Critical Review Form
Diagnostic Test

Rapid detection of pneumothorax by ultrasonography in patients with multiple trauma
Critical Care 2006; 10: R112

Objective: "To assess the ability of appropriately trained emergency department clinicians to perform bedside US to rapidly detect and assess the size of pneumothorax in patients with multiple trauma." (p 2)

Methods: Prospective study (? convenience sampling) at Zhejiang University Hospital (Hangzhou, China) from Sept 2004 – October 2005 of multiple trauma patients in either the resuscitation room or the emergency intensive care unit excluding those with subcutaneous emphysema or cardiac arrest (from suspected tension pneumothorax). Three ED physicians performed the US and each had completed a 28-hour institutional course based upon EM guidelines for US proficiency (*Ann Emerg Med* 2001; 38:470).

Portable CXR and CT chest were obtained either before or after EM physician US, but within three hours. Radiologists interpreting the CXR and CT scans were blinded to the US results, but ultrasonographers were not necessarily blinded to the CXR/CT results. Examination of the anterior, lateral, and posterior-thorax (where?) occurred using a 3.5 MHz probe: Pneumothorax was considered when the absence of both lung-sliding and comet-tail artifacts was noted. (p 3) The Gold standard for diagnosing PTX was CT or air-return by emergent chest tube placement (in four who had chest tube placed before CT could be obtained).

PTX size was determined by CT automatically (small <30%, medium 30-70%, large >70%), while "lung point" was used to estimate size via US. The time required to obtain bedside US, portable CXR, and CT-chest was recorded. US and CXR were compared to CT-chest for detecting PTX size and presence using a Kappa analysis.

Guide		Comments
I.	**Are the results valid?**	
A.	**Did clinicians face diagnostic uncertainty?**	Yes. "Before performing the US, these clinicians were unaware of radiographic and CT findings." (p. 3)

<table>
<tr><td>B.</td><td>Was there a blind comparison with an independent gold standard applied similarly to the treatment group and to the control group?
(Confirmation Bias)</td><td>Yes. “The results of chest CT and radiography were interpreted by independent radiologists who were unaware of patients’ condition and the findings of US.” (p 3)</td></tr>
<tr><td>C.</td><td>Did the results of the test being evaluated influence the decision to perform the gold standard?
(Ascertainment Bias)</td><td>No, all subjects had a chest CT performed (except four who did not have time for CT due to instability). For these four, the surrogate of air rush after chest tube placement was used.</td></tr>
<tr><td>II.</td><td>What are the results?</td><td></td></tr>
<tr><td>A.</td><td>What likelihood ratios were associated with the range of possible test results?</td><td>

135 subjects were eligible (28 were excluded) including 84% males. Average age was 45 yrs and all were blunt trauma victims. <u>The average ISS was 29 and 61.5% had mechanical ventilation.</u>
The sensitivity of portable supine CXR was 27.6% (LR- 0.72).
2x2 Table for EM-Performed US

<table>
<tr><th></th><th>CT PTX+</th><th>CT PTX-</th></tr>
<tr><td>US PTX+</td><td>25</td><td>3</td></tr>
<tr><td>US PTX-</td><td>4</td><td>103</td></tr>
</table>
Sensitivity 86%
Specificity 97%
Prevalence of PTX 21.5%
LR + 30 (10 – 94)
LR - 0.14 (0.06-0.35)

So a positive lung US would change probability of PTX from 22% to 90%, while a negative lung US would change your post-test probability to 4%.
</td></tr>
</table>

		• Kappa for US (0.844) superior to CXR (0.374, $p<0.001$) compared with CT-chest. • US PTX-size measurement concurs with CT-chest ($\kappa=0.669$, $p<0.001$) • US more quickly identifies PTX than CXR (2.3' vs 19.9', $p<0.001$)

III.	How can I apply the results to patient care?	
A.	**Will the reproducibility of the test result and its interpretation be satisfactory in my clinical setting?**	Uncertain since no intra-rater or inter-rater reproducibility assessment was performed. The answer would likely be no since unlike the majority of EM providers, these ultrasonographers were highly trained.
B.	**Are the results applicable to the patients in my practice?**	For TCC multi-trauma patients, yes. These were sick trauma patients. The use of US for PTX on less injured trauma patients is not answered by this paper.
C.	**Will the results change my management strategy?**	Yes, this paper offers compelling evidence that *highly experienced* EM ultrasonographers can more rapidly and reliably identify small, medium, and large blunt trauma related PTX with lung US than via portable CXR.
D.	**Will patients be better off as a result of the test?**	Yes, if sufficient lung US expertise can be developed at your institution to replicate this study's experience level than all-size pneumothoraces can be identified more rapidly permitting more timely life-saving interventions.

Limitations:

1) Lack of intra-rater reliability assessment of EM-clinicians' US findings.
2) Severely injured blunt trauma patient limits extrapolation of findings to less injured or penetrating trauma patients.

Bottom Line:

Highly experienced (>28 hours formal didactic training) EM ultrasonographers can more rapidly and more accurately detect blunt-trauma related pneumothorax in critically injured multi-trauma patients with lung US (absence of lung table and comet-tail artifact) than with portable supine CXR. The results are significant enough to support practice change, but future studies should assess these findings with less-experienced EM ultrasonographers and among less critically injured blunt (and penetrating) trauma patients.