The accuracy of MRI in diagnosis of suspected deep vein thrombosis: systematic review and meta-analysis

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CRD summary
This review concluded that magnetic resonance imaging has similar accuracy to ultrasound for the diagnosis of deep vein thrombosis. However, since the review did not assess ultrasound these conclusions are not supported by the results presented.

Authors' objectives
To determine the accuracy of magnetic resonance imaging (MRI) for the diagnosis of deep vein thrombosis (DVT)

Searching
MEDLINE, EMBASE, CINAHL, Web of Science, the Cochrane Library, DARE, HTA and ACP Journal Club were searched from inception to 2005. The search strategy, which was reported, included a diagnostic filter. The reference lists of included studies were screened to identify additional relevant studies. The review was restricted to studies published in English, French, Spanish and Italian. Abstracts and letters were eligible for inclusion; if insufficient data to assess inclusion were reported, then the study authors were contacted for further information.

Study selection
Study designs of evaluations included in the review
Diagnostic cohort studies that included at least 10 patients were eligible for inclusion.

Specific interventions included in the review
Studies of MRI were eligible for inclusion. The most common MRI technique used was two-dimensional time-of-flight to image flowing blood in the leg veins; one study used direct thrombus imaging. Radiologists interpreted the scans in all studies.

Reference standard test against which the new test was compared
Studies in which ultrasound or venography was included as the reference standard were eligible for inclusion. The reference standard in all but one of the included studies was contrast venography; details of the reference standard used in the remaining study were not reported.

Participants included in the review
Studies of patients with clinically suspected DVT or asymptomatic patients at high risk for DVT were eligible for inclusion. Studies included patients with suspected DVT and or pulmonary embolism, and high-risk asymptomatic patients. The majority of the included studies (12 out of 14) were in patients with clinically suspected DVT. DVT prevalence ranged from 5 to 83% (median 50).

Outcomes assessed in the review
Studies had to report sufficient data to construct a 2x2 table of test performance, or the data had to be obtained by contact with the study authors, for the study to be included. The outcomes reported in the review were sensitivity and specificity.

How were decisions on the relevance of primary studies made?
Two reviewers assessed studies for inclusion and any disagreements were resolved through discussion.

Assessment of study quality
Two reviewers independently assessed the methodological quality of the studies using the following criteria: application of reference standard independent of the MRI results; blinding of MRI interpreters to the reference standard results; blinding of reference standard interpreters to the MRI result.
Data extraction
Two reviewers independently extracted the results data as 2x2 tables of test performance. Any discrepancies were resolved through referral to a third reviewer. The sensitivity and specificity were calculated for each study. Where studies contained 0 values in the 2x2 table, 0.5 was added to each cell before calculating the sensitivity and specificity.

Methods of synthesis
How were the studies combined?
The sensitivity and specificity were pooled using a random-effects model.

How were differences between studies investigated?
Heterogeneity was assessed visually through forest plots and statistically using the Q statistic. Sensitivity analyses based on symptomatic versus asymptomatic cohorts and proximal versus distal DVT were undertaken.

Results of the review
Fourteen studies (811 participants) were included.

All studies applied the reference standard independently of MRI. MRI was interpreted blind to the reference standard results and the reference standard was interpreted blind to the MRI results in 11 studies; the remaining 3 studies did not report on blinding.

The sensitivity ranged from 0 to 100% and the specificity from 43 to 100%. Sensitivity was above 80% in all but 3 studies; the 2 studies with the lowest estimates of sensitivity were in asymptomatic patients. There was strong evidence of heterogeneity (p<0.001) in both sensitivity and specificity. The pooled sensitivity was 91.5% (95% confidence interval, CI: 87.5, 94.5) and the pooled specificity 94.8% (95% CI: 92.6, 96.5). The exclusion of 2 studies conducted in asymptomatic patients resulted in a pooled sensitivity of 95.7% (95% CI: 92.4, 97.8) and a pooled specificity of 92.9% (95% CI: 89.5, 95.4); strong evidence of heterogeneity remained for sensitivity (p=0.007) but was reduced for specificity (p=0.058).

Sensitivity was lower for studies assessing distal DVT (62.1%, 95% CI: 42.3, 79.3; based on 4 studies) than for those assessing proximal DVT (93.9%, 95% CI: 88.8, 97.2; based on 8 studies).

Authors' conclusions
The accuracy of MRI for the diagnosis of DVT is similar to that of ultrasound.

CRD commentary
This was a clearly reported review. The review question was focused and supported by clearly defined inclusion criteria. The literature search involved a variety of databases but a diagnostic filter was used, language restrictions were applied, and no attempts were made to locate unpublished studies. It is therefore likely that relevant studies have been missed and the review may be subject to language and publication bias: 5 studies were excluded on the basis of language. Full details of the review process were reported and these included appropriate steps to avoid bias and error. A formal quality assessment was conducted using appropriate criteria, and the results of this were reported in full.

Adequate details of the included studies were reported in the text and in a table. The methods used to pool studies were acceptable, although the use of more advanced methods that take into account the correlation between sensitivity and specificity would have been preferable. It is unclear why 0.5 was added to 0 cells as this is unnecessary for the outcomes of sensitivity and specificity; such an approach is only required when outcomes such as diagnostic odds ratios or likelihood ratios are assessed. The reliability of the authors' conclusions is not supported by the data presented as the conclusions refer to the accuracy of ultrasound, which was not assessed in this review.

Implications of the review for practice and research
Practice: The authors stated that MRI should not replace ultrasound for the first-line investigation of DVT, owing to its cost and inconvenience. However, it may offer an alternative in patients in whom ultrasound is not appropriate or
feasible, or where inconclusive results are obtained.

Research: The authors stated that future research should investigate the role of MRI in patients in whom ultrasound is impossible or inconclusive.

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Record Status
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.