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The influence of long-term tracheostomy on speech and language development in children

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Abstract

Background: Individuals diagnosed as having primary neurological disorders have a high incidence of abnormal speech and language development. However, results in cohorts where this group are excluded are controversial. With no coexisting neurological impairment, some suggested that tracheostomy has little influence on speech development, whilst others showed a clear pattern of language disability. The aim of this study is to evaluate the influence of tracheostomy on speech and language development. *Method*: Retrospective study using standardised outcome measures. *Results*: A series of 39 paediatric tracheostomies was studied. In the group where children had neurological disorders, 94% showed no language or delayed language development. In contrast, of the group of children without a neurological impairment, 60.9% had normal speech and language development. The median age at the decannulation in those children with delayed speech was 23 months, whilst in those children with normal speech it was 14.5 months. *Conclusion*: Tracheostomy affects speech and language development in those with and without neurological disorders. Crucial factors affecting speech and language development within the neurologically normal group are age at the tracheostomy, and the duration of the tracheostomy until decannulation. Achieving earliest decannulation improves the chance of a normal speech and language development.

Keywords: Paediatric tracheostomy; Decannulation; Speech; Language

1. Introduction

Infants who have had a long-term tracheostomy represent an interesting population to study into speech and language development. Following significant advances in the

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technology of neonatal and paediatric intensive care over the last 20 years, the airway can now be comfortably supported via oro- and nasotracheal intubations for a relatively long period, hence the previous major indication for tracheostomy, acute upper airway infection, has changed to upper airway obstruction from other factors [1]. Benefiting from the same technology, the survival rate of extremely low birth weight and pre-term infants has significantly improved. It is this group of babies and children who are likely to have long-term tracheostomy and represent a growing population that is at risk for delayed speech and language development. Whilst the underlying indication for tracheostomy may serve as a predictor of the long-term outcome and certain aspects of child development, it has been demonstrated that individuals diagnosed as having primary neurodevelopment delay have a high incidence of abnormal speech and language development. However, results in cohorts where this group is excluded are controversial. With no coexisting neurodevelopment impairment, some have suggested that tracheostomy has little influence on speech development [2], whilst others have showed a clear pattern of language disability [3]. The current study is designed to evaluate factors affecting the speech and language development in tracheostomised children. Here we report some preliminary results.

2. Materials and methods

2.1. Subjects

Subjects for this study were 39 children with a history of tracheostomy in infancy and childhood. Patients were chosen from a group of 65 children who had undergone a tracheostomy in their childhood during the years from 1995 to 2000 at Guy's and St. Thomas' hospitals. All children included in the study had their tracheostomy at less than 5 years of age. Children excluded from the current study were those who died (8 out of 65) during the course of the treatment, either due to their primary condition or as a complication of the tracheostomy, or they were older than 5 years old at the time of the tracheostomy.

2.2. Assessment of speech and language development

Patients were divided into two groups. One group includes those who have a primary neurological disorder, mental retardation or severe cranial facial anomalies. These primary conditions would affect their speech and language development even without a tracheostomy. The second group includes those who do not have such conditions. There are 16 children in the first group, and 23 children in the later.

The method of the current study is retrospective review. All children included in the study were assessed and followed up by paediatricians, a paediatric speech and language therapy team and paediatric ENT team. Other than routine clinical assessment, the general development and speech and language development were assessed using standardized measures. These include Griffith's Developmental Scales, MacArthur Communication Developmental Inventory, Pre-school Language Scales, Receptive and

Table 1
Indications for tracheostomy

Indications	Group I	Group II
Acute infection without airway problem	2 (12.5%)	2 (8.7%)
Airway obstruction at laryngeal level	5 (31.25%)	17 (73.9%)
Congenital head and neck deformity	4 (25%)	2 (8.7%)
Long-term ventilation and/or nonventilated respiratory support	5 (31.25%)	2 (8.7%)

Group I: with a primary disorder; Group II: without a primary disorder.

Expressive Emergent Language Scale, Reynell Developmental Language Scales III, and Clinical Evaluation of Language Fundamentals for pre-school. One or more of these measures were used at the follow-up clinics depending on the purpose of the assessment and response of the patient. An overall grade of speech and language development was given to each child according to the performance of these measures and the clinical assessment.

3. Results

3.1. Indications for tracheostomy

A total of four indications were identified. A summary of the indication for each group is shown in Table 1. It shows that the overwhelming indication for children without a primary neurological disorder was airway obstruction at laryngeal level, whilst indications within the group with a primary neurological impairment were almost equally distributed among the airway obstruction at the laryngeal level, congenital head and neck deformity and long-term ventilation.

