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Preoperative Augmentative and Alternative Communication Enhancement in Pediatric Tracheostomy

Rachel Santiago, MS, CCC-SLP; Michelle Howard, MS, CCC-SLP; Natasha D. Dombrowski, BA; Karen Watters, MB, BCh, BAO, MPH; Mark S. Volk, MD, DMD; Roger Nuss, MD; John M. Costello, MA, CCC-SLP; Reza Rahbar, DMD, MD

Objectives/Hypothesis: Describe augmentative communication tools and strategies used by pediatric patients referred to inpatient speech-language pathologists prior to tracheostomy placement.

Study Design: Retrospective review.

Methods: A review of patients who underwent initial tracheostomy placement from 2013-2016 was conducted at a tertiary pediatric center. Eligible patients were those who were referred to a specialized speech-language pathologist prior to the date of the tracheostomy placement to support communication abilities. Patients were identified by surgical procedural and billing codes. Data collected included patient demographics, speech and language disorders, and interventions performed. Chart review and cross analysis of billing data for types of assessment and intervention procedures were conducted by two speech-language pathologists for consensus agreement.

Results: Forty-six patients (aged 1 month–27 years, mean = 12.9 years) were included in the study. Average time between the bedside communication assessment and tracheostomy procedure date was 17 days. Baseline speech-language disorders were identified in 11 patients (24%). Thirty-eight (83%) patients were nonspeaking at the time of consultation. Thirty-two (70%) patients utilized an electronic communication tool, and 36 (78%) utilized low-technology communication strategies during the preoperative period. A total of 32 (70%) patients were documented as using no-technology or speech-enhancement strategies during the acute hospitalization.

Conclusions: Multidisciplinary tracheostomy teams should consider consultation to speech-language pathologists for patients prior to tracheostomy placement to assess for utility of high-technology, low-technology, and no-technology augmentative and alternative communication strategies.

Key Words: Augmentative and alternative communication, tracheostomy, pediatric.

Level of Evidence: 4

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INTRODUCTION

Effective communication between patients and their providers across healthcare settings has been identified as a key factor in patient safety, satisfaction, and overall quality of care.[1] In 2010, the Joint Commission updated its standards for patient-centered communication to include a mandate that necessitates accredited hospitals to identify and address the needs of patients with communication vulnerabilities.[2] The Joint Commission acknowledged communication interventions as a critical factor in care, paramount to preserving the patient's basic human right to effective communication and genuine interactions with families, loved ones, and care providers. Research has shown that the inability to communicate effectively is a leading cause of adverse medical errors and sentinel events,[3,4] and a reduced ability to communicate has been shown to negatively affect a patient's mood, anxiety, fear, and connectedness.[5] Common strategies, including lip reading, gestures, and head nods may result in time-consuming and incorrect interpretation of messages.[6,7] Given the known high risk for nonspeaking conditions in patients with tracheostomies, it can be inferred that this population is therefore at high risk for poor patient-provider communication and emotional distress as a result of reduced phonation and communication access.[8] This risk is often amplified in the pediatric population due to emerging communication development, preliteracy status in some patients, and complex medical and diagnostic considerations.[8–10]

The most common reasons for undergoing tracheostomy placement may include chronic lung disease, neurological impairment, and upper-airway anomalies,[11] all of which could potentially result in a nonspeaking condition for pediatric patients. Therefore, patients may be at risk for communication vulnerability both before and after a tracheostomy procedure. Given that not all pediatric patients tolerate a deflated tracheostomy cuff or speaking valve,[8] options to

From the Department of Otolaryngology and Communication Enhancement (R.S., M.H., N.D.D., K.W., M.S.V., R.N., J.M.C., R.R.) and Augmentative Communication Program (R.S., M.H., J.M.C.), Boston Children's Hospital, Boston, Massachusetts; and the Department of Otolaryngology (K.W., M.S.V., R.N., R.R.), Harvard Medical School, Boston, Massachusetts, U.S.A.

