

Tracheostomy manipulations: Impact on tracheostomy safety

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ABSTRACT

Importance: Tracheotomy is one of the riskiest procedures for composite morbidity within pediatric otolaryngology. During the postoperative period, each time the tracheostomy tube is manipulated, there is opportunity for morbidity (e.g. a patient is vulnerable to accidental decannulation and airway loss).

Objective: To identify areas of improvement in caring for “fresh tracheostomy” patients by determining the number of times a tracheostomy tube is manipulated from placement until discharge. The hypothesis is that the more a tracheostomy is manipulated, the higher probability of morbidity.

Methods: A quality improvement initiative was conducted to map the care of patients who underwent tracheostomy placement over 12 months. Tracheostomy care and manipulation by all providers were reviewed. Complications, wound care, and respiratory treatments were also evaluated.

Results: Patients were hospitalized for an average of 39 days (7–140) following tracheostomy. The first tracheostomy tube change occurred on average 6 days (5–10) following placement. Tracheostomy tubes were manipulated an average of 6 (2.5–11.9) times a day to amount to 216 (51–1091) times between placement and discharge. Bedside nurses and respiratory therapists were responsible for 95% of these actions; physicians accounted for 4%. There were 6 tracheostomy related complications. Three were accidental decannulations resulting in cardiopulmonary arrest. One of these caused long term patient morbidity. Patients with more than 4 manipulations per day during the 2 weeks following tracheostomy tube placement, were more likely to have a tracheostomy related complication than those with less than 4 (*OR*: 12.5; 95% *CI*: 1.2–130.6; *P* = 0.0349).

Interpretation: While uncommon, complications related to tracheostomy can have serious long term effects and at best prolongs length of stay for patients. Reducing the number of tracheostomy manipulations may provide safer postoperative care ultimately reducing morbidity and potentially mortality; children on average have 6 tracheotomy manipulations/day with only 2% being by the physician.

KEYWORDS

Complications, Management, Pediatric tracheostomy, Safety

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INTRODUCTION

More than 4800 children undergo pediatric tracheostomy in the United States annually with infants accounting for one third of these patients.¹ While pediatric tracheostomy is a relatively straightforward surgical procedure, the postoperative care is complex due to the acuity of care required for patients with multiple comorbidities as the tracheostomy heals. Patients are susceptible to complications both unrelated to and related to their new tracheostomies.

A study from the American College of Surgeons' National Surgical Quality Improvement Program Pediatric (ASC-NSQIP-P) database found the highest rate of composite morbidity (23%) in 30 day adverse events for tracheostomy in children under 2 years old. This group also accounted for the largest contribution (27%) to serious adverse events in otolaryngology.²

During the period from initial tracheostomy placement until discharge from the hospital, patients are especially vulnerable as they are recovering from the disease process prompting the tracheostomy, healing from the surgical procedure, and adjusting to the tracheostomy. Furthermore, in this time period, providers closely monitor the tracheostomy and home caregivers learn how to care for the new tracheostomy. This combination of vulnerability to complications and frequent manipulation provides a critical period in which there is a high risk of complications.

An initiative by the American Society for Pediatric Otolaryngology NSQIP Pediatric task force found the need to develop procedure specific risk factors for complications in pediatric tracheostomy.¹ We hypothesize that patients with more frequent tracheostomy tube manipulations will have more complications related to the tracheostomy tube.

METHODS

After obtaining IRB approval, a chart review was completed on all medical records of patients who underwent tracheostomy placement at Children's National Medical Center (CNMC) from January 1, 2016 to December 31, 2016. Patients were identified from a hospital maintained database of all tracheostomy patients. Demographic data, medical history, clinical exams, and complications were recorded from the clinical records. Additionally, charts were queried for every time a clinician touched or manipulated the tracheostomy tube from the time of placement until discharge. This included tracheostomy tube and wound care, tracheostomy tie care, respiratory treatments, suctioning, tracheoscopy, tracheostomy tube changes, and Passy-Muir valve and trach nose placements. These details were recorded. Complications were defined as any occurrence related

to the tracheostomy that required additional patient interventions. Peristomal wound breakdown not causing patient morbidity was not considered a complication. Patients who died of non-tracheostomy related causes prior to discharge from the hospital were excluded.

RESULTS

A total of 29 patients underwent tracheostomy over 12 months. Two patients died due to causes unrelated to the tracheostomy prior to hospital discharge thus were excluded. One patient was decannulated prior to discharge. Almost half (40.7%) of the patients underwent tracheostomy during the first 6 months of life (Table 1). The indication for tracheostomy was respiratory failure in 22 (81.5%) patients and upper airway obstruction in 5 (18.5%). Twenty-five (92.6%) were planned procedures while 2 (7.4%) were emergent tracheostomies.

