Original Article

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Clinical Profile and Clinico-Radiological Correlation of Developmental Dysplasia of Hip in Neonates: A Case Control Study

Neha Goel[1], KC Aggarwal[2], Vikas Gupta[3], R Chandra[4]

[1]Senior Resident, Department of Paediatrics, VMMC and Safdarjung Hospital, New Delhi, India. Email: drnehagoel21@gmail.com, Orcid ID: 0000-0001-9575-0805

[2]Ex- Professor, Department of Paediatrics, VMMC and Safdarjung Hospital, New Delhi, India. Email: nehagoel2110.ng@gmail.com, Orcid ID: 0000-0002-7133-9664

[3]Professor, Department of Orthopedics, VMMC and Safdarjung Hospital, New Delhi, India. Email: drvikas@hotmail.com, Orcid ID: 0000-0002-7306-3251

[4]Professor, Department of Radio- Diagnosis, VMMC and Safdarjung Hospital, New Delhi, India. Email: drranjanchandra@gmail.com, Orcid ID: 0000-0003-1397-2565

Abstract

Background: Developmental dysplasia of hip is one of the common birth defects and affects 1-2% newborns. Early detection and timely management is necessary to prevent avascular necrosis of femoral head, premature arthritis and hip replacement. **Subjects and Methods:** The study aims to identify the risk factors and clinic-radiological correlation for diagnosing developmental dysplasia of hip in newborns. An observational case-control study was carried out in a tertiary care super-specialty hospital and 2403 newborns less than 72 hours of life were enrolled over a period of 18 months. Newborns were classified as case, who have DDH and as control, who does not have DDH. Physical examination were conducted and ultrasonography and radiography were done. **Results:** The incidence of the DDH in new-born was found to be 9.5 per 1000 new-born. The sensitivity of the clinical examination was found to be 97% and specificity was 13.68%. Our study identifies following as independent risk factors for DDH: girl sex (86.96%), primigravida (60.87%), multiple births (52.17%), breech presentation (82.61%) and gestation more than 37 weeks (77.07%). Keeping USG as a gold standard to diagnose DDH, Barlow's and Ortolani's tests could serve as an excellent tool to screen DDH. Female newborns, Primigravida, multiple births, breech delivery, and gestation of more than 37 weeks were found to be statistically significant risk factors for the development of DDH. There was no significant association found between the age of the mother and mode of delivery on the chance of developing DDH in newborns. **Conclusion:** Early screening of DDH is necessary to prevent long term morbidity, especially in newborns with high risk factors.

Keywords: Developmental dysplasia of hip, newborns, clinical profile, clinic-radiological correlation.

Corresponding Author: Dr. KC Aggarwal, Ex- Professor, Department of Paediatrics, VMMC and Safdarjung Hospital, New Delhi, India. Email: nehagoel2110.ng@gmail.com.

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Introduction

Birth defects or congenital malformations are structural or functional anomalies that are present since birth.[1] Birth defects are not uncommon, and could be life-threatening conditions. Birth defects can involve can body part e.g., the heart, brain, foot which affects the body physically, cosmetically or functionally, or in a combination.[2]

Birth defects are a major contributor of long-term disability in the survivors leading to a lifelong economic and social burden on society. These defects require long term physical and medical rehabilitative care and put increased pressure on already overburdened health care services in the developing countries,[1] Developmental dysplasia of the hip (DDH) has been included in ICD-10 under XVII congenital malformations, deformations, and congenital abnormalities (Q65-79)- Congenital malformations and deformations of the musculoskeletal system.[3]

DDH ranges from mildly dysplastic acetabula that may or may not be stable to completely dislocated hip since birth which may either be reducible or irreducible. Owing to the difficulty in accurately and uniformly defining the condition to its appropriate diagnosis and treatment, it has been advised that it should be diagnosed at the earliest to avoid the complications related to the disease e.g., avascular necrosis (AVN) of the femoral head as it is associated with the adverse outcome.[4]

Earlier it was referred to as congenital since it was believed that these abnormalities are present since birth but it was later found that these abnormalities are not necessarily present at birth and may develop postnatally, hence the term congenital has been replaced with developmental. The complications associated with DDH can easily be avoided if the disorder is detected at the earliest and effective treatment is provided. Even though the newborn screening programs have been kept in place, a large number of children with DDH are diagnosed at a later stage.[5]

It tends to affect 1-2% of newborns and can be considered as one of the important reasons that cause premature arthritis and require a total hip replacement.[6,7] The female: male ratio is 4-6 times.[8]

