

## Is Swallowing Assessment for Preterm/High Risk Neonates Important in NICU?

\* Taniya Raj <sup>1</sup>, Faisal Al Zidgali <sup>2</sup>

<sup>1</sup> Senior Speech Language Pathologist & PhD Research Scholar, Inpatient Team lead, Sheikh Shakhboub Medical City (SSMC), Abu Dhabi, United Arab Emirates (UAE).

<sup>2</sup> Dr, Consultant Neonatologist and Chair of Neonatology Division, Sheikh Shakhboub Medical City (SSMC), Abu Dhabi, United Arab Emirates (UAE).

### Abstract

**Background:** Establishing oral feeding in preterm babies is challenging in the Neonatal Intensive Care unit (NICU). Literature shows that more than 70% of babies born as preterm have oral feeding difficulties and 40% of these babies have penetration or aspiration risk with the initiation of oral feeding. The aim of the study was to identify the number of preterm babies referred for swallowing assessment in NICU along with the percentage of preterm babies who needed Videofluoroscopic assessment of swallowing along with its findings January 2020 and December 2021 between 2020 and 2021. In addition the study aimed to determine the percentage of readmission among preterm babies within 3 months of discharge from NICU for aspiration or other oral feeding concerns during the above mentioned time period.

**Methods:** This is a retrospective study done for two years from January 2020 and December 2021.

**Results:** 5.4% of the babies referred to SLP services needed Videofluoroscopic Swallow Studies (VFSS) as clinical bedside swallow assessment indicated penetration/aspiration risk. The VFSS in 3/18 babies had silent aspiration even with safe feeding strategies; thereby, were recommended to continue enteral feeding for nutritional needs. 44.4% of preterm and full term babies in NICU had penetrations during VFSS on oral feeding using the regular fast flow nipples; thereby, needed specialized slow flow nipples.

**Conclusion:** The study concluded that feeding related complications and aspiration in preterm term infants, while in the NICU, can be minimized with the oral feeding rehabilitation provided by the SLP from 33 weeks of corrected gestation age; and this reduces the readmission rate for these babies, in turn reducing the hospital cost.

**Key Words:** Aspiration, Feeding difficulties, High Risk Neonates, NICU, Preterm, Swallowing Assessment.

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### \*Corresponding Author:

Taniya Raj. Senior Speech Language Pathologist & PhD Research Scholar, Inpatient Team lead, Sheikh Shakhboub Medical City (SSMC), Abu Dhabi, United Arab Emirates (UAE). Email: [perumalataniya1985@yahoo.co.in](mailto:perumalataniya1985@yahoo.co.in)

## 1- INTRODUCTION

Establishing oral feeding in preterm babies is challenging in the Neonatal Intensive Care Unit (NICU). Literature shows that more than 70% of babies born as preterm have oral feeding difficulties and 40% of these babies have penetration or aspiration risk with the initiation of oral feeding (1).

Preterm babies in NICU experience a lot of hurdles in making transition from enteral feeding to full oral feeding. The involvement of Speech Language Pathologists in the assessment as well as rehabilitation of these swallowing difficulties plays a vital role for safe discharge home. Speech and Language Pathologists (SLP) uses different strategies to minimize aspiration risk with oral feeding. This, in turn, facilitates early discharge from the hospital, decreasing maternal and family stress as well as reducing financial burden due to the prolonged hospital stay.

SLP pay close attention to the oral feeding readiness cues before weaning the preterm infants from enteral feeding (2). Oral feeding can be introduced by 33 to 34 weeks corrected gestational age. In preterm babies weak sucking, delayed swallow and/or suck, and the swallow-respiration incoordinations are commonly seen as causes that interfere in the transition to the safe full oral feeding (3).

### 1-1. Milestones of preterm oral feeding skills

There are two levels in which preterm babies develop sucking and swallowing as well as suck-swallow-breathe coordination. First is the developmental maturation and synchronization of the muscles and second is the safe coordination between the musculatures of these different functions. In the synchronization of sucking musculature, there is a close correlation between muscles from the oral structures like lips,

tongue, palate for the generation of sucking pressure, the jaw for its opening, and closing and tongue for bolus formation and its peristaltic transport to the pharynx.

