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EDITORIAL

The impact of tracheostomy on spoken language in children: a narrative review

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INTRODUCTION

Paediatric tracheostomy is on the rise, Muller et al.[1] pointing out that almost 40% of tracheostomies in paediatric patients are performed in children under 1 year of age. The statistically significant increase in the rate of tracheostomy in infants is attributed, in part, to the increased survival percentages of extremely preterm infants with severe pulmonary dysplasia who require long-term ventilation[2,3]. Currently, there are a significant number of patients with tracheostomy tubes, which relapse and affect communication and language development when the device is placed at an early age. These findings have made hospitals to develop teams dedicated to the care of these patients, not only during their initial hospitalization but also on an outpatient basis in collaborative multidisciplinary teams involving various medical specialties[4]. Below, we delve a little deeper into some very interesting aspects found in the literature.

DEVELOPMENT

Some researchers indicate that tracheostomy is more dangerous in children than in adults and carries special risks in younger children[3,5]. The last 20 years have seen a big change in the age distribution of tracheostomy. Whereas in the past the operation was mainly performed for the treatment of epiglottitis and laryngo-tracheo-bronchitis, today the main indication is to avoid subglottic stenosis in infants as a consequence of intubation due to respiratory distress syndrome and prematurity[6].

As early as 1990, Hill predicted that speech-language pathologists would have a larger population of children whose communication development has been compromised by long-term placement of a tracheostomy tube[7].

More than 100,000 tracheostomies are performed each year. Only 5,000 are in children and 50% of them are done in children under 1 year of age[8-10]. The number of children in need of tracheostomy has increased tenfold in the last 15 years[9,11]. It is hypothesized that this is due to the increasing number of children living with complex chronic diseases and advances in medical technologies that have enabled the use of ventilation devices at home[11]. On the other hand, the appearance of language is one of the greatest achievements of the first two years of life. During the first eighteen months of life, babies acquire and perfect a whole set of new motor skills that fundamentally transform their experiences with objects and people verbally. Independent motor skills, along with language acquisition, are one of the most impactful in the world of infants[12]. This child developmental milestone is one of the most critical and early language deficits that have been found to be associated with difficulties in cognitive abilities, academic performance, occupational outcomes, and socialization[13]. However, multiple environmental influences are related to language development, from prenatal aspects, birth, socioeconomic status, parental language, and sibling behaviour. However, we cannot avoid the effect of the tracheostomy tube on this. Aspects such as behaviour, quality of relationship, sensitivity, and parental warmth have powerful implications for children's language development[13]. Theoretical explanations of this phenomenon are based on the attachment theory, which argues that sensitive and responsive parenting provides a secure foundation for exploration and aids in the formation of secure attachment[14]. Considering these childhood events, tracheostomy patients have difficulty producing voice due to the changes in airflow that occur with cannula placement;

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airflow usually enters and exits through the tube, resulting in a lack of airflow around the tube and through the upper airway. Therefore, the voice is affected, due to the lack of sufficient airflow, which limits the production of the voice. Children with this condition can present speech delays, articulation disorders, phonological disorders and difficulties in breathing and speech coordination.

Younger infants, who have survived critical situations of illness at an early age, represent a substantial group of cases that continue to require health care[15-17]. With the technological and scientific advances in neonatal care over the past two decades, a large number of children require artificial airway care for prolonged periods of time[18]. Some studies have suggested that tracheostomy has little influence on spoken language development[19,20], while others have shown a clear pattern of language impairment[7,17,21]. A multicenter study found that children with tracheostomy have a poor quality of life[22]. Greene et al.[23] note that tracheostomy is associated with negative effects on voice, speech, and feeding/swallowing. Even studies in adults with Intensive Care Unit tracheostomy found a number of response patterns among patients and staff, highlighting the impact of communication difficulties[24]. The return of the voice not only enhances patient-reported joy and comprehension by others but it is also associated with a positive change in quality of life[25,26]. Authors such as Prigent et al.[27] describe in a study published in 2010 that low-level positive end-expiratory pressure is as effective as the phonatory valve in ensuring good speech quality in mechanically ventilated patients. With the above, we can understand that the phonatory possibility is feasible from the intensive therapy itself. There are authors, such as Freeman-Sanderson et al.[25], who report that these manoeuvres do not expose the patient to greater risks. Returning to the children's group, the research that relates tracheostomy to language development is very limited, it does not provide sufficient evidence on the impact of devices such as a phonatory valve on verbal communication in children. As Zabih et al.[28] pointed out, most of the current literature has focused on tolerance to cannula occlusion, rather than communication, this being an important aspect of early childhood development, and this needs to be further investigated.