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Send correspondence to Reza Rahbar, DMD, MD, Department of Otolaryngology and Communication Enhancement, Boston Children's Hospital, 300 Longwood Avenue, Boston, MA 02115. E-mail: reza.rahbar@childrens.harvard.edu

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enhance communication during wakeful, nonspeaking periods are paramount to ensuring participation in care, social connection to staff and loved ones, and perceived control. Presurgical consultation for communication planning in the case of a known high risk of nonspeaking condition has been shown to yield positive outcomes in pediatric patients.[12] In certain instances, patients too sedated to actively participate in presurgical planning may still be appropriate for consultation through information gathering from caregivers, providers, and families to ensure accessibility and availability of communication tools as sedation is weaned.

Augmentative and alternative communication (AAC) strategies are typically considered when oral speech is not an immediate option. As defined by the American Speech, Language, and Hearing Association, AAC involves all forms of communication beyond oral speech used to express thoughts, feelings, comments, wants, needs, and ideas in an effort to produce true and spontaneous communication.[13] AAC encompasses multiple modalities, including gestures, facial expressions, use of symbols or pictures, writing and orthography, via no-technology, low-technology, and high-technology platforms. For patients with communication vulnerabilities, including those undergoing tracheostomy, implementation of AAC to enhance communication may be essential in supporting true and authentic patient-provider communication.

Despite evidence that highlights the benefits of AAC tools and strategies for individuals who cannot use speech to meet everyday communication needs,[14] there is minimal literature discussing the benefits and types of AAC tools and strategies recommended for pediatric patients undergoing tracheostomy. The objective of this study was to describe bedside AAC assessment and intervention recommendations in patients referred to a formal inpatient augmentative communication service prior to tracheostomy placement in a pediatric acute-care setting.

MATERIALS AND METHODS

A retrospective review was conducted for patients who underwent initial tracheostomy placement at our tertiary referral center and were followed by a speech-language pathologist (SLP) in the Inpatient Augmentative Communication Program between 2013 and 2016. This study was approved by the Boston Children's Hospital Institutional Review Board. Patients were identified by surgical procedure codes for tracheostomy placement and billing codes for speech, language, and communication and/or speech-generating device assessment and intervention. Exclusion criteria were patients who underwent a tracheostomy at an outside hospital, underwent replacement of a tracheostomy tube secondary to temporary nasal or oral intubation for surgical interventions in the setting of prior baseline tracheostomy status, were older than 30 years, and/or were not followed by the Inpatient Augmentative Communication Program. Data collected included timing of the AAC consult relative to the date of the tracheostomy insertion, baseline speech and language skills, recommendations for communication strategies at the time of the initial assessment encounter, and types of AAC interventions on follow-up encounters. Two SLPs (R.S. and M.H.) and an independent research assistant (N.D.D.) reviewed all medical records for consensus agreement.

The Bedside Feature-Matched Assessment

Patients were referred to an SLP for an AAC consult by providers if they were determined to have possible communication vulnerability during their inpatient stay. Communication vulnerability is defined as a diminished capacity in expressive and/or receptive communication abilities and includes baseline vulnerabilities or acute onset vulnerability, such as a new tracheostomy.[5] A feature-matched assessment (described further in Table I) was performed by an SLP during the initial assessment encounter to identify the most appropriate recommendations to enhance the patient's communication. The process of performing a feature-matched assessment includes identifying the individual's unique needs and skills and matching them to available and appropriate communication strategies.[14–16] Bedside feature-matched assessments are dynamic in nature and may occur across the recovery continuum, including times when patients may be sedated or intubated, given patients' changing needs and medical status.[5,14,17]

