A critical appraisal of the use of umbilical artery Doppler ultrasound in high-risk pregnancies: use of meta-analyses in evidence-based obstetrics

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Authors' objectives
To determine which high-risk pregnancies benefit from the use of Doppler velocimetry

Searching
MEDLINE, EMBASE and the Cochrane Library were searched from 1970 to 2000 for published and unpublished reports. Details of the search were described elsewhere (see Other Publications of Related Interest nos. 1-2).

Study selection
Study designs of evaluations included in the review
The authors only included randomised controlled trials (RCTs).

Specific interventions included in the review
Umbilical artery Doppler ultrasound.

Reference standard test against which the new test was compared
The review did not include any diagnostic accuracy studies that compared the performance of the index test with a reference standard of diagnosis.

Participants included in the review
Women experiencing high-risk pregnancies were included. The inclusion criteria of the primary studies differed significantly.

In the 'well-defined studies' (with tighter inclusion criteria), 1,307 patients (60.5%) had suspected intra-uterine growth restriction and 852 patients (39.5%) had suspected intra-uterine growth restriction and/or hypertensive disease.

In the 'general risk studies' (with wider and/or poorly defined inclusion criteria), 12 to 51% of the included pregnancies were classified as suspected intra-uterine growth restriction, 12 to 46% as HD, 5 to 38% as reduced foetal movements, 4 to 35% were post-term, 4 to 12% had antepartum haemorrhage, and 6 to 44% had other high-risk complications.

Outcomes assessed in the review
No inclusion criteria were specified. A variety of outcomes were considered: perinatal mortality, antenatal admission; induction of labour, elective delivery, Caesarean sections (elective and emergency), Apgar score at 5 minutes, and admission to a neonatal intensive care unit (NICU).

How were decisions on the relevance of primary studies made?
The authors do not state how the papers were selected for the review, or how many of the reviewers performed the selection.

Assessment of study quality
The authors do not state that they assessed validity.

Data extraction
The authors do not state how the data were extracted for the review, or how many of the reviewers performed the data extraction.
Data were extracted on the following: the patients' characteristics; the study design, including whether the analysis was intention-to-treat; and the ultrasound method. The odds ratios (ORs) for the outcomes were calculated for perinatal mortality of singleton non-malformed infants, obstetric interventions, and neonatal morbidity (Apgar score and NICU admissions).

Methods of synthesis

How were the studies combined?
The studies were combined by meta-analysis using a random-effects model. The 'well-defined studies' were grouped together separately from the 'general risk studies'. The ORs, with 95% confidence intervals (CIs), were compared using the Mantel-Haenszel method.

How were differences between studies investigated?
Sources of heterogeneity in the included studies were investigated. Differences in terms of patient characteristics, study design and ultrasound method were discussed. The authors attempted to compensate for observed between-study heterogeneity by analysing the 'well-defined studies' and 'general risk studies' separately. A chi-squared test of heterogeneity was also performed.

Results of the review

Thirteen RCTs (8,633 mothers and 8,755 infants) including 2 unpublished studies were included.

The 'well-defined studies' showed a significant reduction in antenatal admissions (OR 0.56, 95% CI: 0.43, 0.72), inductions of labour (OR 0.78, 95% CI: 0.63, 0.96), elective deliveries (OR 0.73, 95% CI: 0.61, 0.88), and Caesarean sections (OR 0.78, 95% CI: 0.65, 0.94) with the use of umbilical artery Doppler velocimetry. The perinatal audit found that more perinatal deaths in the 'well-defined studies' were potentially avoidable by the use of Doppler velocimetry (p<0.0005); the rate of avoidable perinatal deaths was higher among the controls (50%) than the cases (20%) in this group.

Authors' conclusions

The RCTs on umbilical artery Doppler velocimetry showed major differences in terms of the study design and technical and clinical issues. Therefore, they should not be pooled in a simple meta-analysis. By stratification of the meta-analysis, it was found that Doppler velocimetry will only reduce the number of perinatal deaths and unnecessary obstetric interventions in pregnant women with suspected intra-uterine growth restriction and/or hypertensive disease.

CRD commentary

The authors' objective was to determine which high-risk pregnancies would benefit from the use of Doppler velocimetry. The inclusion criteria were not clearly specified to define the review question. The search appears to have been thorough (the details were published elsewhere; see Other Publications of Related Interest nos.1-2), and an attempt was made to locate unpublished material. A formal quality assessment does not appear to have taken place, although the authors separated the trials into the broadly defined categories of 'well-defined studies' and 'general risks'. Some of the included trials used non-standard randomisation procedures which may have compromised the results. Details of the studies were well presented and the meta-analysis was appropriate. Heterogeneity was investigated formally. The review methods at each stage of the process were unclear, e.g. how many reviewers were involved.

The conclusions of this review appear to be sound within the restrictions of the available data. However, all the conclusions should be treated with caution given the study heterogeneity, and the limitations in terms of quality and methodology discussed in the report.

Implications of the review for practice and research

Practice: The authors state that umbilical artery Doppler velocimetry should be restricted to pregnancies with compromised placental function, i.e. those with suspected intra-uterine growth restriction and/or hypertensive disease,
where the use of this technology can reduce the number of perinatal deaths and unnecessary obstetric interventions.

Research: The authors state that, ideally, new RCTs should be performed with strictly defined populations, and at the same time analyse the clinical and delivery policies. However, they highlight ethical problems associated with such trials, and therefore suggest that the RCTs already performed should be reanalysed.

**Funding**

Danish Institute for Health Technology Assessment, grant number 3126- 83-97; Swedish Medical Research Council, grant number 05980.

**Bibliographic details**


**PubMedID**

11422966

**DOI**

10.1046/j.1469-0705.2001.00415.x

**Other publications of related interest**


**Indexing Status**

Subject indexing assigned by NLM

**MeSH**

Confidence Intervals; Denmark; Evidence-Based Medicine; Female; Humans; Obstetrics /methods; Odds Ratio; Pregnancy; Pregnancy, High-Risk; Prenatal Care /statistics & numerical data; Randomized Controlled Trials as Topic; Research Design; Sensitivity and Specificity; Ultrasonography, Doppler /utilization; Ultrasonography, Prenatal /utilization; Umbilical Arteries /ultrasonography

**AccessionNumber**

12001001687

**Date bibliographic record published**

31/08/2002

**Date abstract record published**

31/08/2002

**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.