

Ultrasound in the selective screening of developmental dysplasia of the hip

A.A. AFAQ, S. STOKES, H. FAREED*, H.G. ZADEH*, M. WATSON

Department of Radiology; and *Department of Orthopaedics, West Middlesex University Hospital, Isleworth (UK)

Abstract. – Introduction: Developmental dysplasia of the hip (DDH) can result in chronic pain, gait abnormalities and degenerative arthritis. Infants with a family history, Breech delivery or unstable “clicking” of the hip on examination are at higher risk. The goal is to detect cases early enough for normal hip development and function by the end of adolescence, but clinical examination alone is ineffective.

Materials and Methods: All infants born at the West Middlesex University Hospital, Isleworth, UK, between 3/3/2005 and 21/10/2006 underwent prospective clinical screening to reveal risk factors of unstable hip on examination, family history of DDH and Breech delivery. Infants with risk factors underwent static and dynamic ultrasound of the hips (Harke’s method with Terjesen measurements), performed by a Consultant Radiologist or Sonographer. The infant was then examined by an Orthopaedic Surgeon who was blinded to the ultrasound findings until after creating a management plan.

Results: 5772 infants were born during the study period. 200 (3.5%) at-risk infants were identified, resulting in 400 hip ultrasounds. Following review of ultrasound findings, the majority of cases (163/200, 81.5%) lead to no change in management. Change in timing or type of clinical follow up occurred in 31 cases with normal ultrasounds and 20 cases with abnormal (immature hip) ultrasounds. Dysplasia was demonstrated in 6 infants (3%) on ultrasound, who were treated with Parvlik Harness. Of these, only 5 were detected on examination. Therefore, the ultrasound findings lead to 1 intervention with Parvlik Harness which would have otherwise gone undiagnosed from clinical examination.

Conclusion: Whereas type and timing of follow up was adjusted in 18.5% of the at-risk infants, targeted screening of at-risk with ultrasound lead to only one intervention. This encourages discussion on the resource implication and viability of ultrasound screening, as only one from two hundred lead to an intervention.

Key Words:

Developmental dysplasia, Pediatric hip, Screening, Ultrasound.

Introduction

Screening for Developmental Dysplasia of the Hip (DDH) is important because it has an asymptomatic stage in early infancy which can be effectively treated. Late diagnosis has serious sequelae with potential for chronic pain and disability. It is relatively common with an incidence of 0.7-7 per 1000¹.

Although screening with clinical examination (Barlow and Ortolani tests) has been performed in the UK for over 3 decades and has a high specificity, the sensitivity of clinical examination is low². False positives lead to over diagnosis and over treatment, and high false negatives can lead to late detection of DDH³.

Ultrasound has been increasingly used to evaluate infants with possible DDH over the past two decades^{4,5}.

Most studies have been observational and difficult to compare, but there have been a few randomised trials on primary screening with ultrasound for DDH. A large Norwegian study in 1994 with 11,925 subjects concluded the prevalence of late subluxation or dislocation was lower, but not statistically significant for infants assigned to general ultrasound screening than for those subjected to selective or no ultrasound screening⁶.

More recently, another Norwegian trial with 15,529 infants also found no statistically significant difference when comparing universal ultrasound or clinical screening. A recommendation

was made however, to ultrasound those infants with hip instability clinically or with risk factors⁷.

The American Academy of Pediatrics highlights the resource implications on screening all infants for DDH, and recommends selective use of Ultrasound, as an adjunct to clinical examination⁸.

The Canadian Task force on Preventative Health Care found fair evidence to exclude general screening for DDH from the periodic health examination of infants⁹.

Scandinavian centres which have implemented ultrasound screening in all infants have resulted in a large number of hips being treated unnecessarily and a high frequency of re-examination⁸.

However, most recently, The United States Preventive Services Task Force determined that they could not recommend any screening strategies for developmental dysplasia of the hip, contributing to the current state of confusion on this issue¹⁰.

Subsequently, targeted screening of high-risk infants may be a more appropriate use of ultrasound. Risk factors, (which have not been validated) include Breech delivery, first degree relatives with DDH, or clinical evidence of hip instability¹¹.

Others at higher risk include females more than males, a “click” on examination, congenital foot deformities and fetal growth retardation^{12,13}. See Table I.

A recent study in Dublin showed a promising role for ultrasound in high risk infants¹⁴. The study, from 1994-2001 involved 5485 hip ultrasound scans. Of those scanned, 18 (0.33%) were found to have dislocated hips and 153 (2.78%) to have dysplastic hips.

