Screening of Developmental Dysplasia of the Hip in Neonates with Breech Presentation

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Abstract

Background: Developmental dysplasia of the hip (DDH) is one of the most common congenital malformations and it is an important cause of childhood disability.

Aim of this study: Selective screening for DDH in neonates with breech presentation and evaluating the effectiveness of ultrasound use in diagnosis of DDH.

Patient and Methods: A cross- sectional study in phase I and a prospective study in its phase II, was conducted on 268 full term and near term breech neonates born in Obstetrics and Gynecology Hospital of Ain Shams University, in the period from March 2013 to February 2014. All included subjects were subjected to: Full history taking, thorough clinical examination and ultrasonographic assessment of the hip joint using the static and dynamic method.

Results: The overall final incidence of the disease was 3%. The frequency of the disease was highest in female gender (male: female was 1: 3). Twenty one cases (7.8%) were defined as pathological according to the clinical examination, 15 of them (71%) were defined as pathological according to ultrasonography (USG) and 6 cases (29%) had normal findings. 247 newborns (92.2%) had normal clinical examination, of these clinically normal neonates sonographic abnormalities were found in 36 (14.5%). Considering ultrasonography as a gold standard method in evaluating DDH, the sensitivity and specificity of clinical examination were determined 25.6% and 96.8%, respectively. Among the possible risk factors significantly associated with DDH, oligohydramnios was the only risk factor significantly associated with DDH.

Conclusion: The incidence of DDH in breech presented neonates is variable and clinical examination does not reliably detect ultrasonographically defined DDH in infants being screened for this disease, so routine screening should be done with clinical examination and with US to all of them because early intervention is better and cheaper with less complication.

Keywords: Developmental dysplasia of the hip, Breech presentation, Ultrasonography.

مسح تشخيصى لتشوه نمو مفصل الفخذ فى الأطفال حديثى الولادة ذوى وضع المقعدة

الخلفية: يعتبر تشوه نمو مفصل الفخذ أحد أكثر التشوهات الخلقية شيوعا وهو سبب هام للعجزفى مرحلة الطفولة.

الهدف: إجراء مسح تشخيصى لتشوه نمو مفصل الفخذ فى الأطفال حديثى الولادة ذوى المجيء بالمقعدة وإلى تقييم فاعلية إستخدام الفحص بالموجات فوق الصوتية فى التشخيص.

طرق البحث: أجريت هذه الدراسة على الأطفال حديثى الولادة ذوى وضع المقعدة (مكتملى النمو والمقتربين من إكتمال النمو) الذين تم ولادتهم فى مستشفى أمراض النساء والتوليد– بمستشفيات جامعة عين شمس خلال الفترة من مارس ٢٠١٣ الى فبراير ٢٠١٤ وقد خضع كل طفل حديث الولادة ممن شملتهم الدراسة إلى أخذ التاريخ المرضى الكامل، الفحص الاكلينيكى الشامل الدقيق وإلى تصوير بالموجات فوق الصوتية على مفصل الفخذ باستخدام تقنيتين فى الفحص (الثابتة والديناميكية).

النتائج: أظهرت هذه الدراسة أن نسبة معدل الاصابة بتشوه نمو مفصل الفخذ فى الأطفال حديثى الولادة ذوى وضع المقعدة كانت ٣%. كما أظهرت أن معدل الاصابة فى الاناث كان أعلى منه فى الذكور. كانت نسبة أصابة الذكور الى الاناث ١:٣. أظهرت ٢١ حالة من الحالات التى شملتهم الدراسة (٧,٨%) فحص اكلينيكى مرضى ولكن ١٥ حالة منهم فقط (٧١%) أظهرت فحص مرضى بالموجات فوق الصوتية بينما كانت ٦ حالات منهم (٢٩%) طبيعية عند الفحص بالموجات فوق الصوتية. ٢٤٧ حالة صنفت طبيغية بالفحص الاكلينيكى منهم ٣٦ حالة (١٤,٥%) صنفت مرضية عند الفحص بالموجات فوق الصوتية. باعتبار الموجات فوق الصوتية المعيار الذهبى لتشخيص تشوه نمو مفصل الفخذ كانت حساسية وخصوصية الفحص الاكلينيكى (٢٥,٦%) و (٩٦,٨%) على التوالى. من بين العوامل المفترض أن تكون مرتبطة بحدوث تشوه نمو مفصل الفخذ كان نقص كمية السائل الامنيوسى هو العامل الوحيد الذى أظهر ارتباط ذا أهمية احصائية بالمرض.