In a group of children with non-neurological disorders, 60.9% had normal speech and language development, achieving earlier decannulation, which improved the chances of normal language development[17]. So, one can see that we have a large number of children who can benefit from the use of phonatory valves. But most cases do not have this device and much less are they given speech therapy during the wearing of the tracheostomy tube.

Patients with cannula may have the ability to speak. This can be achieved by generating a flow of air around the tracheostomy tube, so that air passes through the vocal cords. An occlusion of the tube could effectively serve so that the air passing through the cords generates a clear and audible voice. There are some devices, such as the phonatory valves, which allow the entry of air when inhaling and prevent its exit when exhaling, diverting the air to the expiration around the tube and therefore to the vocal cords. First, it is important to check that the cannula has a balloon; if yes, make sure that it is deflated. This ensures that the air rises to the upper airway. Digital occlusion, or finger occlusion, is one of the techniques in which a clean finger, usually with a glove, is placed at the end of the tracheostomy tube; it may also be easier for the person to occlude it only when exhaling. Some research proposes that devices such as Passy-Muir phonatory valves may improve infection control compared to digital occlusion, likewise having a hands-free approach to speaking. This valve is placed at the end (cube) of the tracheostomy tube. Phonatory valves fit tracheostomy tubes of any size, as the tube connector is universally 15mm. Once the valve is in place, air enters through the tube and exhaled air flows around the cannula, through the vocal cords and out through the upper airway to speak. The use of the phonatory valve in addition to the voice includes restoring positive airway pressure, improving secretion management and swallowing, may reduce the risk of aspiration, faster decannulation, use of in-line ventilator, better smell and better oxygenation. Phonatory valves have been shown to improve positive end-expiratory pressure, subglottic pressure, and restore protective expiration to the upper airway after swallowing[29-34].

Crucial factors affecting speech and language development within the neurologically normal group are age at the time of the procedure and the duration of tracheostomy until decannulation. Achieving early decannulation improves the chances of normal speech and language development[17]. Speech valves have been shown to enhance the rehabilitation process in many ways and we believe their use should be encouraged[33].

Research suggests that a multidisciplinary protocol decreases the time between tracheostomy insertion and phonatory valve testing[35-38]. There are even studies that indicate that speech therapist services are underutilized in the rehabilitation of patients with tracheostomy[38]. Findings from a qualitative study of interviews with parents and health professionals, conducted by Nicola Hall et al.[39], suggest that there is a need to facilitate greater standardization of care and support available to parent caregivers and that this may be transferable to other regions. Potential solutions to explore could include developing a paediatric tracheostomy service specification, increasing the use of tracheostomy nurse specialist roles, and addressing the emotional and psychological support needs of carers[39]. We believe that research should focus on speech and language acquisition in patients with tracheostomy, as it represents a specific communication milestone in the early stages of life, and focusing study designs in this field would help us clarify a number of uncertainties.

CONCLUSIONS

The population with tracheostomy has increased in the last two decades. A series of conjectures are pointed out in which technological advances in medical devices and improvements in care are included. The body of literature points out that patients with tracheostomy present difficulties in generating language and oral communication, as well as the development itself when the cannula is installed at an early age, negatively impacting cognitive progress and socialization skills.

It should be noted that research that relates tracheostomy to language development in childhood is very limited, and does not provide sufficient evidence on the impact of devices such as phonatory valves on verbal communication, since most of the literature is restricted only to analysing occlusion tolerance. The few investigations point to a benefit with the use of these devices. In both adults and children, it can even improve infection control compared to digital occlusion, in addition to having hands-free to speak, along with other series of improvements such as better secretion management, improved swallowing, reduction of the risk of aspiration, better smell and better oxygenation. There are articles that show that the multidisciplinary protocol decreases the time between the insertion of the tracheostomy and decannulation.

Our proposal focuses on inviting scientists to increase research in the group of patients with tracheostomy and not limit themselves only to the tolerance of cannula occlusion, but also to investigate the effect of speech and language acquisition.

