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Original articles

Feeding of children with tracheostomy at hospital discharge

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ABSTRACT

Purpose: to describe the work of speech-language-hearing therapists and verify which was the most prevalent feeding method in the sample studied.

Methods: a descriptive observational study based on data surveyed from medical records. The following variables were used: age, medical diagnosis, hospital ward, feeding method before and after the tracheostomy, time of speech-language-hearing care, and speech-language-hearing discharge. The data were submitted to descriptive statistical analysis with the appropriate tests to compare the categorical variables. All infants and children with tracheostomy performed either before or during hospital stay between July 2017 and July 2018, who received speech-language-hearing care upon request of the physician, were included.

Results: a total of 51 children took part in the study, most of whom were males (56.9%), with a median age of 12 months, ranging from 1 month to 12 years old at the time of the speech-language-hearing assessment. The feeding methods at hospital discharge were described as follows: full oral feeding (37%), partial oral feeding (25.5%), nasogastric/nasoenteral tube (19.6%), and gastrostomy (17.6%).

Conclusion: the full oral diet of tracheostomized children was the most prevalent feeding method at hospital speech-language-hearing discharge.

Keywords: Pediatrics; Deglutition Disorders; Tracheostomy; Speech, Language and Hearing Sciences

INTRODUCTION

Pediatric tracheostomy (TT) is indicated for the comfort of patients with acute airway obstruction and for the treatment or improvement of respiratory care, chronic aspiration (whose indication is controversial in the literature), and prolonged orotracheal intubation[1,2]. TT causes neurophysiological and mechanical changes in swallowing, thus increasing the risk of aspiration[3].

Dysphagia is a common problem in adults presented with TT (50%-87%)[4,5], while most of the children with this condition have comorbidities, and up to 70% of them have severe feeding and swallowing problems[6]. Children with feeding and swallowing impairments are at risk of malnutrition, developmental delay, increase in clinical complications, and stressful relationships with their caregivers[7]. Chronic aspiration can cause pulmonary morbidity and even permanent damage to the lungs[8,9].

TT may impact the four phases of swallowing – the oral preparatory, the oral propulsive, the pharyngeal, and the esophageal phases. In the oral preparatory phase, it may diminish the patient's smell and taste and, consequently, their appetite. In the oral propulsive phase, it may change the oral-motor function, interfering with food bolus preparation, ejection, and oral propulsion[10]. In the pharyngeal phase, it may delay the laryngeal vestibule closure, resulting in laryngeal penetration, diminished or absent cough reflex (due to the inability to generate enough intrathoracic pressure), and restricted laryngeal elevation[3]. In the esophageal phase[11], the inflated cuff of the cannula may compress the esophagus, causing food residue to accumulate in the pyriform sinuses, which in turn leads to laryngotracheal aspiration[11].

The clinical assessment of swallowing in children with TT requires a complex understanding of the patient's overall health status and the identification and distinction of sequelae of the underlying disease and of the TT. It must evaluate the function of the stomatognathic system, the presence, amount, and tolerance of orotracheal secretions, and the risks and benefits of the swallowing assessment[12].

The clinical assessment criteria for swallowing dynamics in patients with TT include an interval of at least 48 hours from the TT surgery and the Blue Dye Test (BDT) and/or Modified Blue Dye Test (MBDT)[13,14].

In the BDT, or blue food coloring test, the oral cavity of patients with TT is dyed and they undergo orotracheal aspirations. The American Speech-Language-Hearing Association (ASHA)[15] recommends not to perform this test in patients with kidney problems, intestinal inflammatory disease, or who are allergic to food colorings. The MBDT includes the possibility of dying foods, ice, and liquids in the swallowing assessment[14]. The objective of these tests is to evidence that saliva or food has been aspirated by the presence of dyed content in the TT cannula or TT aspiration. Hence, blue is used to differ the dyed saliva or food from tracheal secretions[14]. The sensitivity and specificity of the BDT/MBDT have been questioned in the literature. However, they are feasible due to their low cost and possibility of being applied by a trained speech-language-hearing (SLH) therapist with no need for technological resources – which are often not available at the health services, resulting in referrals and waiting lists. They can be used as an additional resource, in combination with the clinical assessment and multidisciplinary follow-up, to identify cases at greater risk of dysphagia and that need an objective swallowing assessment.