AAC Strategies

For the purpose of this study, recommendations by the SLP were categorized as being high-technology communication aids, low-technology communication aids, or unaided strategies. High-technology communication aids included speech-generating devices and other forms of aided communication strategies that incorporate voice-output technology and can be implemented to support a wide range of communicative functions, from gaining attention to conveying complex, generative messages.[13,14] Speech-generating devices utilized digital recordings or synthesized speech and ranged from single message systems to robust, dynamic, and dedicated devices. A patient's ability to access a high-technology system was considered during the bedside feature-matched assessment. Access considerations included vision, hearing, impeding medical devices or apparatuses, and fine and gross motor skills impacting strength and coordination. Appropriate accommodations were implemented to support the individual's ability to physically access the system in a functional and reliable manner. Accommodations included use of mounting equipment to hold devices, switches, eye-tracking technologies, pointers, and modifications to device settings to support visual, physical, and auditory access needs. If appropriate, patients were also assessed for readiness and ability to participate in Message Banking (Boston Children's Hospital, Boston, MA, United States). Message Banking involves recording a person's own voice saying a variety of relevant messages, typically chosen by the individual, which are later programmed and integrated into a speech-generating device.[12] A patient who banks messages prior to a surgical procedure may practice using the recommended speech-generating device before the anticipated nonspeaking condition and again once speech production is reduced.

Low-technology AAC systems include aided communication strategies and materials that do not incorporate voice-output technology or electronic platforms.[13,14] These may include picture-communication boards, communication books, letter boards, writing tablets, and other materials. For all aided communication systems, including high-technology and low-technology solutions, language may be represented in various ways based on the individual patient's linguistic, cognitive, sensory, and developmental skills. Symbolic representation of language may include photographs, picture-communication symbols, objects or object symbols, text, or a combination of these. Pediatric patients pose the need for customized strategies due to the heterogeneity of developing language skills. Therefore, dissemination of tools cannot be a one size fits all approach.

Unaided strategies, including methods of communication that do not require use of external materials or equipment, were also considered during the bedside feature-matched assessment. These strategies may include use of eye gaze, eye movement, gestures, facial expressions, body language, sign language, speech, and other physical communication behaviors. [13,14]

Patients who require AAC supports during a hospitalization may benefit from multiple tools and strategies to adequately

TABLE I.
Domains of a Bedside Feature-Matched Assessment*

Assessment Domain	Assessment and Intervention Considerations
Cognition	Sedation level
	Ability to maintain wakefulness
	Baseline/premorbid status
	Medication effect
	Sleep hygiene
	Delirium
	Attention to task
	Attention to others
	Symbolic understanding of visuals (e.g., photographs, picture-communication symbols, written text)
Sensory profile	Vision: current and premorbid status
	Availability of visual aids
	Hearing: current and premorbid status
	Availability of hearing aids, cochlear implant, or amplification equipment
	Feasibility of wearing and tolerating use of sensory aids
	Impact or interference of medical equipment
	Impact or interference of swelling and incision sites
Expressive communication	Primary language
	Baseline/premorbid status
	Expressive language skills
	Speech intelligibility
	Impact of noninvasive ventilation on breath support, volume, articulation, and resonance
	Presence of endotracheal tube
	Ability to mouth single words or phrases in context of ventilation
	Speaking volume
	Presence of airway anomalies that affect speech production
	Tracheostomy cuff status
	Speaking valve tolerance
	Ventilator settings
Receptive communication	Primary language
	Baseline/premorbid status
	Ability to follow verbal directions
	Ability to answer yes/no questions
	Ability to comprehend complex messages
	Ability to comprehend gestures and physical behaviors
Literacy	Comprehension of written words
	Ability to spell single words, phrases, and sentences
	Ability to use a keyboard
	Speed of access to various keyboard layouts
Physical access	Fine and gross motor skills
	Use of gestures for functional communication
	Use of facial expression for functional communication
	Use of eye gaze, eye blinks, and eye pointing
	Motor control and coordination
	Ability to directly select icons on various displays (e.g., via pointing with hand, eyes, pointer, or other direct methods)
	Ability to indirectly select icons on various displays (e.g., via switch scanning, partner-assisted scanning of messages, or other indirect methods)
	Ability to write
	Ability to draw
	Need for mounting equipment to optimize access to AAC tools
	Impact of medical devices and equipment (e.g. IV boards, restraints, EEG leads, chest physical therapy vests, etc.)
	Positioning restrictions
Vocabulary selection	Patient needs
	Patient desires
	Patient personality
	Patient interests
	Participation in play
	Participation in medical discussions
	Participation in social interactions
	Ability to inquire and ask questions
	Ability to opt out, decline, or protest
Bedside environment	Lighting
	Noise
	Impact of mounting equipment at bedside
	Presence of medical devices and equipment
	Staff access to patient
	Storage of AAC tools at bedside
Communication partners	Primary language
	Caregivers and family at bedside
	Frequent providers and team members
	Partner training for implementation of selected communication tools and strategies
	Documentation of AAC assessment and intervention
	Dissemination of information regarding AAC tools
	Education of caregivers and staff members