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REFERENCES

1. Muller RG, Mamidala MP, Smith SH, Smith A, Sheyn A. Incidence, epidemiology, and outcomes of pediatric tracheostomy in the United States from 2000 to 2012. Otolaryngol Head Neck Surg. 2019;160(2):332-8. DOI: 10.1177/0194599818803598.
2. Overman AE, Liu M, Kurachek SC, Shreve MR, Maynard RC, Mammel MC, et al. Tracheostomy for infants requiring prolonged mechanical ventilation: 10 years' experience. Pediatrics. 2013;131(5):e1491-6. DOI: 10.1542/peds.2012-1943.
3. Isaiah A, Moyer K, Pereira KD. Current trends in neonatal tracheostomy. JAMA Otolaryngol Head Neck Surg. 2016;142(8):738-42. DOI: 10.1001/jamaoto.2016.1107.
4. Gien J, Kinsella J, Thrasher J, Grenolds A, Abman SH, Baker CD. Retrospective analysis of an interdisciplinary ventilator care program intervention on survival of infants with ventilator-dependent bronchopulmonary dysplasia. Am J Perinatol. 2017;34(2):155-63. DOI: 10.1055/s-0036-1584897.
5. Wrightson F, Soma M, Smith JH. Anesthetic experience of 100 pediatric tracheostomies. Paediatr Anaesth. 2009;19(7):659-66.
6. Glover WJ. Tracheostomy in children. Int Anesthesiol Clin. 1970;8(4):345-57.
7. Hill BP, Singer LT. Speech and language development after infant tracheostomy. J Speech Hear Disord. 1990;55(1):15-20. DOI: 10.1044/jshd.5501.15.
8. Baker CD. Long-term ventilation for children with chronic lung disease of infancy. Curr Opin Pediatr. 2019;31(3):357-66. DOI: 10.1097/MOP.0000000000000757.
9. Berry JG, Graham DA, Graham RJ, Zhou J, Putney HL, O'Brien JE, et al. Predictors of clinical outcomes and hospital resource use of children after tracheotomy. Pediatrics. 2009;124(2):563-72. DOI: 10.1542/peds.2008-3491.
10. Carr MM, Poje CR, Kingston L, Kielma D, Heard C. Complications in pediatric tracheostomies. Laryngoscope. 2001;111(11 Pt 1):1925-8. DOI: 10.1097/00005537-200111000-00010.
11. Praud JP. Long-term non-invasive ventilation in children: current use, indications, and contraindications. Front Pediatr. 2020;8:584334. DOI: 10.3389/fped.2020.584334.
12. Iverson JM. Developing language in a developing body: the relationship between motor development and language development. J Child Lang. 2010;37(2):229-61. DOI: 10.1017/S0305000909990432.
13. Colberg SR, Sigal RJ, Yardley JE, Riddell MC, Dunstan DW, Dempsey PC, et al. Physical activity/exercise and diabetes: A position statement of the American Diabetes Association. Diabetes Care. 2016;39(11):2065-79. DOI: 10.2337/dc16-1728.
14. Ainsworth MDS, Bell SM, Stayton DJ. Infant-mother attachment and social development: "Socialisation" as a product of reciprocal responsiveness to signals. In: Woodhead M, Carr R, Light P. (eds.) Becoming a person Taylor & Frances/Routledge; 1991, p.30-55. (Reprinted from Richards MPM (ed.). The integration of a child into a social world. Cambridge: Cambridge University Press; 1974, p.99-135).
15. Chorney SR, Brown AF, Brooks RL, Bailey C, Whitney C, Sewell A, et al. Pediatric tracheostomy outcomes after development of a multidisciplinary airway team: a quality improvement initiative. OTO Open. 2021;5(3):2473974X211045615. DOI: 10.1177/2473974X211045615.
16. Kraemer R, Plante E, Green GE. Changes in speech and language development of a young child after decannulation. J Commun Disord. 2005;38(5):349-58. DOI: 10.1016/j.jcomdis.2005.01.002.
17. Jiang D, Morrison GA. The influence of long-term tracheostomy on speech and language development in children. Int J Pediatr Otorhinolaryngol. 2003;67 Suppl 1:S217-20. DOI: 10.1016/j.ijporl.2003.08.031.
18. Donnelly MJ, Lacey PD, Maguire AJ. A twenty year (1971-1990) review of tracheostomies in a major paediatric hospital. Int J Pediatr Otorhinolaryngol. 1996;35(1):1-9. DOI: 10.1016/0165-5876(95)01255-9.
19. Cammack B, Noel-MacDonnell J, Cuna A, Manimtim W. Impact of tracheos-

tomy on language and cognitive development in infants with severe bronchopulmonary dysplasia. J Perinatol. 2020;40(2):299-305. DOI: 10.1038/s41372-019-0540-5.

