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Original Research Article

DETERMINATION OF ABNORMAL HIP ANGLES IN NEONATES BORN WITH RISK FACTORS FOR DEVELOPMENTAL DYSPLASIA OF HIP (DDH)

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Abstract: *Developmental Dysplasia of the Hip (DDH) is a disorder in which parents and doctors can treat the hip joint abnormally in a wide range, from a level of mild ace-tabular dysplasia to the complete displacement of the femoral head from the acetabulum. Thus, the identification of neonates with any possible hip angle abnormality in subjects with risk factors is critical to providing early intervention to eliminate complications like altered gait patterns and osteoarthritis in later years.* ***Objective:*** *The objective of this investigation is to measure hip angles in neonates with risk factors associated with DDH and assess the frequency of abnormal hip angles utilizing ultrasonography.* ***Methods:*** *This was a prospective design study performed in the Department of Orthopedics, Khyber Teaching Hospital, from 21st July 20224 till 21st October 2024. In all, 146 neonates with at least one perceived risk factor for DDH were recruited into the study within six months. Hip ultrasound was performed on all the participants to evaluate alpha and beta angles defining the ace-tabular index and femoral head coverage respectively.* ***Results:*** *146 neonates were enrolled in the study, mean gestational age was 38.5 ± 1.2 weeks, mean birth weight was 3.25 ± 0.45 kg; 91 (62.3%) neonates were female and 55 (37.7%) were male. A total of 292 hips were assessed by ultrasonography and were graded based on the Graf system. Of these, 201 hips (68.8%) were of Type I (normal), 52 hips (17.8%) of Type II (immature), 16 hips (5.4%) of Type III (dysplastic) and 9 hips (3.1%) of Type IV (dislocated).* ***Conclusion:*** *This research encourages risk-based triage and underscores the need for continued awareness amongst clinicians about the need to diagnose and treat at-risk newborns before complications from DDH ensue; although the incidence of DDH in different populations is not the same.*

Keywords: Developmental Dysplasia of the Hip (DDH), Neonatal Hip Ultrasound, Graf Method, Risk Factors for DDH

Introduction

Developmental Dysplasia of the Hip (DDH) is a disorder in which parents and doctors can treat the hip joint abnormally in a wide range, from a level of mild ace-tabular dysplasia to the complete displacement of the femoral head from the acetabulum (1). They are among the frequent neonatal orthopaedic disorders with a birth incidence estimated at 1 to 2/1000 live-born children (2, 3). If detected and treated in the early years, one is unlikely to develop other complications like hip instability, abnormal gait, chronic pain, and even adult osteoarthritis (4, 5). It is also important to note that some neonates are at a higher risk for developing DDH and, therefore require close monitoring (6).

Maternal and neonatal factors have been shown to increase the risk of DDH as explained below (7, 8). These include female sex, breech presentation, family history of DDH, primiparity, oligohydramnios and any condition that limits the child's mobility in utero such as torticollis or clubfoot (9). As much as other clinical examination techniques such as the Ortolani and Barlow tests are common their effectiveness is however limited, especially in identifying mild or progressive stages of DDH (10). Therefore ultrasonography is widely used in screening, especially in high-risk populations, as it is a non-invasive method that can reliably visualize the cartilaginous structures of the infant hip (11, 12).

The purpose of this study is to evaluate the extent of neonates who present with abnormal hip angles and evaluate the correlation between these angles and one or more of the risk factors associated with DDH. The Graf method that uses ultrasound to determine alpha and beta angles categorizes hips as normal, immature or dysplastic based on the ace-tabular roof and femoral head coverage (13). Since the affected children have angular deformities classified by hip angles, early assessment enables these children to be given conservative measures such as bracing to help them grow correctly without having to undergo surgery in their adulthood (14).

Due to the uncertainty of DDH symptoms and its course, it is imperative to carry out targeted screening during the first years of life. The purpose of this research will be to draw attention to the need for early recognition of neonates at risk for DDH and to encourage efforts to optimize the methods of identifying hip pathology through ultrasonography assessment of hip angles. Knowledge obtained from this study could help clinicians in the optimization of screening practices, hence enhancing the prognosis of the disease and preventing disability in children.

