Perspectives on Voice and Voice Disorders June 2008 vol. 18 no. 2 76-86

Passy-Muir Speaking Valve Use in a Children's Hospital: An Interdisciplinary Approach

Lauren Hofmann

Department of Speech-Language Pathology, The Children’s Hospital of Philadelphia

Abstract:

At The Children's Hospital of Philadelphia (CHOP) we treat many children requiring tracheostomy tube placement. With potential for a tracheostomy tube to be in place for an extended period of time, these children may be at risk for long-term disruption to normal speech development. As such, speaking valves that restore more normal phonation are often key tools in the effort to restore speech and promote more typical language development in this population. However, successful use of speaking valves is frequently more challenging with infant and pediatric patients than with adult patients. The purpose of this article is to review background information related to speaking valves, the indications for one way valve use, criteria for candidacy, and the benefits of using speaking valves in the pediatric population. This review will emphasize the importance of interdisciplinary collaboration from the perspectives of speech-language pathology and respiratory therapy. Along with the background information, we will present current practices and a cases tudy to illustrate a safe and systematic approach to speaking valve implementation based upon our experiences.

International Journal of Pediatric Otorhinolaryngology 1999 Nov 5;50(3):197-203.

Passy-Muir valve in children with tracheotomy

Cho Lieu JE, Muntz HR, Prater D, Blount Stahl M.

Robert Wood Johnson Clinical Scholars Program, Yale University School of Medicine, New Haven, CT, USA.

Introduction:

Early vocalization and speech production remains a goal in children who require tracheotomy for airway obstruction or chronic ventilation. Although studies document the efficacy of the Passy-Muir valve (PMV) in adults, none have reviewed its efficacy in children. We performed this study to better understand the clinical complexity of its use in children.

Materials and Methods:

Retrospective evaluation of 55 consecutive cases of children with tracheotomy using the PMV.

Results:

The children ranged in age from 3 days to 18 years at the time of their tracheotomies, and nearly half were 12 months old or younger. Successful use often requires patient and family conditioning. Overall, 52 children out of the 55 who were evaluated as candidates for the PMV tolerated its use. Many required two or more trials prior to the patient and family being comfortable with its use.

Conclusions:

The PMV may be used successfully in children with a variety of airway pathologies as well as diverse medical problems. Discussed is the current protocol for the evaluation of the patient and the introduction of the valve.

Pediatric Nursing 1997 Nov-Dec;23(6):571-3.

Tolerance of the Passy-Muir Speaking Valve in infants and children less than 2 years of age

Engleman SG, Turnage-Carrier C.

Progressive Care Unit, Texas Children's Hospital in Houston, USA.

Abstract:

Research literature confirms the intuitive reasoning that tracheotomy may adversely influence speech acquisition in infants and children. The Passy-Muir Speaking Valve (PMSV) permits inspiration through the tracheotomy stoma and expiration through the glottis, allowing for phonation. Although adults with tracheostomies have demonstrated the ability to speak using the valve without respiratory compromise, there is scant literature regarding the use of this valve in the infant or child population. A retrospective review of 64 charts was conducted to examine documented evidence of tolerance of the PMSV in infants and children 2 years of age and less. Of the 29 children trialed, 24 (83%) tolerated the PMSV and 75% of those children produced vocalization on the first trial. Another 21% produced vocalization on a subsequent trial. The implications of this study indicate that the speaking valve is safe for use in infants as young as 13 days of age when the child is trialed in a monitored setting using appropriate guidelines.
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Neonatal Intensive Care Vol. 24 No. 7 November-December 2011

Use of the Passy-Muir Valve in the Neonatal Intensive Care Unit

Melanie Stevens, MS, CCC-SLP; Jennifer Finch, MA. CCC-SLP; Leslie Justice, RN, MS, CPNP, Erin Geiger, BS/RRT-NPS

Excerpt:

Over the years there has been a trend toward increased usage of tracheostomy tubes to meet the treatment needs of neonatal and pediatric patients. The presence of a tracheostomy tube can impair a child's ability to communicate and bond with caregivers. Communication between babies and their caregivers begins at birth with crying and cooing. Normal speech and language development requires vocal exploration and social interaction, both of which may be limited when a tracheostomy tube is in place (Kalson & Stein, 1985; Simon, Fowler, & Handler, 1983). The early use of a Passy-Muir valve (PMV) wi.th a tracheostomy tube may facilitate improved developmental outcomes for infants born prematurely, as well as outcomes for full term infants at risk for delays due to underlying medical conditions. While there is extensive experience and research to support the use of PMVs in the adult population (Suiter, McCullough, & Powell, 2003; Manzano, J., Lubillo, S., Heriquez, D., Martin, J., Perez, M. & Wilson, D., 1993), use of PMVs in the pediatric population is more limited. There is some support for use of PMVs to promote vocalizations, as well as to improve swallowing skills in pediatrics (Hull et al., 2005; Engleman & Tumage-Cani.er, 1997); however additional information is needed regarding the impact on speech-language development and caregiver interaction.