الخلاصة: تتباين نسبة معدل الإصابة بتشوه نمو مفصل الفخذ فى الأطفال حديثى الولادة ذوى وضع المقعدة بالتالى نوصى بعمل فحص إكلينيكى بالأضافة الى فحص بالموجات فوق الصوتية لكل حديثى الولادة ذوى وضع المقعدة لأن التشخيص المبكر والتدخل بالعلاج المناسب أفضل وأرخص وأقل فى المضاعفات.

الكلمات الكاشفة: تشوه نمو مفصل الفخذ، حديثى الولادة ذوى وضع بالمقعدة، الموجات فوق الصوتية.

Introduction:

Developmental dysplasia of the hip (DDH) denotes a wide spectrum of conditions ranging from subtle acetabular dysplasia to irreducible hip dislocations. It is not restricted to congenital malformation, but also includes developmental disturbance.[9] DDH is one of the most common congenital malformations and it is an important cause of childhood disability.[7] The reported incidence of DDH varies from 188 per 1000 in Canadian Indians to0.1 per 1000 in Hong Kong, and 0 in African natives.[3]

Effective risk factors in DDH are: breech presentation, first delivery, positive family history, female gender, oligohydramnios, cesarean section, torticollis, talipes equinovarus, generalized laxity, low birth weight (< 2500 g), prematurity (before 37 weeks) and use of swaddling.[3] Among these, breech presentation was found to be one of the most important.[21] Although only 2-3% of all babies are born in breech presentation, the rate is 16- 25% for patients with DDH.[18] The American Academy of Pediatrics (AAP) now recommends ultrasound DDH screening of all female breech babies.[16]

DDH is one of the congenital anomalies in newborns that if not diagnosed and treated on time can lead to a severe disability.[3] Early diagnosis leads to a more successful outcome.[19] Clinical diagnostic tests complement ultrasound imaging in allowing diagnosis, classification and monitoring of this condition.[9]

Ultrasonography (USG) is the diagnostic modality of choice for DDH before the appearance of the femoral head ossific nucleus (4- 6 mos)[18] It is accepted in a large number of countries as a method of examination of high risk newborns, or as a method of systematic screening.[20]

The treatment of DDH has undergone significant evolution, but the current gold standard is still the Pavlik harness. Surgical treatment for DDH comprises open reduction alongside a combination of femoral or pelvic osteotomies.[9]

Aims:

1. Screening for DDH in neonates with breech presentation.
2. Evaluating the effectiveness of ultrasound use in diagnosis of DDH.

Subjects and methods:

The current study was conducted on 268 neonates (123 Male, 145 Female) who were born in Obstetrics and Gynecology Hospital of Ain Shams University. Our population was breech- presented neonates born (from March 2013- February 2014) with gestational age ranging between term and near term (≥ 35 wks gestational age). Our study was a cross- sectional study in phase I and a prospective study in its phase II, for early detection of DDH.

The exclusion criteria were as follow:

- Neonates with multiple congenital anomalies including musculoskeletal disorders like arthrogryposis, teratological hip dysplasia, neural tube defects.
- Preterm neonates less than 35 weeks gestational age.
- Parental discontent of participation in the study.

Ethical Aspect: Verbal consent was obtained from parents of the patients upon whom examination was done after explanation of the aim of the study.

Methods And Procedures:

All the included neonates, on the 1st week of life, were subjected to:

1. Full history taking to identify risk factors of DDH.
2. Thorough clinical examination to detect any associated congenital anomaly and laying stress on lower limb as regard asymmetry of the skin folds, limited abduction and limb length discrepancy.
3. Bilateral clinical hip examination using the Ortolani's and Barlow's tests for hip instability or dislocation.
4. Bilateral hip ultrasonographic examination using a high frequency linear array transducer 8 megahertz via general electric (logic 3) machine, the examination was done via two ultrasound methods (static and dynamic techniques) and then classifying the patients according to Graf's classification into 4 types depending on alpha and beta angles.[8]
5. Babies with detected abnormality either by clinical and/or by ultrasound examination came back at 6 weeks of age for re- examination.
6. Babies who were diagnosed as pathological from the start and those with persistent abnormal examination whether clinical and/or ultrasonographic were referred to the orthopedic surgeon for his evaluation and the appropriate required intervention.