The hip is at risk for dislocation during 4 periods: 1) the 12th gestational week, 2) the 18th gestational week, 3) the final 4 weeks of gestation, and 4) the postnatal period. During the 12th gestational week, the hip is at risk of dislocation as the fetal lower limb rotates medially. A dislocation at this time is termed teratologic and leads to the formation of the abnormal elements of joints. By the 18th gestational week, the hip muscles are formed. The teratologic dislocations can also be caused by certain neuromuscular problems during this time, such as myelodysplasia and arthrogryposis. The mechanical forces have an important role to play during the final 4 weeks of pregnancy. Conditions such as oligohydramnios or breech presentations are known risk factors for DDH. DDH has been documented in as many as 23% of the breach deliveries when breech position occurs in 3% of births, making it a risk factor, with a higher risk seen if the child is born in the frank breech position of hip flexion and knee extension. Postnatally, infant positioning such as swaddling, combined with ligamentous laxity, predispose to DDH.[9]

Risk factors for DDH include Breech presentation, first delivery, sibling, female gender, oligohydramnios, torticollis, plagiocephaly, pescalcaneovalgus, calcaneovalgus, generalized laxity, talipes equinovarus, cesarean section, absence of flexion in knee and hip, low birth weight (<2500g), prematurity (before 37 weeks), restricted hip abduction, asymmetrical gluteal folds, wide perinea and use of swaddling.[10]

DDH is an evolving process and the physical findings change on clinical examination as the child grows older. Asymmetry in the thigh or gluteal folds, the discrepancy in the limb length, and restricted motion, especially abduction are clinically convincing findings but are not diagnostic.[11]

Ortolani and Barlow's tests are the two important clinical maneuvers to assess the instability of the hip in new-born. The Ortolani test detects the reduction of the dislocated hip whereas the Barlow detects the dislocation of the unstable hip from the acetabulum. The radiographs of the pelvis and the hips have little importance in diagnosing DDH at birth since the femoral heads are composed entirely of the cartilage in the newborn period. It takes 4 to 6 months for ossification centers to develop in the femoral head.[11]

The effective management of DDH relies on timely identification and early diagnosing of DDH and timely referral to the pediatric orthopedic surgeon.[12] Early diagnosis is essential so that an infant could be protected from suffering the morbid complications that accompany undiagnosed untreated cases of DDH including hip replacement surgery.

American Academy of Pediatrics (AAP) recommends that all newborns at risk of development of DDH based on risk factors and clinical features should be screened at birth for DDH which should be followed by ultrasonography (USG) (target scan) at 6 weeks. Indian system lacks a national policy on diagnosing DDH.[13]

Our study aims to identify the risk factors and clinic-radiological correlation for diagnosing developmental dysplasia of hip in newborns.

Subjects and Methods

An observational Case-Control study was carried out in a Tertiary Care Super- Speciality Hospital over a period of 18 months and 2403 intramural newborns <72 hours of life were examined for DDH. The case group included newborns with suspected DDH on clinical examination and the control group included newborns without DDH. New-borns with severe birth asphyxia, on a mechanical ventilator before 72 hours of life, life-threatening gross congenital deformity, and gross hydrocephalus were excluded. Ethical clearance was obtained from Ethics Committee of the institution-IEC/VMMC/SJH/Thesis/October/2018/11

They were screened by physical examination of the hip joint and clinical method (Ortolani and Barlow examination) for the presence of developmental dysplasia of the hip and were further evaluated by sonography using Graf's method and radiography. New-borns who were screened negative for DDH by clinical methods were taken as controls. Mothers of all babies (Cases and Controls) were interviewed through a predesigned questionnaire. It has been attached in appendix I.

Results

In our study, the majority (44.15%) of newborns' mother age was 20-25 years followed by 25-30 years (35.83%). No significant association was seen in the distribution of age of the mother with negative and positive clinical findings. (p value>.05). The demographic data has been shown in [Table 1].

The majority (53.47%) of the mother belongs to the lower middle class followed by the lower class (42.95%). No significant association was seen in the distribution of socio-economic status with negative and positive clinical findings. (p value>.05)

[Figure 1] shows an association of maternal details with the negative and positive clinical findings

In the majority (99.13%) of mothers, no evidence of oligohydramnios in antenatal USG was found.

A significant association was seen in the distribution of evidence of oligohydramnios in antenatal USG with negative and positive clinical findings. (p value<.05) Evidence of oligohydramnios in antenatal USG of the mothers was not seen in 99.54% of newborns in negative clinical findings which was significantly higher as compared to 56.52% of newborns in positive clinical findings.

