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SENSORINEURAL HEARING LOSS IN MECONIUM ASPIRATION SYNDROME: A CASE STUDY

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ABSTRACT

Meconium aspiration syndrome (MAS) is a condition that occurs when a newborn infant aspirates or breathes in a mixture of meconium and amniotic fluid. The pathophysiology of MAS is multi-factorial and includes acute airway obstruction, surfactant dysfunction or inactivation, chemical pneumonitis with release of vasoconstrictive and inflammatory mediators, and persistent pulmonary hypertension of newborn (PPHN). All of these conditions might lead to hearing loss as lack of oxygen to the developing brain cells leads to developmental abnormalities and hearing loss and subsequently delayed speech and language development. This disorder often leads to complications like respiratory failure, pulmonary air leaks, and PPHN. There are a number of treatment options of which inhaled nitric oxide (INO) has led to the decreased mortality and the need for extracorporeal membrane oxygenation (ECMO) use.

We present a case aged 3yrs with a complaint of speech and hearing problem. The child has a history of meconium aspiration. The child was kept in NICU for 24hours. A full audiological and speech evaluation was conducted. The child is continuing speech therapy. Through this case study we have attempted to document a case of meconium ingestion and loss of hearing leading to delayed speech and language development and to reassure the fact that proper audiological assessment and its rehabilitation along with speech language therapy can facilitate the patients to fight against the obstacle brought from the meconium ingestion and leading a more or less normal life.

Key Words: Meconium aspiration Syndrome, Audiological manifestation, Speech-Language manifestation, Audiological and Speech-Language Rehabilitation.

INTRODUCTION

Aspiration of meconium occurs when a newborn infant aspirates a mixture of meconium and amniotic fluid (the fluid in which the baby floats inside the mother) before birth or during the birth process. Meconium is a newborn infant's first excrement, which is sticky, thick and dark green and is typically passed, the first few days after birth. The aspirated meconium can partially or completely block the baby's airways, making it difficult for the infant to breathe and causing irritation or a lung infection. The meconium aspiration in effect will result into mild, moderate to severe difficulties in breathing. Causes are varied like smoking during pregnancy, gestational diabetes, high blood pressure or other medical conditions, poor growth of foetus, prolonged or difficult delivery and complications with the umbilical cord or placenta.

The study endeavors to focus on the disease course, management and relationship between hearing loss of the child and Meconium ingestion causing speech and language delay. Severely affected babies may develop chronic lung disease, developmental abnormalities and hearing loss (https://www.luriechildrens.org). About 2–9% of infants born through meconium stained amniotic fluid (MSAF) develop MAS (Cleary and Wiswell, 1998; Dargaville and Copnell, 2006; Velaphi and Vidyasagar, 2006). MAS occurred in 1,061 of 2,490,862 live births, reflecting an incidence of 0.43 of 1,000. In the United States, the incidence of MAS decreased nearly fourfold from 5.8% to 1.5% between 1990-1992 and 1997-1998 and this was attributed to a 33% reduction in births at more than 41 weeks gestation (Yoder, Kirsch, Barth Jr., and Gordon, 2002). MAS requiring intubation occurs at higher rates in pregnancies beyond 40 weeks. 34% of all MAS cases born after 40 weeks required intubation compared to 16% prior to 40 weeks (Dargaville, 2006). Treatment includes mainstay therapy with O_2 supplement, intubation and mechanical ventilation, Extracorporeal membrane oxygenation (ECMO), suction of meconium from below the vocal cords, inhaled nitric oxide (INO) in cases of pulmonary hypertension (Dargaville, 2012), and hyperventilation induced alkalosis.

CASE STUDY

A male child, came to the institute at the age of 1year 10 months with a complaint of speech and Hearing problem. He mainly uses gestures with vocalization to express his needs. Problem was noticed at 3months of age. There is no significant prenatal history. In peri-natal history the discharge certificate informs to have meconium ingestion for which the child was in neonatal care unit (NICU) for 24 hours right after birth, the child had a forceps delivery and a full term baby with normal birth cry. Birth weight of the child was 2.5 kg. Post natal history reveals pneumonia at the age of 11 months. Earlier treatment taken from a medical institute and was audiologically diagnosed as severe to profound sensorineural hearing loss and was recommended and fitted behind the ear (BTE) hearing aid binaurally. The developmental history was reported to be age appropriate motor development. Social developmental history was also age appropriate as reported**.**

