Epidemiology, Clinical Screening and early Management of Developmental Dysplasia of the Hip in Sulaimani City Center

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ABSTRACT

Background and Objectives: there is no screening program in our area, no reliable data on incidence, associated risk factors and effects of early management of DDH, and after 30 years of entering ultrasound in the management of DDH, still plain radiographs are in use. to observe effectiveness of early diagnosis and treatment of DDH using clinical screening and ultrasound-based management system. cross-sectional observational study

Methods: 1521 neonates in their first week of age attended the birth office for vaccination from 1st June to 31st July 2009, Ortolani and Barlow method used for clinical screening followed by filling a questionnaire to evaluate risk factor association. Ultrasound used for classification of hips (using Graf's method) followed by treatment in the first three months of age using Pavlik harness splint as a treatment method.

Results: 65.8 per 1000 live birth have DDH, twice common in female, 50% bilateral, ultrasound in the first week shows values of (0, 109, 20, and 3) and at 3 months (124, 5, 3, and 0) values for Graf(I,IIa,IIc&D,III&IV) respectively. Treatment rate with Pavlik harness splint were 17.5% with success rate of 82.5% without open reductions of the hip, finally to have 97.8% normal hips (Graf I) at the end of this study with treatment.

Conclusions: In DDH, early diagnosis and treatment through clinical screening and ultrasound-based management is effective

Key words: Epidemiology, early Management ,.Dysplasia

INTRODUCTION:

Developmental dysplasia of the hip (DDH) describes a spectrum of disease ranging from minor acetabular dysplasia to irreducible dislocation and may lead to premature arthritis in later life[1]. The aim of this study is to show effects of early diagnosis and management of DDH within the first three months, through reviewing the effectiveness of clinical screening and ultrasound-based early treatment. We went through the steps by examination of neonates for DDH, measuring the significance of risk factors, ultrasound classification and treatment with non invasive measures to see the outcome. Developmental dysplasia of the hip (DDH) varying severity, from dislocated, dislocatable, or subluxatable hips to stable or clicky hips with radiological or ultrasound evidence of acetabular dysplasia[2]. The term ‘‘developmental dysplasia of the hip’’ (DDH) first appeared in the title of an article (as listed in PubMed) only in1992, although the concepts were described throughout the 70s, perhaps earliest in an article by Ruth Wynne-Davies. Massie noted that no dislocation of the hip could occur embryologically, because the joint is not developed, and rather the pelvis and femoral anlagen are one[3]. DDH represents one of the most important and most challenging abnormalities of the musculoskeletal system. Since its

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is still not being recognized sufficiently early throughout the world, and may even escape detection until after the child has started to walk. Under these circumstances, treatment becomes progressively more difficult and the results become less satisfactory. Furthermore, DDH, unless treated early and skillfully, leads inevitably to degenerative arthritis of the hip in adult life[4]. Prevalence of the clinical condition has been reported to vary from 0.8 to 1.6 per 1000 births in populations not screened at neonatal period, but with high rates of 10 to 100 per 1000 births among ethnic communities, where infants are traditionally cradled or clothed with their hips extended and adducted; in screened populations, rates of 2.5 to 20 per 1000 births have been reported, but reach 40–90 per 1000 births in some communities. Differences in reported prevalence may be due to genetic differences and differences in clinical skills and methods used in detection as well as definition of the condition[2,5]. A study of the geographical and racial incidence suggests that one of the environmental influences that may be significant in the etiology of the initial dislocation is the position in which the hips of newborn infants are maintained during the early months of postnatal growth and development. Among those races in which the hips of newborn infants are commonly held in flexion and abduction, the incidence of congenital dislocation of the hip is remarkably low. Low incidence groups are the Negroes of Central and South Africa, the Chinese of Hong Kong and the Eskimos of Northern Canada.9 These observations suggest that a developmentally unstable and dislocatable hip, which has been maintained in the position of flexion and abduction during intrauterine life, is "protected" by the postnatal position of flexion and abduction and made worse by the postnatal position of extension and adduction.12,8 Approximately 10% of unstable hips will persist to show classic signs of dislocation in infant life while a further 10% are likely to

