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Original Research Article

Assessment of health-related benefits of tracheostomy as an ancillary treatment in children

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ABSTRACT

Background: Tracheostomy is technically more difficult in children than in adults due to smaller and more pliable trachea and is associated with significant morbidity and mortality. This pilot study aims to assess the health-related benefit of tracheostomy as an intervention in children
Methods: Children who had tracheostomy between January 2010 and January 2024 were reviewed. Demographics, indications and complications were collated. Health benefits were prospectively assessed using The Glasgow Children's Benefit Inventory (GCBI).
Results: Of 133 patients (males 79 and females 54), 24 had missing details,13 had expired and 10 did not consent to participate in the study, so 86 were enrolled for the assessment. The age at tracheostomy ranged from 1.5 to 11 years. Indications for tracheostomy included traumatic brain injury (23), prolonged ventilation (18), sepsis (27), anatomic obstruction (9), seizures (8) and hypoxic injury secondary to partial hanging (1). Duration on tracheostomy ranged from 6 months to 7 years. Recurrent respiratory infections, aspiration, pneumonia and vocal cord palsy were notable complications. Most reported improvement in physical health, 70% in psychological health, 66% noted significant change in vitality however many had learning disabilities
Conclusions: Though outcomes of children on tracheostomy are determined by the underlying aetiology, it is still validated as an ancillary intervention for it ensures significant health related benefits with improvement in psychological and physical well-being along with enhanced vitality

Keywords: Paediatric, Tracheostomy, Health, Benefit

INTRODUCTION

Tracheostomy, is now increasingly performed in children more as an elective than emergency procedure. Its indications have shifted from acute infections such as croup, epiglottitis and diphtheria to more complex and chronic conditions like upper-airway obstruction, prolonged ventilation, cardiopulmonary and neurological disorders.[1,2] Improved survival of sick children due to advancements in critical care has led to an increase in the number of children requiring prolonged ventilation and tracheostomy.[3] Apart from being a life-saving procedure, tracheostomy is associated with significant morbidity and mortality. Complications range from 10% to 58%, overall mortality of up to 59%, with tracheostomy related mortality of 6%.[4,5] Here we aim to assess health related benefit of tracheostomy exclusively, when done as an ancillary procedure for various indications

METHODS

This is a prospective cross sectional, observational study of children below 18 years who underwent tracheostomy from January 2010 to Jan 2024 at St Johns Medical College Hospital Bangalore, India. Children up to 18 years are managed under the care of Paediatrics and Paediatric surgery as per our institutional policy and hence these form our study population. Children with traumatic brain injury, prolonged ventilation, severe sepsis, pneumonia and those with airway abnormalities in whom tracheostomy was done as an ancillary procedure were included in the study. Those undergoing neurosurgical procedures, repair of cleft palate/ craniofacial anomalies etc in whom tracheostomy was required for a secure airway, only for a short duration (till the primary disability recovered) and those children who were already decannulated were excluded from the study. Demographics, aetiology, duration of tracheostomy and complications were collated**.** Health benefits were assessed using the Glasgow Children's Benefit Inventory (GCBI) prospectively by patient recall. Baseline data was gathered from hospital electronic information system, from medical records, OT registers & discharge summaries. GCBI questionnaire was administered to parents during follow up either in person when children were brought to regular physical medicine and rehabilitation (PMR) services or at the time of periodic tracheostomy change and by a telephonic interview for those who could not make it for follow up at that point in time GCBI (Table 1) (Kubba et al) specifically measures the health-related benefit post a particular intervention; because application of conventional health related quality of life (QoL) measures often fail to highlight a change; as small differences produced by the intervention are masked by the large variations in reported QoL between individuals. Also, the variance in the postintervention scores is added to that of the preintervention scores when one score is subtracted from the other creating a wide gap in the response scales limiting the range over which people can report changes in their health.

Additionally, GCBI can be applied to subjects who have undergone an intervention in the past, without the need for completing a preintervention questionnaire. GCBI-comprises of 24 questions on the consequences of a specified intervention, pertaining to child's day-to-day life, without reference to any specific symptoms and is worded to apply to children of any age to retrospectively assess benefit after an intervention. It is completed by parents on behalf of the child and is exceptionally designed for use in pediatric otolaryngology. Likert Rating scale is used to assess the response which analyses four subscales-physical health, psychological, behavioural/ learning and vitality.[6] The purpose of this study was to assess the benefit of tracheostomy exclusively as an intervention on various aspects of child's health.

