Ultrasound screening for hips at risk in developmental dysplasia

IS IT WORTH IT?

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Between May 1992 and April 1997, there were 20,452 births in the Blackburn District. In the same period 1107 infants with hip ‘at-risk’ factors were screened prospectively by ultrasound. We recorded the presence of dislocation and dysplasia detected under the age of six months using Graf’s alpha angle. Early dislocation was present in 36 hips (34 dislocatable and 2 irreducible). Of the 36 unstable hips, 30 (83%) were referred as being Ortolani-positive or unstable; 25 (69%) of these had at least one of the risk factors. Only 11 (31%) were identified from the ‘at-risk’ screening programme alone (0.54 per 1000 live births). Eight cases of ‘late’ dislocation presented after the age of six months (0.39 per 1000 live births). The overall rate of dislocation was 2.2 per 1000 live births.

Only 31% of the dislocated hips belonged to a major ‘at-risk’ group. Statistical analysis confirmed that the risk factors had a relatively poor predictive value if used as a screening test for dislocation. In infants referred for doubtful clinical instability, one dislocation was detected for every 11 infants screened (95% confidence interval (CI) 8 to 17) whereas in infants referred because of the presence of any of the major ‘at-risk’ factors the rate was one in 75 (95% CI 42 to 149).

Routine ultrasound screening of the ‘at-risk’ groups on their own is of little value in significantly reducing the rate of ‘late’ dislocation in DDH, but screening clinically unstable hips alone or associated with ‘at-risk’ factors has a high rate of detection.

Received 24 March 1998; Accepted after revision 9 June 1998

Developmental dysplasia of the hip (DDH) is a potentially disabling condition particularly when treated late; if detected early, operation may be avoided. Clinical screening programmes are important in reducing the incidence of surgery. There are recognised ‘at-risk’ factors in the aetiology of DDH. We have undertaken a prospective study to quantify the relationship between these ‘at-risk’ factors and the presence of dislocation and dysplasia of the hip.

Patients and Methods

Between 1 May 1992 and 30 April 1997 we carried out a prospective ultrasound screening programme for DDH at Blackburn Royal Infirmary. Using an agreed proforma, the Paediatric Department referred all newborn infants with suspected instability of the hip and recognised ‘at-risk’ factors to the Paediatric Orthopaedic Clinic. These factors included family history, breech delivery, postural and structural deformities of the foot, torticollis and oligohydramnios. Infants in these categories or with clinical signs of instability were seen by the staff of the Paediatric Department at birth and then discharged.

All hips referred for ultrasound screening were examined clinically by the senior author (RWP) using the Barlow and Ortolani tests. In addition, the presence or absence of limitation of abduction of the hip was noted. Infants with clinical suspicion of instability were assessed within two weeks of birth. Those with ‘at-risk’ factors were examined at a later date, usually between eight and nine weeks, since 90% of apparent dysplasia at birth would have resolved by this age.

We performed ultrasonography using the dynamic method of Clarke, Harcke and McHugh and Harcke and the static morphological alpha angle of Graf and Graf, Tschauer and Klapsch. A Graf angle of over 60° was classified as normal, 43 to 60° as type II (minor dysplasia) and below 43° (stable on stress testing) as type III or major dysplasia. If the hip was dislocatable or dislocated, it was classified as type IV.

For statistical analysis we calculated exact confidence intervals (CI) for positive predictive values by the Clopper-Pearson method using Arcus Quickstat (Research Solutions, Cambridge, UK). The rates of detection in children with or without ‘at-risk’ factors were compared using Fisher’s exact test.
Results

Over the five-year period there were 20,452 live births. Newborn infants were seen initially in the Paediatric Department at Queen’s Park Hospital, Blackburn. Of these, 1107 were referred by the paediatrician to the senior author (RWP) for ultrasound and clinical assessment, 286 for clinical instability and 821 because of ‘at-risk’ factors alone (Fig. 1) which included breech delivery (532), family history (58), foot abnormality (140), oligohydramnios (13) and others (78).

There were 44 dislocations of which eight presented late, after the age of six months, and two were irreducible at birth. Of the 36 presenting early, before six months, 25 were referred as being unstable or potentially unstable at birth and 11 were detected by prospective ultrasound screening in those infants with ‘at-risk’ factors. The overall rate of dislocation in this series was 1:465 (2.2 per 1000 live births).

Tables I and II give the options of the different methods of screening and their respective rates of detection. The analysis of the rates of dislocation, in those referred for
secondary screening, is shown with respective ‘at-risk’ factors in Table II. Statistical analysis shows that these have a poor predictive value if used in isolation as a screening test for dislocation.

Screening of newborn infants with clinical instability had a significantly higher rate of detection of dislocation of the hip than screening for ‘at-risk’ factors alone (25/286 v 11/821; RR = 6.5; 95% CI 3.3 to 12.9; p < 0.00001). There was no significant variation in dislocation rates between ‘at-risk’ factors (Table II, chi-squared test = 2.2, df = 4, p = 0.70).

Screening for clinical instability and ‘at-risk’ factors had a significantly higher rate of detection than could possibly be achieved in those children without either indication (36/1107 v 8/19 345), assuming that all late dislocations were detectable (RR = 79; 95% CI 37 to 166).