Barlow tests are widely used in clinical screening for DDH. This method of examination is of particular value in the neonatal period up to the age of three months[6]. DDH is an example of a disease for which screening has been routine since the early 1960s. Currently, screening is a very topical and popular concept, and hardly a week goes by without a call for screening in yet another disease. Many of these are surgical diseases and surgeons have to decide whether or not the diseases are suitable for screening[8]. Three screening strategies were identified. In a "*clinical screening alone" strategy*" all infants are screened with the Ortolani and Barlow tests whereby the examiner attempts to reduce a dislocated hip and provoke dislocation or subluxation respectively. Infants in whom one or both hips are dislocated, subluxated, or unstable are referred for further clinical, but not sonographic, assessment. In a "*universal ultrasound strategy*" all infants receive a static and dynamic ultrasound examination in addition to clinical screening; those with sonographic appearances of dislocation or instability and/or a positive Ortolani or Barlow test are referred for further clinical and sonographic assessment. In a "*selective ultrasound strategy*" all infants are screened clinically and assessed for the presence of recognized risk factors: those with a positive Ortolani and/or Barlow test and/or recognized risk factors are referred for sonographic assessment. Thus, in this strategy ultrasound is not used as a primary screening test[9]. Ultrasonography is a noninvasive method for adequate visualization of the cartilaginous hip joint. Diagnosis has been defined by (static) morphologic testing and by (dynamic) assessment of stability of the femoral head in the acetabulum. Graf's standardized morphology criteria are widely used. No standard criteria for the dynamic assessment of joint stability exist, but the infant is usually examined in the lateral position with a Barlow manoeuvre. The

operator dependent. Graf, the pioneer in hip ultrasonography , introduced a method of classifying infant hips based on the depth and shape of the acetabulum as seen on coronal ultrasonograms , *In the Graf 's classification*:- A *type I* hip is considered normal (centered), and developmental dysplasia is ruled out, this means that the degree of ossification is appropriate for a hip joint in a 3-month-old, the cartilaginous acetabular roof encloses the femoral head holding it firmly in the socket (the cartilage covers the head).A type I hip joint may present at birth when there may even be an ultrasonically demonstrable femoral head ossific nucleus. The *type II* hip, which has a slightly shallow acetabular cup and a rounded rim with the femoral head in normal position, and the hip is centered is considered to be developmentally immature in infants less than three months of age, It is possible that these type II hips represent Hunter's concept of predisposition to disease or "susceptibility of impression" . In infants older than three months, a type II hip is considered abnormal and should be treated. Type II hips further divided to a, b, c and D when a, b, c can only be determined by measurement and type D is the first stage of the decentred joint.

A *type III* hip and *type IV* hip is dislocated (decentred), in type III the cartilaginous acetabular roof displaced upward, while pushed downwards by the displaced femoral head in type IV joints[8, 10, 11]. The Pavlik harness is a non-rigid structure made up of a body piece, held in position by two shoulder straps and two leg pieces with anterior and posterior restraining straps. It is by means of these leg straps that the legs can be correctly positioned. The anterior straps hold the hips in flexion, while the posterior straps are used to give the required limitation of adduction; both are easily adjustable. The degree of flexion of the hip is that amount required to point the capital femoral epiphysis at or just below the triradiate cartilage; the amount of flexion is also governed by the age of the sufficient, but in the older child, flexion of the hip to 120 degree or more may be needed to achieve the desired alignment, which should be confirmed radiologically[12]. Among the principles of ultrasound-Based management system for DDH, a decentred hip joints (type IV, III, IID) needs an initial stage of preparation and three stages of treatment .the *preparation stage* directed toward loosening of adductor contractures through traction and adductor tenotomy followed by *stage of reduction* that can be done manually, through traction or by the meaning of an abduction device (e.g. Pavlik Harness).In the *stage of retention*, all hip joints which have been reduced and all unstable joints (such as type IIc unstable), must be subjected to any retention device that fulfils flexion of at least 90 degrees, maximum abduction of 45 degrees and relative immobilization for at least 4 weeks such as a properly applied Pavlik Harness .finally in *maturation stage*, all joints have completed retention and turned into stable joints as well as type IIb,IIc requires a maturation device until they are completely healed ,simply Pavlik harness will do it[10] .