A thorough Audiological and Speech language evaluation was administered at our institution comprised of behavioral observation audiometry, immitance audiometry and Auditory Brainstem Response Audiometry (ABR) techniques initially. The child has been given a Behavioral observation audiometry test which ended with the diagnosis of severe to profound hearing loss whereas in Impedance audiometry it revealed bilateral 'A' type tympanogram with absence of acoustic reflexes bilaterally. ABR test (Fig.1) confirmed the hearing loss which reports, peak V not obtained even at 95 dBnHL in both the ears indicating severe to profound hearing loss bilaterally. After undergoing the batteries of tests audiologically the case was diagnosed to have bilateral severe to profound sensorineural hearing loss. In audiological management, he was recommended and fitted behind the ear hearing aid binaurally which he was recommended and fitted before coming to this institute. In Speech and Language Assessment the Receptive expressive emergent language scale (REELS, Bzoch and League,1971; Bzoch, League and Brown, 2003) was administered which revealed a Receptive and Expressive Language age of 11-12 months. Scales for early communication skills (SECS) (Ann. V Geers, 1975) and Gestural Scale (Savithri, S.R 1988) were administered where the combined receptive language age (CRLA) and combined expressive language age (CELA) are less than 2years and the Gestural Scale opened up in reception and expression of 16 to 18 months. The Communication-DEALL checklist (Karanth, 2007) evaluates the current levels of Gross Motor skills (GM), Fine Motor skills (FM), Activities of Daily Living (ADL), Receptive Language (RL), Expressive Language (EL), Cognitive Skills (CS), Social Skills (SS) and Emotional Skills (ES). The Communication-DEALL checklist, gives the levels pre-therapeutically as - GM, FM, ADL, CS, SS and ES are all in the age range of 32 months whereas RL was 12 months while EL was 14 months. The cognitive developmental milestones (L.Nicolosis, et.al., 1989) was at the level of early childhood (12-24 months). In cognitive development Piagetian stage was Tertiary circular reaction. Social development milestones (L.Nicolosis, et al., 1989) was at the level of early childhood, the age range is 12-24 months. Fine and gross motor developmental milestones (L.Nicolosis, et al., 1989) was at the level of early childhood, 12-24 months. The level of expression (Goetz,et al., 1989), vocally it was formal symbolic communication and in motor gestural it was concrete symbolic communication. Psychological assessment reveals age appropriate developmental function and socially adaptive. Child was availing the early childhood educational program (ECE) at the institute. The case is undergoing speech therapy at the institute. A therapy plan was made. The goals included, Auditory Training, improving receptive and expressive speech and language developmental levels. The pre and post-therapeutical levels of speech-Language and other developments is depicted in table 1.

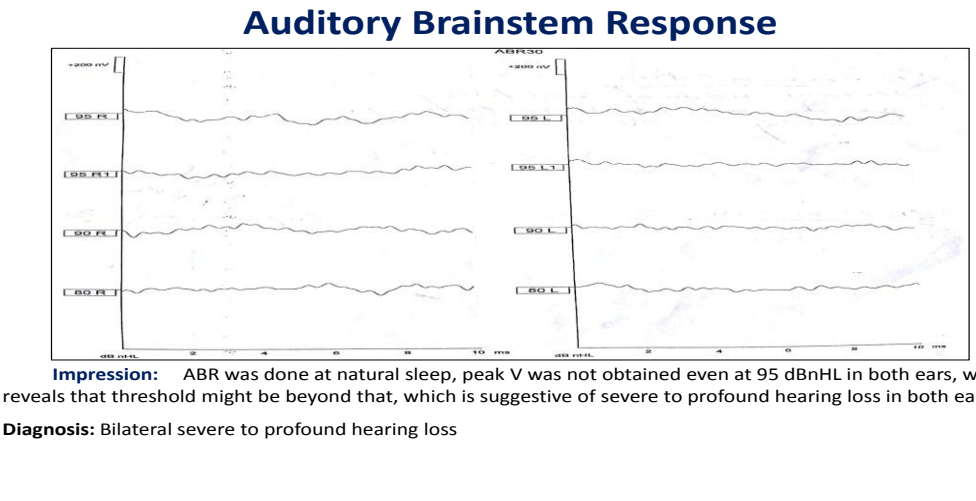

FIG. 1: Auditory brainstem response for the right and left ear of the case

The child is undergoing speech-language therapeutic session at the therapeutic department of the institute once in a week with early childhood education program (ECE) in the education department since last 1 year and more. At present he is 3 years of age.
Post therapeutically after one year two months, in Speech and Language Assessment the Receptive expressive emergent language scale was administered which revealed a Receptive and Expressive Language age of 20-22 months. SECS and Gestural Scale were administered where the CRLA is 3 to 3.11and CELA is 2 to 2.11years and the Gestural Scale enhanced to reception and expression of 18 to 20 months. The Communication-DEALL checklist, gives the levels post-therapeutically as - GM, FM, ADL CS, SS and ES are all in the age range of 42 months whereas RL improved to 28 months while EL became 30 months. The cognitive developmental milestones (L.Nicolosis, et al., 1989) is at the level of preschool (2-4years). Piagetian stage is at preoperational and preconceptual. Social development milestones (L.Nicolosis, et al., 1989) is at the level of preschool, the age range is within 2-5years. The fine and gross motor developmental milestones (L.Nicolosis, et al., 1989) is at the level of preschool, 2-4years range.

