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Value of Physical Examination in the Diagnosis of Developmental Hip Dislocation in Preterm Infants

Arash Bordbar,[1] Parisa Mohagheghi,[2] Ladan Yoonesi,[1] Majid Kalani,[1] Mandana Kashaki,[1] Ali Ghassemian,[3] Sarah Farhadi,[4] and Somayeh Farhadi[1,*]

[1]Shahid Akbar Abadi Hospital, Iran University of Medical Sciences, Tehran, Iran
[2]Hazrate Rasoul Medical Center, Iran University of Medical Sciences, Tehran, Iran
[3]Iran University of Medical Sciences, Tehran, Iran
[4]Tehran University of Medical Sciences, Tehran, Iran

[*]*Corresponding author*: Somayeh Farhadi, MD, Department of Pediatrics, Shahid Akbar Abadi Hospital, Faculty of Medicine, Iran University of Medical Sciences, Molavi St., Tehran, Iran. Tel/Fax: +98-2155632277, E-mail: dr_g_farhadi@yahoo.com

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Abstract

Background: Developmental dislocation of the hip joint is among joint abnormalities and lack of its early diagnosis leads to irreversible complications and disabilities.
Methods: The current cross sectional study was conducted on 210 eighteen - month - old premature infants. Premature infants at term gestational age were examined by a neonatologist and underwent a sonographic scanning by a skilled radiologist. The results of the physical examination and ultrasound reports were collected and analyzed.
Results: In the clinical assessment, hip joint examination was diagnosed abnormal in 22 cases (10.4%) and joint dislocation was diagnosed by ultrasonographic examination in 17 patients (8.1%). In one high - risk case, despite normal clinical examination (0.48%), the dislocation was diagnosed by ultrasonographic evaluation. There was a significant relationship between hip dislocation rate, and reduced mean gestational age and birth weight ($P < 0.05$). The dislocation prevalence in the twins was significantly more than that of other infants ($P = 0.001$). In the current study, there was no statistically significant relationship between gender, family history, oligohydramnios, presentation, and type of delivery with joint dislocation ($P > 0.05$). In diagnosis of joint dislocation, clinical examination (the results of the Ortolani and the Barlow tests) had sensitivity of 94% and specificity of 97% compared with sonography; the positive and negative predictive values were 73% and 99%, respectively.
Conclusions: Clinical examination has high sensitivity and specificity for early diagnosis of developmental hip dislocation. If there are risk factors, ultrasonographic scanning is recommended despite normal physical examination, and ultrasound is not necessary in case of normal physical examination and the absence of risk factors.

Keywords: Premature Infant, Dislocation, Hip, Clinical Examination, Ultrasonography

1. Background

Developmental dislocation of the hip (DDH) is among the most important joint disorders of childhood and is caused due to staying out of the femoral head from the acetabulum cavity (1). The exact cause of this disorder is unknown; but, several factors are involved including positive family history, gender, age, oligohydramnios, race and intrauterine fetal position (1-4). The actual prevalence of this disorder is unknown, but it is reported 1.5 per 1000 to 20 per 1000 living births (5). It is more prevalent among females due to the production of maternal relaxin hormone and occurs as unilaterally or bilaterally before, during, or shortly after birth (6). Several studies show higher prevalence of this complication on the left side, which may be due to left anterior occiput position prevalent in non - breech babies (7). Swaddling also increases the risk (8). When the femoral head is out of its place, the normal growth stops and infants have relative ligamentous laxity at birth (9, 10). Early manifestations of the disorder are rare and it is mostly diagnosed with the Ortolani and the Barlow maneuvers based on the Ortolani and the Barlow clinical symptoms (11, 12). In the Ortolani test, a dislocated hip is reduced and it is felt by the click sound heard when the femoral head is fixed (11). The Barlow test shows the femoral head dislocation in the acetabulum cavity in an unstable hip (12). The Ortolani and the Barlow tests should be conducted separately for each hip joint (11, 12). The Ortolani and the Barlow tests are no longer positive from the

week eight to twelve (13).

Gradually, permanent symptoms and complications of the disease such as inconsistency of folds in gluteal area, reduced abduction, limping, osteoarthritis, and short limbs appear; hence, the delay in diagnosis is associated with severe and irreparable complications (9, 10). Ultrasound is the gold standard diagnosis method (14, 15). For early diagnosis of the disease, it is necessary to be equipped with clinical skills during the physical examination phase. Radiography and ultrasonography are also used to confirm the diagnosis in suspected cases (16-18). Since clinical symptoms are not always detectable, some cases could not be diagnosed at early stages, which leads to serious and irreversible complications (9, 10). Several studies are conducted to compare the diagnostic value of ultrasound to evaluate the clinical examination to diagnose congenital hip dislocation in preterm infants. Preterm refers to a baby born before the week 37 of pregnancy (19-23) and there are few studies on the subject of DDH in premature newborns (6); therefore, the current study aimed at investigating the value of comparative clinical examination and assessment of ultrasound to diagnose DDH in premature newborns due to the importance of early diagnosis of hip dislocation.

