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Clinical evolution of children who adapted to the speech valve resource: a self-reported study by parents

Evolução clínica de crianças que adaptaram ao recurso da válvula de fala: um estudo autorreportado pelos pais

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ABSTRACT

Purpose: To describe the clinical picture of tracheostomized children before and after the speech valve adaptation, through the parents' perception. **Methods:** Retrospective cohort study with convenience sampling through an online survey via REDCap. Parents of tracheostomized or decannulated children aged up to 6 years and 11 months, who had or had not adapted the speech valve, participated in this study. Descriptive analyses were performed. **Results:** In total, 96 parents of tracheostomized children participated, of which 26 adapted the speech valve. Parents reported improvement in dysphagia, in the child's vocalization and reduction in the number of endotracheal aspirations. In addition, they described improvement in the child's general clinical condition in 22 (84%) of the cases. **Conclusion:** When indicated, the adaptation of the speech valve improves swallowing and facilitates the normal production of phonation. Thus, the device can help prevent aspiration pneumonia and nutritional complications, as well as aid in the speech development of tracheostomized children.

Keywords: Tracheostomy; Child; Speech valve; Deglutition; Deglutition disorders

RESUMO

Objetivo: descrever o quadro clínico das crianças traqueostomizadas antes e após a adaptação da válvula de fala, através da percepção dos pais. **Métodos**: estudo de coorte retrospectivo, com amostragem por conveniência, realizado mediante pesquisa on-line via *Research Electronic Data Capture* (REDCap). Participaram pais de crianças traqueostomizadas ou decanuladas de até 6 anos e 11 meses de idade. Análises descritivas foram realizadas. **Resultados**: no total, participaram 96 pais de crianças traqueostomizadas, das quais, 26 adaptaram a válvula de fala. Os pais relataram melhora no quadro de disfagia, na vocalização da criança e redução no número de aspirações endotraqueais. Além disso, descreveram melhora do quadro clínico geral da criança em 22 (84%) dos casos. **Conclusão**: quando indicada, a adaptação da válvula de fala melhora a capacidade de deglutição, reduz o número de aspirações endotraqueais e ainda promove maior facilidade na produção da fonação. Assim, o dispositivo pode auxiliar na prevenção de pneumonia aspirativa e complicações nutricionais, além de contribuir para o desenvolvimento da fala das crianças traqueostomizadas.

Palavras-chave: Traqueostomia; Criança; Válvula de fala; Deglutição; Transtornos de deglutição

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INTRODUCTION

Upper airway disorders are indications for pediatric tracheostomy[1]. The most common ones involve prolonged mechanical ventilator dependency due to conditions like prematurity, aspiration syndromes and congenital diseases, such as laryngomalacia and laryngeal stenosis[2,3]. In addition to the main indications, tracheostomy can aid in mechanical ventilation weaning, shorter hospital stays, and lower incidences of pneumonia and lung damage[4].

Although tracheostomy is sometimes necessary, it changes swallowing physiology and may compromise breastfeeding[5]. These changes in swallowing biomechanics prevent subglottic pressure rise and reduce laryngeal sensitivity, which may cause dysphagia. Consequently, a series of respiratory complications may occur, in addition to malnutrition and dehydration[6,7]. Speaking valve placement can support swallowing biomechanics and oral rehabilitation[8].

A speaking valve is a plastic device that fits onto the end of tracheostomy tubes and mechanical ventilation circuits. The one-way mechanism restores subglottic pressure and laryngeal sensitivity. After inhaled air enters the tracheostomy tube, the valve closes, redirecting exhaled air to the upper airways, thus improving swallowing, communication, and oropharyngeal sensitivity[7]. Furthermore, the valve can reduce secretions, the risk of food penetration or aspiration into the lower airways, and expedite tracheostomy decannulation, resulting in greater benefits to the child's speech and well-being[9,10].

In the literature, studies have described the role of speaking valves in adult tracheostomy rehabilitation. However, for the pediatric population, there is still little scientific evidence assessing the impact of speaking valves on swallowing performance. This study aimed to show parents' points of view regarding the clinical condition and oral functions of children with tracheostomies, before and after adapting to a speaking valve.

METHODS

This retrospective cohort study was performed through an online questionnaire, via the Research Electronic Data Capture (REDcap) platform. The parents of tracheostomized or decannulated children used the questionnaire to self-report retrospective information about the adaptive process, from birth until after the placement of the speaking valves. Researchers used convenience sampling. From October 11, 2021, to July 1, 2022, researchers, collaborators and professional peers publicized an information folder on social media platforms to recruit voluntary participants. The study was approved by the research ethics committee of a federal university of health sciences in Porto Alegre - CEP-UFCSPA, under approval no. 4.972.639. All respondents accepted and signed the Informed Consent Form (ICF).