Passy Muir Valve (PMV) use in the NICU

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ABSTRACT

The presence of a tracheostomy tube can impair a child's ability to communicate and bond with caregivers. Earlier assessment and subsequent use of a Passy Muir Valve (PMV) may improve communication and psychosocial outcomes in these patients. While there is extensive literature on the use of PMV in adults, little is known about the effects of PMV use in the neonatal/pediatric population.

This poster describes a new protocol for assessing and implementing PMV use in the Neonatal Intensive Care Unit (NICU) at Nationwide Children's Hospital. Assessment of candidacy and readiness for a PMV, contraindications for use, and the potential benefits of the PMV are presented. Methods for trialing the PMV and assessing progression/ improvement are described. A case example illustrates the use of the protocol including the PMV readiness assessment, the initial trials, and progression to full time PMV use during all waking hours. Future directions for research are also discussed.

BACKGROUND

Beginning in Fall 2008, Speech Language Pathologists along with an Ear, Nose an Throat (ENT) Nurse practitioner at Nationwide Children's Hospital NICU Bronchopulmonary Dysplasia unit began a more consistent assessment of patients for PMVs. In order to promote increased use of PMVs, a standard coordinated protocol was formally established in 2010. This protocol aims to ensure a consistent referral process for PMV readiness assessments, subsequent supervised PMV trials, and progression of PMV use. Given the medical complexity of this patient population, this protocol was developed as a part of a multidisciplinary team consisting of Neonatologists, Speech-Language Pathologists, Respiratory Therapists and an ENT Nurse Practitioner. Overall, by working together as a multidisciplinary team, the group strives to improve overall patient care and as a result has experienced an increase in referrals for assessment and use of PMVs in the past two years.

Summary of PMV use from Fall 2008 through September 2011:

- 27 total patients were assessed for readiness of a PMV, including children requiring ventilator support and/or direct tracheostomy collar
- 19 of the 27 patients were found to be viable PMV trial candidates
- All 19 trialed the PMV for a 4-5 day period with the Speech-Language Pathologist
- The results showed the PMV to be safe for use with these patients without direct complications from using the PMV
- Thus far the success of this protocol has provided these patients with the ability to produce vocalizations and potentially improve social interaction with caregivers

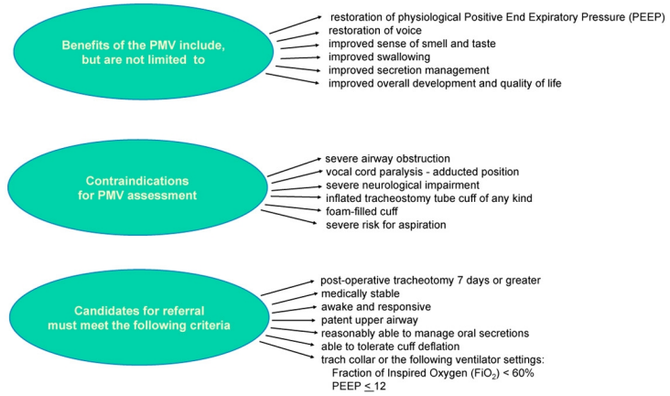
Patient fit with PMV at 15 months of age following downsizing to smaller tracheostomy tube. Positive change in behavior with ability to vocalize observed.

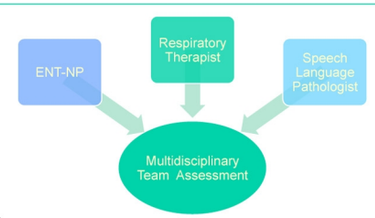
Former 24 week preemies fit with inline PMV at approximately 4 months adjusted age (7 months chronological age). Patients continue to wear the PMV during the day with plans to decannulate.