There are huge resource implications involved in setting up a screening programme for DDH¹⁶. It is our practice to screen “at risk” infants with ultrasound. We have evaluated how ultrasound changes clinical practice in a District General Hospital.

Table I. Risk factors for DDH

<ul style="list-style-type: none"> • Positive family history of DDH • Breech presentation • Persistent click on examination • Hip or lower limb asymmetry (including skin creases) • Stiff hips • Syndromic Children • Associated spinal or foot deformities

Patients and Methods

All infants born at the West Middlesex University Hospital from 3/3/2005 to 21/10/2006 were prospectively evaluated. They underwent clinical screening with Barlow and Ortolani tests, performed by a Pediatric SHO or trained Midwife as part of the 1st day neonatal check. Those infants with any of the following risk factors were identified as at-risk for DDH: A family history of DDH, Breech presentation or a persistent click on examination. Institutional Review Board approval was obtained. Informed Consent was obtained from the parents of the subjects studied.

At-risk infants first underwent ultrasound and then were evaluated by an Orthopaedic Surgeon who was not informed of the ultrasound findings. A management plan was created following clinical assessment, and then the ultrasound report was made available to the Orthopaedic surgeon. Any change to the management plan was recorded prospectively.

Results

5772 infants were born at the West Middlesex University Hospital during the study period. 200 infants had one or more of the required risk factors and underwent ultrasound examination, followed by clinical assessment by an orthopaedic surgeon.

163 infants had normal ultrasound and normal clinical examination, with no subsequent change in management. 11 had a normal ultrasound but abnormal examination. All 11 were offered delayed outpatient follow up once ultrasound findings were revealed. In this group, no additional ultrasounds were performed, but the timing of follow up was changed from 2-4 weeks to 8 months.

21 infants had abnormal ultrasound findings. Of these, 20 had initial ultrasound showed mildly abnormal ultrasound findings, such as a shallow acetabulum, which, on follow up scanning developed into normal hips. This group generated a total of 49 additional ultrasounds and early follow up appointments; these infants were followed up to the point where the hip returned to normal on ultrasound. All of these infants had normal clinical examination.

5 patients had abnormal ultrasound showing dysplasia (Figure 1). Of these, 4 were detected on

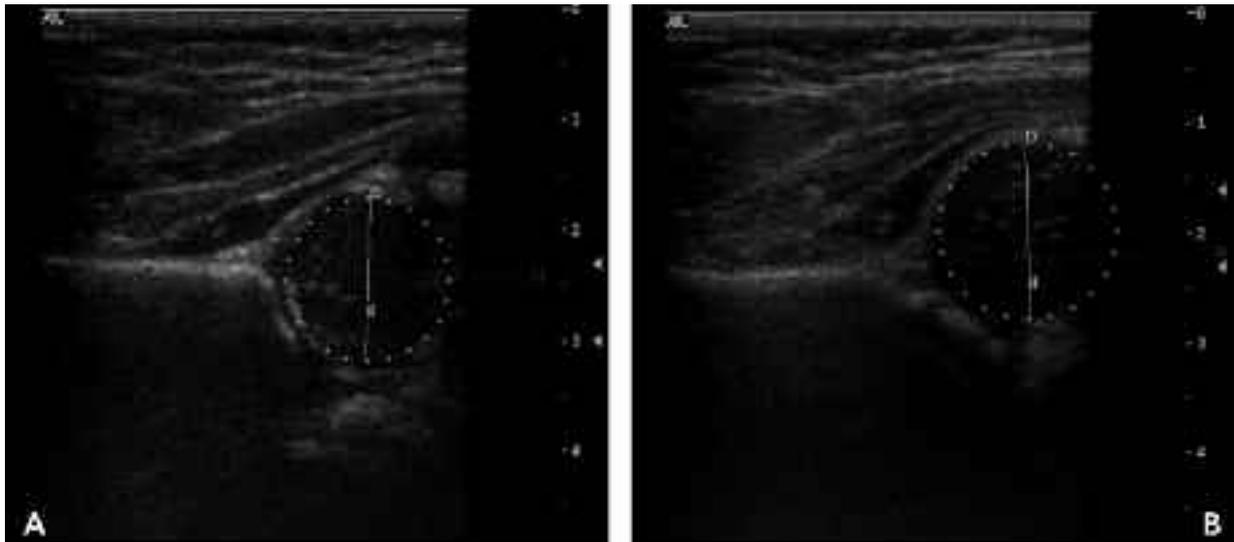


Figure 1. **A**, Normal ultrasound of infant hip with a normal D/d ratio. **B**, Dysplastic right hip, with only 33% coverage of the femoral head. This hip was seen to sublux on stressing.

clinical examination and proceeded to treatment with a Pavlik harness. One infant with DDH was not detected on examination, and would have not received treatment with a harness had it not been for the review of ultrasound findings.