TABLE 1 Patient Demographics

Characteristic	Number of patients, <i>n</i> (%)
Age	
Infant (0–6 months)	11 (40.7)
Toddler (7–36 months)	4 (14.8)
Child (37 months–13 years)	8 (29.7)
Young adult (14 years +)	4 (14.8)
Gender	
Male	16 (59.3)
Female	11 (40.7)
Primary indication for tracheostomy	
Respiratory failure/facilitation of ventilation	22 (81.5)
Upper airway obstruction	5 (18.5)

The first tracheostomy tube change occurred 6 days (5–10) following tracheostomy. Patients were discharged an average of 39 days (7–140, median 25) following tracheostomy placement. From the time of tracheostomy tube placement until discharge, tracheostomy tubes were manipulated 216 times (51–1091, median 139). Each day tubes were touched 6 times (2.5–11.9). Tracheostomy manipulations included tracheostomy exams, stoma wound exams and care, tracheostomy tie exams and adjustments, tracheostomy tube changes, flexible tracheostomy, respiratory treatments, Passy-Muir valve and trach nose placements, and tracheostomy suctioning.

The bedside nurse and respiratory therapist were responsible for 95% of the tracheostomy touches, while physicians accounted for less than 5% (Table 2).

There were complications in 6 patients following tracheostomy manipulations (Table 3). Three of these were cardiopulmonary arrests following inability to ventilate the patient from dislodged tracheostomy tubes. One patient sustained a severe hypoxic brain injury as

a result. One complication was due to mucus plugging of the tracheostomy tube cannula. The remaining two complications were related to trauma of the tracheostomy wound. There were no deaths. Five (83%) complications occurred within the first 2 weeks post tracheostomy placement.

TABLE 2 Providers manipulating tracheostomy

Providers	Total touches, n (%)	Number of touches/patient
Bedside nurse	3007 (51.79)	111.37
Tracheostomy nurse	258 (4.44)	9.56
Wound nurse	18 (0.31)	0.67
Respiratory therapist	2262 (38.96)	83.78
ENT physician	223 (3.84)	8.26
Other physician	11 (0.19)	0.41
Speech therapist	27 (0.47)	1.00
Total	5806 (100.00)	215.05

In patients with complications, there were more than 4 manipulations per day prior to the tracheostomy related complication. Patients with more than 4 manipulations per day during the 2 weeks following tracheostomy tube placement, were more likely to have a tracheostomy related complication than those with less than 4 (*OR*: 12.5; 95% *CI*: 1.2–130.6; *P* = 0.0349). There was no correlation between total number of touches between placement and discharge and tracheostomy related complication.

TABLE 3 Tracheostomy related complications

POD of complication	Touches prior to complication	Touches/day prior to complication	Complication
10	41	4.1	During tracheostomy care, tracheostomy tube dislodged with inability to replace tube in to the stoma or intubate patient with subsequent inability to ventilate and code resulting in severe hypoxic brain injury and chronic encephalopathy.
13	149	11.5	Following suctioning, patient with prolonged desaturations and difficulty ventilating. Resolved following tracheostomy tube change.
1	9	9.0	Following suctioning, perfuse peristomal bleeding without changes in ventilation. Bleeding self-limited without further episodes. Exam consistent with trauma to fresh wound.
116	614	5.3	During tracheostomy tie change, tracheostomy tube dislodged from stoma resulting in code. Upon replacement of tracheostomy tube, patient stabilized with no long term effects of code.
12	49	4.1	During tracheostomy dressing change, patient desaturated with bradycardia and subsequent asytle resulting in a code. Patient was unable to be ventilated through the tracheostomy tube thus was orotracheally intubated. Following successful ventilation, patient stabilized with no long term effects of code. Tracheostomy tube subsequently found to be in a false passage.
14	85	6.1	Following suctioning, perfuse bleeding from tracheostomy tube lumen with clots and difficulty ventilating. Bleeding self-limited without further episodes. Exam consistent with abrasion for tracheal mucosa.

POD, postoperative day.

DISCUSSION

Pediatric tracheostomy is associated with a low overall incidence of procedure related morbidity.³⁻⁹ Complications are typically related to multiple comorbidities in this medically complex patient population.^{3,5,7,10} However, when tracheostomy related complications occur, the consequences can be severe. This is the first study to evaluate frequency of tracheostomy manipulation as a risk factor for tracheostomy related complications.

This study originated following such a complication in which the index patient for this series sustained hypoxic ischemic encephalopathy following accidental tracheostomy dislodgement during tracheostomy care. When revisiting the case to see if the outcome was preventable, we noticed that this patient’s tracheostomy wound had been cared for and examined multiple times previously that day. Each time a tracheostomy tube is manipulated there is opportunity for complications and morbidity.