Patient fit with inline PMV at approximately 5 months of age. Immediate vocalizations with mother observed at initial PMV assessment.

Protocol

Purpose: To establish a standard protocol for referral for evaluation of PMV readiness and use





Respiratory Therapist
- Adjust and monitor ventilator equipment and cuff deflation (if needed)

ENT Nurse Practitioner
- Complete manometry testing to assess transtracheal pressures
- Target transtracheal pressures < 20cm$H_2$0
- Manometry results > 20 cm$H_2$0 require consideration of tracheostomy downsizing to be able to tolerate PMV

Speech Language Pathologist
- Assess vocal ability
- Assess management of secretions

Note: Manometry results > 20 cm$H_2$0 does not automatically disqualify a patient from trialing the PMV. Medical information and clinical judgment is ultimately the deciding factor in trialing the PMV. All team members monitor vital signs (work of breathing (WOB), respiratory rate (RR), heart rate (HR), color, O_2 saturations).

PMV Trials/Wear Time Progression

- Initial PMV trials by SLP only – trials start with length of time worn during initial assessment and progress as tolerated over the 4-5 day trial period
- Trials will be done 4-5 times within a 7 day period with a goal to increase wear time as tolerated.
- Only caregivers/family members who have been educated and have demonstrated knowledge of the PMV can place the PMV on the patient during visitation
- Transition to caregiver and nursing staff with an emphasis on increasing wear time and using the valve in various contexts (therapies, feeding, cares, etc)

CASE EXAMPLE

Baby Boy

Medical History
- Born at 38 weeks gestation
- Tracheomalacia
- Bronchomalacia
- Tetralogy of Fallot
- Pulmonary artery conduit stenosis

2/10/10- Tracheostomy (cuffed trach required due to high pressure ventilation)
7/28/10- Speech Therapy initiated to address early communication skills
9/14/10- Successful cuff deflation trials initiated
9/30/10- Deflated cuff 24 hours/day initiated

10/15/10- **Passy Muir Valve readiness assessment**
SIMV/PS (Synchronized Intermittent Mandatory Ventilation/Pressure Support)
- set rate (breaths/min) 12
- pressure support (cm$H_2$0) 18

PIP (Peak Inspiratory Pressure) 40
PEEP 10
FiO_2 25%
Expiratory pressures via manometry = 10 cm$H_2$0
-Tolerated PMV for 20 minute trial with vocalizations

10/18/10 – **Week long PMV trials with Speech Therapy initiated**
– Tolerated 20 minute PMV trial with vocalizations
10/19/10 – Tolerated 25 minute PMV trial with vocalizations
10/20/10 – Tolerated 25 minute PMV trial with vocalizations
10/21/10 – Tolerated 25 minute PMV trial with vocalizations
** Week long PMV trials with Speech Therapy ended and twice daily PMV use initiated with nursing.*

Patient continued to use PMV through weaning from SIMV/PS to CPAP/PS to trach mist collar.
At discharge patient wearing PMV during all waking hours .

FUTURE DIRECTIONS

Current Quality Improvement initiatives:
- Consistent application of the protocol in the NICU at Nationwide Children's Hospital
- Consistent documentation of PMV wear time by nursing staff
- Carryover of protocol to all inpatient units

Potential Research Topics:
- Effects of PMV use on caregiver/child bonding
- Effects of PMV use on ventilator weaning and length of hospital stay

KEY REFERENCES

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2. Hoffman, L, Bolton, J. & Ferry, S. (2008). Passy-Muir Speaking Valve Use in a Children's Hospital: An Interdisciplinary Approach. *Perspectives on Voice and Voice Disorders, 18,* 78-86.
3. Hull, E, Dumas, H, Crowley, R. & Kharasch, V. (2005). Tracheostomy Speaking Valves for Children: Tolerance and Clinical Benefits, *Pediatric Rehabilitation, 8(3),* 214-219.
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5. Passy-Muir, Incorporated

ACKNOWLEDGEMENTS

* Thanks to Rachel Brown, MD, Ed Shepherd, MD, Leslie Justice, RN, BS, CPNP, & Erin Geiger, BS/RRT-NPS for working with us to create a multidisciplinary team for earlier assessment of Passy Muir Valve use.

* A special thank you also to Linda Dean, RRT, and Julie Kobak, MA, CCC-SLP/L at Passy-Muir, Inc.