MATERIALS & METHODS:

The study was conducted out in SULAIMANIA city center, placed at BIRTH OFFICE-department of registration and vaccination. All neonates aged five days - one week brought to this center by their parents for routine first dose vaccinations and birth registration card. The study involved 1521 neonates, delivered subsequently from 1st June to 30th July 2009 ,after exclusion of those newborns with evidences of paralytic and teratological hip dislocations, a questionnaire filled by the examiner including details of the history and risk factors followed by registering the results of clinical screening tests on each individual hips separately (3042 hips). Clinical screening involved examination of each hip by Ortolani and Barlow maneuvers (the examiner have experience

surgeon include working in the child rehabilitation center), The examiner's hands was warm, the examination gentle, and the baby relaxed, the infant lies on his/ her back with legs towards the examiner and the hips adducted and fully flexed, then hips may be tested for instability one at a time or simultaneously. For examination of the left hip the examiner steadies the infant's pelvis between the thumb of his left hand on the symphysis pubis and the fingers under the sacrum. The upper thigh of the left leg is grasped by the examiner's right hand with the middle digit over the greater trochanter, with the flexed leg held in the palm, and with the thumb on the inner side of the thigh opposite the lesser trochanter. An attempt is now made to move the femoral head in turn gently forwards into, and backwards out of, the acetabulum. In the first part of the maneuver the middle digit is pressed upon the greater trochanter in an attempt to relocate a posteriorly displaced head of the femur forwards into the acetabulum. If the head is felt to move (usually not more than 0.5cm) with or without a palpable and/or audible 'clunk', then dislocation is present. The second part of the maneuver tests for subluxation (dislocatability). With the thumb on the inner side of the thigh, backward pressure is applied to the head of the femur. If the latter is felt to move backwards over the labrum (the fibro-cartilaginous rim of the acetabulum) onto the posterior aspect of the joint capsule (again a movement of not more than 0.5 cm and often accompanied by a 'clunk'), then the hip is said to be subluxatable (dislocatable). To examine the right hip, the role of the examiner's hands is reversed. Positive tests regarded as abnormal. Serial sessions of clinical examination and ultrasound scanning of the hips done in the 1st week, 3rd week, 2nd month, 3rd month respectively. Together , tailored treatments according to the sonographic classification using Graf's method, done for all cases Type I and IIa hips treated only with triple diapers, type IIc and D with Pavlik Harness, with traction, adductor tenotomy (if needed)and then Pavlik harness splint. Type III and IV regarded as a single group (both are decentred and dislocated). figure.1. Statistical analysis done using SPSS (16.0) software and chi-square test done, *P*.value taken to show the significance relations of risk factor variables with the disease(values of $p< 0.05$ regarded as significant)

Figure1: ulrasound scanning of the left hip: - baby incorporated in a cradle with the hip joint flexed. This photo has been taken after permission of the parents.

