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Original Article

Ultrasound Evaluation of Spinal Cord in Newborns with Sacral Pit

Narges Afzali[1], Abdolreza Malek[2*], Sara Ghahremani[3], Mahboubeh Alipour[4]

1. Department of Radiology, Mashhad Medical Sciences Branch, Islamic Azad University, Mashhad, Iran
2. Assistant Professor of Pediatric Rheumatology, Department of Pediatrics, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
3. Assistant Professor of Pediatrics, Department of Pediatrics, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
4. General Practitioner, Mashhad Medical Sciences Branch, Islamic Azad University, Mashhad, Iran

ABSTRACT

***Background*:** Sacral pit is a shallow or deep dimple in the lower sacral region, with a reported prevalence of 3-5% among newborns. The aim of the present study was to investigate spinal cord abnormalities in newborns with sacral pit via ultrasound examinations.

***Methods*:** In this descriptive study, 3071 infants born at 34-42 weeks of gestation were studied in hospitals affiliated to Islamic Azad University of Mashhad, Iran during 2014-2015. Information including age, sex, and birth weight was recorded in a questionnaire. Infants with a sacral pit underwent ultrasonography; spinal shape and mobility in these infants were compared with their healthy counterparts. For statistical analysis, data were entered to Microsoft Excel software. Chi-square and student's t-test were performed, using SPSS version 20.

***Results*:** Based on the findings, 1.6% of the studied infants were born with a sacral pit. The weight and age were not significantly different between healthy neonates and those with a sacral pit. The prevalence of sacral pit was higher in female cases (54.2%), although there was no significant difference between the genders. Ultrasound examination of the spinal cord revealed its normal position and motility in all newborns with a sacral dimple.

Conclusion: The present results showed the normal shape and motility of the spinal cord in newborns with a sacral pit. Therefore, there was no correlation between sacral pit as a cutaneous marker and neural tube defects.

Keywords: Newborn, Ultrasonography, Sacral pit, Spinal dysraphism

Introduction

Congenital spinal cord abnormalities result from three major disorders in embryologic processes. The first disorder is the premature separation of ectoderm from the neural tube, which leads to the entrapment of mesodermal structures (e.g., fat). The second group of disorders includes defects of neurulation phase causing dysraphism. Anomalies of the filum terminale, such as fibrolipoma and caudal regression syndrome, comprise the final group of malfunctions occurring due to embryonic disorders in caudal cell mass absorption (1).

All infants suffering from intestine or bladder dysfunction, skeletal abnormalities, and progressive neural dysfunction are at risk of spinal dysraphism and tethered spinal cord syndrome. In general, three types of spinal dysraphism can be identified: 1) open dysraphism with a non-skin covered back mass; 2) closed spinal dysraphism with a skin-covered back mass; and 3) occult spinal dysraphism without a back mass. All three types of dysraphism maybe associated with tethered spinal cord syndrome, which refers to the location of conus medullaris below L3 level (2).

The association between tethered spinal cord syndrome and the identified cutaneous markers, such as tuft of hair, subcutaneous lipoma, and hemangioma, is well documented; up to 86.3% of children suffering from occult dysraphism present with these lesions. Nevertheless, these skin markers are reported in 5-7% of normal children, with 74% of these cases presenting as a form of simple sacral pit (3, 4).

* *Corresponding author*: Abdolreza Malek, Department of Pediatrics, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran. Tel: 09153131417; Email: MalekAR@mums.ac.ir

Figure 1. A) Sacral pit, B) skin tag, and C) tuft of hair

A simple midline sacral pit is a dimple with a diameter of less than 5 mm and a distance of less than 2.5 cm from the anus. The dimple has no discharge and is not associated with other cutaneous markers such as tuft of hair or hemangioma (Figures 1A, 1B, & 1C) (3). Overall, there is no consensus regarding the management of sacral pits in newborns with no other abnormalities (5). Although magnetic resonance imaging (MRI) is known as the gold diagnostic standard in spinal imaging of newborns with spina bifida aperta or ulcers with cerebrospinal fluid leak after spinal surgery, recent developments have made ultrasonography a more acceptable diagnostic modality in comparison with MRI.

At present, almost every spinal anomaly can be detected within the first days of life. This can in fact help clinicians determine whether immediate intervention is required for the lesion or MRI can be postponed (6). Today, spinal ultrasonography (SUS) is accepted as the first screening tool for spinal dysraphism in suspected neonates. SUS can be useful for the diagnosis of tumors, arteriovenous malformations, traumas, and other spinal anomalies in neonates less than three months (7).