Methodology

This was a prospective design study performed in the Department of Orthopedics, Khyber Teaching Hospital, Peshawar, from 21st July 2024 to 21st October 2024. In all, 146 neonates with at least one perceived risk factor for DDH were recruited into the study within six months. Hip ultrasound was performed on all the participants to evaluate alpha and beta angles defining the ace-tabular index and

femoral head coverage respectively. The eligibility criteria for the study included; Breech position at birth or in the third trimester, A family history of DDH, Neonate born at full term or preterm born but at a gestational age of at least 34 weeks. These were the exclusion criteria used; newborns with congenital abnormalities of the musculoskeletal system, infections or those who had undergone hip surgery or manipulation earlier. Questions about the birth process, such as the mode of delivery, birth presentation, family history of DDH reduced fetal movements and intrauterine crowding were asked of both the mother and the neonate. A physical assessment was carried out and there was a positive response to the Ortolani and Barlow tests. Both hips were sono-graphed using the Graf method in all neonates at the first six weeks of age. Ultrasonography was done with the child in a neutral position to assess the alpha angle which illustrates ace-tabular development as well as, the beta angle, which shows the cartilaginous head of the femur. According to the measurements obtained, hips were grouped according to the Graf classification;

Type I: Normal hip

Type II: Follow up with immature hip.

Types III and IV: Dysplastic or dislocated hip where the child may require hip interventions.

All statistical analyses for the present study were performed using SPSS Version 27.0. Descriptive analysis was used to identify the percentage of students exhibiting abnormal hip angles. The impact of these risk factors was further examined in subgroup analysis on associations with abnormal findings including breech presentation and female sex associated with the condition. Data was analyzed qualitatively and results were presented in percentage forms while quantitatively data was analyzed using a chi-square test was appropriate for categorical data with a significance level of $p < 0.05$.

Results

146 neonates were enrolled in the study, mean gestational age was 38.5 ± 1.2 weeks, mean birth weight was 3.25 ± 0.45 kg; 91 (62.3%) neonates were female and 55 (37.7%) were male. The breech presentation was noted in 47 neonates (32.2%) and 18 (12.3%) had a prior history of oligohydramnios. Vaginal delivery was attempted in 89 neonates (60.9%) and 57 neonates (39.1%) were delivered by cesarean section.

A total of 292 hips were assessed by ultrasonography and were graded based on the Graf system. Of these, 201 hips (68.8%) were of Type I (normal), 52 hips (17.8%) of Type II (immature), 16 hips (5.4%) of Type III (dysplastic) and 9 hips (3.1%) of Type IV (dislocated).

Thus, 39 out of the 146 neonates (26.7%) had abnormal hip angles (Type II, III or IV). Significantly, breech presentation demonstrated higher abductor rotation and higher lateral tilt; 20 of 45 (44.4%) of the breech neonates were found with abnormal hip angles. Similarly, there were 12 of 30 neonates (40.0%) with a positive family history of DDH. There were significantly higher numbers of females with abnormal hip angle being recorded in 39 out of 91 (42.9%) compared to males 10 out of 55 (18.2%).

Significantly, 39 neonates had an abnormal hip angle: 18 (46.2%) had left hip involvement, 14 (35.9%) had right hip involvement, and 7 (17.9 %) had bilateral hip involvement. In follow-up evaluation at 12 weeks, 30 of the 52 Type II (immature) hips (57.7%) resolved without intervention. The rest of the cases 22 (42.3%) needed bracing for correction. Of the dysplastic or dislocated hips (Type III/IV), 15 cases (68.2%) showed improvement with bracing and conservative management, while 7 cases (31.8%) required surgical intervention.