RESULT:

Among the total number of neonates examined (1521), results shown that 99 having clinical screening examination positive (suspected DDH cases) and 33 were bilaterally positive, 93 in left hip and 39 in right. out of (3042) hips ,only 132 of them was positive, means that the incidence of screened positive neonates among the population size of (1000) is 68.08 newborns (6.5%), while 43.39 hips are positive per 1000 hip joints examined (Figure2). All 99 patients were attending the treatment and follow up visits (100% attendance).Results shown that in the initial examination of newborns within the first week of life by Ortolani and Barlow tests 132 hips were suspected having DDH, subsequent examinations

reported 120, 16, 6 in the 3rd week, 2nd month and 3rd months respectively. Ultrasound scanning of the positive hips shows 129 hips with Graf II in the initial scanning (109 Graf IIa and 20 Graf IIc&D), only 3 hips with Graf III and no hips lie in the Graf I … further follow up shows increase Graf I as 15,108, 124 in the 3rd week, 2nd month, 3rd months respectively, followed by a similar decline in Graf (IIa\c&D) as (94\ 20), (8\13) and (5\ 3) in the 3rd week, 2nd month, 3rd months Graf III scanning results remained as such in the 3rd week, 2nd months and then disappeared from the results (Figure.3.4.5.6.7.8). Initially ,all newborns having DDH treated with triple napkins, while Pavlik Harness applied in 17 ,20 ,20 cases in the 3rd week,2nd month,3rd months and adductor tenotomy followed by Pavlik harness in 3 cases in the 2nd month . Traction used in 6 cases in the 3rd week follows up time.(Figure.9).

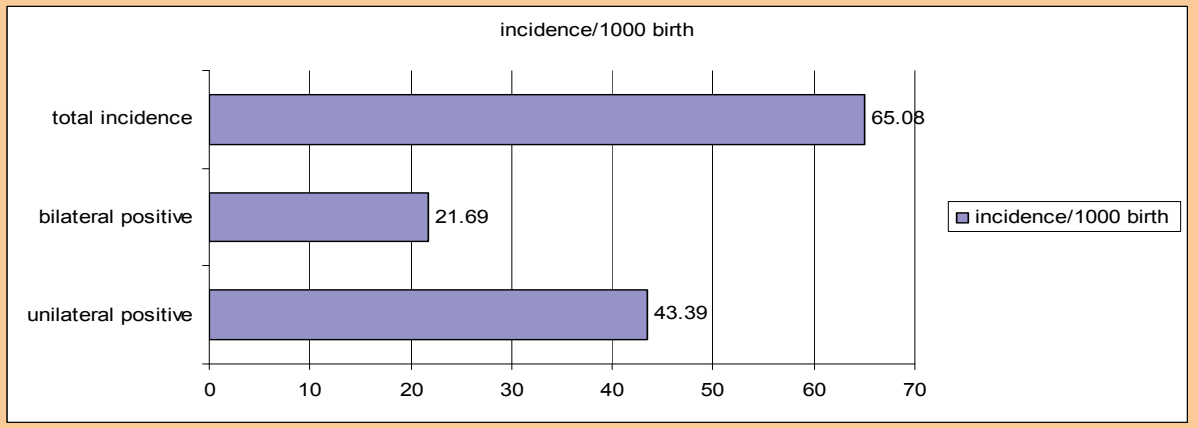

Figure2: incidence of DDH per 1000 live birth.

Table 1: Risk factors for DDH were numerous, but not preterm and differences in ethnicity

Risk factors	P.value
Sex (female)	=0.000
Breech position	= 0.000
Caesarian delivery	= 0.018
First baby	=000
Family history of DDH	=0.000
Swaddling	= 0.017
Asymmetrical skin creases	=0.000
Preterm (<37 weeks)	= 0.946
Different Ethnicity	**=** *0.167*