The SLH therapists work in hospitals to prevent, diagnose, and rehabilitate cases of dysphagia, reduce and prevent complications, and properly and safely establish/reestablish oral feeding[16].

Given the above, the objective of this study was to describe the work of SLH therapists and verify which was the most prevalent feeding method in the sample studied.

METHODS

This study was approved by the Research Ethics Committee on September 10, 2018, under CAAE no. 94272618.2.0000.5415 and consolidated evaluation report no. 2.881.855, of the School of Medicine (*Faculdade de Medicina*) of São José do Rio Preto (FAMERP), São José do Rio Preto, São Paulo, Brazil. It was exempted from having informed consent forms signed because the data were collected from the medical records.

This is a descriptive observational study conducted with data gathered from medical records. All infants and children with TT performed either before or during hospital stay between July 2017 and July 2018, who received care from an SLH therapist upon request of the physician at the Maternity and Children's Hospital of São José do Rio Preto, São Paulo, were included. The purpose of requesting the SLH therapists' attention was to (re)introduce oral feeding. Medical records of infants and children with TT whose clinical condition was not compatible with an SLH intervention to train oral feeding, as well as those who had begun SLH care

but did not finish it either because it was discontinued due to clinical complications, or the patient had died, were excluded.

The work of an SLH therapist in pediatric hospitalization is focused on dysphagia. Hence, given the objective of this study, patients with other pathologies were excluded as well. At hospital discharge, the children were referred to the specialized outpatient center related to the originating institution or service, as long as it provided SLH care to follow up the patients' feeding and other needs.

Data from the patients' electronic medical records were gathered, considering the following variables: sex, age, main diagnosis, feeding method before the TT, period of SLH care, description of SLH procedures, and feeding method at SLH discharge.

SLH care took place upon request of the physician once the child's clinical condition had been stabilized. The SLH therapists involved had both training and experience to treat pediatric dysphagia and were guided by the hospital's Operational Procedures Protocol and Assistance Protocol, which use existing protocols[13,14,17]. Hence, the assessment initially consisted of patient observation and indirect clinical assessment of swallowing, observing their respiratory pattern, oxygen saturation, and heartbeat. Then, the treatment began, assessing orofacial muscle tone and mobility, searching reflex, sucking reflex, tongue movement, presence/absence of sialorrhea, presence/absence of xerostomia, saliva swallowing, articulatory movement, oral hygiene, and dentition. It is important to highlight that the children undergoing care were breathing natural air spontaneously, not using TT mechanical ventilation.

The hospital's SLH team provided care throughout the week, twice a day on average, for about 20 to 30 minutes of stimulation, depending on the child's clinical case. It encompassed tactile[18]-thermal[19]-gustatory[20] stimulation and the BDT and/or MBDT[13,14], considering a liquid or thickened liquid diet for babies under 6 months old and pureed, liquid, and thickened liquid diet for children older than 6 months. They progressively changed to an oral diet according to the child's age and acceptance.

The BDT was performed after the child had stabilized and was ready to begin oral feeding, and the cuff in those who had one could remain deflated. The retest was conducted 24 hours after the negative BDT. The children whose retest was also negative were submitted to the MBDT. In this phase, the test used safer consistencies for the child's age – those under 6 months old initially received thin liquids, while those older than 6 months initially received pureed food. MBDT was repeatedly performed every time new consistencies were introduced, to verify possible colored secretion aspiration after swallowing the food.