Results:

A total of 268 neonates were included in this study, 123 (45.9%) were males and 145 (54.1%) were females. The mean gestational age was 37 weeks (range 35- 41 wk), the mean neonatal weight was 2.6 kg (range 1.7- 4.6 kg). With an average age of initial examination and screening ultrasound of 3 days. The overall final incidence of the disease by ultrasonographic screening was 3% (8 cases), 2 of them (25%) had bilateral DDH, 5 (62.5%) had left- side DDH and one case only (12.5%) had right- side DDH. By gender, frequencies were 1.6% for males and 4.1% for females; the male to female ratio was 1:3.

Out of our included 268 patients, 21 cases (7.8%) had degrees of instability on the clinical examination (had an Ortolani- and/or Barlow- positive hips) or had abnormal clinical findings. Therefore, clinical examination of 247 newborns (92.2%) was normal, of these normal neonates by clinical examination sonographic abnormalities were found in 36 (14.5%). Out of the 21 cases defined as pathological according to the clinical examination, only 15 (71%) were defined as pathological according to ultrasonography and 6 cases (29%) had normal findings.

Clinical examinations versus ultrasonography in terms of numbers defined as normal or pathologic are shown in Table 1.

Table (1) The numbers of hips defined as normal or pathological on clinical examination versus ultrasonography.

	Ultrasonography Normal	Ultrasonography Pathological	Total
Clinical Exam. Normal	211	36	247
Clinical Exam. Pathological	6	15	21
Total	217	51	268

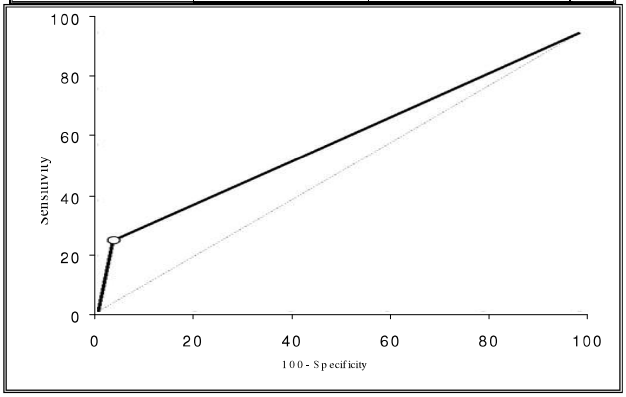

Figure (1) Sensitivity and Specificity of Clinical Examination in the prediction of 1st ultrasound screening results

AUC	Sensitivity	Specificity	+Pv	- Pv
61.3	25.64	96.89	66.7	84.3

Considering ultrasonography as a gold standard method in evaluating DDH, the sensitivity and specificity of clinical examination were determined 25.6% and 96.8%, respectively Figure (1).

From the 268 studied population there were 217 cases (81%) had normal initial screening ultrasound and 51 cases (19%) had abnormal initial ultrasound out of these 51 cases 3 (1.1%) were pathological from the start (referred to pediatric orthopedic) and 48 (17.9%) for follow up (Table 2).

Table (2) 1st USG screening results

Normal	217	81.0%
Abnormal For FU	48	17.9%
Pathological From The Start	3	1.1%

Out of the 51 cases showed abnormal initial USG examination, there were 3 cases that showed gross instability (one was grade IV and 2 were grade III). All of them were females and all underwent treatment with Pavlik harnesses. An additional 48 cases (18%) showed immaturity or laxity (Graf type IIa) on initial USG, but the majority of them (77%) became normal at the subsequent USG at the age of 6 weeks. Only 5 cases out of them (10.5%) remained dysplastic and underwent treatment. Sex cases out of these 48 cases (12.5%) were lost from the follow up. No cases need surgical intervention Table (3).

Table (3) 2nd USG screening results

Type Ia, Ib	217	81.0%
Type Iia	37	13.8%
Type Iib	4	1.5%
Type Iic	1	0.4%
Type III	2	0.8%
Type IV	1	0.4%
Lost In FU	6	2.2%

The distribution of the 268 USG evaluated cases according to Graf classification was as follows: type I (normal hip) 217 (81%), type IIa (physiologic immaturity) 37 (13.8%), type IIb (acetabular dysplasia) 4 (1.5%), type IIc (critical zone) one (0.4%), type III (mildly dislocation) 2 (0.8%) and type IV (dislocated) one (0.4%). 6 cases (2.2%) showed initial abnormal USG (type IIa) were lost from the follow up by 2nd USG and are excluded from the further results (Table 4).