During oral feeding, the diaphragmatic, intercostal musculatures, as well as upper airway muscles from nostrils to glottis play vital roles for respiratory coordination. The Central Pattern Generators (CPGs) for sucking, swallowing, and respiration is in the Medulla Oblongata.

Mature sucking pattern consists of the rhythmic alternation of suction and expression. In addition, an adequate coordination of sucking, swallowing, and respiration is crucial for safe oral feeding with no episodes of desaturation, apnea, bradycardia, and/or aspiration (4).

Developmental sucking are two types.

- i) Non-nutritive sucking i.e. no liquid is given orally and sucking is with a pacifier only.
- ii) Nutritive sucking i.e. milk is given orally from a bottle or breast

For mature nutritive sucking rhythmic alternation of suction (the negative intraoral pressure that draws milk into the mouth) and expression (the positive pressure generated by the compression/stripping of the breast or bottle nipple that ejects milk into the mouth) is vital. The respiratory function will mature as preterm infants mature developmentally. Optimal coordination of sucking, swallowing, and breathing at a ratio of 1: 1: 1 or 2: 2: 1 is trained with safe feeding strategies for preterm babies during the feeding rehabilitation given by the SLP prior to discharge from NICU (5).

Some preterm babies start early nutritive skills by 32 weeks while others may not develop even till 35 weeks of post gestational age. However, most babies will

be able to be weaned from a feeding tube by the following gestational ages:

- 33 to 34 weeks: Preterm babies develop suck thereby facilitating gradual transition from tube feeding to bottle feeding or breastfeeding.
- 35 to 38 weeks: Baby should be able to have mature suck-swallow-breathe coordination to take breast/bottle feeds effectively.

SLP pays close attention to the oral feeding readiness cues before weaning the preterm infants from enteral feeding. In addition to this, if an infant has stable cardiopulmonary status, oral feeding can be introduced around 33 to 34 weeks of postmenstrual age. In preterm babies, weak sucking, delayed swallow and/or suck, swallow and respiration incoordination are commonly seen as causes that interfere in the transition to full oral feeding (6).

Cue-based feeding combined with the use of Non-Nutritive Sucking (NNS) facilitates safe oral feeding transition. Cue-based feeding has a lot of benefits such as those mentioned below:

### *1 Easy transition to oral feeding*

Studies show that cue-based fed infants facilitate easy transition to full oral feedings as well as full oral feeding is achieved 6 and 5 days earlier compared to babies who are fed with only gestational age but without feeding cues.

### *2 Length of stay*

Orally fed Infants, could achieve full oral feeding faster when observed cues and were discharged earlier. Studies by Kirk et al. showed a 4.5 day decrease, while other authors reported a shorter duration of hospitalization (7).

### *3 Fewer adverse events*

Kirk et al. (7) showed a decrease of 9 adverse events when infants received cue based feeding compared to feeding on the

basis of physician's orders which decreased the adverse events.

## **1-2. Aspiration risk in preterm babies with oral feeding**

Research over the last decade has started focusing on the development of oral feeding skills in these infants as they mature, which has increased understanding of their limited skills at varying postmenstrual ages. This knowledge is important in clinical practice regarding the expectations of these infant's oral feeding performance (8).

Common symptoms of aspiration on oral feeding in preterm babies are gagging, hiccups, cyanosis, desaturations with oral feeding, coughing during oral feeding, apnea, bradycardia, wheezing during/post oral feeds, wet voice and noisy breathing during or post oral feeding (9). Not all babies cough while oral feeding or exhibit respiratory symptoms when they aspirate; this thereby indicates a risk for silent aspiration in preterm babies. Silent aspiration mostly occurs in preterm babies due to sensory immaturation.