There was evidence of limited abduction of 15 to 20° in seven of the eight dislocations and in four of the 11 dislocations found in the 821 hips with ‘at-risk’ factors.

Figure 1 shows the comparative rate of dislocations of the two major groups, i.e., the ‘at-risk’ factor group and the clinical instability group.

Discussion

In the UK clinical examination for the screening of DDH was recommended in 1969. This advice was updated in 1986 when it was felt that ultrasound had a role in assessment. It was stated that 60% of dislocations of the hip arose in patients with ‘at-risk’ factors which included breech delivery, family history, congenital postural deformities including those of the foot, caesarean section, oligohydramnios and retardation of fetal growth. Family history, breech delivery and foot deformity were thought to be the most important.1

In our series only 31% of the dislocations had ‘at-risk’ factors of which breech delivery was the most common (82%). Most dislocations were referred from primary clinical screening with instability. This suggests that ‘at-risk’ factors are not as important in the identification of congenital hip dislocation, as previously stated (Fig. 1).

Because of problems with inaccuracy and a poor relationship to the ultimate development of the hip, universal ultrasound screening at birth for DDH has not been advocated.7 Assessing ‘at-risk’ groups did not decrease the rate of surgery.8,9 The only significant ‘at-risk’ factor noted in the past has been family history.1,8 Castelein et al7 felt that breech delivery may be a factor.

The rate of operation for dislocation in our series was 0.48 per 1000 live births. There were two children with persistent major dysplasia after the age of one year which required open reduction, giving an overall rate of surgery of 0.58 per 1000 live births. Before this screening programme, the rate of surgery was 1.2 per 1000 live births.10 These procedures include surgery for dislocation and dysplasia and diagnostic arthrography of the hip undertaken in order to confirm or refute the presence of dislocation suspected in equivocal radiographs. Ultrasound evaluation has rendered arthrographic investigation of the hip largely redundant for diagnostic purposes.11

Most dislocations were referred from the primary clinical screening programme. These unstable hips were then evaluated by ultrasound at one to two weeks of age. This regime identified most hip instabilities (Fig. 1). The ultrasonographic images were interpreted using the Graf classification,5,6 based on the quantitative measurement of the alpha angle, by the senior author (RWP) to prevent any interobserver and intraobserver error.12,13 Ultrasound examination is highly operator-dependent and the technique of performing the examination and the interpretation of the ultrasonographic image obtained may influence the result.12,13 We did not use the global visual analysis method of Zieger14 because we have found that it overestimated the incidence of dysplasia.

Statistical analysis15 has questioned the need for widespread screening programmes due to the large number of negative investigations. Any screening programme must weigh up the costs of identifying the condition, the investigation and of the consequences of ‘missing’ late cases. Surgery has not been avoided in units in which universal screening has been adopted.7,9

The main role of ultrasound evaluation of the hip is in the accurate diagnosis of instability thereby reducing the need for splintage and invasive diagnostic arthrograms.10 Universal ultrasound screening of the hip has, in many cases, resulted in an increase in the number of infants requiring splintage without a reduction in the number diagnosed ‘late’ who need surgery.10 The natural rate of operation in DDH in which early splintage is not advocated is 1.6

### Table II. Statistics on ultrasound screening. Dislocation rates by ‘at-risk’ factor in children screened due to ‘at-risk’ factors

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Number</th>
<th>Dislocation present</th>
<th>Dislocation rate per thousand (95% CI)</th>
<th>Number needed to screen to detect one dislocation (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breech</td>
<td>532</td>
<td>9</td>
<td>17 (8 to 32)</td>
<td>59 (31 to 129)</td>
</tr>
<tr>
<td>Family history</td>
<td>58</td>
<td>1</td>
<td>17 (0.4 to 92)</td>
<td>58 (11 to 2294)</td>
</tr>
<tr>
<td>Foot abnormality</td>
<td>140</td>
<td>1</td>
<td>7 (0.2 to 39)</td>
<td>140 (26 to 5525)</td>
</tr>
<tr>
<td>Oligohydramnios</td>
<td>13</td>
<td>0</td>
<td>0 (0 to 247)</td>
<td>- (4 upwards)</td>
</tr>
<tr>
<td>Other risk factors</td>
<td>78</td>
<td>0</td>
<td>0 (0 to 46)</td>
<td>- (22 upwards)</td>
</tr>
<tr>
<td>Total</td>
<td>821</td>
<td>11</td>
<td>13 (7 to 24)</td>
<td>75 (42 to 149)</td>
</tr>
</tbody>
</table>
per 1000 live births.\(^1\) In most series in which early splingtage is used for clinically unstable neonatal hips the rate of late dislocation is between 0.5 and 0.8 per 1000 live births.\(^2\)-\(^4\) Our results suggest that selective screening of infants with ‘at-risk’ factors in isolation is of little value in reducing the incidence of late dislocation.

We wish to thank Sister K. Eccles for her support and care of the infants visiting the Paediatric Orthopaedic Clinic during the study, and for her help in the collection of the data on the ultrasound examinations.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References


THE JOURNAL OF BONE AND JOINT SURGERY