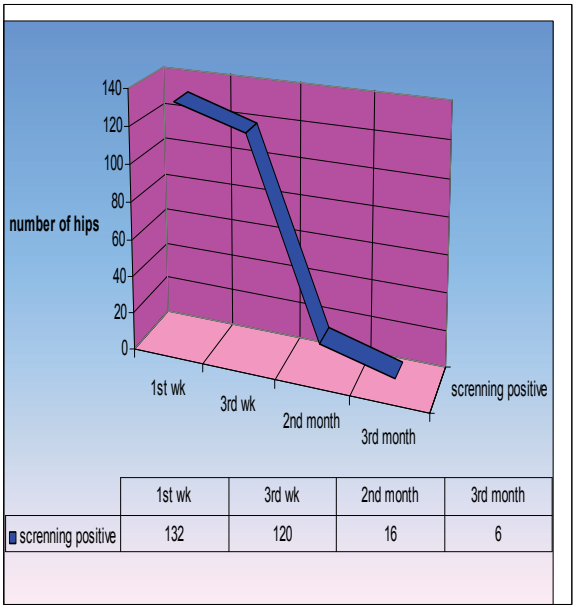

Figure 3: Results of serial clinical examinations of the hip

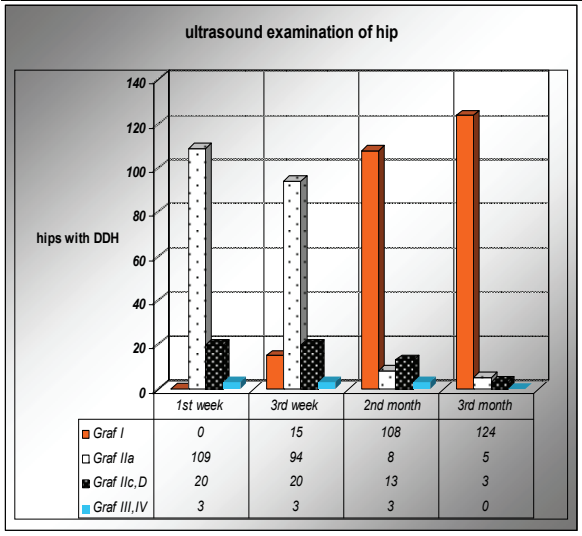

Figure4: results of serial ultrasonography of the hip

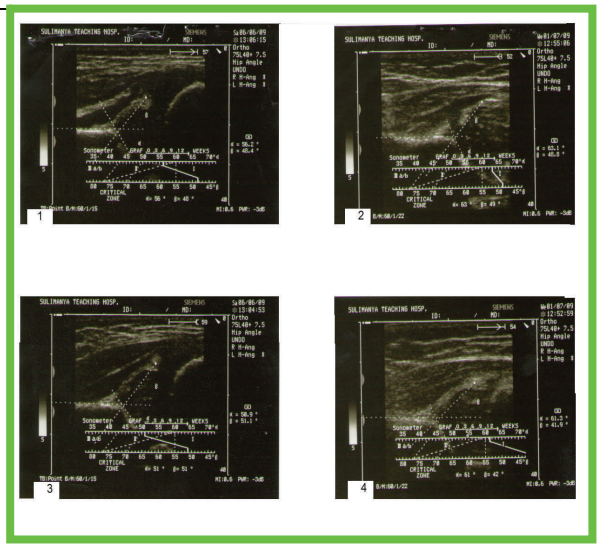

Figure 5: ultrasound of the hip shows bilateral Graf IIa at first week of age (1 and 3) changed to Graf I bilaterally (2 and 4) without treatment (only triple napkins) after three weeks indicating physiological immaturity.