These findings are demonstrated in Table II.

5 cases of DDH were demonstrated in the at-risk population screened with ultrasound.

18.5% of the 200 cases lead to a change in type or timing of follow up. However, only 1 intervention occurred as a result of the ultrasound. This was 1 case in the group of 21 with normal clinical examination, but abnormal ultrasound. Whereas the remaining 20 in this group developed normal hips on follow up, this one infant maintained an abnormal hip in keeping with DDH.

Discussion

This study has a smaller number of patients than similar studies, but the incidence of abnormal scans is compatible¹⁴.

There is an argument which challenges the very usefulness of identifying at risk infants at all. This is because the majority of infants with DDH (60%) will not have any risk factors¹². As a result, screening for patients only with the stated risk factors will miss the majority who will go on to develop dysplasia.

This fits with our figures, as there were 2 late presentations of DDH during the study period. Both of these, had no demonstrable risk factors, and one of the two was not born at our hospital.

Ideally, the ultrasound and clinical examination should have been performed at time, or as close to as possible. However, this was not always possible, and there was often a delay between each study, which could have been up to 2 weeks.

The timing of the ultrasound examination is particularly important with respect to the degree of maturity of the hip. At a very early stage, such as under 6 weeks, it is very difficult to distinguish between developmental dysplasia and immature hip. This will need follow up to normality, with subsequent ultrasounds. However, if the first ultrasound is performed after 6 weeks, the proportion of immature hips requiring additional investigation will be reduced. All those 20 infants who had initially abnormal hip US and went onto normal hips had been scanned under 6

Table II. Ultrasound and clinical examination findings and change in management as a result of review of the ultrasound findings.

	Normal Clinical Examination	Abnormal Clinical Examination
Normal US	164	11
Abnormal US	21	4

weeks. However, there is a balance to find between avoiding scanning too early, and not missing opportunities for early detection of DDH.

Unless the same operator performed every ultrasound scan, there is always a risk of introducing error from inter-operator variability. Although specific measurements are taken to aid the diagnosis of DDH, this potential error cannot be completely eliminated.

DDH is undoubtedly an important condition to screen for. However, the most important question to answer is – Does ultrasound meet the criteria as the most appropriate screening test?

There is a low false positive and low false negative result with ultrasound. The examination is relatively easy to perform in skilled hands. It is not an unpleasant test. These criteria are all convincingly met. However, the biggest challenge is the cost effectiveness of targeted screening with ultrasound. There are considerable resource implications for developing and maintaining such a service, particularly for a one-stop service, which is ideal.

Radiologists and sonographer training will need to be addressed, and time would be taken away from other ultrasound sessions to examine these infants.

Apart from the costs of establishing the service, there will be repercussions on altering clinic appointments, and further ultrasound examinations, particularly in immature hips and dysplastic hips. In our study, many additional or earlier outpatient appointments were necessary as a result of ultrasound findings. These costs must be outweighed by the benefit of diagnosing DDH at an early enough stage to prevent the major complications. Paton et al¹⁵ concluded that the main role for ultrasound was in the accurate diagnosis of instability and to reduce the need for splintage and invasive diagnostic angiograms. These Authors suggested selective screening of at risk infants in isolation was of little value in reducing the incidence of late dislocation. In our study, this benefit was only seen in 1 infant from 200 screened who was not detected on clinical examination. In theory, this infant could have developed degenerative changes and necrosis requiring total hip replacement at a future date. The costs of surgery, rehabilitation, time off work etc would be large. The cost of a hip replacement at our hospital is £8000¹⁶. However, the costs of establishing a targeted ultrasound service are also great.

Considering the cost implications in our study, 163 infants had normal ultrasound and normal clinical examination, with no subsequent change

in management – 116 of these were reviewed at 8 months with a radiograph at a cost of £183¹⁶. 11 had a normal ultrasound but abnormal examination. All 11 were offered delayed outpatient follow up once ultrasound findings were revealed. This would have not influenced cost, as the timing was altered rather than creation or cancellation of a follow up appointment, and no additional ultrasounds were necessary.

21 infants had abnormal ultrasound findings on initial study. All of these infants were recalled for an earlier follow-up outpatient appointment and repeat ultrasound due to the ultrasound findings – These infants were followed up to the point where the hip returned to normal on ultrasound, (with the exception of the 1 case of DDH) in total 49 consultations were necessary ($49 \times 236 = 11,564$).