Premature infants are often intubated because of respiratory distress, pneumonia, bronchopulmonary dysplasia, or apnea, which increases their risk of aspiration while oral feeding (10). Kim et al. reported penetration and aspiration in 33% of preterm babies. Babies with laryngomalacia, cleft lip-palate, and down syndromes are also at risk for aspiration on oral feeding (11).

Videofluoroscopic Swallow Studies (VFSS) is mostly used as an instrumental swallow assessment to identify silent aspiration risk in preterm babies when shown clinical signs at bedside. VFSS involves exposure to radiation, and the possible long-term effects of radiation on infants are a concern for preterm babies thereby it is recommended only when babies do not respond to safe feeding strategies and if challenges were identified

in achieving full oral feeds. Hall (12) reported that preterm babies are more sensitive to radiation-induced cancer than adults, with reported exposure resulting in leukemia, developmental delay and so on. Preterm babies are often considered for VFSS if baby shows no improvement for at least 2-3 weeks of oral feeding rehabilitation by SLP and if neonate still continue to exhibit clinical signs of penetration/aspiration on oral feeding trials at bedside.

Common symptoms of aspiration on oral feeding in preterm babies are gagging, hiccups, cyanosis, and desaturations with oral feeding, coughing during oral feeding, apnea, bradycardia, wheezing, wet voice, and noisy breathing during or after oral feeding (13).

Not all babies cough while oral feeding or exhibit respiratory symptoms when they aspirate which indicates a risk for silent aspiration in preterm babies (14).

Silent aspiration mostly occurred in preterm babies due to sensory immaturities are identified by Videofluoroscopic Swallow Studies VFSS, the most recommended instrumental swallow assessment when preterm or high risk neonates shows clinical signs of penetration/aspiration on oral feeding trials at bedside during swallow rehabilitation.

Sheikh Shakhbout Medical City (SSMC), which was established in 2020 has made its footprint on the national and the regional stage as one of the largest hospitals providing world-class holistic healthcare service. SSMC Neonatal Intensive Care Unit is a Level 3 unit with 26 ICU cots managing complex medical and surgical neonatal cases including extreme premature babies as early as 22 weeks of gestation. Managing premature infants is a specialised field, challenging to clinicians as well as families due the post-delivery complications secondary to

immaturity of body organs and their functions (15).

One of the specialized services provided at SSMC is swallow assessment and rehabilitation of feeding difficulties for preterm babies as well as high risk full term babies in NICU. SLP at SSMC works as a part of NICU multidisciplinary team and collaborates closely with physicians, nurses, and Lactation consultant nurses in weaning enteral feeds and achieving full oral feeding with no secondary complications such as aspiration for preterm and high-risk babies. The clinical significance of this service includes the following:

- 1) This is a unique service in UAE providing a comprehensive approach of assessing and screening all preterm and at risk neonates for swallowing abilities which helps to minimize aspiration risk with oral feeds.
- 2) This is a proactive and preventative approach where all preterm babies are referred to SLP before they become symptomatic with aspiration from oral feeding due to the swallow breathe incoordination.
- 3) The service delivery encourages and supports breastfeeding by working closely with lactation team.
- 4) Parents are educated on safe feeding strategies while oral feeding their babies during NICU stay thereby ensuring safe home discharge of these high-risk preterm babies.
- 5) Reduces hospital readmission post discharge due to aspiration or oral feeding difficulties.
- 6) This is a high-quality service with improvement measures in clinical outcome, patient safety and family centered patient care.

### 1-3. Objectives

The aims of the present study are as below:

-To identify the number of preterm babies referred for feeding or swallowing assessment in NICU from January 2020 and December 2021.

- To identify the percentage of preterm babies who needed Videofluoroscopic Swallow Studies along with its findings between 2020 and 2021.

-To determine the percentage of readmission among preterm babies within 3 months of discharge from NICU for aspiration or other oral feeding concerns from 2020 to 2021.

### 2- MATERIALS AND METHODS

This is a retrospective study done for two years from January 2020 to December 2021.

