Associated risk factors in children who had late presentation of developmental dysplasia of the hip

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Abstract

Purpose The purpose of this study was to assess the role of clinical examination, associated risk factors and plain radiograph of the pelvis in children who had late presentation of DDH.

Methods We report on a 7-year prospective study, in children who had late presentation of developmental dysplasia of the hip (DDH). For this purpose, 740 hips in 370 referred children, age range 3–7 months (mean 3.44 months) were clinically and radiologically assessed, and the associated risk factors recorded.

Results Female sex, first born, positive family history and breech presentation were confirmed as risk factors for DDH. Significant findings were an increased risk for vaginal delivery over caesarean section for breech presentation ($P = 0.002$). There was an increased risk for caesarean section in the absence of breech presentation. Multiple births and preterm births had a reduced risk. For breech presentation, the risk of DDH was estimated to be at least 1.6% for girls and 3.4% for boys; a combination of factors increased the risk. Limitation of abduction (43.2%) and asymmetry of the groin skin folds (72.7%) were found to be the two most common clinical findings associated with DDH. Bilateral acetabular dysplasia is more common than unilateral dysplasia. Foot deformities were rarely encountered in children with acetabular dysplasia.

Conclusions The percentage of first-born babies who had DDH is lower than reported in the literature (34%), but still shows significant risk. We did find that bilateral acetabular

dysplasia is more common than unilateral dysplasia. Torticollis and foot deformities are rarely found to be associated with DDH. All these findings need further evaluation in children who had surgical treatment for DDH, to see if they are different from dysplastic groups. Limitation of abduction is an important clinical finding, but is not always associated with DDH. Asymmetry of the skin folds in the groin were found to be an important clinical finding associated with DDH for all age groups. As clinical examination depends on many factors, and most DDH cases are of the dysplastic type, it is mandatory to depend on further diagnostic tools for confirmation of DDH.

Keywords DDH · Risk factors · Female child · First-born · Skin folds

Introduction

Developmental dysplasia of the hip (DDH) refers to a spectrum of disease, including hips that are unstable, subluxated, dislocated, and/or have dysplastic acetabula [1–3]. Clinical examination (Ortolani's and Barlow's tests) plays a considerable role in the diagnosis of unstable hips, especially in the first 2 months of life. It is currently believed that clinical examination has not been successful in finding all children with developmental dysplasia of the hip (DDH) [4]. Prior to clinical examination, some factors commonly associated with developmental dysplasia of the hip (DDH), such as positive family history, breech presentation, female sex, oligohydramnios, and associated congenital anomalies should arouse the suspicion of developmental dysplasia of the hip (DDH) [5]. Over 3 months of age, limitation of abduction of the hip, Galeazzi's sign, asymmetry of the thigh and inguinal skin

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fold, and telescoping signs are important clinical findings [5, 6]. Traditionally, radiological examination has been used in diagnosis of DDH, but in the last two 2 decades ultrasound has been used as the best method of assessment of DDH in children younger than 6 months of age [7–9]. Ultrasound has the potential to identify minor abnormalities that are likely to resolve spontaneously without treatment [10]. Studies have shown that using ultrasound detected more cases, resulting in more children being treated [11]. A number of unfavorable treatment outcomes have also been shown from treatment of unaffected children with a false positive diagnosis [12]. A well-centered anteroposterior pelvic radiograph is a sensitive and useful technique for diagnosis and treatment of DDH in children above the age of 3 months [13, 14]. The purpose of this study was to assess the role of clinical examination, risk factors and plain pelvic radiograph in the diagnosis of late referred DDH in young infants. Anteroposterior pelvic radiograph was used as the final diagnostic method, as all cases presented above the age of 3 months.

Patients and methods

Being a tertiary referral center, between October 1999 and September 2006 a total of 370 children was evaluated in the pediatric orthopaedic clinic. Five hundred and eighty-one hips were diagnosed as developmental dysplasia of the hip (DDH) by the two authors (311 girls and 59 boys). In girls, 40.5% (126) were unilateral and 59.5% (185) were bilateral, while in boys 56% (33) were unilateral and 44% (26) were bilateral. The mean age at the time of diagnosis was 3.44 months (range 3–7 months). None had teratologic dislocation or neuromuscular disorders. After diagnosis of DDH by performing the clinical examination, a standardized pelvic radiograph was performed (the mother was asked to hold the lower limbs in mid abduction and mid internal rotation) [15]. The radiological assessment depended on whether the hip was dysplastic, subluxed or dislocated. Dysplasia was considered for the hips when the femoral head ossification centre was found still in the acetabular socket medial to Perkin's line (Tonnis grade I), Subluxation if lateral to Perkin's line and below Hilgenreiner's line (Tonnis II), and dislocation if lateral to Perkin's line and above Hilgenreiner's line (Tonnis III) and if above the superiolateral margin of the acetabulum (Tonnis IV) (16). All cases had an acetabular index angle of more than 30°. None of the cases had ultrasound studies due to late presentation of the cases and unavailability of hip ultrasound in the clinic. Associated factors were recorded, e.g., facial asymmetry, torticollis, abnormal skin folds in the groin and thigh, feet deformity, and limitation of abduction. Abnormal groin folds were