*Adapted from Costello et al.[16]
AAC = augmentative and alternative communication.

ensure access to supports throughout the day.[5] Depending on the patient's medical status, strength and coordination abilities, speech and language skills, and various other factors (Table I), certain strategies may be warranted simultaneously or in succession throughout the recovery continuum. Level of sedation and degree of wakefulness are important determinates of AAC intervention, as patients who are wakeful while intubated require immediate access to communication materials, whereas patients under heavier sedation may benefit from caregiver education and collaboration to prepare for the patient becoming more wakeful. Therefore, a communication system comprised of multiple tools and strategies is often considered and recommended.

TABLE II.
Patients Referred for Speech-Language Pathologist Consultation Pretracheostomy.

Age	No.	High-Technology Strategies	Low-Technology Strategies	Both High- and Low-Technology Strategies	Speech Enhancement Strategies (No Technology)
0–18 months	6	0 (0%)	0 (0%)	0 (0%)	6 (100%)
19 months–4 years, 11 months	3	1 (33.3%)	3 (100%)	2 (66.7%)	1 (33.3%)
5–9 years, 11 months	8	7 (87.5%)	6 (75.0%)	6 (75.0%)	4 (50.0%)
10–14 years, 11 months	5	4 (80%)	4 (80.0%)	3 (60.0%)	4 (80.0%)
15–27 years	24	20 (83.3%)	23 (95.8%)	18 (75.0%)	17 (68.0%)
Total	46	32 (69.6%)	36 (78.3%)	29 (63.0%)	32 (69.6%)

RESULTS

Eighty-three patients underwent tracheostomy and were concurrently referred for assessment and intervention support by SLPs from the Inpatient Augmentative Communication Program during the study period. Forty-eight (58%) of these patients were referred prior to tracheostomy placement. One patient was excluded due to lack of follow-up assessment and one patient was excluded for age >30 years. Therefore, a total of 46 patients were included in the study. Patient ages ranged from 1 month to 27 years old, with a mean age of 12.9 (±7.5) years (Table II). Reason for tracheostomy was variable, with prolonged ventilator dependence and/or failure to extubate being the most common etiology (Table III). Baseline speech and language impairments were documented in 24% (n = 11) of all included patients.

Upon initial preoperative assessment, 83% (n = 38) were already intubated or otherwise nonspeaking at the time of SLP consultation. Following the bedside feature-matched assessment, recommendation for a high-technology, electronic communication tool was made for 70% (n = 32). Eight (17%) patients were identified as being able to use oral speech prior to the tracheostomy procedure, and 50% (n = 4) of those patients participated in Message Banking. Patients who did not participate were between the ages of 12 and 20 years old and had an existing supplemental oxygen requirement at the time of consult including bilevel positive airway pressure (BiPAP), nasal cannula, or high-flow nasal cannula. One patient did not use oral speech as a primary communication method at baseline; rather, they utilized a speech-generating device and other AAC strategies. Two patients required 24-hour BiPAP support. Although they were determined to be able to sprint for brief periods to record their own voice, they ultimately declined. The fourth patient had prior experience with speech-generating devices that utilized a synthetic voice and declined participation. Low-technology communication strategies were recommended for 78% (n = 36) of patients assessed preoperatively, all of whom were older than 18 months. Twenty-nine (63%) patients were offered both high- and low-technology strategies preoperatively. Unaided strategies were formally documented in 70% of patient charts, with 100% of patients <18 months of age having documented use of unaided strategies and/or speech enhancement strategies. The mean number of days between the initial assessment by the SLP and the tracheostomy procedure was 17 days. Approximately 56.5% (n = 26) of patients were referred and assessed >7 days prior to tracheostomy placement.

TABLE III.
Reason for Tracheostomy Among 46 Patients.

