Test characteristics of ultrasonography for the detection of pneumothorax: a systematic review and meta-analysis
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CRD summary
This review concluded that chest ultrasound had superior sensitivity and similar specificity to supine chest radiography for the diagnosis of pneumothorax. These conclusions reflect the data presented but should be interpreted cautiously due to limitations in the review process and meta-analyses.

Authors’ objectives
To compare the diagnostic accuracy of ultrasound with that of chest radiography in patients with suspected pneumothorax.

Searching
MEDLINE and EMBASE were searched for studies in English. The search strategy was reported as an appendix. Searches were up to November 2010. Bibliographies of included studies and recent reviews were screened for additional articles. Experts in the field were contacted.

Study selection
Prospective studies of chest ultrasound in adults with suspected pneumothorax (any cause) were eligible for inclusion. Included studies were required to use computed tomography (CT) scan findings or release of air on insertion of a chest tube as the reference standard to confirm diagnosis.

Pneumothorax was traumatic in six studies and iatrogenic in two studies. Chest radiographs were performed in a supine position for most of the included study participants. Studies used various ultrasound probes (linear, curved and micro convex). In half of all studies ultrasound examination was done by an emergency physician. All studies except one used the absence of lung sliding and comet-tail signs as criteria for detection of pneumothorax. Most studies used CT as the reference standard.

Two reviewers independently assessed studies for inclusion. Any disagreements were resolved by discussion.

Assessment of study quality
The methodological quality of included studies was assessed using the 14-item QUADAS tool.

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Data extraction
Data were extracted to calculate the sensitivity and specificity, with 95% confidence intervals (CIs), of ultrasound and chest radiography for each included study. Weighted mean difference (WMD), with 95% CIs, in sensitivity and specificity between ultrasound and chest radiography was calculated for each study.

Where studies reported the number of hemithoraces scanned, the total number was halved and the number of positive and negative test results were averaged to produce an approximation to per patient data.

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Methods of synthesis
Pooled estimates of sensitivity and specificity, with 95% CIs, of ultrasound and chest radiography and weighted mean difference between the two tests for both measures were calculated. Fixed-effect (no evidence of statistical heterogeneity) or random-effects (evidence of statistical heterogeneity) models were used.

Sub-group analyses were conducted for trauma patients and iatrogenic pneumothorax.
Results of the review
Eight studies (1,048 participants) were included in the review. Pneumothorax was traumatic in six studies (767 participants) and iatrogenic in two studies (281 participants). Chest radiograph data were available for 864 participants. All studies were reported as being of good to average quality. Ultrasonographers were blinded to the reference standard in all eight studies.

Pooled estimates of sensitivity were 90.9% (95% CI 86.5% to 93.9%) for ultrasound and 50.2% (95% CI 43.5% to 57.0%) for chest radiography. Pooled estimates of specificity were 98.2% (95% CI 97.0 to 99.0%) for ultrasound and 99.4% (95% CI 98.3 to 99.8%) for chest radiography.

Ultrasound performance was similar for trauma patients and iatrogenic patients.

Authors’ conclusions
Ultrasonography had superior sensitivity and similar specificity to supine chest radiography for the diagnosis of pneumothorax.

CRD commentary
This article reported a clear research objective. Inclusion criteria were defined for the study population, index test and reference standard. Only two bibliographic databases were searched for relevant studies and searches were restricted to studies in English so relevant studies may have been omitted and language bias was a possibility. Measures to minimise error and bias were applied throughout the review process. The authors stated that they assessed the methodological quality of included studies; the results of this assessment were reported only as a general description of study quality so it was not possible to assess the possible effects on the findings of the review of any methodological weaknesses in the included studies. The meta-analytic methods used are not those currently recommended for comparison of diagnostic performance between tests.

The authors’ conclusions reflect the data presented but should be interpreted cautiously given the limitations in the review process and meta-analyses.

Implications of the review for practice and research
Practice: The authors stated that their findings supported adoption of chest ultrasound for routine use in patients with clinically suspected pneumothoraces.

Research: The authors stated that studies that compared the performance of erect and supine chest radiographs in detecting pneumothorax were lacking.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.