Statistical analysis

The exploratory data analysis included the descriptive statistics, mean, median, standard deviation, and minimum and maximum values of the numerical variables, and number and proportion of the categorical variables. The behavior analysis of the continuous variables considered the descriptive statistics, histograms, boxplots, and the Kolmogorov-Smirnov specific test for the theoretical presupposition of normality[21]. The categorical variables between two related groups (feeding method before and after the TT) were compared with the McNemar test and between two independent groups with Fisher's Exact test. Kruskal-Wallis test for comparative age analysis between three groups and the Mann-Whitney test for post hoc analysis in paired comparison[22] were used. The statistical analysis was made in the IBM-SPSS, version 27 (IBM Corporation, NY, USA). The significance level was set at $p < 0.05$.

RESULTS

The study comprised 51 children. Most of them were males (56.9%), at a median age of 12 months, ranging from 1 month to 12 years old at the SLH assessment. The sample characterization is shown in Table 1.

Table 1. Demographic and clinical data of the children included in the study

Variable	N = 51
Age, months	12 (1 – 155)
Sex, n (%)	
Males	29 (56.9)
Females	22 (43.1)
Hospital ward, n (%)	
Cardiac pediatric ICU	21 (41.2)
Pediatric ICU	18 (35.3)
General ward	10 (19.6)
Neonatal ICU	2 (3.9)
Diagnoses found, n (%)	
Cardiopathies	22 (43.1)
Neuropathies	13 (25.5)
Respiratory problems	9 (17.6)
Sepses	5 (9.8)
Syndromes	1 (2.0)
Tumors	1 (2.0)
Feeding method before TT, n (%)	
Full oral feeding	12 (23.5)
Alternative method	
NGT/NET/OGT	26 (51.0)
Gastrostomy	8 (15.7)
Not reported	5 (9.8)
Time of orotracheal intubation, days	11 (0 – 77)

Numerical variables are described in median (variation); categorical variables are described in numbers (percentage).
Captions: ICU = Intensive Care Unit; TT = Tracheostomy; NGT = nasogastric tube; NET = nasoenteral tube; OGT = orogastric tube.

The comparative analysis of TT feeding methods according to the children's age revealed significant differences. The paired comparison revealed a younger age for the children in alternative feeding (nasogastric/nasoenteral tube, orogastric tube) than for those in full oral feeding and with gastrostomy feeding, as demonstrated in Table 2.

Table 2. Comparative analysis of the feeding methods before the tracheostomy according to the child's age

	Feeding method before TT			P-value
	Full oral feeding N = 12	NGT/NET/OGT N = 26	Gastrostomy N = 8	
Age, months	16.5 (2.0 – 155)	4.5 (1.0 – 76.0)	43.5 (15.0 – 119)	**0.002**

Numerical variables are described in median (variation).
Paired comparison: Full oral feeding vs. NGT/NET/OGT (p = **0.040**); Full oral feeding vs. Gastrostomy (p = 0.395); NGT/NET/OGT vs. Gastrostomy (p = **0.001**).
Captions: TT= tracheostomy; NGT = nasogastric tube; NET = nasoenteral tube; OGT = orogastric tube.
Kruskal-Wallis test.

As for SLH care, 24 (47.1%) children studied had received attention during the hospital stay, before the TT, and 20 (39.2%) of them had not received attention. However, this information was not available in the electronic medical record of 7 (13,7%) children. The time between the TT and the SLH assessment lasted a median of 6 days, at a minimum of 1 day and a maximum of 84 days. The SLH assessment lasted a median of 22.5 days, at a minimum of 1 day and a maximum of 405 days of stimulation.

The SLH assessment procedures described at first were classified as tactile-thermal-gustatory stimulation in 40 (78.4%) assessments and BDT in the other 11 (21.6%). The BDT and MBDT results are shown in Table 3, revealing that most of the children underwent the two stages of the test and had negative results in both examinations.