Reason for Tracheostomy	No. of Patients (% of Total)*
Ventilator dependence/failure to extubate	25 (54.3%)
Respiratory failure	13 (28.3%)
Continuous positive airway pressure or bilevel positive airway pressure dependence	12 (26.1%)
Cystic fibrosis	8 (17.4%)
Unstable airway	5 (10.9%)
Recurrent desaturations	3 (6.5%)
Severe obstructive sleep apnea	3 (6.5%)
Bilateral vocal fold paralysis	3 (6.5%)
Poor pulmonary toilet	2 (4.3%)
Extracorporeal membrane oxygenation dependence	2 (4.3%)
Acute respiratory distress syndrome	1 (2.2%)
Recurrent head/neck tumor	1 (2.2%)
Hyper-IgM syndrome	1 (2.2%)

*Patients had multiple reasons for tracheostomy.
IgM = immunoglobulin M.

DISCUSSION

Enhancing communication of patients at risk for nonspeaking conditions, including pediatric patients undergoing tracheostomy, is often warranted due to anticipated reduction in speech production and phonation.[5,12,17–22] In this study, augmentative communication consultation more commonly occurred prior to tracheostomy placement rather than after the procedure. All patients, regardless of timing of consultation, underwent a bedside feature-matched assessment to identify appropriate communication systems given current or anticipated skills and needs. Seventy percent of all patients were provided with a high-technology communication aid or speech-generating device, and 78% utilized low-technology strategies, with 63% utilizing both. The provision of high-technology communication aids and speech-generating devices suggests the need for communication

strategies that incorporate voice-output technology, or the ability to speak a message aloud using an external device. Communicative functions may include the need to gain attention within or beyond the patient's room, increase the child's sense of control, increase one's ability to participate in their own care, interact socially with loved ones and medical providers, and reduce frustration and stress. The ability to utilize and access a high-technology or low-technology communication aid is dependent on a variety of assessment domains. The way language is symbolically represented in these aided communication strategies may vary depending on the patient's literacy level and baseline linguistic and cognitive skills. For this reason, the feature-matched assessment by an SLP remains the gold standard for ensuring the appropriate tools and strategies are recommended and implemented by patients undergoing tracheostomies at all points of care.

Patients with a plan to undergo a tracheostomy who were simultaneously alert without intubation were assessed for the ability to participate in Message Banking. Message Banking has been identified as a beneficial and effective strategy for presurgical pediatric patients with anticipated nonspeaking conditions.[12] Half of alert, nonintubated patients in this study participated in the Message Banking process (n = 4). As the results indicated, several patients were either inappropriate for participation or declined. Other documented reasons for decline were feeling too sick to participate and reported preference to continue with previously established strategies during the postoperative period. During bedside discussions with the SLP, several patients also endorsed poor self-reflection of vocal quality in the context of declining respiratory status, discomfort sprinting from BiPAP to participate in recording natural speech, and perception of reduced speech and aphonia as a short-term problem. Though only 8.5% of patients referred for AAC support preoperatively participated in Message Banking, all wakeful, nonintubated patients participated in preoperative planning if able and appropriate. This was achieved by engaging in preoperative discussions directly or via a proxy family member, identifying appropriate tools and strategies, and selecting messages or vocabulary to include in a high-technology or low-technology communication system for postoperative use.

About 70% of all patients in this study had documented recommendations for speech-enhancement strategies including all patients under 18 months old. This consisted of strategies to promote speech production, sign language production, voice amplification, receptive language, and expressive language. Unaided communication modalities were widely recommended across all age groups and included strategies such as vocalizations, facial expressions, eye gaze, body language, gestures, and other physical communication behaviors.