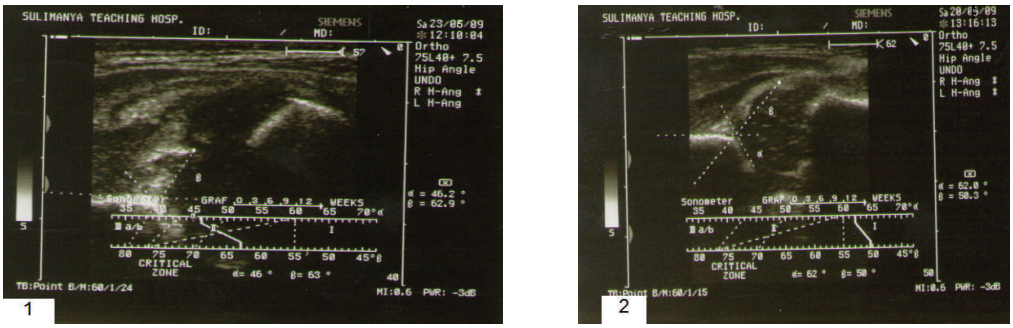

Figure6: ultrasound of left hip in a female baby with bilateral DDH, Graf IIc (1) treated with Pavlik harness, changed after three months to Graf I (2).

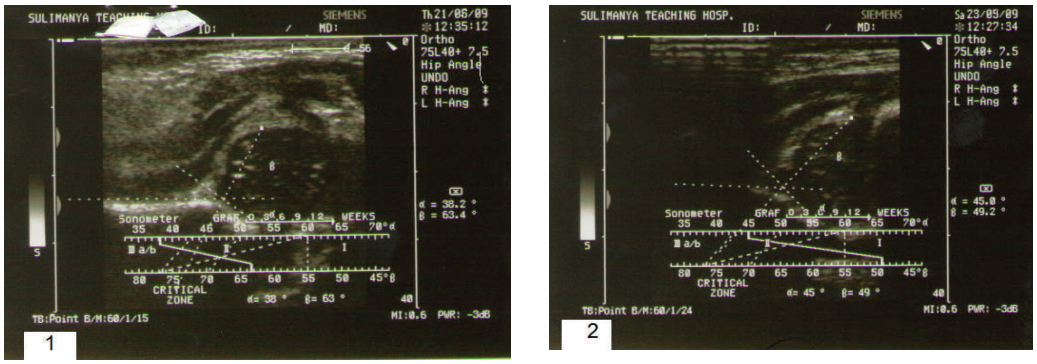

Figure7: ultrasound of the left hip joint shows decentred hip Graf III (1), however treated with traction, adductor tenotomy and subsequent Pavlik harness becomes centred(Graf IIc), still need treatment

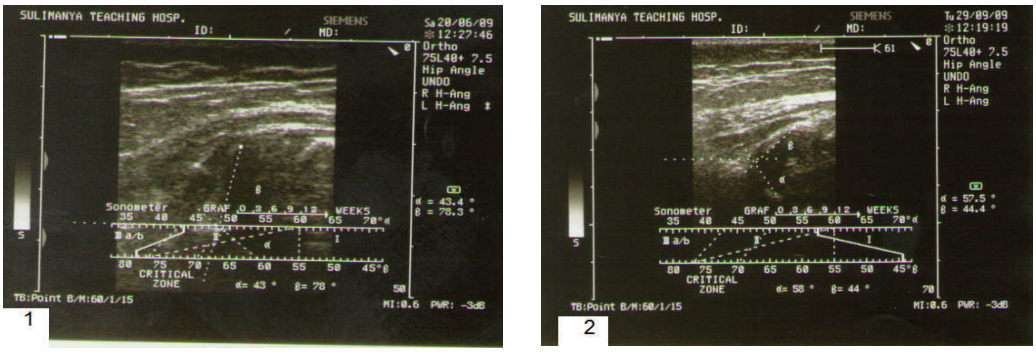

Figure8: Ultrasound of the left hip joint shows the decentred hip Graf D (1), but normalized to Graf I (2) after three month's treatment with Pavlik harness.

