Clinical and Experimental Health Sciences

Case Report: Motor and Sensory Development of a Case Followed with Suspicion of Neonatal Thiamine Metabolism Dysfunction Syndrome

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ABSTRACT

The aim of this study was to follow early motor and sensory development of the infant with Thiamine Metabolism Dysfunction Syndrom (TMDS). Newborn with 38 weeks gestational age, 2600 kilograms weight admitted to neonatal intensive care unit (NICU) due to respiratory distress, absence of suction reflex, and floppy appearance. Case had respiratory support during 5 weeks. Infant was referred to SANKO University Physiotherapy unit on postterm 12th week due to hypotonia after discharge. Prechtl's Generel Movements (GMs) and Hammersmith Infant Neurological Evaluation (HINE) was performed at 3rd and 4th months. Sensory processing parameters were evaluated with the Newborn Sensory Profile-2 (NSP-2). Case had no Fidgety movements (FMs). The HINE score was 37-45 in the 3th and 4th month respectively. Total score in NSP-2 was 33 in the 3th month (general = 12, auditory = 7, visual = 8, tactile = 2, movement = 2, oral sensory processing = 1). While the case's Newborn Sensory Profile-2 (NSP-2) total score was in newborn norms, visual, tactile, movement but intraoral sensory parameters and auditory parameters were in low limits. The low motor performance was associated with low NSP-2 score and showed interaction with motor-sensory development. It is concluded that early physiotherapy program can be effective.

Keywords: Thiamine Metabolism Dysfunction Syndrome, Sensory Profile, Prechtl's Generel Movements (GMs)

1. INTRODUCTION

Thiamine; is a complex B vitamin that helps to support growth, is necessary for the healthy function of the nervous system, heart and other tissues. Neurological findings such as motor function, cognitive, speech and communication in patients with thiamine metabolism dysfunction syndrome (TMDS), also there may be developmental disorders, cardiological, orthopedic retardation with a high mortality risk [1, 2].

Thiamine metabolism dysfunction (TMDS) is an autosomal recessive neurometabolic condition [3, 4]. TMDS is a rare disorder. This disorder has several acronyms since it was first described by Ozand et al, in 1998 [4]. These names include solute carrier family 19 (thiamine transporter), member 3 (SCL19A3) gene defect, biotin-responsive basal ganglia disease (BBGD), biotin-thiamine–responsive basal ganglia disease (BTBGD), and thiamine metabolism dysfunction syndrome 2 [5]. The worldwide incidence and prevalence of SLC19A3 gene defect disorders are unknown. It is most commonly reported in Saudi Arabians, who contributed 70 (52%) of the 134 known cases. However, this gene defect is pan ethnic [4, 5].

Patients have episodes of acute encephalopathy with symmetrical lesions in the cortex, basal ganglia, thalamus, or periaqueductal gray matter, biotin or thiamine deficiency [6, 7]. It may lead to coma and death, with progressive neurodegeneration such as confusion, seizures, and dysphagia [4]. Early signs of thiamine deficiency include fussiness and irritability in infants. Weakness, nystagmus, ophthalmoplegia, ataxia, and cognitive impairment accompany progression of the disease. Infants may be noted to have a lack of tone. Neurologic symptoms are often reversed quickly with treatment, but lasting effects may be seen in severe cases or with delayed treatment. As thiamine deficiency progresses, extreme loss of muscle mass can be observed. Early reports of the phenomenon particularly indicate severe wasting of the gastrocnemii. Adults demonstrate considerable weakness related to muscle loss and peripheral neuropathy [7]. But there is no assessments about motor and sensory development in infants with TMDS in the literature. Long term stay in NICU can cause sensorial deficits in TMDS infants, too. So there can be asssosciation between motor and sensory

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develeopment of these infants. Therefore, the aim of this study was determine the deviations in motor and sensory development of a newborn who is followed up with the TMDS. In addition, to determine the improvements in motor development with early physiotherapy program.