Pediatric Rehabilitation, July 2005; 8(3): 214–219

Tracheostomy speaking valves for children: tolerance and clinical benefits

Hull EM, Dumas HM, Crowley RA, Kharasch VS.

Speech-Language-Hearing Department, Franciscan Hospital for Children, Boston, MA (EMH, RAC), USA

Introduction:

Use of a tracheostomy speaking valve allows the expiratory flow of air to exit over the vocal folds promoting phonation. The purpose of this retrospective review was to determine: (1) what percentage of trial candidates tolerated a speaking valve; (2) whether candidates achieved phonation with a valve; and (3) which secondary benefits (coughing ability, secretion management, swallowing/feeding and oxygenation) could be clinically observed.

Methods:

Twelve cases of children and youth (ages 8 months to 21 years) evaluated for a tracheostomy speaking valve at an inpatient rehabilitation hospital were reviewed. A speech-language pathologist and respiratory therapist evaluated the children for valve tolerance and candidacy for ongoing use. Clinical observations were used to determine phonation ability and to examine potential secondary benefits.

Results:

All 10 subjects who tolerated the valve achieved phonation. Vocalizations included audible crying, nonspecific vocalizations, word approximations, single words and short phrases. Minimal-to-no improvement was noted for coughing, secretion management, swallowing and oxygenation with clinical assessment.

Discussion:

With supervision and training, speaking valves can enhance communication options for children and youth with tracheostomies and oxygen and ventilator dependence. Physiological and functional secondary benefits were observed but were more difficult to assess.

Journal of the Medical Association of Thailand 2005 Jul;88(7):928-33.

Measurement of end-expiratory pressure as an indicator of airway patentcy above tracheostomy in children

Utrarachkij J, Pongsasnongkul J, Preutthipan A, Chantarojanasri T.

Abstract:

The tracheostomy speaking valve is a one-way valve that closes during exhalation. It causes redirection of exhaled gas into the larynx, mouth and nasal cavity, thus enabling children with long-term tracheostomies to speak. Whether a child can tolerate the valve depends mainly on the patency of the upper airway around and above the tracheostomy tube. To measure end-expiratory pressure (EEP) at the tracheostomy tube when the speaking valve is being put in place may be a useful noninvasive tool to assess the patency of the exhalation pathway. The authors, therefore, measured EEP when the patients were first put on the speaking valves and tried to follow-up the patients thereafter. Twenty-two tracheostomized children (aged 3.2 months to 1 7years, male/female 16/6) were recruited for the present study and EEP was measured. It was found that 13 children having the EEP in the range of 2-6 cmH2O could breathe normally through the valves and later could use the valves without any problems, whereas 9 children with EEP in the range of 10-40 cmH2O demonstrated breathing difficulties and the valves had to be taken off immediately. Bronchoscopy revealed upper airway narrowing in all of those children with unsuccessful valve placements. It was concluded that EEP was exceedingly high in children with upper airway narrowing. The measurement of EEP via speaking valves can, thus, be used as an objective indicator to evaluate the patency of upper airway proximal to the tracheostomy tube.

International Journal of Pediatric Otorhinolaryngology Volume 35, Issue 1, March 1996, Pages 11–17

Selection of pediatric patients for use of the Passy-Muir valve for speech production

Sezelle A. Gereau[1], Gretchen C. Navarro[2], Bella Cluterio[3], Edward Mullan[4], Maha Bassila[1], Robert J. Ruben[3]

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[2] Department of Otolaryngology, Phillipine Children's Medical Center, Quezon City, Philippines
[3] Department of Pediatrics, Blythedale Children's Hospital, Valhalla, NY, USA
[4] Department of Respiratory Therapy, Blythedale Children's Hospital, Valhalla, NY, USA

Abstract:

A potential side effect of tracheotomy in the pediatric population is poor speech development. It has been well documented that children with tracheotomies have delays in expressive and receptive language out of proportion to the child's degree of intellectual functioning. While numerous methods of augmentative devices have been proposed, none are ideal for the child with a tracheotomy. Of the choices available, the Passy-Muir valve is best suited for use in the pediatric population. We present a method of selection of patients for Passy-Muir valve placement currently in use at Blythedale Children's Hospital. The criteria employed include measurement of trans-tracheal pressures. This has not previously been presented in the literature, but has been found to be of significant value in determining who will benefit most from Passy-Muir valve placement.