To determine the proportion of the outcome of speaking valve adaptation, a sample size calculation was conducted, with a 15% amplitude for the confidence interval (with an additional 10% for losses and refusals). The Wald method and the online PSS Health tool[11] were used to calculate the 95% confidence level and 44% of the expected percentage for speaking valve adaptation[12]. The total estimated size was 169. Eligible parents had tracheostomized or decannulated children, 6 years and 11 months or younger, who successfully adapted to a speaking valve or failed to adapt.

The questionnaire was developed by the authors after extensive discussions and the use of references like the Brazilian Consensus on Tracheostomy in Children[13], other research on the subject[6,14-16], and the family socioeconomic profiles in the 2020 census issued by the Brazilian Institute of Geography and Statistics (IBGE)[17]. In addition, professional peers, including a thoracic surgeon, a physiotherapist, and a speech-language pathologist - all experts in the area - analyzed the draft of the questionnaire and made suggestions. Afterwards, pilot tests were carried out with extended relatives of the tracheostomized children, as well as internal tests among the researchers and collaborators. The revised version of the questionnaire was considered final when there were no more suggestions for improvement.

The questionnaire consisted of five parts, contained 130 questions and took an average of twenty-five minutes to complete. The study sample was characterized by data from the clinical diagnoses and the reasons that led to tracheostomy. Three stages were outlined (family profile and situation, clinical conditions of the child, and adaptation to the speaking valve). The following variables were analyzed: regions of Brazil (Southeast, South, North, Northeast and Central-West); education (no formal education, unfinished elementary education, complete elementary education, unfinished high school, complete high school, unfinished higher education, complete higher education, vocational education, master's or doctorate); average family income (between 1 to 1 thousand brazilian real, 1 to 3 thousand brazilian real, 3 to 5 thousand brazilian real, 5 to 10 thousand brazilian real, 10 to 20 thousand brazilian real, or 20 to 100 thousand brazilian real); hospital care (through private health insurance or public health insurance - SUS); clinical diagnoses of children who adapted to the valve (neurologic impairment, lower and upper airway disorders, gastrointestinal disorders and lung disease); reason for using the speaking valve (decannulation strategy, communication, improved swallowing and mechanical ventilation weaning strategy); health care professional (speech-language pathologist, doctor or physiotherapist); speech-language therapy during adaptation (yes or no); health insurance coverage of the valve (private or public - SUS); signs during the first trial of the valve (respiratory discomfort, irritability, crying, attempts to blow it off, cyanosis, vocalization, no behavioral changes, sweating and paleness); endotracheal aspirations before the valve; endotracheal aspirations after the valve; dysphagia before the valve (yes or no); dysphagia after the valve (yes or no); vocalization before the valve (yes or no); vocalization after the valve (yes or no); current conditions of the child after the valve (improved, worse, unchanged).

The descriptive data analysis included raw and relative frequency calculations, mean and standard deviation or median and interquartile range dispersion measures. All analyses used RStudio (version 1.1.383), an integrated development environment, and R statistical software (version 3.6.1).

RESULTS

A total of 145 responses were collected, and 96 (66%) were considered complete and valid. The largest group of respondents came from the Southeast region, with 48 (50%) responses, followed by the South region with 32 (33%). The predominant level of education was a complete bachelor's degree, 34 (35%) participants, and 40 (41%) of the respondents reported the most

frequent family income, between 1 to 3 thousand brazilian real. There was an equal match between private and public health insurance coverage for hospital care - including hospitalization, diagnosis, treatment and rehabilitation (Table 1).

There were 96 tracheostomized children, and 26 (38%) adapted successfully to the speaking valve. Table 2 presents the main clinical diagnoses of the children with indications for the device, with neurologic impairment in 18 (69%) and lower airway disorders in 13 (50%) being the most common. The main reason for recommending the valve was decannulation strategy in 19 (19%) cases, and 20 (76%) of the speaking valves were paid out of pocket. The speech-language pathologist was the main professional responsible for recommending the speaking valve in 15 (57%) of the cases and accompanied 24 (92%) of the fittings. At the first trial of the speaking valve, the main signs parents observed were respiratory discomfort in 16 (16%), irritability in 15 (15%), crying in 14 (14%) and attempts to remove the device in 14 (14%) (Table 2).