2. CASE PRESENTATION

The infant was followed up due to lack of movement and intrauterine growth retardation in prenatal period, was admitted to the SANKO University Neonatal Intensive Care Unit (NICU) (Table 1). Case had respiratory distress, lack of sucking, floppy appearance. Demographic information was taken from hospital records (Table 1). Cephalic hematoma was observed at Magnetic Resonance Imaging (MRI) in the right frontoparietal area. SMN1-2, SLC19A3 gene analysis and neonatal metabolic screening were performed. Hypotonia and delay in motor development were observed in the postterm 12th week after discharge, then referred to the Physiotherapy and Rehabilitation Unit of SANKO University, followed up with home physiotherapy program by monthly visits. Observations of the case before the Physical Therapy program was shown in Table 1.

Table 1. *Demographic Characteristics, motor and sensory assessments of the case*

<table>
<tr><th colspan="2">Demographic Characteristics of the Case</th><th colspan="2">12th week (3 months) observations of the case (BPT)</th><th colspan="2">16 th week (4 months) observations of the case (APT)</th></tr>
<tr><td>Birth weight (kg)</td><td>2.600</td><td colspan="2">– Excessive hypotonic posture
– Exaggerated external rotation in the hips and frog posture
– Bilateral lower extremities kicking were low
– Hands were not in the midline and could not touch knees.
– Antigravity movements were too limited</td><td colspan="2">– Midline orientation
– Normal tone at lower and upper extremities
– Hands were in midline and can touch to the knees
– More antigravity movements observed.
– Weight shifting were observed in pelvis and hips.
– Achieved hand to hand/ hand to mouth
– Hands can reach to the objects in midline.</td></tr>
<tr><td>Birth length (cm)</td><td>52</td><td colspan="2" rowspan="5"></td><td colspan="2" rowspan="5"></td></tr>
<tr><td>Gestational Age (w)</td><td>38</td></tr>
<tr><td>Hopitalization duration(d)</td><td>90</td></tr>
<tr><td>Apgar score (1 - minute)</td><td>5</td></tr>
<tr><td>Live birth of mother</td><td>3</td></tr>
<tr><td>Mother age</td><td>32</td><td colspan="2">Newborn Sensory Profile (NSP-2) Row Scores</td><td colspan="2" rowspan="11"></td></tr>
<tr><td>MV Support (w)</td><td>10</td><td>General processing</td><td>32</td></tr>
<tr><td>Intra-Incubator oxygenation (w)</td><td>5</td><td>Auditory processing
Visual processing</td><td>7
8</td></tr>
<tr><td>Discharge of NICU (d)</td><td>90</td><td>Tacdil processing</td><td>2</td></tr>
<tr><td colspan="2" rowspan="7"></td><td>Movement processing</td><td>2</td></tr>
<tr><td>Oral sensorial processing</td><td>1</td></tr>
<tr><td colspan="2">Neonatal Sensory Profile (NSP-2) age compliance code quadrants</td></tr>
<tr><td>Sensorial Seeker</td><td>4</td></tr>
<tr><td>Sensorial Avoidant</td><td>7</td></tr>
<tr><td>Sensorial Sensitivity</td><td>7</td></tr>
<tr><td>Sensory Recorder</td><td>5</td></tr>
<tr><td colspan="2" rowspan="2">Motor assessments of the case</td><td>FMs
(3 months)</td><td>F-</td><td>FMs
(4 months)</td><td>F-</td></tr>
<tr><td>HINE
(3 months)</td><td>37</td><td>HINE
(4 months)</td><td>45</td></tr>
<tr><td colspan="6">Neonatal Sensory Profile of the Case NSP-2 age-matched quadrant at 3 months</td></tr>
<tr><td colspan="2" rowspan="2">Neurological Threshold Process</td><td colspan="4">Behavior Response Process</td></tr>
<tr><td colspan="2">Acting in harmony with the threshold</td><td colspan="2">Acting on the threshold</td></tr>
<tr><td colspan="2"></td><td colspan="2">High</td><td colspan="2">Low</td></tr>
<tr><td colspan="2">Poor recording ability</td><td colspan="2">+</td><td colspan="2"></td></tr>
<tr><td colspan="2">Seeking stimuli</td><td colspan="2"></td><td colspan="2">+</td></tr>
<tr><td colspan="2">Sensitivity to stimulus</td><td colspan="2"></td><td colspan="2">+</td></tr>
<tr><td colspan="2">Avoiding the stimulus</td><td colspan="2"></td><td colspan="2">+</td></tr>
</table>

