

Ultrasonography in screening for developmental dysplasia of the hip in newborns: systematic review

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Abstract

Objective To assess the accuracy and effectiveness of the screening of all newborn infants for developmental dysplasia of the hip (DDH) using ultrasound imaging, as is standard practice in some European countries but not in the United Kingdom, the United States, or Scandinavia.

Design Systematic review.

Data sources Twenty three medical, economic, and grey literature databases (to March 2004), with no limitations of design or language; some references were provided by experts.

Selection of studies Only diagnostic accuracy studies and comparative studies conducted in an unselected newborn population were eligible for the review. Two reviewers independently selected the studies and performed the quality assessment.

Results The review identified one diagnostic accuracy study, and this was of limited quality. In this study the reference standard was treatment up to age of 8 months or an abnormal ultrasound finding at age 8 months. Ultrasound screening had a sensitivity of 88.5% (95% confidence interval 84.1% to 92.1%), specificity of 96.7% (96.4% to 97.4%), a positive predictive value of 61.6% and a negative predictive value of 99.4%. Ten studies evaluated the impact of ultrasound in screening, but these too had various methodological weaknesses, limiting the reliability of their findings. Compared with clinical screening, general ultrasound screening in newborns may increase overall treatment rates, but ultrasound screening seems to be associated with shorter and less intrusive treatment.

Conclusions Clear evidence is lacking either for or against general ultrasound screening of newborn infants for DDH. Studies that investigate the natural course of the disorder, the optimal treatment for DDH, and the best strategy for ultrasound screening are needed.

Introduction

Various screening strategies are available for early detection and treatment of developmental dysplasia of the hip (DDH). Clinical screening of newborns includes medical history and clinical examination. With ultrasound screening, cartilage can be visualised, allowing detection of abnormal positioning of the

femoral head within the acetabulum, instability, and dysplasia at a very young age. Some argue that all newborns should have ultrasound screening within the first week of life,¹ whereas others favour screening after two or three months because at an earlier age most hips with abnormal ultrasound findings subsequently develop normally.² Early non-invasive interventions in those suspected of being at risk of DDH include broad diapering, splinting, overhead extensions, or the Pavlik harness.^{3,4} However, evidence on their effectiveness is scarce.⁵

Proponents of ultrasound screening assume that untreated cases will have an adverse outcome¹ and should be treated very early or should be followed up intensively. Others believe that the risk of overtreatment is considerable and that the cost-benefit equation for ultrasound screening is not favourable enough.^{4,6} The screening of all newborn infants at birth for DDH using ultrasound imaging is standard practice in some countries—for example, Germany and Switzerland—but has not been accepted in the United Kingdom, the United States, or Scandinavia.^{7,8} We conducted a systematic review to determine the diagnostic accuracy of ultrasonography for detecting DDH in a unselected population of newborns and to assess the impact of ultrasound screening of newborn infants.

Methods

Literature search and study selection

The literature search, last updated in March 2004, used the terms “ultrasonography”, “hip dysplasia”, and “new-born” and involved a range of 23 medical, economic, and grey literature databases. We identified further studies from the reference lists, the Swiss Federal Office for Social Security, and individual experts.

Two reviewers independently appraised each reference. Disagreements were resolved by consensus. Studies eligible for inclusion were diagnostic accuracy studies in an unselected newborn population or studies comparing an ultrasound screening regimen with another screening strategy that reported on

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Two further tables of data are on bmj.com



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outcomes such as overall treatment rates, rates of operative intervention, rates of abduction splinting, rate of delayed diagnosis, time to treatment, duration of treatment, rate of treatment complications, false diagnostic labelling, and any long term functional outcomes. We aimed to review only studies of an unselected population of newborns, rather than infants with suspected or frank DDH or notable risk factors for DDH.

Data extraction and analysis

We extracted data on to predesigned forms. Diagnostic accuracy studies were assessed for quality using the QUADAS checklist.⁹ For studies evaluating the impact of ultrasound screening we created a checklist, which related to very general issues of study quality. The included studies were combined in a narrative synthesis and treatment differences calculated (mean differences or absolute risk differences) with 95% confidence intervals. Findings were not pooled statistically because of the diversity of study designs, ultrasound techniques, and therapeutic management.

Results

The search strategy generated 787 references. We selected 188 studies for full text assessment, of which 10 met the inclusion criteria (for details, see the full version of this article on bmj.com).

Diagnostic accuracy

We identified one study that evaluated the diagnostic accuracy of ultrasound. The index test was ultrasonography at the age of 1, 2, and 3 months, and the reference standard was defined by the decision to treat or by an abnormal ultrasound finding at the age of 8 months. The quality of the study was limited because the reference test might not have correctly classified patients and was not independent of the index test. The calculated sensitivity of ultrasonography was 88.5% (95% confidence interval 84.1% to 92.1%), the specificity 96.7% (96.4% to 97.4%), the positive likelihood ratio 29.1, the negative likelihood ratio 0.12, the positive predictive value 61.6%, and the negative predictive value 99.4%.

Impact of ultrasound screening

We identified two randomised controlled trials and eight non-randomised studies comparing ultrasound screening of newborns with another screening regimen. The level of experience of the examiners could not be compared between the studies. The overall quality of the included studies was limited. Even the two randomised controlled trials were of limited quality: in one, treatment allocation was not truly random, and in neither trial were assessors blind to the screening group.

Treatment rate

Both RCTs and all but one of the other five studies that reported overall treatment rate found an increase associated with general ultrasound screening. However, ultrasound screening was associated with a reduction in surgical procedures or inpatient treatment for the correction of DDH.