Table 1: GCBI.

S. no.	Questionnaire
	In this questionnaire, we are interested to know how much change you think there has been in your child's general condition since his or her operation
1	Has your child's operation made his/her overall life better or worse?
2	Has your child's operation affected the things he/she does?
3	Has your child's operation made his/her behavior better or worse?
4	Has your child's operation affected his/her progress and development?
5	Has your child's operation affected how lively he/she is during the day?
6	Has your child's operation affected how well he/she sleeps at night?
7	Has your child's operation affected his/her enjoyment of food?
8	Has your child's operation affected how self-conscious he/she is with other people?
9	Has your child's operation affected how well he/she gets on with the rest of the family?
10	Has your child's operation affected his/her ability to spend time and have fun with friends?
11	Has your child's operation affected how embarrassed he/she is with other people?
12	Has your child's operation affected how easily distracted he/she has been?
13	Has your child's operation affected his/her learning?
14	Has your child's operation affected the amount of time he/she has had to be off nursery, playgroup, or school?
15	Has your child's operation affected his/her ability to concentrate on a task?
16	Has your child's operation affected how frustrated and irritable he/she is?
17	Has your child's operation affected how he/she feels about himself/herself?
18	Has your child's operation affected how happy and content he/she is?
19	Has your child's operation affected his/her confidence?
20	Has your child's operation affected his/her ability to care for himself/herself as well as you think they should, such as washing, dressing, and using the toilet?
21	Has your child's operation affected his/her ability to enjoy leisure activities such as swimming and sports, and general play?
22	Has your child's operation affected how prone he/she is to catch colds or infections?
23	Has your child's operation affected how often he/she needs to visit a doctor?
24	Has your child's operation affected how much medication he/she has needed to take?
Choices underneath each question-much better (1), a little better (2), no change (3), a little worse (4), much worse (5)	

Statistical methods

All statistical analysis were performed using Stata version 17.0 (Stata Corp LLC, College Station, TX, USA). The responses to the GCBI were analysed to assess perceived changes in physical health, psychological well-being, behavioural (learning) aspects, and vitality following tracheostomy. Each GCBI item was scored on a five-point Likert scale, where lower scores (1-2) indicated improvement, a score of 3 indicated no change, and higher scores (4-5) indicated worsening in the respective domain. For each question, the frequency and percentage of responses in each category were calculated. Descriptive analyses were conducted to summarize the distribution of responses across the four domains. The proportion of participants reporting improvement, no change, or worsening was calculated for each item, and domain-specific average percentages were computed to represent the overall pattern of change within each health dimension.

RESULTS

86 children on tracheostomy were finally recruited and analyzed (Figure 1). Age at tracheostomy ranged from 1.5 to 11 years (mean-5 years) with male preponderance (M: F=58%:42%) (Table 2). Indications for tracheostomy are collated (Table 3) with prolonged ventilation and traumatic brain injury contributing to almost 48% of the cases.

Accidental decannulation, recurrent respiratory infections, aspiration pneumonia, vocal cord palsy and trachea-cutaneous fistula were the complications noted.

Health benefits under various subscales in each patient was collated. Under physical health benefits (Table 4), almost all children reported improvement in overall outcome, however they showed worsening in terms of absence from school, proneness to infection resulting in increased number of hospital visits. Nearly 70% reported psychological benefit, especially in terms of improvement in confidence and not feeling embarrassed when among people (Table 5). Though, 69% acknowledged improvement in overall behavior but learning abilities showed no improvement or deteriorated significantly in a majority (Table 6). Overall improvement in the vitality was noted in 66% with significant change in ability to socialize, being lively during the day and sleeping well at night (Table 7).

Table 2: Demographic data.

Number of patients	N
Total	133
Included in the study	86
Age at tracheostomy (in years)	1.5-11 (Mean-5)
Gender	58%: 42% (Male:Female)
Duration on tracheostomy	6 months-7 years

Table 3: Indications for tracheostomy.