Table (4) Distribution of hips by Graf type and gender

Graf Type	Ia- B	IIa	IIb	IIc	III	IV
Male	100	17	1	1	0	0
Female	117	20	3	0	2	1
Total	217	37	4	1	2	1

Among the possible risk factors significantly associated with DDH Oligohydramnios was the only risk factor significantly associated with DDH Table (5). The frequency of the disease was highest in female gender (Male: Female was 1: 3) but was not statistically significantly associated with it.

Table (5) Effect of the amount of amniotic fluid on occurrence of DDH

Oligohyd.	DDH Group		Normal Group		Chi- Square Test	
	No.	%	No.	%	X^2	P- Value
Positive	1	12.5%	4	1.6%	4.945	0.026
Negative	7	87.5%	250	98.4%		

This table showed there is significant relation between oligohydramnios and occurrence of DDH.

Discussion:

DDH is one of the congenital anomalies in newborns that if not diagnosed and treated on time can lead to a severe disability.[3] Ultrasonography is the diagnostic modality of choice for DDH before the appearance of the femoral head ossific nucleus (4- 6 mos).[17] The importance of newborn hip screening has been universally accepted, but there is still no strong evidence regarding the superiority of either universal (screening of all newborns) or selective (screening of high- risk newborns) ultrasonographic newborn hip screening programmes[14] Hence, the present study was designed aiming at selective screening for DDH in neonates with breech presentation and evaluating the effectiveness of ultrasound use in diagnosis of DDH.

A hip joint becomes ultrasonographically mature at 34 weeks of gestation[14] so as regard gestational age we included 2 groups in our study: Near- term neonates (35- 37 wks) and full term (37wks) and excluded preterm less than 35 weeks.

In this study we preferred to combine both static and dynamic techniques in our USG examination as dynamic tests alone may fail to detect stable hips with acetabular dysplasia. Our protocol for pediatric hip US adheres to the American College of Radiology (ACR) guidelines 2013 that combine the static method of Graf and the dynamic method of Harcke. A landmark study by Graf indicated that static and dynamic images should be used in conjunction.[8]

In our study the overall incidence of the DDH in breech neonates was 3%. This is concordant with the result of the study of Matrawy and Nouh 2014 carried out in Egypt at Alexandria University and reported an incidence 2.8% to have different grades of dysplastic hips after ultrasound screening. They included Egyptian neonates with risk factors for DDH (positive family history, breech presentation and inconclusive clinical examination) but our study was confined only to breech neonates.

Breech presentation is a well- known risk factor for DDH, and rates in the literature vary based on the definition of dysplasia and the method of its determination.[10] DDH occurs more frequently in breech presentations, reportedly in as many as 23%.[2] However, in a German study done by Partenheimer et.al., 2006 they found that there was no correlation between intrauterine presentation and sonographic hip instability. Holen et.al., 1996 reported a 9.8% incidence of neonatal hip instability in breech patients.

Finally we can conclude that the incidence of DDH is related to different ethnic groups, geographical and cultural factors.

In this study, we identified 247 newborns (92.2%) with the risk factor of breech presentation and normal clinical examination; 36 cases (14.5%) of these clinically normal neonates had abnormal initial screening ultrasounds Table(1).

This result is higher than that of Holen et.al. 1996 who reported that 3.7% of their included cases had normal clinical examinations, but abnormal dynamic ultrasounds. Yet it is lesser than that reported by Imrie et.al., 2010 who identified 27% of their 266 included breech presented cases and had normal clinical examination to have abnormal screening ultrasound. This wide range of difference can be attributed to the subjective nature of the clinical examination and the wide variation of its result according to the personal experience.

Considering ultrasonography as a gold standard method in evaluating DDH, the sensitivity and specificity of clinical examination in our study were determined 25.6% and 96.8%, respectively Table (1) figure (1).

These are similar to some of the studies but different from others. It is concordant with the study of Arti et.al., 2013 who reported sensitivity 28.1% and specificity 94.5%. Sewell and Estwood 2011 reported specificity >99% and sensitivity 60%. A. A. P. 2000 stated that the sensitivity of clinical examination

was 60% and its specificity was 90%. The reason of the difference is the relatively large sample size of some studies because small sample size leads to change in sensitivity and specificity. Besides the experience of the examiner and sonographer has an essential role in making difference.[13]

In our study the results of clinical hip examinations and ultrasonographic reports were similar in 84.3% (226 cases) and different ultrasonographic results in (36 cases) 13.4% of neonates with normal hips according to clinical examination were reported. Also, in 2.2% of cases (6 cases) with pathological hips based on reports of clinical examination, normal ultrasonographic reports were mentioned.