Duration of treatment

Two studies reported effects on treatment duration. One used broad diapering, splinting, and, where

necessary, overhead extensions as treatment and reported a reduction in treatment duration from 11.6 (standard deviation 6.5) months to 7.8 (3.7) months after the introduction of ultrasonography. The other study involved treatment with the Pavlik harness and found that ultrasound screening at birth was associated with a shorter mean treatment duration (1.16 months) than screening at age 3-4 months of age (mean treatment duration 2.9 months).

Rate of developmental dysplasia of the hip diagnosed late

Three studies defined "late" diagnosis as diagnosis after age 1 month. In two of these studies the rate of late diagnosed DDH after clinical screening plus ultrasonography was compared with that seen with clinical screening alone, with prevalences per 1000 of 1.4 (95% confidence interval 0.18 to 3.39) versus 2.6 (1.0 to 4.19), and 0.7 (0 to 1.41) versus 2.6 (1.8 to 3.39). Two of the studies (both randomised controlled trials) compared general ultrasound screening with clinical screening plus selective ultrasound screening and reported higher rates with selective screening, but in neither study was the difference significant. The differences between studies may be explained partly by the small absolute number of cases from which the rates are calculated, but they may also be a reflection of an increasing level of expertise with ultrasound imaging over time.

In the study in which "late" was defined as at or after age 8 months, the number of cases of DDH missed by the two screening programmes (that is, those identified only at the reference test) was 17 (0.8%) with clinical screening compared with 31 (0.6%) with ultrasound screening; this difference was not significant (-0.2%; 0.75% to 0.17%).

Discussion

Our systematic review identified three important findings. Firstly, there is insufficient evidence for the diagnostic accuracy of ultrasound imaging as a screening tool. Secondly, ultrasound screening is likely to increase overall treatment rates, which could represent overtreatment. Finally, duration and intrusiveness of interventions are likely to be lowered with ultrasound screening.

Major methodological shortcomings of the available studies, however, limit these findings. The one diagnostic accuracy study that was performed in an unselected population of newborns provided only limited information. The reference standard was flawed because it ignored the fact that early detected DDH is known to resolve spontaneously in many cases.

The objective of screening for DDH is to prevent it being diagnosed late. The two randomised controlled trials did report this as an outcome measure, but both had short follow-up periods; a late detected case was one detected after age 1 month. The clinical validity of this outcome is debatable as DDH identified at 1 month is often not true disease.¹⁰ When late was defined as at or after age 8 months, there was no significant difference between the proportion of cases that were detected late with clinical screening compared with ultrasound screening.

Data from randomised controlled trials indicate that ultrasound screening that is started in the first few

days of life is associated with an increased rate of treatment compared with clinical screening. Ultrasound screening started at age 1 month is also associated with an increased rate of treatment but achieved with a greatly reduced referral rate. Studies do suggest that the number and severity of surgical procedures for the correction of hip dysplasia is reduced under a regimen of general ultrasound screening. The importance of overall treatment rate as an outcome measure is debatable. Increased treatment rates can be taken as an indication that fewer cases of DDH are missed. They can also be interpreted, however, as a measure of overtreatment. Clearly the reduction in surgical procedures associated with ultrasound screening seems to be an important benefit, but the risk-benefit ratio of an increase in less invasive forms of treatment has not yet been clearly established.

The use of historical controls in many studies means that the effects of ultrasonography cannot be differentiated from the effect of changing treatment practice. Also, in most of the studies treatment outcome was not reported. Our review was not of studies of the effectiveness of treatment for DDH, but it is acknowledged that the evidence base is not strong⁵ (see bmj.com).

We have been unable to provide information on the adverse effects of general ultrasound screening—either of the treatment or of the screening programme as a whole. Of the 10 studies we identified, none properly assessed adverse events. This is an important omission.

Our review has confirmed the conclusions reached by the Canadian Task Force⁴ and the American Academy of Pediatrics⁶ that ultrasound screening cannot yet be recommended. To date, a huge body of literature describes ultrasound imaging as a useful and accurate diagnostic tool for DDH, but it fails to provide clear evidence either for or against its use in the general screening of newborn infants. A recently published decision model acknowledged the lack of evidence to support universal screening for DDH in newborns.¹¹ It predicted that compared with clinical screening or selective use of ultrasound imaging, universal ultrasound screening would achieve the highest number of favourable outcomes. Another decision model concluded that general ultrasound screening at three months was found to perform best.¹²

Good quality trials to establish the optimum treatment and management for DDH are needed. A randomised controlled trial incorporating optimum treatment and management and comparing general ultrasound screening at 1 month and at 3 months is warranted.

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Ethical approval: Not needed.

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What is already known on this topic

Ultrasound imaging has become an accepted tool for accurately diagnosing developmental dysplasia of the hip (DDH) and for monitoring the development and treatment of the condition

Debate continues over whether DDH that is detected by ultrasonography is necessarily clinically relevant

Ultrasound screening at birth for DDH in all newborn infants is standard practice in some European countries but not in the United Kingdom, the United States, or Scandinavia

What this study adds

The diagnostic accuracy of ultrasound imaging for DDH in the screening population has not been investigated adequately

Evidence is insufficient to support or reject general ultrasound screening of newborns for DDH

Studies that investigate the natural course of the disorder, the optimal treatment for DDH, and the best strategy for ultrasound screening are needed

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Endpiece

A foretaste

Every parting gives a foretaste of death; every coming together a foretaste of the resurrection.

Arthur Schopenhauer (1788-1860) in
Studies in Pessimism (1851)

Fred Charatan, retired geriatric physician, Florida