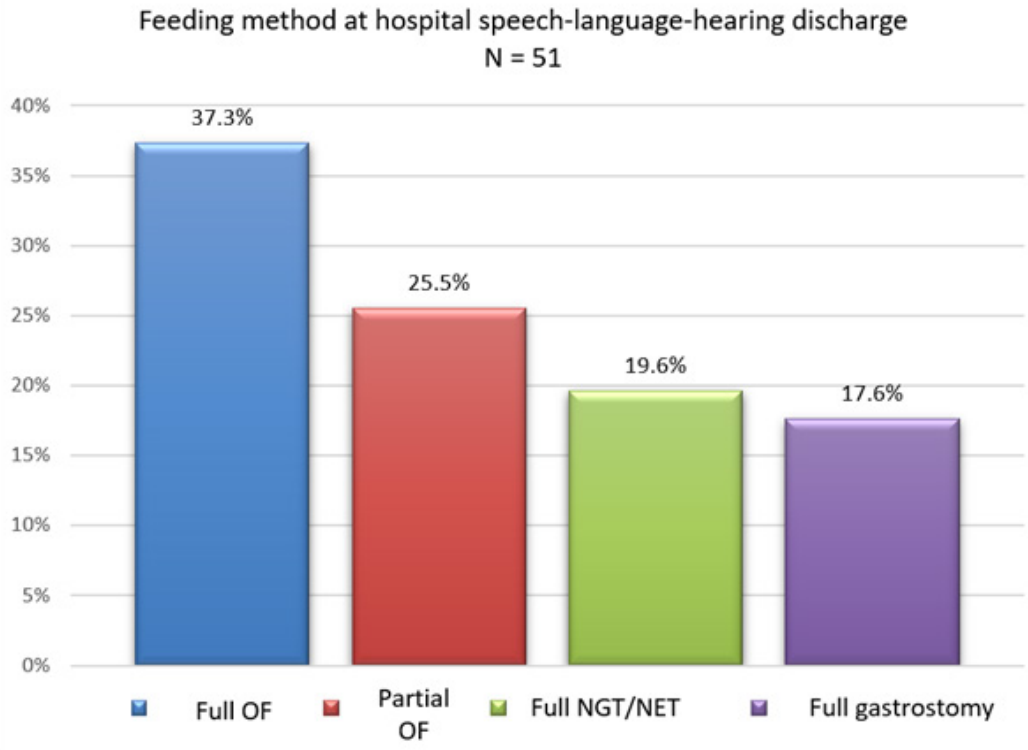
The children who had a positive BDT result in the first test underwent SLH intervention with tactile-thermal-gustatory stimulation. Once the patient's clinical condition had improved, they were again submitted to the BDT to verify whether they could begin training and/or receiving oral feeding.

Table 3. Distribution of the patients according to the Blue Dye Test and Modified Blue Dye Test results

Test	Result		Not performed
	Negative	Positive	
Blue Dye Test	66.7% (34)	9.8% (5)	23.5% (12)
Blue Dye Test (retest)	64.7% (33)	3.9% (2)	31.4% (16)
Modified Blue Dye Test	72.5% (37)	2% (1)	25.5% (13)
Modified Blue Dye Test (retest)	60.8% (31)	5.9% (3)	33.3% (17)

Full oral diet was the prevalent feeding method at hospital SLH discharge (37.3%) among the 51 patients included in the study, as demonstrated in Figure 1.

The comparison of feeding methods before the TT and at hospital discharge is described in Table 4. This analysis included 46 cases because, as in the previous situation, the medical records of five children did not report the feeding method before the TT. Twelve children had full oral feeding before the TT. Five out of these 12 children (41.7%) remained with full oral feeding at hospital discharge, while seven changed to alternative methods. Nevertheless, the total number



Captions: OF= oral feeding; NGT= nasogastric tube; NET= nasoenteral tube.