Physical examination of the infant hip is part of the baby examinations, but it is often insufficient to diagnose DDH, because in some dysplastic hip joints it is unstable, slippery or moving, especially if remained undiagnosed by a less experienced person; or sometimes normal joint may be considered a pathological case by mistake (false positive) (24, 25).

2. Methods

The current descriptive, cross sectional study was conducted on preterm infants born from 22 March 2013 to 21 March 2015 in Akbar Abadi teaching Hospital in Tehran, Iran. A total of 210 premature infants reaching the age of full - term were examined by a neonatologist and after completion of the proposed questionnaire (including positive family history, gender, gestational age, oligohydramnios, race, and intrauterine fetal position) were referred to a radiologist for ultrasound hip scanning. Infants with genetic and structural defects and symptoms of intrauterine infection or early sepsis were excluded from the study. Clinical examinations included the Ortolani and the Barlow tests conducted separately on each hip. Ultrasound was conducted using multi - frequency linear probe and MedicalC260 6 - 8MHZ ultrasound device in a static - dynamic state. In static position, the newborn or infant was placed in the supine position and legs were put in the parallel mode, and the ultrasound probe was adjusted in the outer margin of the hip joint using coronal slices. Specific alpha and beta angles and ultrasonic type joints were later determined. In the dynamic control, knees were placed in the flexion state and after applying the posterior and lateral pressure on the femurs, the displacement rate of the femoral head was recorded. The cases with femoral head displacement rate of less than 6 mm were considered as hypermobile (non - morbid), and cases with displacement greater than 6 mm, were diagnosed with morbid dislocation. The complete dislocation and subluxation refer to the states where the femoral head is completely out of the acetabular cavity and in case of a brief displacement, respectively. Then, ultrasound report of infants was compared with the examination questionnaire. Finally, necessary information was extracted in accordance with the objectives of the study and was later analyzed with SPSS. The following formula extracted from the study by Sezer et al., was used to calculate the sample size; P = 0.12 was considered as the level of significance and d parameter (estimation accuracy) was set to 0.04 (N = 210).

$$n = \frac{Z^2_{1-\frac{\alpha}{2}} pq}{d^2} \quad (1)$$

3. Results

At the end of the current study, which aimed at investigating the prevalence of congenital hip dislocation in premature infants referred to Akbar Abadi Hospital in Tehran, 210 infants were studied. The mean gestational age was 32.3 $\pm$ 2.5 weeks (ranged 25 to 36). (Diagram 3); 108 infants were female (51.4%) and 102 (48.6%) male (Diagram 1). The mean birth weight was 1618.3 $\pm$ 426.6 g (ranged 600 to 2850) (Diagram2). In the current study, 155 (73.8%) and 55 (26.2%) infants were born by cesarean section and normal vaginal delivery, respectively. A total of 24 infants (11.4%) were twins. The positive family history existed in three patients (1.4%). Also, oligohydramnios was observed in 10 infants (4.8%). Breech and cephalic presentation was observed in 28 (13.3%) and 182 infants (86.7%), respectively. Hip dislocation was observed in 17 infants (8.1%) during the sonography examination. All the infants had at least one risk factor and 193 infants (91.9 %) were normal while the clinical assessments for hip dislocation were positive in 22 infants (10.4%). As shown in Table 1, the mean gestational age and birth weight were significantly lower in the group with dislocation than the normal group (P < 0.05). As shown in Table 2, the prevalence of dislocation in the twin babies was significantly higher than other infants (P = 0.001), while there was no statistically significant difference between infants with dislocation and the normal ones in terms of gender, type of delivery, type of presentation, family history,

and oligohydramnios ($P > 0.05$). Twin pregnancy, gestational age, and low birth weight were among factors affecting increased risk of DDH. Also, the clinical examination had high sensitivity and specificity for the diagnosis of DDH.

Results of the sonography showed that the mean gestational age and birth weight were significantly lower in the group with hip dislocation than the normal group.

Results of the sonography showed that the prevalence of dislocation in the twin babies was significantly higher than regular infants.