The surgical wounds from tracheostomies are prone to wound breakdown, pressure ulcers, and infection as the wound is contaminated and moistened from respiratory secretions, tracheostomy tubes place pressure on the healing skin, and patients’ comorbidities result in immobility and poor wound healing.¹¹ Changes in care with system wide practices, specialized nursing, and education protocols have decreased complications of tracheostomy wounds.¹¹⁻¹³ However, this diligence for wound surveillance has created a culture of frequent tracheostomy manipulations which can increase

complications.

As demonstrated in previous studies,⁵⁻⁹ the majority of patients in our series were infants and underwent tracheostomy for respiratory failure. It is routine procedure to change a fresh tracheostomy tube between post-operative days 5 and 10. The decision of when to first change a fresh tracheostomy tube is made by the surgeon and is dependent on patient factors such as wound healing, neck and airway anatomy, and overall clinical stability. Patients with poor wound healing, unfavorable anatomy, and clinically labile will have their tracheostomies changed later as opposed to more stable patients. Our finding of the first change on day 6 is consistent with this practice. The 35 day interval from tracheostomy placement until discharge is similar to previous reported intervals of 28 and 45 days.^{1,10} Our complication rate of 25% is also in line with previously reported complication rates of 18%–63%.⁵⁻⁹

Prior authors,^{1,9} have grouped tracheostomy complications into major and minor categories. As this was a small sample size with few complications, we did not categorize the severity of the complication, rather chose to describe them. We did not consider minor wound breakdown without patient morbidity a complication as this can be considered as part of the disease process rather than a complication.¹² Every time the tracheostomy tube is manipulated there is risk for trauma to the tracheostomy wound or accidental decannulation.

Multiple specialties and ancillary services are involved in the care of tracheostomy patients due to their medical complexity,¹⁰ hence we expect different providers to examine the tracheostomy as they care for the patient. It is not surprising that over 95% of tracheostomy manipulations are by nurses and respiratory therapists as they provide the majority of patient care. Our hospital has a specialized nursing protocol which has reduced the frequency of tracheostomy wound complications.¹³ This protocol encourages frequent wound check which contribute to the high nursing numbers. Specific tracheostomy related training focusing on how to safely manipulate the tracheostomy may help prevent complications with manipulations.

All but one of the complications occurred within the first 2 weeks. This is a vulnerable time for tracheostomy wounds as the tracts may be intact and first tracheostomy change has occurred, but the wound is still healing. Furthermore, following the first tracheostomy change, home caregivers begin to learn to care for the tracheostomy. These novice caregivers may be more likely to touch the trach in such a way that a complication occurs.

While the overall number of tracheostomy touches over the course of the hospitalization did not increase the risk

for complication, the patients with complications all had more than 4 touches per day in the days prior to the complication. Since most complications occurred in the first 2 weeks following surgery, we looked at the number of touches per day over the first 14 days of tracheostomy placement in all patients. The patients with more than 4 touches per day during this time period had an increased risk of tracheostomy related complication. Therefore, we propose that tracheostomy touches are minimized to 4 or less per day during the 2 weeks following tracheostomy.

Providers must touch the tracheostomy in order to care for the patient, but by eliminating unnecessary manipulations, complications may be able to be avoided. When a patient is being examined by multiple providers in a given time period, these exams may be able to be combined to reduce the touches. For example, the bedside nurse can examine the wound with the physician evaluating the patient. This also facilitates teamwork and communication to address any potential issues.

In all 3 complications in which the tracheostomy tube was accidentally dislodged a code resulted. All of these patients were ventilator dependent, as we would not have expected this result from patients requiring tracheostomy for upper airway obstruction. The majority of the patients undergoing tracheostomy in our series were ventilator dependent which is similar to other pediatric tracheostomy populations.^{7,9}

The Global Tracheostomy Collaborative (GTC) is working to improve outcomes in tracheostomy care by developing best practices and standardization of care.³ This study may help their effort by demonstrating that increased tracheostomy manipulation within the first 2 weeks is a risk factor for tracheostomy related complications.

This study has several limitations. First, our analysis is limited by a small sample size. Further studies with more patients, may show a strong relationship between tracheostomy manipulations and complications. Second, it is limited to a single, academic, tertiary care center where our practices may not apply to other settings. However, given the similarity in overall complications and patient demographics with prior studies, our findings are likely to be generalizable.

While tracheostomy related complications are rare, they can be serious. When tracheostomy tubes are manipulated more than 4 times a day in the 2 weeks following tracheostomy placement, there is increased risk of complications. During this time frame, extra care should be taken when manipulating the tracheostomy. Additionally, exams can be combined to reduce the number of tracheostomy touches to reduce post tracheostomy morbidity.

CONFLICT OF INTEREST

All authors declare no conflicts of interest.

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