Emergency physician ultrasonography for evaluating patients at risk for ectopic pregnancy: a meta-analysis

CRD summary
This well-conducted review concluded that visualisation of an intrauterine pregnancy by an emergency physician using bedside ultrasonography was generally sufficient to rule out ectopic pregnancy. This conclusion is likely to be reliable.

Authors’ objectives
To evaluate the accuracy of emergency physician ultrasonography for evaluation of patients at risk of ectopic pregnancy.

Searching
MEDLINE and EMBASE were searched from 1966 to August 2009 without language restrictions. Search terms were reported. Abstracts from two relevant conferences were searched from 1990 to August 2009. Reference lists of retrieved articles were screened and experts in the area were contacted to locate unpublished studies.

Study selection
Studies that evaluated bedside pelvic ultrasonography (transabdominal, transvaginal, or both) performed by an emergency physician in women in the emergency department at risk of ectopic pregnancy were eligible for inclusion. Diagnosis had to be confirmed in all patients using a single or compound reference standard (formal radiology ultrasonography, gynaecology ultrasonography, radiology overread of emergency department ultrasonography or clinical record review). Studies had to report sufficient data to construct a 2x2 table of test performance. Where necessary, authors were contacted for additional information.

Most studies were conducted in academic medical centres; two were in community hospitals. Training of examiners varied; most consisted of a brief didactic course followed by a variable number of hands-on cases or proctored examinations. Studies used transvaginal ultrasonography and/or transabdominal ultrasonography. Most studies used clinical or telephone follow-up as the reference standard. Prevalence of ectopic pregnancy ranged from 3% to 13%.

Two reviewers independently selected studies for inclusion. Disagreements were resolved through discussion with a third reviewer.

Assessment of study quality
Study quality was assessed using the 14-item QUADAS tool.

The authors did not state how many reviewers performed the quality assessment.

Data extraction
Two reviewers independently extracted data to populate 2x2 tables of test performance and used these to calculate sensitivity, specificity and positive and negative predictive values, together with 95% confidence intervals (CIs). A positive ultrasonography was defined as the absence of a definite intrauterine pregnancy. A negative ultrasonography was defined as the presence of a definite intrauterine pregnancy. Disagreements were resolved through discussion with a third reviewer.

Methods of synthesis
Sensitivity, specificity, positive and negative predictive values, negative likelihood ratios and diagnostic odd ratios (DOR), together with 95% CIs, were pooled using a random-effects model. Heterogeneity was assessed with $I^2$. A hierarchical summary receiver operating characteristic (HSROC) analysis was used to generate a summary receiver operating characteristic (SROC) curve. This model was also used to estimate the summary sensitivity and specificity.
Sensitivity analysis was conducted by restricting the analysis to studies that included an appropriate patient spectrum and restriction to studies that avoided differential verification bias. Sequential exclusion of each study from the analysis was conducted to investigate the influence of individual studies.

**Results of the review**

Ten studies were included (n=2,057 participants). Three studies were retrospective. Seven studies were prospective. Four studies enrolled consecutive patients. Five studies did not include an appropriate patient spectrum. Differential verification bias was a possibility in nine studies. Incorporate bias was a possibility in one study. Six studies did not report on blinding of the interpreters to the index test result. None of the studies provided information on blinding of the person who interpreted the reference standard.

Results from the HSROC analysis are reported here as these are the most statistically robust. Sensitivity was good in all studies (range 80% to 100%) and was 100% in seven studies. Summary sensitivity was 97% (95% CI 92% to 99%). There was no evidence of heterogeneity ($I^2 = 0\%$). The summary negative likelihood ratio was 0.08 (95% CI 0.03 to 0.25). Estimates of specificity were lower and showed greater variation (range 42% to 90%) with a pooled estimate of 71% (95% CI 60% to 80%). There was strong evidence of heterogeneity ($I^2 = 95\%$).

Restriction of the analysis to studies that fulfilled the QUADAS item on patient spectrum showed similar results. Exclusion of individual studies from the analysis did not substantially influence summary estimates.

**Authors’ conclusions**

Use of bedside ultrasonography performed by emergency physicians as a diagnostic test for ectopic pregnancy provided excellent sensitivity and negative predictive value. Visualisation of an intrauterine pregnancy by an emergency physician was generally sufficient to rule out ectopic pregnancy.

**CRD commentary**

This review addressed a clear question. Inclusion criteria were defined. The literature search included two electronic databases. Some attempts were made to identify unpublished data, which limited the risk of publication bias. Appropriate steps were taken to minimise bias and errors when selecting studies and extracting data; it was unclear whether such steps were taken when assessing study quality. Study quality was assessed using appropriate criteria and the results were presented in a table and considered in the analysis. Although the more statistically robust HSROC model was used to pool data the primary analysis focused on individual pooling of sensitivity and specificity, which was not as reliable. Predictive values are strongly influenced by the prevalence of disease; disease prevalence varied across the studies and it was not appropriate to pool these data. However, in the discussion the authors used the summary likelihood ratios combined with various estimates of the prevalence of disease to obtain an estimate of the post-test probability of disease (predictive value), which was a more appropriate method to generate predictive values.

This was generally a well-conducted review and the authors conclusions are likely to be reliable, but the summary estimates of predictive values should be interpreted with caution.

**Implications of the review for practice and research**

**Practice:** The authors stated that the review findings supported appropriate use of pelvic ultrasonography by emergency physicians in clinical practice.

**Research:** The authors did not state any implications for research.

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