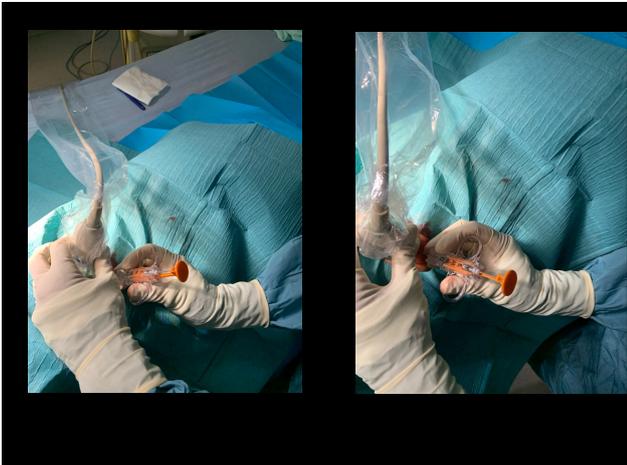
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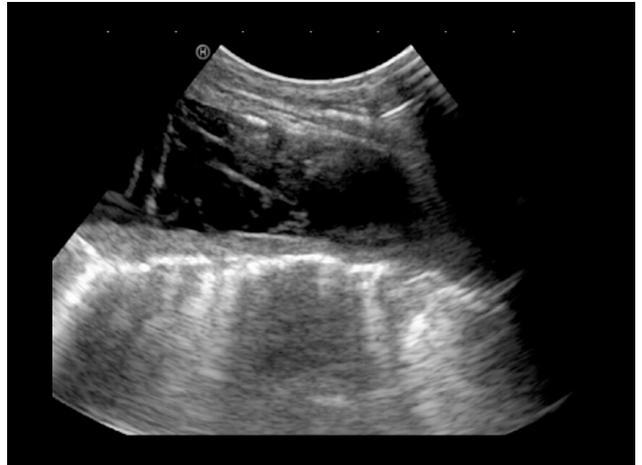
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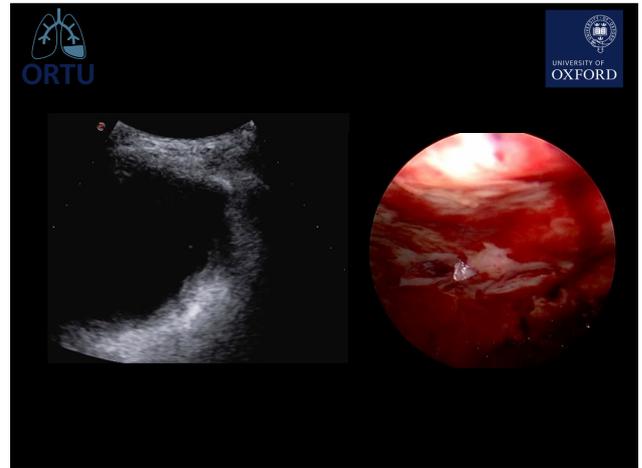
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## Complications

**Minor expected:**

- Inadequate sample (10-15%)
- Pain / skin bruising (10-15%)

**Major:**

- Pleural infection (<1%)
- Major thoracic bleeding (<1%)
- Thoracic organ damage (<1%)
- "Air embolus" – extremely rare

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## Intercostal Artery Detection

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Intercostal vessel screening prior to pleural interventions by the respiratory physician – a prospective study of real world practice

Ernst D, Sadler, Anelka Tsvetkova, Magdal Henzen, David J, McCracken, Rachelle Acosta, Rachel M, Mace, Nicholas I, Katsikalis, Fergal V, Clewley, Rob J, Halliday, John M, Wightman, Nishi M, Palmer

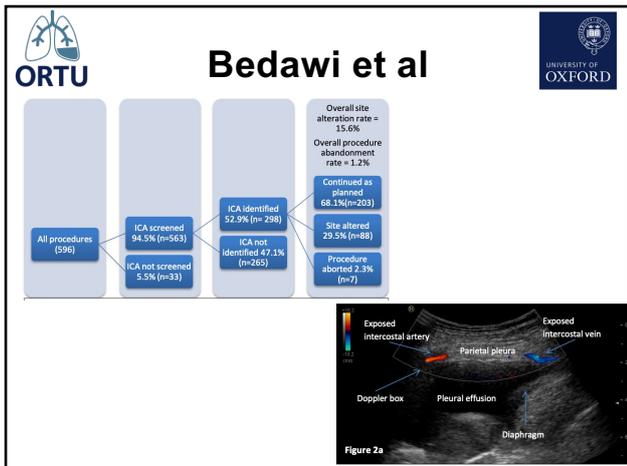
European Respiratory Journal 2020; DOI: 10.1183/13993003.02241-2019