Indications	Number (86)
Traumatic brain injury	23
Prolonged ventilation	18
Pneumonia, Sepsis infections	27
Anatomic obstruction	9
Seizures	8
Hypoxic brain injury (secondary to hanging)	1

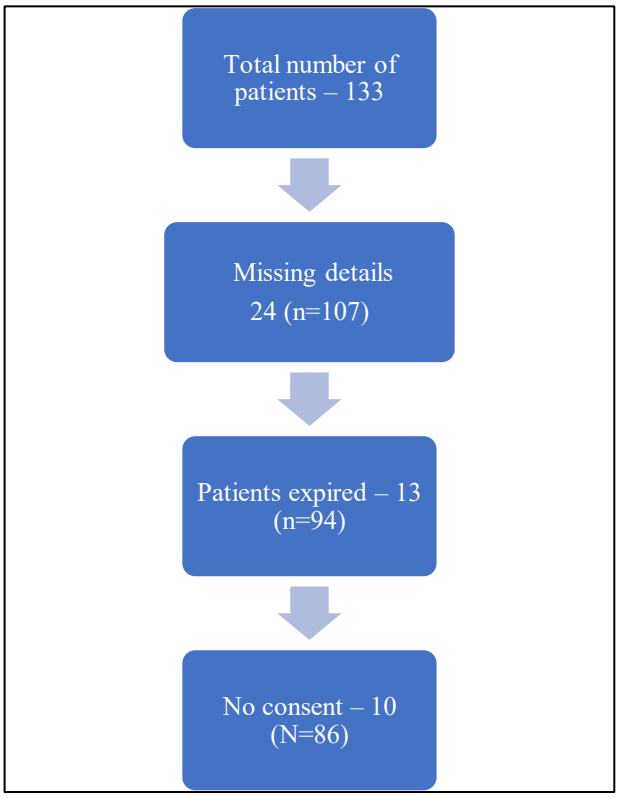


Figure 1: Recruitment of patients.

Table 4: Physical health assessment.

Questions	Improvement (1, 2)	No improvement (3)	Worsening (4, 5)
Is overall outcome better	86 (100%)		
Amount of time off school	1 (1.5%)	1 (1.5%)	84 (97%)
Prone to catch infections	1 (1.5%)	1 (1.5%)	84 (97%)
Frequency of doctor visits	1 (1%)	12 (14%)	72 (85%)
Need to take medications	59 (68%)	27 (32%)	
Average percentage	34.4.%	9.6%	56%

Table 5: Psychological health assessment.

Variables	Improvement (1, 2)	No improvement (3)	Worsened (4, 5)
Self-consciousness	47 (55%)	39 (45%)	
Embarrassment with other people	68 (79%)	18 (21%)	
Self esteem	44 (51%)	36 (42%)	6 (7%)
Happy/content with self	63 (73%)	17 (20%)	6 (7%)
His/her confidence	71 (83%)	15 (17%)	
Average %	68%	29.6 %	9.8%

Table 6: Behavioral (Learning) assessment.

Variables	Improvement (1, 2)	No improvement (3)	Worsening (4, 5)
Overall behavior	59 (69%)	27 (31%)	
Progress and development	65 (76%)	21 (24%)	
Gets on with rest of the family	79 (92%)	7 (8%)	
Gets distracted easily	51 (59%)	13 (15%)	22 (26%)
Learning ability	12 (15%)	67 (78%)	7 (7%)
Concentration ability	53 (62%)	25 (29%)	8 (9%)
Frustration/ irritability	44 (51%)	23 (27%)	19 (22%)
Average percentage	54%	41.5%	9.5%

Table 7: Vitality assessment.

Questions	Improvement (1, 2)	No improvement (3)	Worsening (4, 5)
Affected the things he/she does	65 (76%)	21 (24%)	-
Lively during the day	64 (75%)	22 (25%)	-
Sleeps at night	81 (94%)	5 (6%)	-
Enjoyment of food	43 (50%)	43 (50%)	-
Ability to socialize	71 (83%)	15 (17%)	-
Participation in leisure activities	28 (33%)	58 (67%)	-
Self-care ability	47 (55%)	39 (45%)	-
Average percentage	66%	33.4 %	-

DISCUSSION

In the pre vaccination era, upper airway obstruction was the commonest indication for tracheostomy in children, however in recent times prolonged ventilation has been the primary indication. This could be secondary to underlying neurological (Guillain Barre syndrome, meningoencephalitis, central hypoventilation syndrome, intracranial tumours etc), cardiopulmonary (post-cardiac surgery, acute respiratory distress syndrome etc) or infectious causes (diphtheria neuropathy with sepsis etc.). Airway obstruction due to congenital or acquired causes and chronic neuromuscular diseases also require tracheostomy.[7,8]