Figure 1. Distribution of the patients regarding feeding method at hospital discharge

Table 4. Feeding method progress between the two periods: before the tracheostomy and at hospital discharge, of the 46 patients

Feeding method before the TT	Feeding method at hospital discharge				Total
	Full oral feeding	NGT/NET	Gastrostomy	Partial oral feeding	
Full oral feeding	5 (41.7)	2 (16.7)	1 (8.3)	4 (33.3)	12 (100)
NGT/NET/OGT	11 (42.3)	7 (26.9)	2 (7.7)	6 (23.1)	26 (100)
Gastrostomy	1 (12.5)	0 (0.0)	6 (75.0)	1 (12.5)	8 (100)
Total	17 (37.0)	9 (19.6)	9 (19.6)	11 (23.9)	46 (100)

Categorical variables are described in numbers (percentage).
Captions: TT= tracheostomy; NGT = nasogastric tube; NET = nasoenteral tube; OGT = orogastric tube.

of children with full oral feeding increased from 12 to 17 at hospital discharge. This took place because 11 (42.3%) of the 26 children with nasogastric/nasoenteral/orogastric feeding before TT changed to full oral feeding at hospital discharge, as well as one (12.5%) of the eight children with gastrostomy.

For the statistical analysis, the patients were grouped into two categories regarding feeding method: partial or full oral feeding versus alternative methods (tubes, gastrostomy). The comparative analysis revealed a significant difference between the two periods, as seen in Table 5. Three (25%) out of the 12 patients with oral feeding before the TT changed to an alternative method. On the other hand, 19 (55.9%) out of the 34 patients with an alternative feeding method before the TT improved to full or partial oral feeding at hospital discharge, with a significant difference (p = 0.001).

Table 5. Comparative analysis of the feeding methods between the two periods: before the tracheostomy and at hospital discharge

Feeding method before the TT	Feeding method at hospital discharge		Total	P-value
	Full and partial oral feeding	Alternative method		
Full and partial oral feeding	9 (75.0)	3 (25.0)	12 (100)	**0.001**
Alternative method	19 (55.9)	15 (44.1)	34 (100)	
Total	28 (60.9)	18 (39.1)	46 (100)	

Categorical variables are described in numbers (percentage).
Caption: TT= tracheostomy.
McNemar test.

Concerning the time of orotracheal intubation, 5/43 (11.6%) and 38/43 (88.4%) children remained intubated for less than 48 hours and for 48 hours or more, respectively (the information was not available for eight cases). The comparative analysis of the feeding methods at hospital discharge according to the time of orotracheal intubation and the descriptive analysis according to the main diagnosis are both shown in Table 6.

Table 6. Comparative analysis of the feeding methods at hospital discharge according to time of orotracheal intubation

	Feeding method at hospital discharge		Total	P-value
	Full and partial oral feeding	Alternative method		
Main diagnosis, n (%)				
Cardiopathies	18 (81.8)	4 (18.2)	22 (100)	-
Neuropathies	6 (46.2)	7 (53.8)	13 (100)	
Respiratory problems	4 (44.4)	5 (55.6)	9 (100)	
Sepses	3 (60.0)	2 (40.0)	5 (100)	
Syndromes	1 (100)	0 (0)	1 (100)	
Tumors	0 (0)	1 (100)	1 (100)	
Total	32 (62.7)	19 (37.3)	51 (100)	
Time of intubation, n (%)				
Less than 48 hours	4 (80.0)	1 (20.0)	5 (100)	0.643 *
48 hours or more	24 (63.2)	14 (36.8)	38 (100)	
Total	28 (65.1)	15 (34.9)	43 (100)	

Categorical variables are described in numbers (percentage).
* Fisher's Exact test.

DISCUSSION

A significant change in the subjects' feeding patterns, as the number of children with oral feeding increased after TT and SLH intervention, was observed in this study.