No intrapartum complication was seen in the majority (99.88%) of mothers.

The majority (74.32%) of the newborns were born via the vaginal mode of delivery followed by LSCS mode (25.18%).

Presentation in the majority (97.50%) of newborns was cephalic followed by breech (1.41%), the majority (51.69%) of babies were boys.

Birth weight (in grams) was >2500 gms in majority of new-

borns (66.38%) followed by 2000-2500 gms (22.47%), 1500-2000 gms (7.49%) and 1000-1500 (2.75%). Birth weight (in grams) was <1000 in only 22 out of 2403 patients. The majority (98.09%) of the newborns were singleton pregnant. [Table 2] shows an association of delivery details at birth with negative and positive clinical findings.

In majority (77.07%) of patients, gestation (in weeks) was >37 followed by 34-37 (17.35%), 32-34 (2.75%) and 28-32 (2.16%). Gestation (in weeks) was <28 in only 16 out of 2403 patients.

No significant association was seen in the distribution of mode of delivery with negative and positive clinical findings. (p value>.05)

[Table 3] shows an association of clinical features of DDH with negative and positive clinical findings

[Figure 2] shows the sensitivity and specificity of X-ray and clinical findings for predicting developmental dysplasia.

Table 1: Distribution of demographic characteristics of study subjects.

Demographic characteristics	Frequency	Percentage
Age of mother		
<20 years	212	8.82%
20-25 years	1061	44.15%
25-30 years	861	35.83%
30-35 years	211	8.78%
>35 years	58	2.41%
Age of father		
<20 years	63	2.62%
20-25 years	634	26.38%
25-30 years	1189	49.48%
30-35 years	445	18.52%
>35 years	72	3.00%
Education		
Illiterate	549	22.85%
Upto 7th class	671	27.92%
7th -10th class	815	33.92%
More than 10th	368	15.31%
Socio- economic status		
Upper middle	86	3.58%
Lower middle	1285	53.47%
Lower	1032	42.95%
Consanguinity		
Consanguineous	20	0.83%
Non consanguineous	2383	99.17%

Table 2: Association of delivery details at birth care with negative and positive clinical findings.

Delivery details at birth care	Negative (n=2380)	Positive (n=23)	Total	P value	Test performed
Baby gender					
Girl	1141 (47.94%)	20 (86.96%)	1161 (48.31%)	0.0002	Fisher Exact test
Boy	1239 (52.06%)	3 (13.04%)	1242 (51.69%)		
Birth weight (in grams)					
<1000	21 (0.88%)	1 (4.35%)	22 (0.92%)	0.001	Fischer Exact test
1000-1500	64 (2.69%)	2 (8.70%)	66 (2.75%)		
1500-2000	174 (7.31%)	6 (26.09%)	180 (7.49%)		
2000-2500	535 (22.48%)	5 (21.74%)	540 (22.47%)		
>2500	1586 (66.64%)	9 (39.13%)	1595 (66.38%)		
Multiple births					
No	2340 (98.32%)	17 (73.91%)	2357 (98.09%)	<.0001	Chi square test,72.268
Yes	40 (1.68%)	6 (26.09%)	46 (1.91%)		
Gestation (in weeks)					
<28	16 (0.67%)	0 (0%)	16 (0.67%)	0.001	Fischer Exact test
28-32	49 (2.06%)	3 (13.04%)	52 (2.16%)		
32-34	65 (2.73%)	1 (4.35%)	66 (2.75%)		
34-37	409 (17.18%)	8 (34.78%)	417 (17.35%)		
>37	1841 (77.35%)	11 (47.83%)	1852 (77.07%)		
Presentation					
Cephalic	2339 (98.28%)	4 (17.39%)	2343 (97.50%)		
Breach	15 (0.63%)	19 (82.61%)	34 (1.41%)	<0.001	Fischer Exact test
Others	26 (1.09%)	0 (0%)	26 (1.08%)		

Table 3: Association of presence of clinical features of CDH with negative and positive clinical findings.