Kg: kilograms, cm: centimeter, w: week, d: day, BPT: before physical therapy, APT: after physical therapy, NICU: Neonatal Intensive Care Unit, FMs: Fidgety movements, HINE: Hammersmith Infant Neurological Examination, F-: No Fidgety movements
NSP-2: Neonatal Sensory Profile

Prechtl's General Movements (GMs) assessment shows quality of spontaneous motor movements without any stimulus [8]. GMs analysis has high reliability and validity (98% sensitivity) in predicting developmental disorders such as CP. GMs shows Fidgety character during 9-20 weeks [8]. Fidgety movements (FMs) was assessed by the 5 minute video records, 2 times until the end of the 4th month. Fidgety movements (FMs) of the case were evaluated. There was no Fidgety (F-) in the 14 and 16 weeks (Table 1). The posture of the case at 14th and 16th week during GMs assessments was shown in Figure 1.

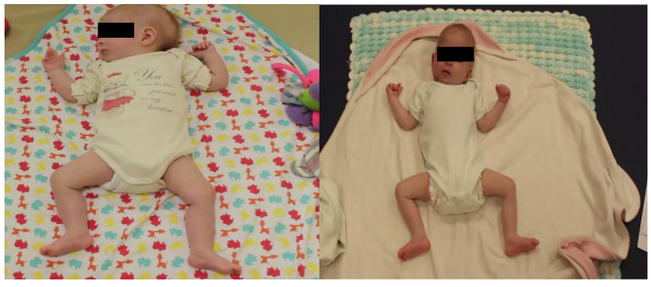

Figure 1. *The posture of the case at 14th and 16th week during GMs assessments*

Hammersmith Infant Neurological Evaluation (HINE) is one of the neuromotor evaluation methods of infants between 2 and 24 months old. It can be used in different high and low risk populations for preterm and term infants. Total score range from 0 to 78. 67-70> score indicates normal range, <57 shows that there is a 96 % risk for CP between 3-6 months. The HINE test has a 90 % predictive value for CP risk in infants aged 2-24 months [9]. HINE was performed at 3th and 4th months. HINE score of the case was 37 and 45, respectively (Table 1).

The physiotherapy program included training of parents about therapeutic holding and carrying principles, facilitation of voluntary head, trunk-hip extension against gravity in prone position, ensuring elongation on the weight-bearing with unilateral reaching in prone position with 'hands on' pelvic stabilization, weight bearing of the forearms with keeeping scapular adduction, active head movements with the support of physiological flexion in supine, supportied sitting or sidelying position, midline orientation in sidelying with various supports, reaching out of hands to feet with active or passive movements in various supine positions, facilitation of head and trunk movements with using wrighting reactions, passive 'hands on' rotation facilitations from supine to prone or opposite, facilitation of the use of hands during high lyied, supported or independent sitting position and development of voluntary hand-eye coordination, head control, grasping, and trunk control. Family trained according to the goals like head control, holding feet, middline orientation, rotations of two side, reaching objects, devoloping righting reactions, weight bearings and weight shiftings set within the framework of the motor movements that the infants could achieve. Also feeding or functional playing postures were explained for the writhing and balance reactions.

