Diagnostic value of transthoracic Doppler echocardiography in pulmonary hypertension: a meta-analysis

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CRD summary
This review found that transthoracic Doppler echocardiography (as a non-invasive test) had acceptable mixed sensitivity, but had insufficient specificity to confirm a diagnosis of pulmonary hypertension. These conclusions are appropriately cautious. However, weak included study designs and limitations in the analysis methods mean that the pooled estimates of test performance should be interpreted cautiously.

Authors' objectives
To assess the accuracy of transthoracic Doppler echocardiography for the diagnosis of pulmonary hypertension.

Searching
PubMed and Web of Science were searched from inception to March 2010; search terms were reported. Bibliographies of included studies were screened for additional articles. Only full publications in English were included.

Study selection
Studies that reported the sensitivity and specificity of transthoracic Doppler echocardiography for the diagnosis of pulmonary hypertension were eligible for inclusion.

Most of the included studies were conducted in the USA. In all studies, the reference standard used to confirm the diagnosis of pulmonary hypertension was right heart catheterisation. The diagnostic thresholds for pulmonary hypertension by transthoracic Doppler echocardiography used by included studies varied, with pulmonary artery systolic pressure that ranged from ≥30mmHg to ≥45mmHg, and right ventricular systolic pressure that ranged from >35mmHg to ≥50mmHg.

Two reviewers independently assessed studies for inclusion; any disagreements were resolved by consensus.

Assessment of study quality
The methodological quality of included studies was assessed using the standards for reporting diagnostic accuracy studies (STARD) initiative and the quality assessment of diagnostic accuracy studies (QUADAS) tool. Both instruments were used to calculate overall quality scores. The maximum possible score for STARD was 25 and the maximum score for QUADAS was 14.

Two reviewers independently assessed methodological quality; any disagreements were resolved by consensus.

Data extraction
Data to populate 2x2 contingency tables were independently extracted by two reviewers. These were used to calculate sensitivity and specificity values for each study. Any disagreements between reviewers were resolved by consensus.

Methods of synthesis
Pooled estimates of sensitivity, specificity, positive and negative likelihood ratios and diagnostic odds ratio (DOR), with 95% confidence intervals (CIs), were calculated. A random-effects model was used to generate pooled estimates. A summary receiver operating characteristic (SROC) curve was constructed (model not specified). The effect of STARD and QUADAS scores on the estimated diagnostic performance of transthoracic Doppler echocardiography (measured by diagnostic odds ratio) was assessed using univariate regression analyses.

Between study heterogeneity was assessed using the $\chi^2$ and Fisher exact tests. Publication bias was assessed using Egger's test.
Results of the review

Six diagnostic case-control studies (188 pulmonary hypertension patients and 548 control patients) were included in the review. STARD scores ranged from 12 to 17; QUADAS scores ranged from 6 to 10.

Estimates of the sensitivity of transthoracic Doppler echocardiography for the diagnosis of pulmonary hypertension ranged from 58 to 100% (pooled sensitivity 82%, 95% CI 76 to 88); the specificity estimates ranged from 29 to 96% (pooled specificity 68%, 95% CI 64 to 72). The pooled positive likelihood ratio was 2.88 (95% CI 1.77 to 4.70). The pooled negative likelihood ratio was 0.31 (95% CI 0.18 to 0.53). The pooled diagnostic odds ratio was 11.36 (95% CI 4.62 to 27.94). There was significant between study heterogeneity for all parameters, with the exception of the diagnostic odds ratio. The area under the summary receiver operating characteristic curve was 0.86; QUADAS and STARD scores did not significantly effect relative diagnostic odds ratios.

There was no evidence of significant publication bias.

Authors’ conclusions

Available evidence suggested that transthoracic Doppler echocardiography (as a non-invasive test) had acceptable mixed sensitivity, but had insufficient specificity to confirm a diagnosis of pulmonary hypertension.

CRD commentary

The review addressed a clearly stated research question. Appropriate inclusion criteria were defined. The restriction of included studies to full publications in English raised the possibility of publication and/or language biases. Publication bias was assessed, but standard methods of assessing publication bias have been shown to be unreliable for test accuracy studies. Methods to minimise error and/or bias were applied throughout the review process.

The methodological quality of included studies was assessed, but the results of this assessment were only reported as summary scores, a method which is not recommended. The meta-analytic methods used were broadly appropriate, although a bivariate of hierarchical summary receiver operating characteristic modelling approach may have been preferable to simple random-effects pooling. In addition, all studies included in the review were diagnostic case-control studies, so would have not been representative of the population in whom the test would be used in practice; case-control studies may produce overestimates of test performance.

Overall, the authors’ conclusions were appropriately cautious, but the pooled estimates of sensitivity and specificity should be interpreted cautiously given the weaknesses in the study design of included studies and limitations in the analysis.

Implications of the review for practice and research

Practice: The authors stated that transthoracic Doppler echocardiography may be useful as a first line surveillance test to rule-out pulmonary hypertension, but diagnoses of pulmonary hypertension should be confirmed by right heart catheterisation.

Research: The authors stated that further studies are needed to assess the value of combining transthoracic Doppler echocardiography with other non-invasive tests for the diagnosis of pulmonary hypertension.

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