Original Article

Effect of Early Intervention on Post Tracheostomy Infants on Developmental Delay

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Abstract

Background: In the pediatric population, tracheostomy is most common to provide good ventilator support, and that too is most commonly performed in the infant population. Tracheostomy is frequently associated with devices such as ventilators, which can further interrupt the neck motion and this in turn, may also affect the gross motor development.

Purpose: To determine the effectiveness of early intervention in post-tracheostomy infants with developmental delays.

Materials and Methods: A randomized control trial was conducted with a total of 20 tracheostomy infants with a mean age of 2 months. Subjects were randomized into the early intervention group (n = 10) and the conventional group (n = 10). Both groups were treated with routine chest care in the Pediatric Intensive Care Unit. In addition, the early intervention group included neck postural and movement activities for 20 minutes per day for 5 days for 4 weeks.

Results: One outcome concentrated on neck control by using a clinical rating scale for head control (HCS), and another outcome concentrated on gross motor milestones (lying and rolling components) by using the Gross Motor Functional Measure (GMFM-88). Both groups were similar at baseline, with a p-value of 0.8493 in HCS and 0.56866 in GMFM. Following improvement in head control, the GMFM score improves from 29% to 74% in the conventional group. Early intervention groups progressed from 25% to 89%.

Conclusion: Early intervention programs concentrated on post-tracheostomy infants showed significant improvement in the development of neck control and rolling. And organized head movement in space was noted when compared to conventional groups.

Keywords: Postural and movement training, Neck control exercises, High-risk infants, Clinical rating scale for head control, GMFM-88.

Introduction

A tracheostomy is a surgical operation that includes opening the cervical trachea to provide an airway[1]. Pediatric tracheostomies are becoming more prevalent, accounting for nearly 40% of tracheostomy procedures performed on infants under the age of

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12 months[2] . Pediatric tracheostomy, tracheostomy tube selection, and post-surgery rehabilitation in infants and children need specialized and advanced treatments [3].

Infant tracheostomies provide various advantages, including minimizing the need for extended intubation, decreasing the risk of tracheal stenosis, and boosting feeding and development. Tracheostomies help infants to be more comfortable during oral feeds, which can be absorbed, resulting in improved nutrition[4]. While most studies have focused on the impact of tracheostomies on speech, language, and swallowing[5]. Tracheotomy infants, notably develop neck flexor weakness, immobility, and discomfort as a result of the incision site.

Head control is often achieved by infants as their first gross motor milestone. Once they have gained control of their heads, they can go on to other milestones like rolling, sitting, standing, and walking[6]. Adults normally require approximately two weeks to recover from the decannulation phase after the tracheostomy is removed. However, the healing process may differ for infants aged one to five months, when gaining neck control may take longer, potentially resulting in delays in gross motor milestones.

An infant with developmental delay (DD) fails to meet age-appropriate developmental goals in one or more areas, such as gross motor abilities, fine motor skills, language/speech development, and social development[7-9]. Globally, the prevalence of developmental delays ranges from 1.5% to 19.8% of children. The estimated frequency of developmental delays in India is roughly 10%, and it is significantly greater among infants released from neonatal intensive care units (sick newborn units)[10]. For infants with developmental delays, early detection and intervention are critical. Infants have a higher chance of fulfilling their developmental potential if the delay is identified early and proper support and treatments are provided[11].

Gross motor delays (GMD) were found to be most common in children aged 2-4 months (10.3%). Early intervention is critical for infants who are at risk of developmental delays (DD), emphasizing the importance of early childhood development therapies and programs. Motor development in children follows a pattern in which movement ability impacts others[12]. Head control is an important early milestone that should be reached by 3 months of age, and delay in developing head control can have a substantial influence on overall development[13].

The Gross Motor Functional Measure (GMFM-88) is a thorough assessment instrument for assessing gross motor skills. It examines five areas of gross motor function, which are as follows: Rolling, lying, Crawling, kneeling, Sitting, Standing Walking, running, and jumping[14]. Chavan SR developed the clinical rating scale for head control (HCS) in 2008 to assess the postural control necessary for head control in infants with neurological diseases or developmental delays. It rates head control on a 5-point scale (ranging from 0 to 4) in prone and supported sitting postures, and on a 4-point scale (ranging from 0 to 3 in supine). The clinical rating scale is a reliable instrument used to measure the progression of head control in children with cerebral palsy. It was found that there were very substantial positive correlations between the prone ($r = 0.845$), supine ($r = 0.802$), and supported sitting ($r = 0.827$) dimensions[15].

When developmental delays are diagnosed early, suitable treatments to promote the child's development can be undertaken, resulting in improved learning results, improved behavior, and fewer functional difficulties.