Sensory processing parameters were evaluated with the Newborn Sensory Profile-2 (NSP-2) questionnaire filled by the mother at 3 months. It bases on individual family responses, adapted from the Infant Toddler Sensory Profile (ITDP) [10, 11, 12]. The NSP-2 has 24-question with consisting of sensory profile, general sensory, auditory, visual, tactile, motion processing, oral sensory processing sub-scores. The total raw score of NSP is calculated with the sum of sub scores (Table 1). In addition, age compliance codes quadrants of the baby such as seeking, avoiding, sensitivity and recording are defined. NSP-2 raw total score of the case was 32 (overall:12, auditory:7, visual:8, tactile:2, movement: 2, oral sensory processing: 1) at 3 months (Table 1). NSP-2 total score of our case had lower range than her peers. Accordingly, when looking at the compatibility of the infant's general sensory processing, infant seemed 4 % sensorial seeker, 7% sensorial avoidant and 7% sensorial sensitivity, and 5 % sensory recorder. Also it was observed that the case had poor recording ability, lower threshold for seeking stimuli, sensitivity to stimulus and avoiding the stimulus acoording to their healty peers quadrant scores.

3. DISCUSSION

It has been shown that, sensory processing and motor problems can be detected at an early stage of life, and improvement with the motor development can be with early physiotherapy program with this case report. Also the interaction of motor-sensory development was revealed. Sensory processing has been conceptualized by Dunn as the emergence of appropriate responses and behaviors in neurological processes where messages from visual, auditory, tactile, oral, olfactory, vestibular, proprioceptive and kinesthetic inputs are regulated [13]. The interactions between the individual's neurological thresholds, emotional and behavioral responses or self-regulation strategies are permanent. Dunn developed four different response categories based on the interaction between the individual's neurological threshold and behavioral responses [13]. These are called sensory seeking, avoidance, low registration, and increased sensory sensitivity [13]. These processes develop in accordance with natural stimuli from infancy. However, sometimes there may be deviations in development from early infancy. One of them is NICU, which is required to support vital functions. Reduced spontaneous movements for any reason and exposure to excessive sensory stimuli may cause negative consequences in the normal sensory and motor development of the infant. Newborn preterm infants receive less tactile and vestibular stimulation in the NICU than prenatal period. However, there are negative stimulations such as bright lights, high noise levels, excessive use and frequent painful interventions. This condition can have permanent effects on the developing brain and affect the natural development of sensory systems [14, 15]. Machadoa et all. and Celik et all. found a significant difference between

term infants and preterm infants in terms of sensory profile scores [14, 15]. Although our case was term, some deficiencies in sensory parameters revealed. It is thought that, this may be due to the relationship between motor development and sensory development, or to the difference in hospitalization time compared to other term infants.

Studies examining the relationship between sensory processing parameters and motor development in infants are limited in the literature from the neonatal period [15]. Preterm infants are thought to be exposed to these stimuli for a longer period of time. However, the fact that the term infant, who was exposed to many stimuli in the long-term NICU in this study, was less sensitive in terms of sensory processing total scores showed that sensory processing problems could also occur in term infants in the early period of life. Although cognitive and behavioral problems are detected in hypotonic infants, studies examining sensory processing and motor problems in early infancy are limited [15]. Excessive inactivity and low motor performance suggested that low NSP-2 total scores might be related in our case. However, the fact that the sensory profile test was not repeated with the increase in motor development scores constituted a limitation of our study in terms of determining its relationship with the increase in motor parameters. It is recommended to conduct long-term studies with large samples that examine the relationship of motor-sensory development in early infancy in further studies.

4. CONCLUSION

It is concluded that sensory processing and motor problems can determine at an early period of life, also motor development can be improved by early physiotherapy and rehabilitation program.

Conflict of Interest

The authors have no conflict of interest to declare.

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