The diagnostic sensitivity of SUS is similar to that of MRI. However, in contrast to MRI, SUS can be performed without general anesthesia or sedation and can be applied using portable devices. Furthermore, MRI is highly dependent on factors affecting image resolution, e.g., patient movements, physiological movements of cerebrospinal fluid, pulse rate, and vascular flow, which do not affect SUS.

The new generation of high-frequency ultrasonography devices allows imaging with high diagnostic quality in newborns (7). The first three months of life is the ideal period for performing spinal ultrasonography. On the other hand, achieving the same image quality in older patients would be difficult due to the mineralization of posterior spinal processes; in spite of this, SUS can be performed even after six months of birth in case of mineralization delay or spinal defects (8).

Methods

In this study, 3071 infants born in hospitals, affiliated to Islamic Azad University of Mashhad, were evaluated during 2014-2015. The neonates' information, including sex, gestational age, and birth weight, was recorded in a questionnaire. After the primary examination of newborns by a pediatrician, the newborns were referred for SUS examination in case of sacral pit detection.

SUS of all newborns was performed by a single radiologist and the same ultrasound device. Ultrasonography was performed, using Medison V20 ultrasound device (Korea), equipped with a linear multi-frequency probe (7-10 MHZ); ultrasound examination was performed in a warm place. The neonate was placed in the prone position with flexed legs, and the spine was evaluated in both sagittal and axial planes.

Information such as the inferior position of the spinal cord,
natural mobility of spinal cord and filum terminal fibers in the spinal canal, number of sacral vertebrae, and sacral pit skin (for dermalsinus or lipoma) were evaluated and recorded in a questionnaire. The level of spinal cord at canal was determined by descending count from the 12th rib or ascending count from L5-S1 level.

Presence of any physical anomaly or abnormality was the exclusion criterion in the present study. Considering the safety of SUS in terms of ionizing radiation and the associated side-effects, as well as the free performance of this test, the present study was approved by the Ethics Committee of Azad University of Mashhad.

The gathered data were described using

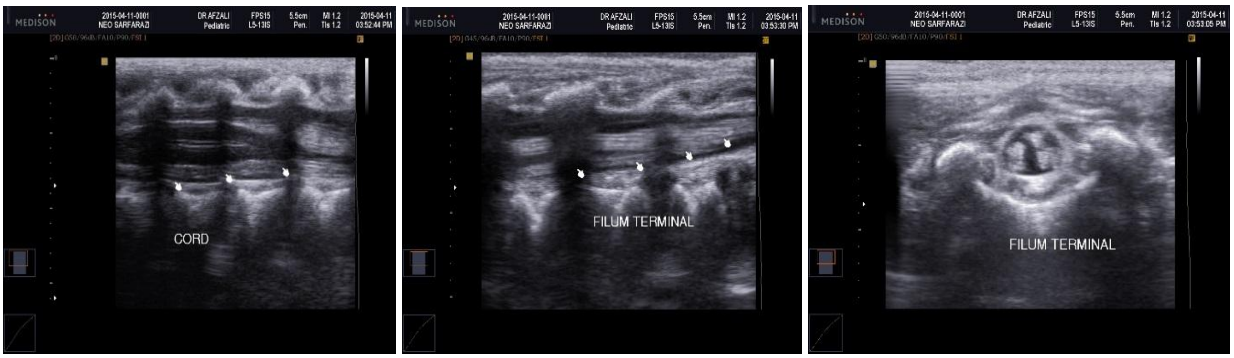

Figure 2. A) Spinal cord ultrasonography in a longitudinal section, B) filum terminal in the longitudinal section, and C) filum terminale in the cross section

statistical tables and indices (e.g., mean). For statistical analysis, the likelihood ratio Chi-square test was used. If more than 20% of the expected table distribution was below five (Cochran's test), Fisher's exact test was performed. Student's t-test was used to compare the mean values. SPSS version 20 was used in this study for data analysis, and P-value less than 0.05 was considered statistically significant (in the results section, * represents P<0.05 and ** indicates P<0.01).

Results

Among 3071 infants studied in this research, 3023 (98.4%) cases did not have any sacral pits, and only 48 (1.6%) cases of sacral pit were detected. The mean weight was 3225.2 and 3221.7 g in healthy newborns and those with a sacral pit, respectively; the difference between the two groups was not statistically significant (P=0.695).