According to Berry et al.,[23] approximately 57% of pediatric patients undergoing tracheostomy are infants under the age of 1 year. Referral to an SLP specifically to assess need for AAC strategies may be lower among this age group due to their prelingual status and, in many cases, highly complex medical needs and tenuous condition.[10,11] Still, the need for communication intervention in prelingual patients, typically under 18 months of age, is paramount to later speech and language development.[24] Older children may have more obvious needs for AAC supports due to their typical postlingual status and, for many, developed literacy skills. This is supported by a retrospective review by Arvedson and Brodsky,[25] in which the majority of children referred to an SLP were older than 18 months. Though pediatric patients in that study were referred to assess both swallowing and communication issues, approximately 70% were found to have moderate to severe deficits in speech and language within 1 year of tracheostomy placement. Given this finding, it may be concluded that early assessment for communication enhancement strategies in nonspeaking children will support potential attainment of necessary skills for later language growth. Additionally, continued feature-matched assessments should help guide communication recommendations as children get older and language skills change and develop.

Timing to referral for an initial bedside AAC assessment prior to tracheostomy placement varied greatly depending on the patient's level of sedation, level of wakefulness, age, and medical recommendation for tracheostomy need. Overall, early assessment prior to tracheostomy placement was achieved in this study given that over half of patients who were referred for consultation were assessed preoperatively. The incidence of early referrals may stem from the existence of a dedicated service focused on bedside AAC and communication enhancement, ongoing in-servicing and education for medical staff, and recognition of need by acute-care providers given a history of AAC intervention at bedside at our institution. Once a tracheostomy is identified as a course of treatment, or when a patient begins experiencing communication difficulties due to an acute or existing nonspeaking condition, a referral should be made to perform a bedside assessment.

Though this study looked specifically at broad AAC strategy types being high-technology, low-technology, or unaided in nature, results highlight the need for a range of tools and strategies to be readily available for pediatric patients undergoing a tracheostomy. SLPs should be knowledgeable in the area of AAC and pediatric speech-language development to perform careful bedside feature-matched assessments. Diagnostic assessment may be warranted due to the dynamic nature of an AAC assessment and the often-evolving needs of children with new tracheostomies throughout the recovery continuum. It is equally important for medical providers to be aware of the benefits of communication access at all points of care for patients across the age span to make appropriate referrals for consultation. Long-term support for these patients should also be considered, including outpatient follow-up by a SLP for children experiencing chronic nonspeaking conditions that extend beyond the acute-care hospitalization.

Limitations

Results are limited by the retrospective nature of this study. Documentation was carefully reviewed for all patients, and therefore, results were dependent on inclusion of study information in the patient's electronic medical record. As such, our data may potentially underrepresent the incidence of recommendations made during the patient's

hospitalization. Given that only patients referred to a SLP were included and that there are no set referral criteria for clinicians at our institution, referral bias serves as an additional limitation of this study. Although careful bedside feature-matched assessment was conducted for all patients, only one AAC-trained clinician was employed during the time of the review period, meaning all recommendations were made by a single professional with the tools and strategies available at Boston Children's Hospital. Because these tools may not be accessible at other hospitals or in other care settings, these results may not be completely generalizable. However, our institution serves a broad regional, national, and international patient population, which provides heterogeneity in our study sample with regard to age and comorbidities, making our findings more widely applicable. Future studies may consider prospective review of AAC recommendations and implementation across the acute-care recovery continuum in pediatric patients. Measuring how SLP recommendations are utilized pre- and post-tracheostomy may yield further suggestions for bedside assessment considerations and the need for example tools and strategies at the bedside of patients requiring AAC support.

CONCLUSION

Pediatric patients are at risk for nonspeaking conditions when undergoing tracheostomy placement. Augmentative and alternative communication strategies may be required to enhance overall development, expressive communication, receptive communication, emotional wellbeing, and participation in care. SLPs in acute-care settings should be knowledgeable about AAC evaluation practices and available for recommendation of strategies based on patients' unique and dynamic needs. High-technology and low-technology tools should be available for patient use in conjunction with unaided strategies based on bedside evaluations at the initial time of need, which may often be prior to tracheostomy placement. Message Banking should be considered as a possible consideration for appropriate patients. It is equally essential that medical providers refer to SLPs for assessment of communication skills for patients of all ages when undergoing tracheostomy to provide comprehensive care throughout the recovery continuum. Due to changes in medical status and patient recovery, communication needs and potential speech readiness are expected to evolve following tracheostomy placement based on patients' unique presentations. Bedside assessments and AAC recommendations are therefore dynamic in nature and a key element in patient recovery.

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