examined at about 100° of hip flexion and 60–80° of hip abduction, and judged to be abnormal if they were asymmetrical in depth or length or if symmetrical folds reached or extended post to anus [6]. Abnormal thigh folds were examined while the child lying prone position, and judged to be abnormal if they were transverse folds in the proximal thigh, whether short or long. Other related factors were questioned and documented, e.g., rank of the child in the family, baby's sex, presentation at delivery, oligohydramnios, method of delivery, and family history of DDH. All clinical findings, radiological parameters, associated factors, and other related factors were recorded in detail on a computerized checklist under direct supervision of the authors. Statistical analysis of the data was performed by using a PC program (SPSS 14 for Windows) (Table 1).

The Pearson Chi-squared analysis was used to test the difference between the variables in associated risk factors and the clinical findings. Statistical significance was set at a level of $P = \leq 0.05$.

Results

Acetabular index angle is the most consistent radiographic parameter for assessment of developmental dysplasia of the hip in children above 3 months old [13, 17]. Normally the mean acetabular index angle for girls aged 3 months is $25 \pm 3.5^\circ$, and for boys aged 3 months $22 \pm 3.5^\circ$; $<30^\circ$ is considered the upper limit of normal [5, 15]. Dysplasia were graded as mild when the acetabular index angle was between 30° and 34° , moderate when between 35° and 39° , and severe above 39° . Of the total of 740 hips evaluated clinically and radiologically, 581 hips were confirmed to have DDH, 413 (71%) were classified mild dysplasia (Tonnis grade I), 122 (21%) moderate dysplasia (Tonnis

Table 1 Statistical values of important factors in DDH

Findings	<i>P</i> value
Abnormal groin skin folds are more significant than thigh skin folds	$P = 0.000$
Groin skin folds are more common in bilateral than unilateral DDH	$P = >0.05$
Occurance of DDH is more common in the first compared to the second child	$P = 0.0009$
Bilateral DDH is more common than unilateral DDH	$P = 0.002$
Abnormal groin skin folds in the presence of other risk factors play an important clue to suspicion in DDH	$P = <0.0002$
High risk for vaginal delivery over caesarean section in breech presentation	$P = 0.002$

Table 2 Clinical findings in hips with DDH

Clinical findings	Number of children	Percentage
Asymmetry of the skin folds	307	83%
Limitation of hip abduction	160	43.2%
Facial asymmetry	17	4.6%
Feet deformity	8	2.16%
Torticollis	2	0.54%

grade II), and 46 (7.9%) severe dysplasia (Tonnis grade III); none were grade IV. There were 211 (57%) children with bilateral DDH, 87 (23.5%) left-sided DDH, and 72 (19.5%) had right-sided DDH. Clinical evaluation entails inspection for skin-crease abnormalities, shortening in lower limbs, limitation of abduction, and Ortolani's test. Limitation of abduction was described as a hip abduction of less than 70° [18, 19]. Two hundred and fifty one hips (43.2%) of those radiographically diagnosed as having DDH had limitation of abduction. When associated congenital anomalies were taken into consideration, 4.6% had facial asymmetry, 2.16% had feet deformity in the form of calcaneovalgus, and 0.54% had torticollis. No congenital talipes equinovarus or matatarsus adductus was reported (Table 2).

Statistical analysis for feet deformities and torticollis in hip dysplasia was not possible in view of the small number with associated hip instability. The Ortolani test is the test of choice in the first 2 months of life. All cases were 3 months old and above, and mostly dysplastic or subluxation type, and eight hips (1.37% of cases) were Ortolani positive, which form the lowest clinical finding in acetabular dysplasia. Eighty-three percent of the cases had abnormal skin folds, 36% had short groin skin folds, 37% long groin skin folds, 5.4% short thigh skin folds, and 5% long thigh skin folds (see Fig. 1). Seventeen percent of the abnormal hips had normal skin folds. Abnormal groin skin folds are more common in bilateral and unilateral DDH than thigh skin folds ($P = 0.000$)(Fig. 2). Short and long groin skin folds are more common in bilateral than

unilateral DDH, but this is not statistically significant ($P = >0.05$). The delivery of female child carries the highest risk of DDH (84.1%), followed by first-born child 34.3%, positive family history 28.3% and delivery by Caesarian section 10% (Table 3).