Success Predictors for Passy-Muir Speaking Valve Use In a Pediatric Population: A Method Evaluation

Liz B. Trotter, B.S., R.R.T., C.P.F.T., Perinatal Pediatric Specialist.

The Children's Seashore House, Philadelphia, PA

Introduction:

After discussing the anatomy and flow dynamics of pediatric tracheas with two pediatric critical care physicians, it was hypothesized that an audibly measured leak of 15 centimeters of water pressure (cmH20) or less and/or an electronically measured leak of 50% or greater should predict successful use of the Passy-Muir valve. This size gas leak should support sufficient gas passage around the tube without producing excessive PEEP. The Passy-Muir Speaking Valve is a one way valve intended for use with tracheostomized patients of all age groups to improve speech. Speech pathologists have incorporated use of the valve in their treatment plans for patients with swallowing discoordination. A method to predict successful use of the speaking valve was needed to prevent patient fear, distress and trauma, and future non-compliance.

Method:

Six non-mechanically ventilated tracheostomized patients between six months and five years of age were studied. Sample size was limited by our institution's total number of tracheostomized children who were not mechanically ventilated. The gas leak around each patient's tracheostomy tube was evaluated audibly with a flow-inflating resuscitation bag with an in-line pressure manometer. Electronic evaluation of the tube leak was performed in accordance with the Bear Neonatal Volume Monitor User Manual and results were reported as a percentage (expired tidal volume/inspired tidal volume=% leak). Audible evaluation with the resuscitation bag was achieved by placing a stethoscope over each patient's trachea while gradually tightening the resuscitation bag valve to achieve increasingly higher airway pressures. The pressure at which the leak was heard was recorded in cmH20. Patients with audibly measured leaks of 15 cmH20 or less and/or an electronically measured leak of 50% or greater were hypothesized to have a high probability of success with the Passy-Muir Valve. This hypothesis was tested via institution of the valve.

Results/Experience:

Successful outcomes were predicted in all six cases when the patients' measured parameters positively correlated with the defined criteria for predicting success or failure. Other monitoring systems, such as end-tidal CO2 and Sp02 were initially used to evaluate patient response. Monitoring Sp02 was abandoned, because patients often failed acutely before a desaturation could be measured. These patients were often agitated and unmeasurable using oximetry. End-tidal C02 was only minimally acceptable and was used secondarily as a confirmation of

success. Select patients with established language skills were tested with a speech pathologist present. These patients needed reassurance and coaching to attempt verbalization. The session was disrupted when the end-tidal monitor was placed in the patient's mouth.

Conclusion:

Identification of potential success with leak measurements is a valuable tool when instituting the Passy-Muir Valve. Potential for patient distress and harm is greatly reduced and patient trust is protected. Although this study reflects only non-mechanically ventilated patients, mechanically ventilated patients could be studied in a similar fashion. A substantial leak is necessary for use of the Passy-Muir Valve with a ventilator, because all exhalation occurs around the tube through the patient's natural airway. Passy-Muir, Inc. recommends the tracheal tube only occupy one third of the tracheal lumen when used with a mechanical ventilator. A non-invasive assessment of tube size would enable the practitioner to be confident in use of the Passy-Muir Valve in both ventilated and non-ventilated patient populations.

Advance for Speech-Language Pathologists & Audiologists

Children with Trachs

Katy Peck, MA, CCC-SLP, CBIS

Excerpt:

Children less than 12 months of age account for the majority of new tracheotomies each year. The most frequent patients are ages 3-4 months. The anatomical and physiological changes in airflow after a tracheotomy limit the ability to experience use of the upper aerodigestive tract. These changes impact typical sensory and motor experiences, including the ability to smell, taste, vocalize, and coordinate the suck-swallow-breathe sequence for safe oral intake of breast milk or formula.

In addition, these children may experience poor oral secretion management due to reduced oral, nasal and pharyngeal sensation. Decreased sensation is a result of routine invasive medical procedures in the child's airway and limited airflow to stimulate the sensory receptors of the upper airway.

Pediatric Nursing. 1994 Mar-Apr;20(2):149-53.

Enhancing communication with the Passy-Muir valve

Jackson D, Albamonte S.

Abstract:

The Passy-Muir Valve is a speaking valve. It is one alternative for enhancing communication skills in children with long-term tracheostomies. As this population of children continues to grow, nurses must have an awareness of interventions that can promote language development.