The most common age range of pediatric patients needing TT is under 1 year old[23]. The procedure guidelines have changed over the last 30 years. It is more often performed in children with prolonged intubation, followed by children who need a better tracheobronchial clearance and who have obstructive airway malformations. Another study[24] verified that the neuropathies were the most frequent comorbidities requiring TT, followed by pulmonary diseases, genetic syndromes, and prematurity. In the present study, it was seen that the age range had a median of 12 months and that the cardiopathies and neuropathies were the most prevalent diagnoses, followed by respiratory problems, sepses, and tumors.

Children needing prolonged orotracheal intubation (more than 48 hours) are at a greater risk of dysphagia[25] – such a risk increases by 14% for each day in prolonged intubation[26]. The children reported in this study had prolonged intubation, at a median of 11 days, indicating a greater risk of dysphagia.

A study[27] reports that TT does not increase the risk of aspiration and dysphagia. However, another study[28] found a strong correlation between TT and pneumonia, although they ascribed pneumonia to the prolonged intubation before the TT.

The assessment and intervention in TT patients with feeding and swallowing problems must be carried out by SLH therapists with specific training. It involves a complex understanding of the patient's health, considering their feeding profile, clinical conditions, and associated pathologies[29]. The specific types of assessment are defined based on the environment and the child's age and problems[30]. Different observation scales may be used to assess the patient's health status, readiness for feeding, nutritive and non-nutritive oral-motor skills, and safe swallowing[31,32]. The criterion for the clinical assessment of TT patients' swallowing dynamics is a minimum 48-hour interval from the TT surgery[13,14]. In the present study, the median interval from the TT to the SLH assessment was 6 days.

The BDT is a simple, low-cost test that does not require imaging room and equipment and can be performed by the bedside. It can also be used as an initial screening in TT patients. However, since it may have false-negative results, the SLH clinical assessment, SLH follow-up, and clinical progress verification must not be dismissed. A multidisciplinary team must discuss the overall health status of patients with satisfactory evolution, to progress their diet to oral feeding and likely refer them for objective swallowing examinations. In this study, the saliva BDT was performed first and, if colored secretion was absent, the patient was given colored food, progressively increasing its volume.

In research[33] with 31 TT children, 19 aspirated food material, and the authors considered that most of the children had swallowing problems in the various swallowing phases and were at greater risk of aspiration. In the present study, an increased number of patients with oral feeding at hospital discharge – 32 (62.8%) children had oral feeding, 19 (37.3%) of whom with full oral feeding, was verified. The patients with partial oral feeding or alternative feeding at hospital discharge did not have a worsened clinical condition and/or signs of aspiration during hospital follow-up. Their need for an alternative method was due to the hospital discharge, and they were referred for SLH follow-up in their hometown or at the specialized outpatient center for possible diet progression, guidance, and speech and language intervention.

Thus, the SLH therapist is the one responsible for assessing the patient's overall health status, changing their diet according to the child's clinical progress and overall health status, and keeping constant feedback with the multidisciplinary team responsible for the child. Therefore, the SLH therapist is greatly important in the therapeutic planning for children with TT, checking the possibility of oral feeding or adjusting the oral functions. Transdisciplinary teamwork and communication are necessary for the patient's safety and quality of life, aiming at the improvement of their clinical condition.

It must emphasized that, at the time of the research, the hospital was not yet furnishing swallowing and speaking valves for the SLH assessments.

Studies on (re)introducing food to children with TT are few. Hence, further research is necessary to benefit professionals in this field and improve the care given to this population.

CONCLUSION

The whole population in this study had previous comorbidities, were rather young, and had been submitted to prolonged orotracheal intubation. The hospital SLH intervention for pediatric patients with TT must take place early and be grounded on techniques described in the literature, aiming to help in a safer transition from alternative to oral feeding. The full oral diet was the most prevalent feeding method at SLH hospital discharge.

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