Table 1: The study population's clinical and demographic characteristics

Variable	Frequency (n=146)	(%)
Gestational Age (weeks) Mean ± SD	38.5 ± 1.2	
Gender		
Male	55	37.7%
Female	91	62.3%
Birth Weight (kg) Mean ± SD	3.25 ± 0.45	
Birth Presentation		
Breech	47	32.2%
Cephalic	94	64.4%
Family History of DDH	30	20.5%
Oligohydramnios	18	12.3%
Mode of Delivery		
Vaginal Delivery	89	60.9%
Cesarean Section	57	39.1%

Table 2: Hip Angle Graf Classification in the Research Population (n=292 hips)

Graf Type	Description	Frequency (Hips)	(%)
Type I	Normal Hip	201	68.8%
Type II	Immature Hip	52	17.8%
Type III	Dysplastic Hip	16	5.4%
Type IV	Dislocated Hip	9	3.1%

Table 3: Distribution of Abnormal Hip Angles by Risk Factors

Risk Factor	Total (n=146)	Abnormal Hip Angles (n)	(%)
Breech Presentation	45	20	44.4%
Family History of DDH	30	12	40.0%
Oligohydramnios	18	8	44.4%
Female	91	39	42.9%
Male	55	10	18.2%

Table 4: Abnormal Findings in Neonates with Abnormal Hip Angles: Laterality

Laterality	Frequency (n=39)	Percentage (%)
Unilateral (Left)	18	46.2%
Unilateral (Right)	14	35.9%
Bilateral	7	17.9%

Table 5: Follow-up and Management Outcomes for Abnormal Hip Angles

Hip Classification (Initial)	Follow-up Outcome (at 12 weeks)	Frequency (n)	Percentage (%)
Type II (Immature)	Resolved Without Intervention	30	57.7%
Type II	Required Bracing	22	42.3%
Type III/IV (Dysplastic/Dislocated)	Improved with Bracing/Follow-up	15	68.2%
Type III/IV	Required Surgical Intervention	7	31.8%

Discussion

The findings of our study should be compared to meta-analyses such as the one reviewed by BMJ Pediatrics Open 2023 where the prevalence of DDH was established to vary between 0% and 22.66% and the pooled estimates varied by region. For example, the prevalence in China was 1.74%, and the prevalence in other countries only averaged 0.77%. This variation corresponds with other research suggesting that prevalence depends on such factors as geographical location, gender, and screening (BMJ, 2023) (15).

Earlier cross-sectional and systematic review studies have indicated higher prevalence in some countries such as Turkey and Iran. These disparities are not solely due to genetic variations, but also screening methods – some of the trials implemented ultrasound screening, wherein more cases are identified at the initial stages than with physical exams (Burger et al., 2021; Ortiz-Neira et al., 2020) (16, 17).

Most of the research, including Graf's ultrasound study from the early 1990s, focuses on the incidence rather than the discovery of the condition. Your findings could match by whether similar tools were used. The Graf method remains popular among researchers in the present day, and its features impact reported prevalence (Moyer et al., 2014; Burger et al., 2021) (18, 19).

In many published studies including those in the BMJ review above, infants in the 0 to 12 months age group are usually considered. It is also acknowledged that the detection of dysplasia screen rate (1.45%) and dislocation screen rate (0.21%) are different depending on the time of screening. Our data may reflect trends observed in other studies where females had a higher rate of DDH identified. Other sources of variation include swaddling practices which are reflected by the environment and should also be considered (Ortiz-Neira et al., 2022) (20).

Conclusion

This research encourages risk-based triage and underscores the need for continued awareness amongst clinicians about the need to diagnose and treat at-risk newborns before complications from DDH ensue; although the incidence of DDH in different populations is not the same, the need to diagnose and properly manage the condition using observation, bracing or surgery where necessary to improve outcomes cannot be overemphasized. More research can be done in the area of long-term consequences of conservative and surgical management of patients with identified risk factors, as well as in developing the criteria for neonatal screening.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-KTHP-331/23)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Coordination of collaborative efforts.
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Conception of Study, Development of Research Methodology Design
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Manuscript revisions, critical input.
Coordination of collaborative efforts.
Manuscript drafting.
Data entry and Data analysis, drafting article.

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