The reasons of this discrepancy between clinical and USG examination results may be as follows: The structure of the hip in the early birth time is still immature (not fully developed) so that the soft tissue and capsular laxity around the hip and immature hip can naturally be existed in the first few days to weeks and this immature laxity of hip although not so considerable to make usual clinical tests positive, can be detectable on the ultrasonographic examinations.[3] Dogruel et.al., 2008 suggested that possible reasons for this difference include the need for experience and a relaxed infant, the clinical diagnosis of an unstable hip in a newborn can be difficult to make even in skilled hands.

When studying the relation between DDH and the studied variables (sex, gestational age, birth weight, pregnancy status, order of birth, mode of delivery, oligohydramnios, family history and postural molding condition), non significant results were obtained except with oligohydramnios. This is going with Charles, 2006 who reported that most cases of DDH are not associated with risk factors. Also Sewell and Eastwood 2011 stated that risk factors are not always a good predictor of DDH. Dogruel et.al., 2008 studied many patient characteristics as possible risk factors for DDH; however, they did not find any of them to be significantly associated with DDH in the infants in their series. Moreover, one prospective study showed only one in 75 infants with a risk factor had a dislocated hip (Paton et.al., 1999).

This study revealed statistically significant relation between oligohydramnios and DDH, $P< 0.05$ (Table 5). This is consistent with Akman et.al., 2007 who reported that according to risk factor analysis, the only risk factor in unilateral analysis was presence of oligohydramnios. According to their study the most important risk factor for DDH was oligohydramnios.

The results of our study showed that 6 of the 8 patients who had DDH (75%) were females and 2 were males (25%), though this had no statistical significance but yet DDH frequency was much higher in females than in males. Also the 3 cases diagnosed as pathological from the initial USG were females. This goes with Sankar et.al., 2015 who reported that DDH is more common among female patients (80%). The AAP 2000 reported that the incidence of DDH is higher in girls; androgens present in male infants provide some protection against the maternal hormone relaxin, which may contribute to increased joint laxity in the neonatal period with the resultant instability of the hip.

In our study According to the results of the neonatal ultrasound screening examination, 81% of the subjects examined could be described as normal (had a type I hip) and 13.8% had a type IIa hip (unilateral or bilateral) which inevitably required a repeat sonography (Table 3). Our figure does not differ significantly from those reported in the literature. Yau et.al., 2012 reported 82% of their screened breech neonates as type I and 18% as type IIa. Blom et.al., 2005 found 10- 20% of their studied newborns to have type IIa"physiological immature" hips. Also Akman et.al., 2007 demonstrated Physiological immaturity in 19% of their studied babies.

In this study we preferred to do initial ultrasonographic screening on the 1st 3 days of life and to do follow up for those with type IIa at six weeks of age. This agrees with Gulati et.al., 2013 who performed USG screening study in the first week of life while Dogruel et.al., 2008 performed their study in infants who are four to six weeks of age.

In this study on revaluation by USG at 6 weeks, 10.5% (5 cases) out of those who had initial abnormal ultrasound and were candidate for follow up (48 cases) were still abnormal. This is consistent with Bialik et.al.. , 1999 who stated that only 10% of hips found to have abnormal ultrasound at 1 to 3 days of life remained abnormal at 6 weeks.

Conclusion:

On the basis of our data and relevant literature and taking into consideration all the possible conditions related to DDH, we can conclude that the incidence of DDH in breech presented neonates is variable and clinical examination does not reliably detect ultrasonographically defined DDH in infants being screened for this disease, so routine screening should be done with clinical examination and with US to all of them because early intervention is better and cheaper with less complication.

Recommendations:

Routine ultrasonographic examination should be done to all breech presented neonates at the age of two weeks. All the neonates suspicious on clinical examination or with risk factors should be reexamined by USG for DDH. Clinical and ultrasonographic examination should be conducted with those who are highly trained and qualified. All neonatologists should know how to perform hip clinical examination efficiently and they should know the importance of such screening. An extended multicentric study is needed to detect the incidence of DDH in breech presented Egyptian neonates with extended follow up.

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