Early childhood treatments have been found to have long-term advantages, such as sickness prevention and general health and well-being promotion. Early identification and appropriate intervention can significantly affect an infant's long-term trajectory and enhance developmental results[16]. Early intervention programs take advantage of this neuroplasticity by delivering personalized therapies and activities that encourage the formation of brain connections and pathways. Early intervention is especially critical for post-tracheostomy newborns since they may have special developmental requirements and issues. Infant's head control improves significantly throughout the first few months after birth as part of their motor development. Early intervention plays an important role in improving the general development and well-being of post-tracheostomy infants by offering tailored therapies and involving families. To determine the effectiveness of the early intervention on post-tracheostomy infants on developmental delay.

Aim

To determine the effectiveness of the early intervention on post tracheostomy infants on developmental delay.

Material and Methods

It is an experimental study conducted from June 2022 to Januray 2023 on 20 post tracheostomy infants from Saveetha Institute of medical and technical science (SIMATS). According to the inclusion and exclusion criteria. Concealed envelope sampling technique was used in this study. The infants included in the study were based on the following criteria:

Inclusion criteria

- Full term baby
- After the diseases get cured for which the tracheostomy was done
- After 2 weeks from decannulation
- Infant age group (1-4 months)

Exclusion criteria

- Once neck control was achieved
- Congenital disorder
- Congenital disabilities
- Prenatal and perinatal complications
- Immediate postnatal complications such as NICU stay, low birth weight, seizure
- Recent surgery to head

Outcome Measure

Clinical rating scale for head control

The clinical rating scale for head control is used to assess head control in supine, prone, and sitting postures. This scale grades prone and supported sitting positions on a 5-point scale (0–4), whereas the supine position is rated on a 4-point scale (0–3).

GMFM-88

The GMFM-88 item assesses the range of gross motor activities in five dimensions. Divided into five dimensions, of which lying and rolling (17 components) were assessed in supine and prone postures with a total score of 51. The scoring of GMFM consents to four-point scoring from 0–3, where 0 does not initiate, 1 initiates, 2 partially completes, and 3 completes.

Procedure

A total of 20 infants were randomly selected and divided into an early intervention and conventional group by using concealed envelope method. The study was conducted in Saveetha medical college & hospital. Informed assent was obtained from their parents, and they were also explained the safety and simplicity of the procedure.

Study Procedure

***Early intervention group*:** Infants in the early intervention group underwent routine PICU chest care along (conventional treatment) with posture and mobility activities[17] administered by the physical therapist for a period of twenty minutes daily for five days or four consecutive weeks.The training protocol includes

Exercise 1: **Tummy time (3 minutes)**

Phase 1: a) Infant is placed on the therapist's chest and abdomen with his or her elbow's weight beard and raised to develop usage of the shoulder and neck muscles while sitting in a reclining position. b) The therapist interacted with the infant to keep the head elevated.

Phase 2: a) Further infant is placed on the floor with his or her tummy while maintaining their elbow's weight, beard and head raised to develop usage of the shoulder and neck muscles.

b) Present a doll in front of the infant and encourage them to focus their attention on it.

c) The doll is then moved from side to side, allowing them to turn their head and follow the toy's movements. Then the toy is placed in front while the infant is in a tummy for as long as possible.

Exercise 2: Head control against gravity for extensors (3 minutes)

Infant is placed on the therapist's chest and abdomen (prone) on his or her stomach with the upper limb extended and supported. The therapist gradually lifted the infant, 12 to 18 inches (30.4 - 45.7 cm) above the chest level. Hold for ten seconds before lowering the tummy gently.

Exercise 3: **Head control incline position for flexors (3 minutes)**

The therapist places the infant on bent knees then gently grasps the infant›s shoulders and then pulls up to a sitting posture on a count of three. Interact with the infant to keep his or her head up. This posture was maintained for 10 seconds. While performing this exercise the infant's head tilts back slightly and support to the head is given by placing index fingers on the occiput.

Exercise 4: Head control on a flat surface for flexors (2 minutes)

An infant is placed on the floor. The therapist's thumb is placed inside the infant's palms, the hands resting at their sides. Then the infant's hands are brought together and taped over their chest, keeping them as straight as possible. Hold them in this posture for a few seconds, keeping their elbows as straight as possible. Consider singing a song while engaging in this activity to keep entertained.

Exercise 5: **Advanced (3 minutes)**

The following task will take place of Exercise 3 once the infant has demonstrated excellent head control in Exercise 3.

The therapist positions the infant on their lap with both knees bent and then proceeds to hold the infant's hands. The infant pulled up to sitting posture on the count of three. While performing this activity the infant is encouraged with attractive lights to maintain their head up. This posture is maintained for 10 seconds. The infant was lowered back to the floor using the same method. A slight head drop noted while lifting to a sitting posture.

Once the infant gains head control while translating from pulling to sitting significantly, then head control in the sitting posture should be encouraged.