One infant with DDH was not detected on examination, and would have not received treatment with a harness had it not been for the review of ultrasound findings. For this patient, 3 additional ultrasounds were necessary. Potentially, this patient would have gone on to develop symptoms of complications of hip dysplasia, eventually requiring hip replacement at £8000, in addition to multiple outpatient appointments and plain radiographs.

The cost could further be reduced by scanning infants at a slightly later date, (after 6 weeks). This could have saved £11,564 in our study. However, considering the full at-risk cohort – 200 infants being assessed clinically and with ultrasound would have cost ($200 \text{ infants} \times £236$) £47,200 – Almost six times more than the cost of assessment and surgery for one “missed” infant.

In conclusion, although our study group was small, the incidence of abnormal hips was similar to larger studies. Only 1 (0.5%) patient had a treatment intervention as a consequence of screening US for DDH at our institution.

Concerns for the individual patient aside this was at considerable financial cost to the hospital and it raises important questions about the cost/benefit ratio of this screening program

References

- 1) BIALIK V, BIALIK GM, BLAZER S, SUJOV P, WIENER F, BERANT M. Developmental Dysplasia of the hip. A new approach to incidence. *Pediatrics* 1999; 103: 93-99.

- 2) STANDING MEDICAL ADVISORY COMMITTEE. Screening for the detection of congenital dislocation of the hip in infants. London: Department of Health and Social Security, 1966.
- 3) DEZATEAUX C, BROWN J, ARTHUR R, KARNON J, PARNABY A. Performance, clinical pathways and effects of alternative policy options for screening for developmental hip dysplasia in the United Kingdom. *Arch Dis Child* 2003; 88: 753-759.
- 4) GRISSOM LE, HARCKE HT. Ultrasonography and developmental dysplasia of the infant hip. *Current opinions in Pediatrics* 1999; 11: 66-69.
- 5) MARKS DS, CLEGG J, AL-CHALABI AN. Routine Ultrasound screening for neonatal hip instability. Can it abolish late-presenting congenital dislocation of the hip? *J Bone Joint Surg [Br]* 1994; 76-B: 534-538.
- 6) ROSENDAHL K, MARKESTAD T, LIE RT. Ultrasound screening for developmental dysplasia of the hip in the neonate: the effect on treatment rate and prevalence of late cases. *Pediatrics* 1994; 94: 47-52.
- 7) HOLEN K, TEGANDER A, BREDLAND T, JOHANSEN OJ, SAETHER OD, EIK-NES SH, TERJESEN T. Universal or selective screening of the neonatal hip using ultrasound? A prospective, randomised trial of 15529 newborn infants. *J Bone Joint Surg* 2002; 84B: 886-890.
- 8) COMMITTEE ON QUALITY IMPROVEMENT, SUBCOMMITTEE ON DEVELOPMENTAL DYSPLASIA OF THE HIP. Clinical Practice Guideline: Early detection of developmental dysplasia of the hip. *Pediatrics* 2000; 104: 896-895.
- 9) PATEL H WITH THE CANADIAN TASK FORCE ON PREVENTATIVE HEALTH CARE. Preventative Health Care, 2001 update: screening and management of developmental dysplasia of the hip in newborns. *CMAJ* 2001; 164: 1669-1677.
- 10) MAHAN ST, KATZ JN, KIM YJ. To screen or not to screen? A decision analysis of the utility of screening for developmental dysplasia of the hip. *J Bone Joint Surg Am* 2009; 91: 1705-1719.
- 11) IMRIE M, SCOTT V, STEARNS P, BASTROM T, MUBARAK SJ. Is Ultrasound screening for DDH in babies born breech sufficient? *J Child Orthop* 2009; Epub ahead of print.
- 12) SHIPMAN SA, HEFLAND M, MOYER VA, YAWN PB. Screening for developmental dysplasia of the hip: a systematic literature review for the US preventative services task force. *Pediatrics* 2006; 117: e557-576.
- 13) HINDERAKER T, DALTVIT AK, IRGENS LM, UDÉN A, REIKERÅS O. Intra-uterine factors on neonatal hip instability. An analysis of 1,059,479 children in Norway. *Acta Orthop Scand* 1994; 65: 239-242.
- 14) LOWRY CA, DONOGHUE VB, MURPHY JF. Auditing hip ultrasound screening of infants at increased risk of developmental dysplasia of the hip. *Arch Dis Child* 2005; 90: 579-81.
- 15) PATON RW, SRINIVASAN MS, SHAH B, HOLLIS S. *J Bone Joint Surg* 1999; 81: 255-259.
- 16) DATA FROM WEST MIDDLESEX HOSPITAL COSTING SYSTEM (2006/7).