Advance for Speech-Language Pathologists and Audiologists March 13, 2006

Speaking Valves for Infants

Kyra Cordle, MSP, CCC-SLP

Excerpt:

As pediatric speech-language pathologists continue to expand their roles within intensive and acute care settings, it becomes increasingly evident that infants may benefit from specific interventions that are routinely considered with the young child. Expanding certain practices to infants who are medically fragile requires a carefully balanced approach to treatment that supports both medical and developmental needs.

A tracheostomy speaking valve is one of the many tools successfully used with young children that often receives limited recognition for application with infants. However, the use of speaking valves with infants who are tracheotomized is gaining popularity as functional gains are clearly demonstrated in this dynamic population.

Perspectives on the Pediatric Larynx with Tracheotomy

Suzanne S. Abraham

In The Larynx 2009 by Marvin P. Fried, Alfio Ferlito, Alessandra Rinaldo

Excerpt:

Abraham reported on 50 patients ages 2 months to 4 years 9 months (Mdn = 19 months) with open tracheostomy tubes. She found that all 50 presented with secretion management issues and 49 (98%) of the 50 had abnormal airway protection baselines on their initial outpatient visit. In the presence of audible, accumulated tracheal secretions, 22 (44%) did not elicit a reflexive cough to clear, 18 (36%) had a delayed cough to clear, and 9 (18%) coughed only when their cannulas were suctioned. Abraham utilized a comprehensive protocol for determining candidacy for Passy-Muir placement including preplacement assessment, initial wear time trial, increasing wear time and tolerance, and home programming. Given treatment and consistent carryover in the home, Abraham[29] found that 24 (49%) of 49 tracheotomized infants and young children achieved tolerance for Passy-Muir placement on a daily, consistent, full-time basis with removal only for sleep. Once full time wear time was in place, these children displayed laryngotracheal secretion management within normal limits in an average time frame of 2 weeks.

Neonatal Intensive Care Vol. 16 No. 1, January/February 2004

Problems Caused by Tracheostomy Tube Placement

Lisa Y. Torres, MA, CCC-SLP, Donna J. Sirbegovic, RCP, RRT

Introduction:

Although a tracheostomy tube placement is a medical necessity for many neonates, there are several physiological functions that are altered with tracheostomy placement that can be restored within hours by utilizing the Passy-Muir Tracheostomy and Ventilator Speaking Valve (PMV) in the NICU.

Due to the placement of the tracheostomy tube below the level of the vocal folds, inspiration and expiration through the tube bypass the vocal folds, which causes aphonia, the inability to create voice. Speech and language development, which begins at birth with crying, is delayed the moment the tracheotomy is performed. The bonding process for parents and care providers is severely impacted by this lack of communication.

Neonatal Intensive Care Vol. 17 No.4 July/August

Clinical Benefits of the Passy-Muir Tracheostomy and Ventilator Speaking Valves in the NICU

Lisa Y. Torres, M.A., CCC-SlP, Clinical Specialist; Donna J. Sirbegovic, Rep. RRT, Clinical Specialist, Passy-Muir, Inc.

Excerpt:

It is common for premature neonatal patients to remain intubated with an endotracheal tube for 2 to 6 months after birth. However, once tracheostomized, it is important that the neonate be evaluated for use of a Passy-Muir Tracheostomy and Ventilator Speaking Valve (PMV) as soon as possible. The PMVs provide several physiologic and cost effective benefits for tracheostomized and ventilator dependent patients.

Dysphagia 15:206–212 (2000)

Swallowing Physiology of Toddlers with Long-Term Tracheostomies: A Preliminary Study

Suzanne S. Abraham, PhD[1] and Ellen L. Wolf, MD[2]

Departments of [1]Otolaryngology and [2]Radiology, Montefiore Medical Center and the Albert Einstein College of Medicine, Bronx, New York, USA