3.2. Impairment of speech and language development

Table 2 shows the extent of speech and language development impairment among the children in the two groups. Ninety-four percent of children with a neurodevelopment impairment showed absent or delayed speech and language development. In contrast, 60.9% of children who do not have such a condition had normal speech and language development.

Table 2
Speech and language development in tracheostomised children

Speech and language development	Group I	Group II
Absent	6/16 (37.5%)	3/23 (13%)
Delayed	9/16 (56.3%)	6/23 (26.1%)
Normal	1/16 (6.2%)	14/23 (60.9%)

Group I: with a primary disorder; Group II: without a primary disorder.

Table 3
Details of tracheostomised children who were older than 1 year old at insertion

Case	Age at tracheostomy	Duration	Age at decannulation	Speech outcome
1	15	1	16	normal
2	20		undecannulatable	normal
3	30	7	37	normal
4	46	2	48	normal
5	48	24	72	normal
6	60	2	62	normal

Age and duration in months.

3.3. Effects of age at tracheostomy and the duration of the cannulation

The effect of the age at the tracheostomy and the duration of cannulation on speech and language development were studied within the group of children who do not have neuro-developmental impairment. We chose 1 year of age as a cutoff point, since it is a milestone in the linguistic development. There were six children who had a tracheostomy after they passed their first birthday. Table 3 shows details of the age at tracheostomy, duration of cannulation, age at the decannulation, and outcome of their speech and language development. The mean age was 36 months at the time of the tracheostomy and a median duration of only 2 months until decannulation. All six children had normal speech at the time of the test. This group therefore had relatively short periods of tracheostomisation, or had already developed language at the time of the tracheostomy.

Table 4 shows an outcome summary of 17 patients who had their tracheostomy when they were less than 12 months old. The mean age at the tracheostomy in this group is 4.5 months (S.D. = 3; median age = 3 months). Three children were absent of speech, and all of them are undecannulatable. In six children with delayed speech development, median duration of the cannulation was 18 months (mean = 21 S.D. = 10.1), and median age at the decannulation was 23 months (mean = 25.4, S.D. = 9.4, $n = 5$, one child was undecannulatable). In contrast, eight cases with normal speech and language development showed a median duration of the cannulation of 12 months (mean = 9.8, S.D. = 6.8). Their median age at decannulation was 14.5 months (mean = 14.4, S.D. = 6.9).

Table 4
Details of children who were less than 1 year old at tracheostomy

Speech outcome	Number of patients	Duration of cannulation			Age at decannulation		
		Median	Mean	S.D.	Median	Mean	S.D.
Absent	3				All undecannulatable		
Delayed	6	18	21	10.1	23	15.4	9.4
Normal	8	12	8	6.75	14.5	14.4	6.9

Age and duration in months.

4. Discussion

Most previous studies on the influence of long-term tracheostomy on speech and language development included either a mixed group of children who may or may not have primary neurological disorders [4], or a group in which such disorders were excluded completely [3]. It has been demonstrated that the speech and language delay in those children with a primary neurological disorder, mental retardation or severe physical disabilities was largely due to their primary disorders. Even within the group of children who do not have a primary neurological disorder, the overall language skills are commensurate with intellectual functions [5]. However, a shared compelling reason for speech and language impairment in children, with or without a primary neurological disorder, is that the tracheostomy tube inhibited both vocalization and language development. In our study, we have separated the children into two groups, one with a primary neurological disorder, mental retardation or severe physical disabilities, and one without. The current study has shown that children with the above primary disorders were almost inevitably going to suffer from delayed speech and language development. Other than the effect of their primary disorder on the speech and language development, a high proportion of them were not suitable for decannulation (5 out of 16, 31%), which suggests that the duration of the cannulation may play an important overall role (see below).

Due to possibly the small sample bias, the current study cannot demonstrate the influence of the age at the tracheostomy on the speech and language development. The trend is suggested that tracheostomy at older ages, when language fundamentals have already been formed, allows normal language development.

For those children without a primary neurological disorder who had a tracheostomy before their first birthday, however, the duration of the cannulation is the key factor affecting their speech development. We have showed that achieving decannulation before the age of 15 months gives a good outcome on speech and language development. This result is consistent with earlier studies. Simon et al. [2] showed that children decannulated during the prelinguistic stage had speech and language skills commensurate with their intellectual function, whilst children decannulated during the linguistic stage exhibited specific spoken language delays including phonological impairment.

We conclude that achieving earliest decannulation improves the chance of normal speech and language development.

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