The main stages of implementation for the Speech Language Pathology service delivery in NICU at SSMC are discussed below:

**A) Developing a departmental performance improvement proposal and developing an evidence-based clinical practice guideline on neonatal oral feeding assessment and management in NICU which was approved by NICU Physician Chair as well as Consultants and NICU nursing manager.** Based on this guideline the SLP consultation criteria are highlighted below which is also in accordance with the international standards to early identify oral feeding difficulties as well as to provide early rehabilitation to facilitate weaning of enteral feed and safe transition to full oral feeds. Till date clinical practice guidelines on oral feeding assessment and management in acute care hospitals are minimal thereby this involved a collaborative team work between NICU

physicians and Speech Language Pathologist.

SLP consultations were placed for babies with the below criteria in NICU

1. Premature babies from 33+ weeks corrected age with no ventilator support;

2. Babies below 33 weeks corrected age would be considered in specific instances for oral feeding assessment when consulted by NICU physicians (such as if their gestation accuracy is +/- 1 week from the estimated gestation from last menstrual period (LMP) or /and antenatal scan dating as some of these babies are bigger and exhibit a lot of feeding readiness cues as early as 33 weeks).

3. Babies greater than or equal to 35 weeks of age admitted to NICU requiring  $\geq 72$  hrs of stay with challenges in achieving full oral feeding.

4. Babies with developmental concerns such as dysmorphic features, cleft lip and palate, Down syndrome, and/or other syndromic or craniofacial disorders etc.

5. Babies for oral feeding initiation post resuscitation, post extubation or weaned from Non-invasive ventilation as Humidified High-Flow Nasal Cannula (HHFNC).

6. Full term babies in NICU who have desaturation, tachypnea, or tachycardia on oral feeds.

7. Full term babies with neurological concerns e.g. hypotonia, post cooling therapy for Hypoxic Ischemic Encephalopathy (HIE), Seizures or congenital abnormalities like cardiac issues.

**B) Training the NICU nurses through periodic in-service educational sessions conducted by SLP's and Clinical Resource Nurses specialized in NICU.** These sessions provide awareness to the NICU nursing team on SLP consultation

criteria. Sessions also provide education to the NICU nurses on the safe feeding strategies to facilitate safe discharge and to minimize aspiration risk. At least 3 educational sessions are given annually to NICU registered nurses coordinated with the clinical resource nurse which facilitated nurses to place SLP consults in a timely manner and in par with the departmental clinical guidelines.

**C) Clinical bedside swallow/feeding assessments** are done by the trained SLP for preterm and high-risk babies consulted to assess safety of oral feeding as well as they provide further rehabilitation as needed to minimize aspiration risk and safe discharge. Based on the swallow/oral feeding assessment, SLP conducts instrumental swallow assessments such as Videofluoroscopic swallow studies VFSS for babies who are identified to be high risk for aspiration on oral feeding considering radiation safety. following discussion with the primary NICU physician consultant. SLP pay close attention to signs of readiness to feed orally before transition from enteral to oral feeding. The video fluoroscopic swallow studies help SLP to determine if the babies have aspiration or penetration with oral feeding.

Along with the NICU nurses, the parents are educated by SLP on the safe feeding strategies during NICU stay to be prepared for safe discharge and to minimize readmission due to difficulties in oral feeding.

**D) Closed file Audit was done by Speech Language Pathologists** to identify any readmission within 3 months following NICU discharge from January 2020 till December 2021 to determine efficacy of SLP service delivery in NICU.

### 3- RESULTS

The results showed that 348/906 babies were consulted to the SLP services for swallowing /feeding assessment as

well as further rehabilitation in NICU between January 2020 and December 2021. Taking into consideration the exclusion criteria, (such as intubated babies, babies on HHFNC, babies who are less than 33+ weeks of gestational age) 56% of total admitted babies were consulted for feeding/swallowing difficulties among preterm and high-risk NICU babies, of which the consults were mainly for extreme preterm babies and moderate preterm babies. Few full-term babies with syndromic features as well as neurological causes were consulted to assess the swallowing safety while oral feeding.