Presence of clinical features of CDH	Negative (n=2380)	Positive (n=23)	Total	P value	Test performed
Leg appearing shorter on side of dislocation					
No	2380 (100%)	10 (43.48%)	2390 (99.46%)	<.0001	Fisher Exact test
Yes	0 (0%)	13 (56.52%)	13 (0.54%)		
Leg turned outwards on side of dislocation					
No	2380 (100%)	13 (56.52%)	2393 (99.58%)	<.0001	Fisher Exact test
Yes	0 (0%)	10 (43.48%)	10 (0.42%)		
Folds on skin of thigh					
No	2380 (100%)	1 (4.35%)	2381 (99.08%)	<.0001	Fisher Exact test
Yes	0 (0%)	22 (95.65%)	22 (0.92%)		
Space between legs appears wider					
No	2380 (100%)	14 (60.87%)	2394 (99.63%)	<.0001	Fisher Exact test
Yes	0 (0%)	9 (39.13%)	9 (0.37%)		

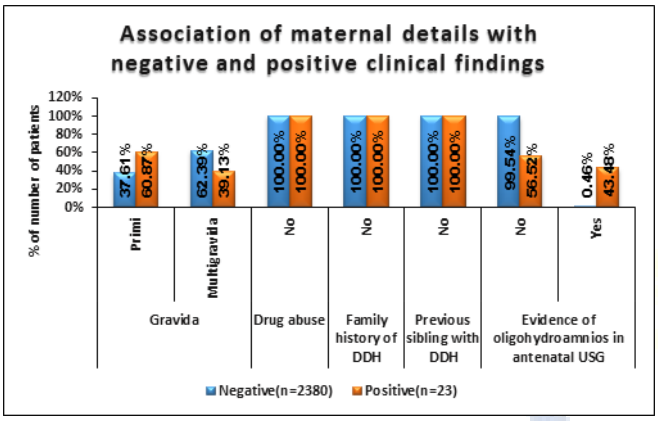

Figure 1: Association of maternal details with negative and positive clinical findings.

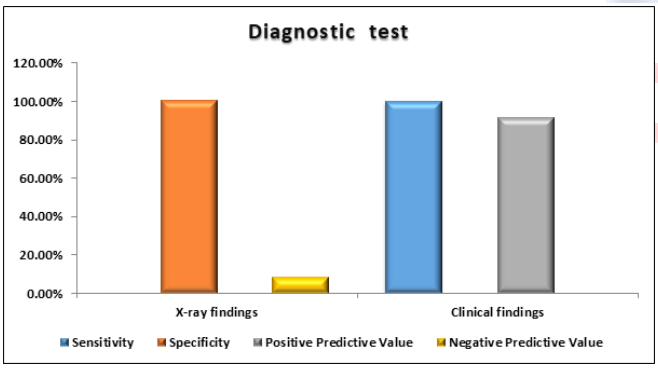

Figure 2: Sensitivity and specificity of x-ray and clinical findings for predicting developmental dysplasia.

Discussion

Our study intends to determine the incidence of DDH in the Indian population and the correlation between the clinical findings, ultrasonography, and radiographic findings that are suggestive of DDH. We examined 2403 newborns (4806 hips). 44.15% of the newborns were born to mothers aged between 20-25 years and 35.83% of the newborns were born to mothers aged between 25-30 years. None of the examined newborns had either a family history of DDH or a previous sibling with DDH. Amongst 2403 newborns examined, 23 of them were suspected of having DDH by Barlow's and Ortolani's method (9.5 per 1000 newborns). When these infants were subjected to USG using Graf's method, 2 amongst the 23 suspected had Type I DDH (8.7%) and 21 had Type IIA DDH (91.3%). The leg appeared to be short on the side of dislocation in 13 patients amongst the 23 suspected (56.52%) which has a significant p-value of <0.001 & folds were present on the affected side of the thigh in 22 out of 23 newborns (95.65%) with a significant p-value of <0.001. A significant association was seen in the distribution of leg turned outwards on side of dislocation with negative and positive clinical findings. (p value<.05) The leg was not turned outwards on side of dislocation in 100.00% of patients in negative clinical findings which was significantly higher as compared to 56.52% of patients in positive clinical findings. A significant association was seen in the distribution of space between legs that appears wider with negative and positive clinical findings. (p value<.05) Space between legs appears was not wider in 100.00% of patients in negative clinical findings which was significantly higher as compared to 60.87% of patients in positive clinical findings

In our study, Ortolani and Barlow's were found to be positive in all 23 children who were on USG, were found to have evidence of DDH (specificity 100%) whereas none of the suspected DDH had any abnormalities on X-Ray. Hamidreza Arti et al.[8] found the sensitivity and specificity of the clinical method to diagnose DDH to be 28.1% and 94.5% respectively.[4] However, H. Dogruel et al,[14] found the sensitivity and specificity of clinical examination to be 97% and 13.68% respectively keeping ultrasound as a standard. It suggests that the clinical examination cannot reliably detect ultrasonographically defined DDH in infants being screened for the disease.[15]

Considering USG to be the Gold standard for diagnosing DDH, clinical examination via Ortolani's and Barlow's has a higher sensitivity and specificity in suspecting DDH in newborns at birth which can further be confirmed by USG using Graf's method. In a study by Cervonide Martno M et al,[16] all Ortolani's positive hips were pathological (100%) which is a similar result as in our study. This suggests that the USG examination may be an excellent help to clinical examination, which if performed well, has top priority for early diagnosis of DDH.