Paediatric tracheostomy is technically more difficult than in adults as the trachea is smaller and more pliable in children. None the less it has hastened weaning from mechanical ventilation and improved survival in critically ill children. In-spite of being a lifesaving procedure it is associated with significant morbidity and mortality. Thus far there have been no studies assessing the health-related benefits of tracheostomy in children. Potential documented advantages of tracheostomy are that it allows early weaning off the ventilator as it decreases the work of breathing by reducing the dead space and the airway resistance offered by an endotracheal tube.[9] It provides for a good pulmonary toilet decreasing the pooling of secretions and bypassing the obstruction in subglottic stenosis. It facilitates early feeding and mobilisation thereby decreasing the length of hospital stay and minimising the financial burden on families.[10]

Age at tracheostomy in our children ranged from 1.5 to 11 years with varied pathologies, however single centre experiences have reported mean and median ages of 1.4 years and 2 months respectively indicating a low threshold for early tracheostomy as a salvage procedure.[11,12] Amongst the children who underwent tracheostomy, 40% were less than 1 year with more neonates undergoing the procedure due to better health facilities supporting their survival. This study highlighted that adequate domiciliary care can be provided by the caretakers at home without any significant increase in complications.[13,14]

A contemporary review documented, upper airway obstruction due to laryngotracheal anomalies and

prolonged ventilation as common indications for tracheostomy in children.[15] Traumatic brain injury and prolonged ventilation were the major indications in our cohort.

Accidental decannulation, recurrent respiratory infections, aspiration pneumonia, vocal cord palsy and trachea-cutaneous fistula were the complications noted in our children akin to those reported by Robert et al.[5]

Outcome following decannulation is mainly determined by the indication for tracheostomy and duration on tracheostomy, with increased failure rates noted in patients with airway stenosis, prolonged ventilation and more than 6 months on tracheostomy.[16] Decannulation was reported successful in 120/526 patients in a case series study which proposed a decannulation protocol. Another long-term study reported 83.5% successful decannulation.[17,18]

Our study however did not include children who were decannulated. Mortality is mostly due to primary pathology and associated comorbidities whereas direct tracheostomy related deaths are around 6-9%.[4,19] We noted a 10% (13/133) overall mortality in the children who had tracheostomy during the study duration mostly due to primary pathology.

A study on QoL in tracheostomized children and their caregivers concluded that the impact of disease burden is particularly higher with tracheostomies as compared to other serious childhood diseases and coping with tracheostomy care and child's health not only reduced the QoL of caregivers significantly but also increased the anxiety about the future.[20] Assessment using a validated Pediatric Tracheotomy Health Status Instrument (PTHSI) tool; documented poorer QoL of tracheostomized children and their families especially those with comorbidities.[21] Using Peds QL questionnaires; the mean QoL score for paediatric tracheostomy patients was 75.51, with physical and psychosocial health scores of 74.0 and 76.5, respectively. The family impact score was 75.1, with health-related QoL and family functioning scores of 75.9 and 77.6, respectively, indicating a significant impact on the QoL of both patients and caregivers.[22]

Health benefit assessment of tracheostomy in children is distinctive to our study not reported thus far in literature unlike the quality-of-life assessments following tracheostomy discussed earlier. We note that there is a reasonable improvement in psychological and behavioral health with improvement in the vitality in terms of heightened self-confidence, ability to socialize, being lively during the day and sleeping well at night. However, there is a notable deterioration in learning abilities and worsening in physical health due to proneness to infections, increased number of hospital visits and absence from school, all of which remain an unavoidable peril of the procedure.

The limitations of our study are that there can be bias related to the parent's prior expectation of benefit or their perceived benefit which may not be the same as what is sensed by the child. However, the advantage is that the GCBI score does clearly notify the outcomes before and after a particular intervention and is especially applicable for chronic conditions where the primary disease has a bearing on the eventual outcome of health

CONCLUSION

Outcome in children on tracheostomy is determined by the underlying etiology; none the less tracheostomy is validated in these children as it not only hastens weaning off the ventilator but significantly reduces the hospital stay and hence the financial burden on the family. Though tracheostomy care is a challenge it definitely ensures significant health related benefits with respect to psychological and behavioral wellbeing with improvement in vitality

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Ethical approval: The study was approved by the Institutional Ethics Committee

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