First-born has the highest incidence 34.3%, and the rate progressively decreases with multiple parity. There was statistical significance between the incidence of occurrence of DDH in first and second child ($P = 0.0009$, Fig. 3). Bilateral DDH is more common than left or right DDH, (57%, 23.5% and 19.5% respectively) ($P = 0.002$, Fig. 4). There was no statistical difference between right and left DDH ($P = 0.179$).

Fig. 2 Asymmetry of the skin folds and DDH side**Fig. 1** Pattern of the skin folds in DDH

Table 3 Associated risk factors in children with DDH

Associated risk factors	Number of children	Percentage
Full term mature delivery	362	97.83%
Female Baby sex	311	84.1%
First child in the family	127	34.3%
Family history of DDH	105	28.4%
Caesarian section	37	10%
Breech delivery	7	1.9%
Breech delivery + caesarian section	1	0.3%
Oligohydramnios	0	0%

Discussion

Female child remains the most important risk factor in DDH in all the literature [5, 16]. We support this risk, as 84.1% of females in the study had DDH. The cause of this association has been widely investigated before, and attributed to potentiation by endogenous estrogens produced by the female infant and the transiently increased ligamentous laxity in the perinatal period caused by high levels of circulating maternal hormones [20]. First-born babies carry a high risk of DDH, and form more than 50% [16, 21, 22]. We noted that the rate of first-born babies who had DDH is lower than that reported in the literature (34%), but it is still a high risk factor, and first-born are affected more frequently than subsequent siblings, which may be related to the confining effects of an unstretched primigravid uterus and abdominal wall, with subsequent effects on fetal limb position and hip joint development through the intrauterine crowding effect [5]. We could not find any case of oligohydramnios; maybe if this is present it will form a risk factor for DDH [23, 24]. Feet deformity has been reported as an association factor in the form of metatarsus adductus, with a range of 1.5% to 39% [16, 25, 28]. We noted that the positive findings for postural foot deformity were too small to be analyzed (2.2%).

Fig. 3 Rank of the child in the family **Fig. 4** Sidedness of DDH

Left hip is more common in the literature and forms about 60% [5], but in our series we did find that bilateral acetabular dysplasia is more common than left side (57% and 23.5% respectively), and this may be explained by environmental factors and variations in DDH [26]. We did find most of the families had the habit of adducting the lower limbs and wrapping the legs together in the first 4 months postnatally. The other explanation could be that we may have over-treated mild cases (border line) of acetabular dysplasia; thus, we need to study children operated for DDH to see the validity of this difference in the sidedness of DDH. There was a family history of DDH in 28.3% of children, which is compatible with the incidence in the literature of 10–28%, and supports the relevance of familial or genetic factors in DDH [5, 16, 27]. Ten percent of the children delivered by Caesarian section had DDH; this supports the associated risk with DDH as mentioned in the literature [28]. Normally 2–3% of children are born in breech presentation [5]. In our study, 16% of children with DDH were born in the breech position; in a previous study, 20% of cases of congenital dislocation of the hip were

reported to have been in frank breech, and 2% in breech with flexed hips and knees [29]. For breech presentation, the risk of DDH was estimated to be at least 1.6% for girls and 3.4% for boys; a combination of factors increased the risk. All our children were delivered by breech with flexed knee and hips, which is compatible with the reported literature. Association of DDH with torticollis is quite strong [5, 30], but this was not a significant factor in our children; only 0.54% had torticollis. Short and long groin skin folds are important findings in suspected cases of DDH [6]. Of our cases, 72.7% had abnormal groin folds, and 10.3% had abnormal thigh folds. We have shown that abnormal groin skin folds should lead to suspicion of DDH in the presence of other risk factors ($P = <0.0002$). It was also evident that an experienced physician could always detect decentric, subluxated and dislocated hips during a clinical examination, but hips with acetabular dysplasia can be missed easily [19, 25, 31]. Clinical examination in our patients supports this; 1.37% of our cases had a positive Ortolani test. Plain pelvic radiograph plays an important role in the detection of dysplastic hips without any evident clinical finding above the age of 3 months, if the facility of ultrasound is not available. Limitation of abduction is the most common positive clinical finding involving the detection of DDH [19]. Limitation of abduction was seen in approximately one-tenth of normal hips, and this might be due to anxiety of the infant during clinical examination, even though optimal conditions had been obtained [25]. In this prospective study we have attempted to weigh the different risk factors. We suggest that limitation of abduction is an important clinical finding but is not always associated with DDH. We found asymmetry of the skin folds in the groin to be an important clinical finding associated with DDH for all age groups. As clinical examination depends on many factors, and in most DDH cases of the dysplastic type it is mandatory to use further diagnostic tools for confirmation of DDH. The highest suspicion of DDH in the dysplastic group is reserved for infants with associated positive clinical findings and with positive risk factors. Detection of associated positive clinical findings from a careful treating physician is significant, as well as the existence of at-risk factors, which needs needs further radiographic or ultrasonographic assessment.

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