No significant association was seen in the distribution of age of the mother with negative and positive clinical findings. (p value>.05) and cannot be considered as a risk factor of DDH. Intrapartum complications (prolonged labor, difficult extraction, CPD, obstructed labor) were found in 20 out of 23 newborns (86.96%), with a significant p-value of <0.001 and thus can be considered as a risk factor for DDH. A statistically significant association was seen in the distribution of gravida with negative and positive clinical findings. (p value<.05. Thus, according to our study primigravida is to be considered as a risk factor. 19 out of 23 newborns have had a breech presentation (82.61%), with a significant p-value of <0.001, and thus can be considered as a risk factor for DDH similar to study results by a retrospective study by Bahar Kural et al.[16] Also, in a study by Teddy Quan et al,[17] they found out that both preterm breaches, as well as term breech, have a similar incidence of DDH. Similarly, in a study carried by A Chan et al, to identify perinatal risk factors for DDH in 1997, breech presentation, oligohydramnios, female sex, and primigravida were confirmed as risk factors.[18]

A significant association was seen in the distribution of multiple births with negative and positive clinical findings. (P value<.05) No multiple births were found in 98.32% of patients in negative clinical findings which were significantly higher as compared to 73.91% of patients in positive clinical findings, similar to Bahar Kural et al,[16] where multiple pregnancies were found to be a risk factor and gestation of more than 37 completed weeks were found in 12 out of 23 pregnancies (52.17%) with a p-value of 0.002, similar to study done by Siomek et al (19), where gestation less than 38 weeks was not a risk factor and hence, multiple pregnancies and gestation more than 37 weeks can be considered as a risk factor as per our study results. Similarly, in a population-based survey of Neonates in Pomerania (SNiP) (20), they found that preterm less than 36 weeks gestational age have a decreased incidence of DDH.

15 out of 23 newborns were girls (65.22%) with a p-value of <0.099 which is highly suggestive, significant at p<0.1. However, in a prospective study by Someik et al,[19] amongst the examined risk factors, only sex of the infant turned out to be significant for the development of DDH, no statistically significant correlation was found between Graf hip types and family history of DDH, breech presentation, pregnancy duration under 38 weeks or infant birth weight.

To summarise, in our study, on performing univariate logistic regression, evidence of oligohydramnios in antenatal USG, Intrapartum complication, Breech, multiple births, Leg appearing shorter on side of dislocation, Leg turned outwards on side of dislocation, Folds on the skin of thigh and Space between legs appears wider were significant risk factors of positive clinical findings with an odds ratio of 160.258, 812.854, 654.054, 21.465, 6121.2857, 3703, 5.47E+127, 5.456 respectively. On the other hand, babies with birth weight: -2000-2500, >2500 had significantly lower chances of positive clinical findings with an odds ratio of .147, .086 respectively. Also, on performing multivariate logistic regression, breech and other presentations were significant independent risk factors of positive clinical findings with an adjusted odds ratio of 205.860, 30.712 respectively. On the other hand, babies with birth weight: -2000-2500, >2500 had significantly lower chances of positive clinical findings with an adjusted odds ratio of .016, .033 respectively.

Conclusion

The incidence of the DDH in new-born was found to be 9.5 per 1000 new-born. On clinical examination, the leg appearing short on the side of dislocation folds on the side of dislocation, leg turned outwards and space between legs appearing wider was found to be a statistically significant clinical parameter to screen for DDH. The sensitivity of the clinical examination was found to be 97% and specificity was 13.68%. Keeping USG as a gold standard to diagnose DDH, Barlow's and Ortolani's tests could serve as an excellent tool to screen DDH. Female newborns, Primigravida, multiple births, breech delivery, and gestation of more than 37 weeks were found to be statistically significant risk factors for the development of DDH. There was no significant association found between the age of the mother and mode of delivery on the chance of developing DDH in newborns.

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