Conventional group*:*

Both groups underwent routine physiotherapy care in the pediatric intensive care unit, such as positioning, vibration, percussion, and suctioning.

Results

This study involved Twenty infants. The mean age of participants in the conventional group is 2 months with an SD of 0.67, and that of the early intervention group is 2.2 months with an SD of 0.74. Both groups were similar at baseline, with a p-value of 0.8493 in HCS and 0.56866 in GMFM. Wilcoxon signed rank was used to compare pre- and post-values at 4, 5, and 6 months of infant age. Mann-Whitney t test analyzed data between groups by comparing the pretest and post-test at 4,5, and 6 months of age for conventional and early intervention groups. The mean value of both groups is converted into the GMFM percentage calculation.

Table 1- Mean, SD and P- Value using clinical rating head control scale for conventional group

HCS	Mean	SD	p -value
Pretest	2	1.825	<0.05
Post test at 4 months of age	3.2	1.619	
Post test at 5 months of age	4.5	1.715	
Post test at 6 months of age	7	2.403	

Table 2-Mean, SD, P - Value using clinical rating scale for head control for early intervention group

HCS	Mean	SD	p - value
Pretest	2.2	1.873	<0.05
Post test at 4 months of age	3.9	2.024	
Post test at 5 months of age	7.2	1.316	
Post test at 6 months of age	9.8	1.229	

Table 3- Mean, SD & P- Value using GMFM for conventional group

GMFM	Mean	SD	P-value
Pretest	15.2	4.366	<0.05
Post test at 4 months of age	19.3	3.2676	
Post test at 5 months of age	27.7	8.577	
Post test at 6 months of age	38.9	8.9746	

Table 4- Mean, SD & P - Value GMFM for early intervention group

GMFM	Mean	SD	P-value
Pretest	13.9	3.6651	<0.05
Post test at 4 months of age	24.4	4.7888	
Post test at 5 months of age	34.4	6.008	
Post test at 6 months of age	45.8	5.0946	

Table 5- Comparing the pre-test and post-test between group

Test	HCS (P-Value)	GMFM (P-Value)
Pretest	0.8493	0.56868
Post test At 4 Month of age	<0.05	<0.05
Post test At 5 Month of age		
Post test At 6 Month of age		

Table 6 -Percentage mean value of GMFM

GMFM %	Pretest	Post test at 4 months of age	Post test at 5 months of age	Post test at 6 months of age
Conventional group	29%	37%	52%	74%
Early intervention group	25%	47%	66%	89%

Discussion

The purpose of this study is to look at the effects of an early intervention program on post-tracheostomy infants with developmental delay (DD). Infants with developmental delays frequently exhibit obvious functional difficulties as a result of limited access to early intervention treatments and delays in detecting developmental problems[18]. Early detection and intervention for DD improve the activity of the impaired children[19].

The research included infants under the age of four months who underwent tracheostomy and were diagnosed with developmental delay. On the first day of the research, a pediatrician performed a baseline assessment such as the infant's birth records to determine any difficulties during labor, APGAR scores, birth weight, feeding type, and gestational age before beginning the intervention program. A physiotherapist with expertise working with infants evaluated the infant's head control using a clinical rating scale and GMFM-88, especially the lying and rolling component. Pretest was performed two weeks following decannulation. The therapist treated one-month-old infants with great care, notably during the supported sitting component when the therapist's hand softly stabilized the neck to prevent atlantoaxial instability. Between each exercise, appropriate rest intervals are given. Immediate post-treatment results may not indicate substantial treatment benefits until developmental sequences occur, the infants were assessed at 4, 5, and 6 months of age. Following the intervention, the early intervention group improved significantly on average. However, it was shown that two infants still had developmental delays in the early intervention group. Further study of their medical histories revealed that these two infants had been on ventilator support for an extended period throughout their stay in the Pediatric Intensive Care Unit (PICU).

A recent study has shown that intervention programs are cost-effective and may have long-term effects, and that intervention should start early to maximize developmental accomplishment [20-21].

Nonetheless, some risk factors, like extended ventilator support, can have an impact on the intervention's efficacy and careful assessment of the infant's medical history is critical in establishing suitable intervention strategies.

Hence, Tailored therapy should be given according to the duration of the PICU stay in future practice. In this study, we concentrated on neck control exercises, and future studies should incorporate other components such as sitting, kneeling, crawling, standing, and walking. In the conventional group, six infants were found to have developmental impairments. There are no single dropouts in the study, as we scheduled assessment dates before the study and explained the study procedure to parents. Regular follow-up through telephone calls a day before assessment. Since the sample size is small, we could follow up easily.

Conclusion

Early intervention training concentrated on neck control for post-tracheostomy infants showed significant improvement in their neck control and rolling. And organized head movement in space was noted when compared to conventional groups. These improvements contribute to the infant's overall motor development and may facilitate their engagement in age-appropriate activities and interactions.

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