Table 1. Family profile of children with tracheostomies (n=96)

VARIABLE	n (%)
Regional Divisions of Brazil	
Southeast	48 (50%)
South	32 (33%)
Central-West	8 (8%)
North	4 (4%)
Northeast	3 (3%)
Parent or Guardian Educational Level	
Bachelor's degree	34 (35%)
Complete high school education	23 (23%)
Unfinished college education	17 (17%)
Unfinished elementary/middle school education	12 (12%)
Master's or doctorate	5 (5%)
Vocational education	3 (3%)
Complete elementary education	1 (1%)
No formal education	1 (1%)
Family income (average)	
1 to 3 thousand brazilian real	40 (41%)
5 to 10 thousand brazilian real	22 (22%)
Between 1 to 1 thousand brazilian real	14 (14%)
3 to 5 thousand brazilian real	12 (12%)
10 to 20 thousand brazilian real	4 (4%)
20 to 100 thousand brazilian real	4 (4%)
Health insurance	
Private health insurance	48 (50%)
Public health insurance (SUS)	48 (50%)

Subtitle: n (%) = number of children (percentage)

Table 3 describes the clinical progress of the children before and after adapting to the speaking valve. For most of the children, the frequency of nocturnal endotracheal aspiration was reduced to none after using the valve. A total of 15 (60%) were diagnosed with dysphagia before using the speaking valve. This percentage was reduced to 7 (24%) after adapting to the

Table 2. Clinical diagnosis, reason for using the speaking valve, health care professional, and signs in children adapting to speaking valves (n=26)

VARIABLE	n (%)
Clinical diagnoses of children adapting to speaking valves	
Neurologic impairment	18 (69%)
Lower airway disorders	13 (50%)
Upper airway disorders	5 (19%)
Gastrointestinal disorders	5 (19%)
Lung disease	2 (7%)
Reason for using speaking valve	
Decannulation strategy	19 (19%)
Communication	17 (17%)
Improved swallowing	17 (17%)
Ventilator weaning strategy	3 (3%)
Health care professional	
Speech-language pathologist	15 (57%)
Doctor	8 (30%)
Physiotherapist	3 (11%)
Health insurance coverage for the speaking valve	
Private health insurance	20 (76%)
Public health insurance (SUS)	6 (23%)
Speech-language therapy in the adaptive process	
Yes	24 (92%)
No	2 (7%)
Signs in children on the first trial	
Respiratory discomfort	16 (16%)
Irritability	15 (15%)
Crying	14 (14%)
Attempts to blow off the valve	14 (14%)
Cyanosis	5 (5%)
Vocalization	5 (5%)
No behavioral changes	5 (5%)
Sweating	4 (4%)
Paleness	1 (1%)

Subtitle: n (%) = number of children (percentage)

Table 3. Clinical progress in children using a speaking valve (n=26)

VARIABLE	n (%)
Endotracheal aspiration before and after using the speaking valve (at night)	**14 (53%)**
1 occurrence before and none after	2 (12%)
2 occurrences before and none after	3 (16%)
3 occurrences before and none after	3 (16%)
4 occurrences before and none after	2 (12%)
5 occurrences before and none after	1 (6%)
6 occurrences before and none after	1 (6%)
20 occurrences before and 10 after	1 (6%)
4 occurrences before and 4 after	1 (6%)
Dysphagia diagnosis before using the speaking valve	
Yes	15 (60%)
No	11 (40%)
Dysphagia diagnosis after using the speaking valve	
Yes	7 (24%)
No	19 (76%)
Vocalization before using the speaking valve	
Yes	7 (24%)
No	19 (76%)
Vocalization after using the speaking valve	
Yes	20 (77%)
No	6 (23%)
Current status after using the speaking valve	
Improved	22 (84%)
Worse	1 (3%)
No change	3 (11%)
Mode of Ventilation (at the time of the interview)	
Ambient air	21 (80%)
Ayre's T-piece breathing circuit	2 (7%)
Mechanical ventilation	2 (7%)
BiPap	1 (3%)
Nutrition delivery mode (at the time of the interview)	
Oral	15 (57%)
Gastrostomy tube	15 (57%)
Nasogastric tube	3 (11%)
Parenteral nutrition	1 (3%)
Children successful at tracheostomy decannulation	7 (26%)
Use of the speaking valve to occlude the tracheostomy tube before decannulation	3 (11%)

Subtitle: n (%) = number of children (percentage); BiPap = BiLevel Positive Airway Pressure machine

device. Vocalization increased in 20 (77%) of the children after adaptation. According to the parents, 22 (84%) of the children who successfully adapted to the valve showed improvement in their conditions. At the time of the questionnaire, 21 (80%) of the children breathed ambient air; 15 (57%) were fed orally and 15 (57%) by gastrostomy tube. Table 3 also shows that 7 (26%) of the children who were fitted with the speaking valve had already completed decannulation. In 3 (11%) of the cases, the valve was used to occlude the tracheostomy tube before decannulation.

DISCUSSION

The parents self-reported improvement in the children's clinical conditions after adapting to the speaking valve, especially vocalization issues and dysphagia. The device has proven to be an important resource for the health and adequate rehabilitation of tracheostomized children. Speaking valves are only available in a few inpatient units since, in most cases, families have to purchase the device out of pocket. Income and education level may be limiting factors when acquiring the valve because it is not available through the public health system (SUS). This means the healthcare team must inform the family about the out-of-pocket expense. In addition, a multidisciplinary inpatient team must monitor the child throughout the process. Future efforts should aim to guarantee wider access and adequate adaptation.