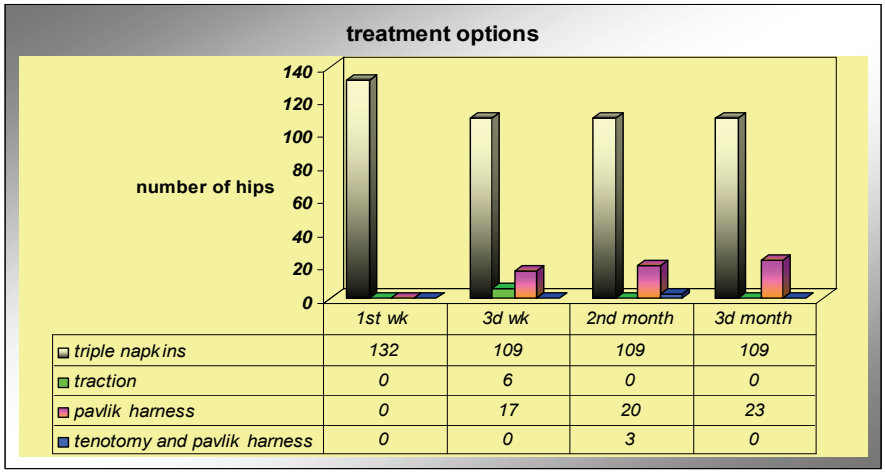

Figure 9: results of treatment

DISCUSSION:

We used clinical examination using Ortolani and Barlow tests for each hip joint, as a diagnostic sign for DDH as it is well known, widely accepted and when the Ortolani and Barlow tests are combined, they show high specificity (0.98-0.99) in the diagnosis of DDH [13, 14, 15]. In our study, an incidence of 68.08 per 1000 live birth (6.5%) was found for the screened population comparing to 4.1 to 168 cases per 1000 live births (0.41% to16.8%) in most of literatures after introduction of routine clinical screening program.[4] if we calculate each hips as separate, the incidence will be 43.39 per 1000 hips (4.33%) with positive screening comparing to (4.51%) in other series.[4] In other studies, screened cases within first week were 5-20, 5-10, 40-90and 18.4 cases per 1000 live births, respectively .[14,16,2,13]. Among the positive hips in our study, 50% were bilateral, 45% involved only the left hip and 5% in the right side alone, comparing to results of 39%, 47% and 14% in a similar study done in Newcastle respectively.[17]. such a high bilateral involvement (more than 50%) were observed in a study done by Mackenzie.[18] DDH considered a multifactorial disease in which both environmental and genetic factors play a role.[11] Many risk factors have been identified with DDH, and it's suggested that they operate either through increasing pressure on the fetus or through decreasing resistance to dislocation.[2] In this study we found female gender, breech