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## Bedawi et al

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**Bedawi et al**

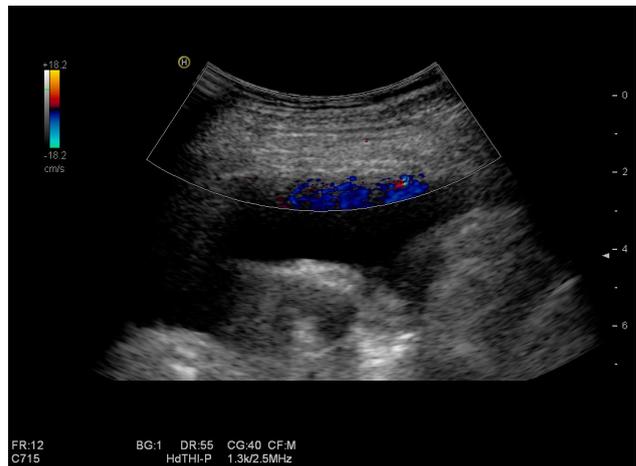
Procedure	Procedures performed (% of all procedures)	ICA screening attempted (% of performed)	Successfully Identified (% of attempted)	Chi-squared ( $\chi^2, df$ )	p-value
MT	105 (17.6)	100 (95.2)	41 (41.0)	6.95	<0.01*
IGBx	72 (12)	70 (97.2)	51 (72.9)	12.74	<0.01*
ICD	62 (10.4)	54 (87.1)	29 (53.7)	0.01	0.905
IPC	47 (7.9)	46 (97.9)	19 (41.3)	3.22	0.728
Tx Asp	256 (42.9)	245 (95.7)	126 (51.4)	0.34	0.560
Dx Asp	54 (9.1)	48 (88.9)	32 (66.7)	7.71	<0.01*
ALL PROCEDURES	596	563 (94)	298 (52.9)		

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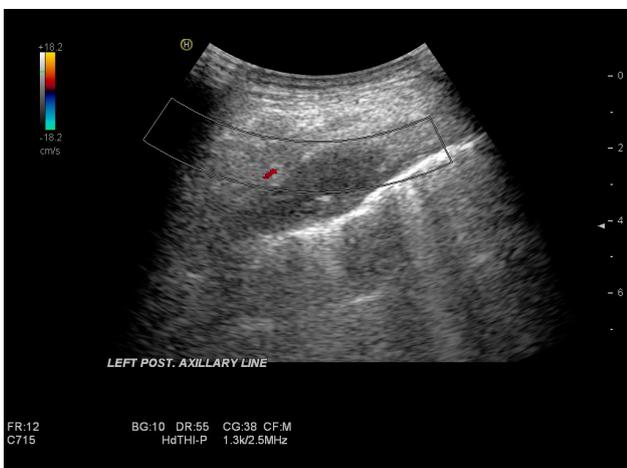
**Bedawi et al**

Procedure	Identified	Site altered (% of identified)	Chi-squared ( $\chi^2, df$ )	p-value
MT	41	13 (31.7)	0.11	0.742
IGBx	51	27 (52.9)	16.20	<0.01*
ICD	29	8 (27.6)	0.06	0.809
IPC	19	3 (15.8)	1.84	0.175
Tx Asp	126	30 (23.8)	3.43	0.064
Dx Asp	32	7 (21.9)	1.01	0.315
ALL PROCEDURES	298	88 (29.5)		

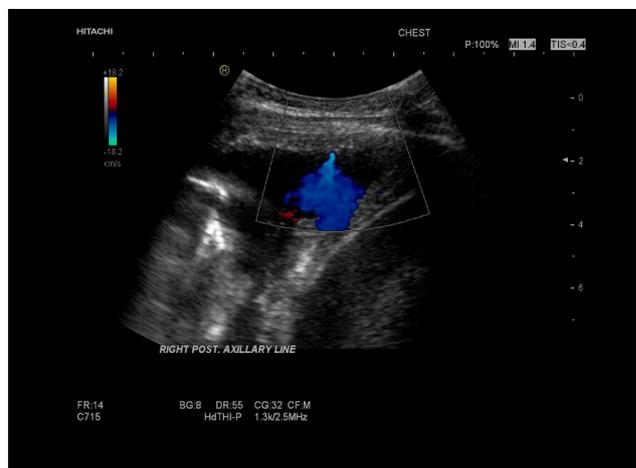
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## Summary



### Image guided Cx Needle Biopsy:

- In those not fit enough for thoracoscopy
- Difficult anatomy / no pleural space / septations
- High yield for all diagnoses if done in realtime

### How to do it:

- In line technique
- Correct patient / operator orientation
- Multiple samples (x6) from different angles
- Ensure tangential biopsy crossing the pleura and soft tissue