Abstract. This study investigated the swallowing physiology of toddler-aged patients with long-term tracheostomies. Structural movements and motility of the pharyngeal stage of swallowing were studied in four toddlers ranging in age from 1:2 (years:months) to 2:9 with long term tracheostomies. A patient aged 1:2 years with no tracheostomy served as a toddler model for comparison. Videofluoroscopic recordings of the patients' liquid and puree bolus swallows were analyzed for a) onset times for pharyngeal stage events, laryngeal vestibule closure, and tracheostomy tube movement; b) timeliness of swallow response initiation; and c) pharyngeal transport function. Results found differences in timing of pharyngeal stage movements between the tracheostomized patients and the patient with no tracheostomy. Laryngeal vestibule closure occurred before or within the same 0.033-s video frame as onset of upper esophageal sphincter (UES) opening in the patient with no tracheostomy, but occurred 0.033–.099 s after onset of UES opening in the tracheostomized patients. The time line required to close the laryngeal vestibule once the arytenoids began their anterior movement was longer in the tracheostomized patients than in the patient with no tracheostomy and was associated with laryngeal penetration. The patient with no tracheostomy displayed superior excursion of the arytenoid and epiglottis during the swallowing; the tracheostomized patients did not. No association was found between onset of tracheostomy tube movement and laryngeal vestibule closure. Delayed swallow response initiation was observed across tracheostomized patients at a mean frequency of 45% with associated penetration. Pharyngeal dysmotility was not observed. Findings supported the concept that long-term tracheostomy in toddler-aged patients affects swallowing physiology.

Pediatric Critical Care Medicine 2010; 11:484–487

Dysphagia testing and aspiration status in medically stable infants requiring mechanical ventilation via tracheotomy

Steven B. Leder, PhD; Kenneth E. Baker, MD; T. Rob Goodman, MD

Objective:

To perform objective testing to determine aspiration status with the goal of initiating safe and timely oral alimentation in medically stable infants who require mechanical ventilation *via* tracheotomy. Medically compromised infants who require mechanical ventilation *via* tracheotomy and are nil by mouth are conventionally deemed as being at risk for aspiration and feeding difficulties. There is little information available in the literature regarding diagnostic testing and habilitation intervention to promote safe and timely initiation of oral alimentation when these infants are medically stable.

Design:

Prospective, consecutive, referral-based sample.

Setting:

Newborn, pediatric, and respiratory intensive care units in an urban, tertiary care, teaching hospital.

Patients:

Fourteen consecutive medically stable but mechanically ventilated infants (mean chronological age, 8.1 mos, range, 3–14 mos; mean gestational age, 28.4 wks, range, 24–39 wks) referred for swallow evaluation between April 2003 and May 2008.

Interventions:

Videofluoroscopic and fiberoptic endoscopic evaluations of swallowing.

Measurements and Main Results:

Aspiration status was determined by objective testing with videofluoroscopic and fiberoptic endoscopic evaluations of swallowing. Aspiration was defined as evidence of food material in the airway below the level of the true vocal folds. Eight infants exhibited a coordinated suck-swallow reflex, and six infants exhibited an oral dysphagia characterized by a weak, inconsistent, or absent suck. Nonetheless, 13 of 14 (93%) infants demonstrated a successful pharyngeal swallow with no evidence of aspiration and were started successfully on an oral diet.

Conclusions:

Pediatric Critical Care Medicine 2010; 11:484–487

Objective dysphagia testing is recommended for medically stable infants who are ventilator dependent *via* a tracheotomy. The prevalence of aspiration in this group is low and a negative examination can promote safe and timely oral alimentation.

The Journal of Laryngology & Otology 2008 Feb;122(2):161-9.

Choosing a paediatric tracheostomy tube: an update on current practice

Tweedie DJ, Skilbeck CJ, Cochrane LA, Cooke J, Wyatt ME.

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Objectives:

A variety of paediatric tracheostomy tubes are available. This article reviews those in current use at Great Ormond Street Hospital.

Methods:

We outline our preferences and the particular indications for the different tubes, speaking valves and other attachments.

Results:

Practice has changed significantly in recent years. One product has been re-sized by its manufacturer; others are no longer commonly used. An updated sizing chart is included for reference purposes, together with manufacturers' contact details.

Conclusions:

The choice of paediatric tracheostomy tube is driven by clinical requirements. A small range of tubes are suitable for the majority of children, but some will require other varieties in specific circumstances.

American Journal of Respiratory Critical Care Medicine January 1, 2000 vol. 161 no. 1 297-308

Care of the Child with a Chronic Tracheostomy

This Official Statement of the American Thoracic Society Was Adopted by the ATS Board of Directors, July 1999

Abstract:

Children with a chronic tracheostomy constitute an important subgroup of children who are at risk for potentially devastating airway compromise. There have been no standards published for their care and disappointingly little research. The Pediatric Assembly of the American Thoracic Society funded a working group with input from the disciplines of pediatric pulmonology, pediatric surgery, pediatric otolaryngology, respiratory therapy, speech pathology, and nursing to develop a consensus statement regarding their care. This statement has been reviewed and revised by the committee members, who concur with its recommendations. Many of the recommendations are by consensus in the absence of scientific data, and suggestions are made for areas of research.