20. Simon BM, Fowler SM, Handler SD. Communication development in young children with long-term tracheostomies: preliminary report. Int J Pediatr Otorhinolaryngol. 1984;6(C):37-50. DOI: 10.1016/s0165-5876(83)80102-5.
21. Kaslon KW, Stein RE. Chronic pediatric tracheotomy: assessment and implications for habilitation of voice, speech and language in young children. Int J Pediatr Otorhinolaryngol. 1985;9(2):165-71. DOI: 10.1016/s0165-5876(85)80017-3.
22. Mirza B, Marouf A, Abi Sheffah F, Marghlani O, Heaphy J, Alherabi A, et al. Factors influencing quality of life in children with tracheostomy with emphasis on home care visits: a multi-centre investigation. J Laryngol Otol. 2023;137(10):1102-9. DOI: 10.1017/S002221512200202X.
23. Greene ZM, Davenport J, Fitzgerald S, Russell JD, McNally P. Tracheostomy speaking valve modification in children: A standardized approach leads to widespread use. Pediatr Pulmonol. 2019;54(4):428-35. DOI: 10.1002/ppul.24209.
24. Magnus VS, Turkington L. Communication interaction in ICU–Patient and staff experiences and perceptions. Intensive Crit Care Nurs. 2006;22(3):167-80. DOI: 10.1016/j.iccn.2005.09.009.
25. Freeman-Sanderson AL, Togher L, Elkins MR, Phipps PR. Quality of life improves with return of voice in tracheostomy patients in intensive care: An observational study. J Crit Care. 2016;33:186-91. DOI: 10.1016/j.jcrc.2016.01.012.
26. Wallace S, McGowan S, Sutt AL. Benefits and options for voice restoration in mechanically ventilated intensive care unit patients with a tracheostomy. J Intensive Care Soc. 2023;24(1):104-11. DOI: 10.1177/17511437221113162.
27. Prigent H, Garguilo M, Pascal S, Pouplin S, Bouteille J, Lejaille M, et al. Speech effects of a speaking valve versus external PEEP in tracheostomized ventilator-dependent neuromuscular patients. Intensive Care Med. 2010;36(10):1681-7. DOI: 10.1007/s00134-010-1935-0.
28. Zabih W, Holler T, Syed F, Russell L, Allegro J, Amin R. The use of speaking valves in children with tracheostomy tubes. Respir Care. 2017;62(12):1594-601. DOI: 10.4187/respcare.05599.
29. Suiter DM, McCullough GH, Powell PW. Effects of cuff deflation and one-way tracheostomy speaking valve placement on swallow physiology. Dysphagia. 2003;18(4):284-92. DOI: 10.1007/s00455-003-0022-x.
30. Prigent H, Lejaille M, Terzi N, Annane D, Figere M, Orlikowski D, et al. Effect of a tracheostomy speaking valve on breathing-swallowing interaction. Intensive Care Med. 2012;38(1):85-90. DOI: 10.1007/s00134-011-2417-8.
31. Sutt AL, Caruana LR, Dunster KR, Cornwell PL, Anstey CM, Fraser JF. Speaking valves in tracheostomised ICU patients weaning off mechanical ventilation - do they facilitate lung recruitment? Crit Care. 2016;20:91. DOI: 10.1186/s13054-016-1249-x.
32. Wiberg S, Whitling S, Bergström L. Tracheostomy management by speech-language pathologists in Sweden. Logoped Phoniatr Vocol. 2022;47(3):146-56. DOI: 10.1080/14015439.2020.1847320.
33. Eichar BW, Kaffenberger TM, McCoy JL, Padia RK, Muzumdar H, Tobey ABJ. Effect of speaking valves on tracheostomy decannulation. Int Arch Otorhinolaryngol. 2024;28(1):e157-64. DOI: 10.1055/s-0043-1767797.
34. Nomori H. Tracheostomy tube enabling speech during mechanical ventilation. Chest. 2004;125(3):1046-51. DOI: 10.1378/chest.125.3.1046.
35. Kam K, Patzelt R, Soenen R. Pediatric tracheostomy speaking valves: A multidisciplinary protocol leads to earlier initial trials. J Child Heal Care. 2023;27(3):386-94. DOI: 10.1177/13674935211070416.
36. Hess DR. Facilitating speech in the patient with a tracheostomy. Respir Care. 2005;50(4):519-25.
37. Russell SM, Highsmith L, Henriquez O, Belagaje S, Moore C. The efficacy of tracheostomy tube changes by speech-language pathologists: A retrospective review. Int J Ther Rehabil. 2017;24(11):466-72.
38. Davis S, Weyh AM, Salman SO, Madbak F, Fraker JT. Speech pathology services are integral, but underutilized in tracheostomy rehabilitation. Craniomaxillofac Trauma Reconstr. 2021;14(2):110-8. DOI: 10.1177/1943387520948381.
39. Hall N, Rousseau N, Hamilton DW, Simpson AJ, Powell S, Brodlie M, et al. Providing care for children with tracheostomies: a qualitative interview study with parents and health professionals. BMJ Open. 2023;13(1):e065698. DOI: 10.1136/bmjopen-2022-065698.

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