4. Discussion

The results of the current study showed that prematurity had a direct significant impact on the incidence of DDH. Therefore, out of 210 studied premature infants, 17 cases (8.05%) were diagnosed with DDH, which was higher than the results of similar studies on term infants (19-23). For example, Arti et al., conducted a comparative study on the value of physical examination and ultrasound to diagnose congenital hip dislocation in Ahvaz, Iran. After examining 5701 infants, 167 cases (2.9%) were diagnosed with DDH (20). Also, Khatami et al., conducted a study on the hip dysplasia screening using ultrasonography in neonates admitted to Razavi Hospital in Mashhad, Iran. They stated that the ultrasound prevalence of congenital hip dislocation was 5.2% (21). Gharedaghi et al., reported the ultrasound prevalence of congenital dislocation of the hip in 19 (6.5%) out of 294 infants (22). Cezar et al., conduct a similar study on the prevalence of DDH in preterm infants and the sonography examination showed that out of 421 preterm infants, only one case (0.24%) was diagnosed with DDH (6). However, the reason was that they only considered the Graph 2 C type as DDH, while the cases higher than type 1 were diagnosed with hip dislocation and subluxation in the current study. Among the risk factors reported for DDH, the most important ones include female gender, family history, and breech presentation (6, 26). These risk factors along with positive clinical symptoms have a significant effect on increasing the diagnosis of DDH, although the impact of female gender was lower than that of family history and breech presentation. The positive family history is mentioned in 20% of the cases in DDH etiology and if one of the parents is diagnosed with this disorder, the risk of DDH in their children increases 10 times (27). In the current study, a positive family history was observed only in three cases out of 210, and only one of them (5.9%) had DDH according to the ultrasound results and this percentage was much lower than those reported in scientific literature. In fact, the positive family history had no significant impact on the incidence of DDH in the current study. In the current study, 60% of infants with typical DDH were the first - born (4). According to the scientific literature, mechanical factors including breech position were considered effective on the incidence of DDH (20, 26, 28). In the current study, there was no significant difference between infants with DDH and the normal ones in terms of breech presentation, which was due to the prematurity; considering fetal small size in many cases of preterm pregnancies, the fetus lies transversely and there is small risk for the breech presentation (6). The female gender is proposed as a risk factor for DDH in some studies (29, 30). It was stated in a previous study that 80% of infants with DDH were female (30). However, only 52% of infants were female in the current study and there was no significant difference between the two genders in terms of morbidity rate. The difference in this regard can be due to age differences between infants in the current study and those in previous studies. According to previous studies, DDH can be associated with some other risk factors such as oligohydramnios, congenital disorders of the foot, first pregnancy, cesarean delivery, nationality, low birth weight, low gestational age, maternal hyperthyroidism during the first trimester of pregnancy (31), congenital muscular torticollis (32), and twin pregnancies (33). DDH rate may vary from 0.1% to 10% considering one or more risk factors in newborns (34). The findings of the current study showed that the mean gestational age and birth weight in the group with hip dislocation were significantly lower than those of the normal group. The twin prevalence was significantly higher among patients with DDH, but there was no significant difference between the two groups in terms of incidence rate of oligohydramnios. However, after conducting the sonography in a recent study, Akman et al., stated that oligohydramnios and swaddling were among the important risk factors for DDH in the unilateral analysis in female infants (35). Physical examination of the infant hip is part of the baby examinations, but it is often insufficient to diagnose DDH since some dysplastic hip joints are unstable, slippery or moving, especially if remained undiagnosed by a less experienced person; or sometimes normal joint may be considered a pathological case by mistake (false positive) (24, 25). Although it was thought that the clinical examination can solve the DDH problem for all babies and physicians, it is recently observed in many centers that the clinical examination alone is not sufficient to diagnose some DDH cases or may lead to unnecessary treatments (36, 37). According to numerous studies, ultrasonography is a very accurate, sensitive, and non - invasive diagnostic method for DDH and enhancing the articular cartilage of the femoral head and the acetabulum increases the ultrasound sensitivity. However, if this process is performed on the first day after birth, it leads to

Table 1. Comparison of Qualitative Factors in the Studied Cases

Parameters	Normal Sonography (N = 194)	Sonography with DDH (N = 17)	P Value
	Mean ± SD	Mean ± SD	
Weight (g)	4.424 ± 1.1640	7.378 ± 5.1368	0.012
Gestational age (wk)	5.2 ± 4.32	6.2 ± 1.31	0.040