The assessment of gestational age at birth showed no significant difference between the two groups (P=0.523). Gestational age varied from 34 to 42 weeks in healthy newborns (mean= 38 weeks) and from 38 to 41 weeks for newborns with a sacral pit (mean= 38.1 weeks). Among neonates with a sacral pit, 22 (45.8%) cases were male and 26 (54.2%) cases were female; the difference was found to be statistically insignificant (P=0.485).

Tuft of hair (as a regional skin sign) was detected in the examination of 3 (0.1%) healthy newborns, whereas no such sign was found in the remaining 3020 (99.9%) cases. Also, this sign was not detected in 46 (95.8%) newborns with a sacral pit, while it could be found in only 2 (4.2%) cases. Other cutaneous markers, including skin color change in the sacral region (hyper- or hypo-pigmentation), were not visible in any of the newborns. Also, 2 (4.2%) cases of skin bump (lipoma in ultrasound) were detected at the end of the spine; however,the spinal cord was normal in ultrasound exam.

Ultrasound examination revealed the normal position and mobility of the spinal cord and filum terminale fibers in all newborns with sacral pit. The inferior level of the spinal cord was at L1 position in 10 (20.8%) cases with sacral pit and at L1/L2 in 38 (79.2%) newborns. Signs of tethered spinal cord syndrome were visible in none of the newborns with sacral pit (Figures 2 A, B, & C).

Discussion

Sacral pits in newborns, with or without cutaneous markers, are among indications for imaging, which can rule out neural defects and spinal dysraphism. Although MRI is considered as the gold standard imaging technique, recent developments in ultrasonography have led to the acquisition of high-quality images; as a result, ultrasonography is considered as an acceptable modality for diagnostic purposes and clinical decision-making (6, 8). Considering the importance of neural defect diagnosis in suspected neonates and the literature confirming the use of SUS as the first screening tool in these neonates (9, 10), we used this modality in order to investigate possible neural tube defects in newborns with sacral pit.

In the present study, the prevalence of sacral pit in 3071 newborns was estimated at 1.6%. In previous studies, the prevalence rate has been reported to be 0.5-5% (3, 4, 9). Distribution of weight and gestational age at birth among newborns with sacral pit and healthy infants was not significantly different, which is comparable to a study by Acw Lee et al. in China. Also, distribution of sacral pits between males and females was not significantly different in the present study, whereas in the study by Acw Lee et al., the prevalence was significantly higher among females. Both studies showed no spinal anomaly

in ultrasound evaluations and neural disorders were not reported in the follow-ups.

In a study by Robinson AJ et al. on 86 newborns with sacral pit in 2005, ultrasound evaluation of all cases was found to be normal (11), which is comparable to the results of the present study. In addition, in a study by Lode HM et al. in2007 on newborns with lumbosacral skin anomalies (i.e., four cases of asymmetrical gluteal fold, two cases of dermal sinus, one case of hairy tuft, one case of pigmented mole, one case of hemangioma and skin tag, and one case of unilateral leg paralysis), spinal ultrasonography showed the following abnormalities: tethered cord (n=6), diaste-matomyelia (n=2), filum terminale stiffness (n=2), lipoma (n=3), lipomye-lomeningocele (n=2), myelocystocele (n=1), and hydromyelia (n=1) (12).

In addition, a study by C. Schropp et al. in Germany in 2004 showed a significant correlation between spinal abnormalities and visible dermal anomalies such as vascular naevus, tuft of hair, and skin color changes (13). It should be noted that physical abnormalities in newborns were the exclusion criteria in the present study, which can explain the discrepancy between the present results and previous studies.

In a recent study published in 2014 (the largest cohort study in this field), 3884 newborns with simple sacral pit, without any other physical or dermal abnormalities, were evaluated at two health centers in the United States over 12 years. Based on the findings, abnormal sonography results were reported in 3% of all cases. The follow-ups, including sonography, MRI, and clinical analysis, showed that only 0.13% of the evaluated children required surgical intervention. The results of this compre-hensive study showed the low risk of spinal abnormalities in cases with simple sacral pits (14).

Conclusion

The results of this study showed no correlation between sacral pit as an isolated cutaneous marker in the sacral region and neural tube defects. Based on the findings, newborns with this marker were comparable to those without sacral pit in terms of the position and mobility of the spinal cord.

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Conflicts of interests

The authors declare no conflicts of interest.

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