caesarian delivery, first born baby, family history, prematurity, swaddling and asymmetrical skin creases as a positive risk factor for occurrence of DDH. In this study, we used ultrasound examination for hip joints having DDH on clinical screening examination; each hip joint have been examined four times (in place of plain radiographs practiced in our country), because it's a safe, non invasive method of imaging that can be used for both diagnosis and monitoring treatment, giving information on hip position, stability, and morphology and can distinguish the cartilaginous components of acetabulum and the femoral head from the rest of soft tissues [19,10]. added to that radiographs are indicated when DDH is suspected at an age more than three months (beyond the age limit of this study) and when diagnosed, successful treatment with Pavlik harness will become difficult beyond that age [11]. furthermore normal findings on plain radiograph do not exclude the possibility that films of dislocatable hips was taken in the reduced position and ultrasound can be used to resolve the dilemma of weather to treat an unstable hip with a splint immediately or to delay treatment in the hope that the instability or the maturation deficit will resolve spontaneously [18,19]. We found this fact obviously in our study as most of DDH cases found by clinical examination were classified as Graf IIa and were normalized only with triple diapering without further intervention. The static technique proposed by Graf were selected emphasizes morphology and classifies the status of the hip on the basis of angular measurements of the acetabulum, it is easy to be learned and results of measurement will not affected by position of the baby in the cradle while dynamic approach consists of multi positional evaluation that resembles physical examination and more operator dependant [10.11]. We classified the hip joints after ultrasound scanning according to Graf's method and treated according to ultrasound based management system.10 ultrasound results (Graf II and above), means that ultrasonography is 100% sensitive for the screened population compared to 100% and 97% in two other series respectively [20, 21]. But we could not assess hips that were positive on ultrasound but negative on clinical screening, because we depended on clinical phenomenon for diagnosis, but it's mentioned that ultrasound will detect abnormalities not found on clinical examination[19]. We found that 82% of those hips screened positive were lies in the Graf IIa or physiological immature hips (alpha angle =50-59) which is compatible with a series 76% observed by H. Dogruel on 2007.18toward the second month without treatment only one hip remained 0.75% compared to 1.7% by the same author, others normalized to Graf I ,this will reflects true physiological immaturity stated in most of literatures, while the single cases was a male with right side DDH underwent treatment of Graf IIc. Still in the 2nd month, 8 hips having Graf IIa, but there were normal on clinical examination, a fact that is accepted with other series 19, but normalized thereafter. In the results, we have had three female patients with bilateral DDH (6 hips), there left hips classified as Graf III or IV (while right sides Graf D), gallows traction used as preparatory stage to relax the adductor tightness after 3rd week, but left side adductor tenotomy added at 2nd month to ensure good reduction followed by Pavlik harness, because non were reducible spontaneously (the same fact observed by E.Peled 2008).[21] At the end of 3rd month, these three hips were remained in the Graf II c while no hips in Graf III and IV. Overall no hips were remained in the decanter groups of Graf (D, III, and IV), the same findings of Malkawi ten years ago[21]. Hips with Graf IIc and D treated with Pavlik harness alone, wearing 24 hours and monitored each week for adjustment, Pavlik applied as soon in the 3rd weeks to maintain the hips in 90-100 degrees of flexion and 30-60 degrees of abduction

mentioned in other series and 0% chance of avascular necrosis of femoral head) 20,33,however another study in Jordan giving the mean two months time for treatment.26 After two months treatment with Pavlik harness, out of 13 hips, no one remained with Graf II c or D, only 5 still remained with Graf IIa .these were compatible with same outcomes in other series[13]. Treatment rate with Pavlik harness were 17.5% for all hips screened positive and the successful rate after two months use for decentred types (Graf D, III and IV)were 100% and 87% for the rest (Graf IIc), still more assessment needed after three months (beyond this study) to determine weather they will normalize or needs further intervention. But it's obvious that only 2.2% needed adductor tenotomy and 4.5% skin traction and 0% surgical open reduction of hip joint. In a study by P.M.DUNN, adductor tenotomy required in 1.1% of cases and the final results were 99% of hips with DDH treated with Pavlik harness splintage and simple adductor tenotomy were normalized comparing to 97.8% in our study (only three hips remained with Graf IIc) and rate of 85-95% is accepted in most literatures during the early months of life[13].

CONCLUSIONS AND RECOMMENDATIONS

Developmental dysplasia of hip (DDH) is a disorder of abnormal relations between the femoral head and the acetabulum highly resolving by using simple measures if diagnosed and treated early in the neonatal period with very low rate of possible surgical interventions.

1. The incidence of DDH in Sulaimani city is 6.5% of the live births, in which 82% were resolved using triple napkins and prevention of swaddling, while the rest took benefit from early splintage using Pavlik harness splint.
2. Most of the factors like family history, female gender, breech presentation and caesarian section, first child and uses of swaddling are positively related to incidence of DDH.
3. Ultrasound scanning of the hip is a safe and reliable way for imaging hips with dysplasia, both for diagnosis and planning of treatment, using Graf's method for classification and subsequent treatment is successful.
4. Pavlik harness is successful in treatment of DDH in early age.

We recommend more similar studies involving bigger population sizes in other countries of Iraq both to confirm the incidence and to detect differences in different ethnicities and communities, as we recommend adapting clinical screening program in early neonatal life and finally, using ultrasound for diagnosis and planning treatment in early age .

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