Table 2. Comparison of the Qualitative Factors in the Studied Cases

Parameters	Normal Sonography (N = 193)	Positive DDH in Sonography (N = 17)	P Value
Gender			0.896
Male	94 (48.7%)	8 (47.1%)	
Female	99 (51.3%)	9 (52.9%)	
Type of delivery			0.158
Normal delivery	53 (27.5%)	2 (11.8%)	
Cesarean section	140 (72.5%)	15 (88.2%)	
Twin pregnancy			0.0001
Positive	17 (8.8%)	7 (41.2%)	
Negative	176 (91.2%)	10 (58.8%)	
Presentation			0.843
Breech	26 (13.5%)	2 (11.8%)	
Cephalic	167 (86.5%)	15 (88.2%)	
Familial history			0.106
Positive	2 (1.0%)	1 (5.9%)	
Negative	192 (99.0%)	14 (94.1%)	
Oligohydramnios			0.821
Positive	9 (4.7%)	1 (5.9%)	
Negative	184 (95.3%)	16 (94.1%)	
Physical examination (the Barlow and the Ortolani tests)			-
Positive	6 (3.1%)	16 (94.1%)	
Negative	187 (96.9%)	1 (5.9%)	

false - positive results given the laxity of the joint capsule (38). Therefore, simultaneous use of physical examination and ultrasound diagnostic method is the best and most appropriate procedure to evaluate DDH (29). According to the current study, the physical examination had more diagnostic power, compared with the ultrasound; therefore, only one case of hip dislocation confirmed by ultrasound was not diagnosed in the clinical examination, and the reason can be attributed to lack of risk factors (breech position) and a negative test result in order to request sonography. In this sense, the value of clinical examination (the Ortolani and the Barlow test results) enjoyed sensitivity of 94% and specificity of 97% compared with the ultrasound test. Sensitivity and specificity measured in the study by Etri et al., were 28.1% and 94.5%, respectively (20). In the current study, the results of clinical evaluation and ultrasound report on the hip dislocation was similar in 96.5% and the results of ultrasound were different in 0.5% of newborns with normal hip based on clinical examination. In addition, the sonography report was normal in 27.2% of infants with pathological joint according to examination reports. The reasons for this mismatch may include hip structure at the initial time of birth; the soft tissue and capsule laxity can naturally exist around the hip and immature hip joint during the first few days to weeks after birth (39). The laxity of the immature hip, though not so noticeable, can be distinguished in the sonographic evaluations until achieving positive routine clinical assessment (40).

However, the clinical experience and medical skills in hip physical examination and radiologist's skills in sono-

graphic evaluations are considered as the most important parameters to diagnose DDH; in addition to the specialist's experience, infant's restlessness during examination may lead to misdiagnosis both in the clinical and sonographic examinations (41). However, although examiner's precision and experience is very important to diagnose hip dislocation or subluxation, not all consequences of noncompliance with this assumption can be justified. Besides, the Barlow and the Ortolani tests usually remain positive only during a few weeks (2 - 3 months) and finally the hip joint is fixed in the wrong or less right position (11, 12). In contrast, determining the quality of clicks depends on the personal perception and there is always a controversy over its accuracy. However, given the need to put the hip in a position very different from the normal range; i e, putting the hip in a certain position to create a complete dislocation and severe weakness certain sound quality clicks are less important. However, it is important to hear any clicking sounds of the hip (13). Orthopedic surgeons are the best individuals to conduct pelvic examinations in infants and periodic medical examinations are usually performed by them. However, it should be mentioned that repeated clinical examinations can reduce the loss of stability of the knee and hip (42, 43). Based on high specificity of clinical examination, negative dislocation can be largely relied on patients with negative clinical test (44). The ideal screening test should be simple, reliable, with high levels of sensitivity and specificity, and provide more cost - effective results (45). Since these criteria are not met in DDH cases, based on the current study data and those of other related studies, it is more suitable to use surveillance instead of screening (46, 47). During the screening of congenital hip dislocation, the issues of cost, parental anxiety, and execution of commands for repetitive control should be considered (48). Therefore, there is still no consensus for general screening using ultrasound for all infants (24). Considering all above points, it can be concluded that after clinical examination to diagnose DDH, the sonographic screening should be conducted in infants clinically suspected to developmental dislocation of the hip or the related risk factors (24, 44-48).

4.1. Conclusion

According to the current study, the clinical examination enjoyed valuable diagnostic power compared with the ultrasound method; therefore, only one case of dislocations confirmed by the ultrasound was not diagnosed in the clinical examination. In this sense, the value of clinical examination (the Ortolani and the Barlow tests results) enjoyed the sensitivity of 94% and specificity of 97% compared with those of ultrasound test. Also, the clinical examination had positive predictive and negative values of 73% and 99%, respectively. All infants diagnosed with DDH had at least one risk factor; hence, it might be concluded that ultrasound tool can be used to diagnose DDH in infants with positive physical examination or risk factors. Therefore, in a premature infant without risk factors, physical examination may rule out DDH diagnosis. Twin birth, gestational age, and low birth weight were among factors affecting the risk of DDH. Also, the clinical examination has high sensitivity and specificity to diagnose DDH.

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