International Journal of Pediatric Otorhinolaryngology 2009 Jul;73(7):975-80.

Experience of the school-aged child with tracheostomy

Patel MR, Zdanski CJ, Abode KA, Reilly CA, Malinzak EB, Stein JN, Harris WT, Drake AF

Department of Otolaryngology-Head & Neck Surgery, University of North Carolina Memorial Hospitals, Chapel Hill, NC 27599, USA.

Background:

Little is known about the school experience of children with tracheostomy tubes. These children may represent a population that qualifies for special services in school. Understanding how tracheostomy affects school-aged children may provide information needed to develop programs that provide these children with invaluable experiences.

Objective:

To understand what children with tracheostomies experience in school as it relates to tracheostomy care and how their condition affects academic achievement and social adjustment.

Methods:

We identified a cohort of 38 eligible school-aged children with indwelling tracheostomy tubes for ongoing upper airway obstruction through the North Carolina Children's Airway Center. A questionnaire was developed to assess support of their medical condition throughout the school day. Twenty-three patients responded to the questionnaire.

Results:

School experience for a child with a tracheostomy varied. Approximately half the children attended special needs classes, the other half were in mainstream classrooms. Speech services and Passy-Muir valves were used in 43% and 57% of cases, respectively. Over half the students were excluded from physical activity because of the tracheostomy. Most students missed at least 10 days of school for medical care in an academic year. Fifty percent of the students reported attending schools where school personnel had no training in tracheostomy care. In some cases, a trained nurse accompanied the child to school to help with tracheostomy care. In other cases, the child coped with tracheostomy care alone.

Conclusions:

As children with special medical needs are increasingly incorporated into mainstream schools, it is important to understand the potential hurdles they face in managing tracheostomies. In particular, school personnel should have the ability to provide basic care for students with

International Journal of Pediatric Otorhinolaryngology 2009 Jul;73(7):975-80.

tracheostomies. Student speech and educational outcomes require further investigation and analysis.

Neurorehabilitation & Neural Repair March 2003 vol. 17 no. 1 32-36

Respiratory Management of Pediatric Patients with Spinal Cord Injuries: Retrospective Review of the duPont Experience

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Abstract:

Pulmonary complications contribute to morbidity and mortality in spinal cord injuries (SCIs). A retrospective review of 20 years of experience with tracheostomy- and ventilator-dependent SCI children is presented. The authors developed and analyzed a database of 47 children (average age = 11.4 years). Of the patients, 27% had concomitant brain injuries, 6% had prior histories of reactive airway disease, and 2% had thoracic fractures. Injuries were caused by motor vehicle accidents (53%); gunshot wounds (19%); sports-related accidents (19%); and vascular injuries, transverse myelitis, or spinal tumors (8%). Of the injuries, 52% were high level (C1 to C2) and 48% were mid- or low level (C3 to C5). Two groups were analyzed for demographic information. Complications included tracheitis, atelectasis, and pneumonia. Mean tidal volume was 14 cm^2/kg (maximum = 22 cm^2/kg). Bedside lung function parameters were attempted to assess readiness and the rapidity of weans. T-piece sprints were used to successfully wean 63% of patients. Successfully weaned patients were compared with those not weaned. No deaths or readmissions for late-onset respiratory failure postwean occurred. The authors' clinical impression favors higher tidal volumes and aggressive bronchial hygiene to minimize pulmonary complications and enhance weaning. Successfully weaned patients had fewer complications. A critical pathway for respiratory management of SCI children is presented.

Topics in Spinal Cord Injury Rehabilitation, Volume 10, Number 3/Winter 2005

The Child with a High Tetraplegic Spinal Cord Injury

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Abstract:

Caring for children and adolescents with high tetraplegic spinal cord injury (SCI) is particularly challenging because of the significant impact that their severe neurologic impairment has on all spheres of their lives. Distinctive anatomic, physiologic, growth, and development characteristics of children and adolescents result in unique manifestations, complications, and consequences in this population. This article will highlight several of the unique and critical aspects of high tetraplegic SCI in children and adolescents.