5.4% (18/328) of babies needed instrumental swallow assessment i.e., VFSS, as the clinical bedside swallow assessment suggested possible penetration or aspiration risk which was indicated due to the associated desaturation or tachypnea while oral feeding even when used pacing strategies as well as with specialized slow flow nipples. Among the 18 babies who had VFSS, 3 babies had silent aspiration even with safe feeding strategies; thereby, it was recommended to remain nil by mouth and to continue enteral feeding for nutritional needs. 44.4% (8/18) of preterm and full term babies in NICU had penetrations on successive sucking thereby specialized feeding devices as well as slow flow nipples were used along with pacing strategies to minimize aspiration risks. Seven out of eighteen (7/18) babies, i.e., 39%, had no aspiration on oral feeding.

Our data showed that only 7 out of 328 babies which constituted less than 1% of babies consulted to SLP had readmission due to feeding related concerns such as vomiting due to over feeding, coughing from fast flow nipple use, and suspected aspiration pneumonia with RSV bronchiolitis. 99 % of the preterm and high risk babies had no readmission to hospital within 3 months of discharge due to oral feeding related concerns. The

common causes for readmission to hospital were interestingly for bronchiolitis, vomiting, constipation, RSV infection, COVID infection, hernia, running nose with URTI, need for blood transfusion, identified jaundice, diarrhea and gastroenteritis.

#### **4- DISCUSSION**

Most of the preterm babies delayed pharyngeal swallow which induced penetration risk when fed from fast flow nipple as well as on successive sucking. In 2020-2021, during the COVID pandemic, the SLP NICU consultation volume was 56% with less than 1% of readmission rate post discharge for oral feeding related concerns. From 2022 till date we are working consistently as team to achieve 90% SLP consultation rate for eligible babies with the clinical guidelines developed for oral feeding assessment and management of neonates in NICU. Our 1% readmission rate is significantly low which is a great achievement compared to the international benchmarking of 4-7% among these high-risk neonates for oral feeding related concerns. This shows the efficiency of SLP service delivery in NICU for the management of feeding and swallowing difficulties in preterm and high risk neonates.

In NICU, the mothers were trained for safe breast feeding strategies from the corrected age of 34 weeks and strategies for bottle feeding with milk flow regulating specialized nipples. The parents receive advice from feeding specialists, nurses, and lactation team consults during the babies' stay in NICU prior to discharge. It gives them the opportunity to identify the challenges while oral feeding their preterm babies. This approach has played a major role in minimizing readmission to hospitals after discharge.

##### **4-1. Impact on service delivery**

Involving SLP in the NICU service delivery can reduce aspiration while oral

feeding not only during NICU hospital stay but also after discharge. Safe discharge to home with full oral feeds is significantly an important factor in NICU for preterm and high-risk neonates. With optimal parental education on safe feeding strategies and postural recommendations while oral feeding, readmission rate of these babies to hospital can be minimized, in turn reducing the hospital cost.

We are thereby recommending this comprehensive management approach of having swallow assessment and rehabilitation by SLP for these high-risk newborns as a part of the standard care in the NICU with the aim of delivering high quality and family centred patient care.

#### **5- CONCLUSION**

The study concluded that feeding related complications and aspiration in preterm term infants while in the NICU can be minimized with early identification of penetration or aspiration signs during the oral feeding rehabilitation provided by the SLP from 33 weeks of corrected gestational age. SLP's who work in the NICU provide great contributions to train mothers/caregivers before discharge on safe feeding strategies to minimize aspiration while oral feeding post discharge.

#### **6- FUTURE DIRECTIVES**

a) The future directive of this project is to periodically and annually monitor the readmission rate of preterm and high-risk neonates getting discharged from SSMC NICU for oral feeding related concerns.

b) Spreading awareness to other hospitals around the globe by doing presentations, workshops, and journal publications to adopt this standard of care in NICU where all preterm babies are evaluated by SLP for early identification of oral feeding issues.

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