Table.1: Pre and Post therapeutically Speech-Language and other developmental levels.

Categorical level/scale	**Pretherapy- at 1year 10 months of age**	**Post therapy- at 3 years of age**
REELS (RLA & ELA)	11-12 months	20-22 months
Gestural Scale	16 to 18 months	18 to 20 months
SECS	<2 years (CRLA & CELA)	3 to 3.11(CRLA), 2 to 2.11(CELA)
Communication DEALL	32months (GM, FM, ADL, CS, SS, ES) 12months (RL), 14months (EL)	42months(GM, FM, ADL, CS, SS, ES) 28months (RL), 30months (EL)
Cognitive developmental milestones (Piagetian stage)	12-24 months (category-Early childhood) (Tertiary circular reaction)	2 - 4 years (Category-Preschool) (Preoperational, Preconceptual)
Social development	12-24 months (Early childhood)	2 to 5 years (Preschool)
Fine and gross motor	12-24 months (Early childhood)	2 to 4 years (Preschool)

DISCUSSION

Aspiration of meconium during intrauterine breathing results in MAS. The pathophysiologic mechanism of hypoxemia in MAS include- a) acute airway obstruction, b) surfactant dysfunction and inactivation, c) chemical pneumonitis with release of vasoconstrictive and inflammatory mediators and d) PPHN (Swarnam, Sovaisham, Sivananda 2012). PPHN often results in the need for mechanical ventilation due to severe respiratory distress. Oxygen deprivation may be responsible for increased risk of acquiring hearing loss (Mann, Cutler and Campbell 2001) and delay in acquisition of speech and language in the long run. ECMO is one of the treatment methods for MAS. Infants with MAS make up approximately 35% of the infant population who require ECMO (Short,

1995). Survivors of extracorporeal membranous oxygenation (ECMO) treatment are at risk for serious neuro-developmental disorders or neurologic sequelae. Study conducted on 123 ECMO survivors born between 1987 and 1996, at least 30 survivors have confirmed sensorineural hearing loss, and progressive hearing loss has been confirmed in 10 subjects (Mann and Adams, 1998). The risk factors that appear relevant to late-onset progressive hearing loss are persistent pulmonary hypertension of the newborn (PPHN), family history of hearing loss, prematurity, and mechanical ventilation (Mann, Cuttler and Campbell 2001). PPHN and Mechanical ventilation co-exist in cases with MAS, which contributes to hearing loss. The case originated during the perinatal period where following the delivery the child was in NICU and under mechanical ventilation for 24hours which have contributed to the onset of hearing loss. The child came to us at age of 1year 10months after which a thorough audiological and speech language assessment was conducted which revealed a severe to profound sensorineural hearing loss resulting to speech and language delay. The child had undergone speech therapy for about 1year two months. The hearing loss resulted in speech and language delay. The comparison of pre and post therapeutic levels in all the aspects reveals improvement of the child (table 1). Post-therapeutic levels reveals that he has reached the level of 2 years and above with one year two months of rigorous speech therapy from the level of 1 year pre-therapeutically. In REELS the RLA and ELA have reached the level of 20 to 22 months from the level of 11-12 months. REELS scale has been administered as the case was wearing hearing aid and had taken some speech therapy sessions before coming to the institute. In gestural scale we achieved a much opted result that is there is not much improvement as the child has started using the audio-verbal mode of communication more frequently. In SECS the child has surmounted another 1 year of delay from the initial level in expression, and approximately 2 years in reception. A valuable improvement has been noticed in receptive and expressive level of communication DEALL. In reception and expression, the pre-therapeutic level was at 12 months and 14 months, where the level has reached 28 months and 30 months respectively post-therapeutically. The other aspect of development like social, cognition and motor development is age appropriate pre and post-therapeutically as expected in a pure hearing loss case. The outcome of the study indicates that early detection and proper audiological, speech and language management may bring improvement in the cases of sensorineural hearing loss where the cause is meconium ingestion. It is also evident from the study and literature review that when the ingestion of meconium brings lung disease and developmental abnormalities, it complicates the situation further, which the case is spared off.

CONCLUSION

This is a rare syndrome with heterogeneous group of changes in various organs. It requires teamwork in order to provide early diagnosis and treatment of numerous malformations. Hearing loss is one of the anomalies associated with this syndrome which can be diagnosed at the earliest. Although the loss might not occur at infancy but as the child grows it may gradually develop. A proper test battery approach in relation to audiological tests, speech language assessments and appropriate guidance and counseling can bring optimal rehabilitation if the child is identified at an early age. Rehabilitation requires an ongoing regular checking and monitoring on all the domains of the disorder. The prognosis of these cases is satisfactory as they can lead a less hazardous, normal life if they get proper assessment and treatment through life.

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