Tracheostomy decannulation improves oral functions, expedites hospital discharge, and provides greater patient comfort. Within this context, speaking valves can play a key role in accelerating the decannulation process[18,19]. In the present study, we identified decannulation as one of the main reasons for recommending a speaking valve. In addition, the results showed a decrease in nocturnal endotracheal aspiration after adapting to the device. This corroborates the findings of another tracheostomy study that showed a reduction in secretions and, consequently, endotracheal aspiration[5].

Using a speaking valve restores the closed respiratory system, thus favoring normal airflow physiology and reestablishing subglottic pressure. This is essential for vocal fold and upper airway function, and vocalization[20]. In the present study,

an increase in vocalization after adaptation to the valve was similarly observed. Likewise, the one-way valves restored swallowing function in the study sample, resulting in better management of secretions and the cough reflex. This was due to the more effective closed system which prevents exhaled air from escaping through the valve, thus reducing the risk of dysphagia[21]. Another study interviewed 22 parents of children with speaking valves, and 17 reported progress in communication and secretion management. Additionally, nine parents reported that feeding had improved, 15 parents felt that the valve had a positive impact on the child, and 14 described a positive impact on the family[22]. All respondents said they would recommend speaking valves.

Our research revealed certain signs in children adapting to a speaking valve. A different study analyzed ten medical records of tracheostomy-dependent children who were fitted with speaking valves. The authors observed the following signs and situations: coughing, breath holding, using forced exhalations to blow off the valve and, in some cases, immediate vocalization[23]. Any discomfort can be attributed to high transtracheal pressure, which can be measured by a manometer[24]. Checking and adjusting pressure can relieve discomfort. The family's willingness to monitor the child during daily adaptation hours also helps stabilize clinical signs. The researchers stated that babies younger than 12 months need a longer adaptation time, compared to children over 5 years old[25].

The support of a speech-language pathologist when the valve is prescribed, and also during the child's adaptation and rehabilitation process, has proven to be fundamental. One study described the importance of a speech-language pathologist in routine pediatric assessments and the process of building speaking valve tolerance during waking hours[23]. Another study showed that patients using speaking valves gain muscle strength more successfully in speech therapy rehabilitation, thus reconditioning oral functions. Furthermore, speech therapy helps with the preparatory phase of swallowing, through therapeutic orofacial sensory-motor stimulation. Direct and indirect exercises can improve the strength, mobility and sensitivity of the structures involved in this process, reawakening the child's interest in food while encouraging safer oral feeding[26]. The role of the speech-language pathologist in the rehabilitation of these patients is underscored.

Regarding the children who did not successfully adapt to the speaking valve, most of the families explained that they did not understand the device, nor did they have the support of qualified healthcare professionals. Another study reported on the impact of lack of knowledge as they analyzed a multidisciplinary team from a Pediatric Intensive Care Unit, and their understanding of the speaking valve. The study highlighted that more than half of the interviewees reported knowing more or less, a little, or not at all about the speaking valve. As for handling the device, the interviewees reported understanding more or less, a little or not at all. The conclusion was that, for the most part, the professionals had insufficient knowledge about the speaking valve, and needed team training to ensure that more children adapt as indicated. With proper handling, children can have a positive experience, improving their quality of life and that of the family[27].

This study had limitations. Parent self-reports make it difficult to obtain accurate responses, and may be influenced by memory bias. Not all parents were familiar with the terms or the procedures performed by the multidisciplinary team, and they may have forgotten which procedures or situations applied to their child. The age variable was also a limiting factor in characterizing trials with the speaking valve, because the adaptation period may be different for each age group. This point of investigation is recommended for future studies. Another limiting factor was the sample which did not reach the calculated size, probably because of the highly specific target audience and fewer means of publicizing information. Moreover, the questionnaire was not validated. Despite these limitations, few studies in the literature describe the benefits of speaking valves in the pediatric population or the progress of these patients. Additionally, they present small sample sizes. Therefore, the value of this study still stands as a contribution to the knowledge among health professionals and families, by detailing the effects of the speaking valve in the rehabilitation of children with tracheostomies. Given the shortage of studies in this area, more research is needed to ensure evidence-based practice.

CONCLUSION

According to the parents' reports, the speaking valves improved swallowing, reduced the number of endotracheal aspirations, facilitated phonation, and supported speech development in their children. Moreover, they reported other general benefits, such as greater comfort and quality of life for the children. Therefore, it is important to have a qualified multidisciplinary team assess this population because speaking valves have been shown to prevent aspiration pneumonia and nutritional complications.

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