A Pediatric Decannulation Protocol: Outcomes of a 10-Year Experience

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Abstract

Objectives. (1) Describe an institutional protocol that focuses on the essential steps for decannulation of pediatric patients with long-term tracheostomies. (2) Discuss the preliminary observations of the safety of this protocol in regard to decannulation failures and successes in a selected patient population.

Study Design. Case series with chart review.

Setting. A tertiary pediatric hospital.

Subjects. Subjects were pediatric patients with chronic tracheostomies undergoing decannulation. Ages ranged from 1 to 17 years old. Indications for initial tracheostomy included chronic lung disease, airway obstruction, and trauma.

Methods. Subjects underwent decannulation attempt following a specific protocol. The protocol consisted of operative laryngoscopy and bronchoscopy. If the airway was deemed adequate for decannulation at that time, the tracheotomy tube was removed, and the child was monitored overnight; the patient was considered for discharge the following day if no complications arose. No routine capping, downsizing, or polysomnography was performed.

Results. Thirty-five patients fit the criteria and were decannulated within 24 hours of endoscopy. Successful decannulation served as the primary outcome. Of the 35 decannulated patients, 54% (n = 19) were discharged the day following decannulation and another 37% (n = 13) on postdecannulation day 2. There were no acute failures or readmissions. Average inpatient stay for those decannulated was 1.8 days.

Conclusion. This study describes the preliminary observations of a decannulation protocol in a small subset of patients. The protocol resulted in no acute failures and offers a conservative approach to resource utilization, making it unique when compared with other published protocols.

Keywords
decannulation, tracheostomy, protocol

Decannulation is the ultimate shared goal of the patient, family, and provider for those children with chronic tracheostomy. Pediatric tracheostomy is performed most commonly for indications of obstruction (eg, oral/oropharyngeal obstruction, craniofacial abnormality, or subglottic stenosis), chronic lung disease, chronic ventilator dependency, or a neuromuscular disorder. Long-term tracheostomy carries with it medical morbidity and negative psychosocial impact. The majority of these pediatric patients requiring tracheostomy can expect effective resolution of their underlying airway pathology and will tolerate decannulation. The question then becomes, What is the best way to proceed with decannulation?

To answer this, providers need to evaluate the safety of their methods. Acute decannulation failures can be catastrophic, and this risk should be minimized. In addition to safety, resource utilization should also be considered when evaluating a particular decannulation method. The literature discusses a myriad of protocols that use varying combinations of inpatient resources, specialized tests, and procedures. In the current cost-conscious health care environment, an ideal protocol should present an efficient utilization of resources while not sacrificing patient safety.

The lack of consensus among providers for an optimal decannulation protocol can, in part, be attributed to the paucity of studies focusing on decannulation and outcomes. There have been limited prospective studies specifically on decannulation or studies comparing various decannulation methods. In 2013, a clinical consensus statement on tracheostomy management was published by Mitchell et al that commented on pediatric tracheostomy. The paper recommends tracheostomy-dependent children to be free

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from ventilator support for 2 to 4 months as well as free from any aspiration events to be considered for decannulation. The authors also recommend visualization of the airway to confirm patency and removal of any obstructing suprastomal granulation prior to a decannulation attempt. In addition, a daytime tracheostomy tube–capping trial is recommended for those children of at least 2 years of age leading up to decannulation. Further options are also mentioned, such as a capped sleep study, capped exercise test, and inpatient nighttime capping trial. These recommendations are constructed from expert opinions and serve as a sound guideline based on the existing evidence, but there remains room for further discussion and research on the subject. The following study explores a unique protocol consisting of a resource-conserving approach to decannulation.

**Methods**

The study was approved by the Children’s Hospital Institutional Review Board. Patient charts were gathered from the electronic medical record from 2004 through 2013 consisting of patients treated by 3 pediatric otolaryngologists at a tertiary care facility. Charts were selected that included procedure codes for tracheostomy tube removal or bronchoscopy for patients with a diagnosis code representing current tracheostomy status. The charts included in the study comprised those patients who were admitted solely for the purpose of decannulation. Only those patients for which decannulation was attempted per protocol were included. Exclusion criteria included decannulation following airway reconstruction and inpatient status leading up to decannulation.

The criteria for patients being chosen for decannulation included stable pulmonary status, resolution of offending obstruction, and no further necessity for ventilator support for at least 2 months, which is in accordance with the recently published clinical consensus statement. The specific protocol being studied consisted of the following.

Operative laryngoscopy and bronchoscopy are performed for the purpose of diagnostic airway evaluation and therapeutic procedures to the airway in preparation for decannulation. The patient is sedated but left spontaneously breathing. The tracheostomy tube is removed in the operating room, and the airway is evaluated via transnasal flexible bronchoscopy. The flexible scope is utilized to avoid any incidental stenting of the airway that could occur with rigid techniques, which may mask minor airway collapse with spontaneous breathing. The stoma is gently finger occluded, and the patency along with the dynamics of the entire airway is observed while the patient breathes. Specifically, the airway is examined for areas of obstruction, stenotic segments, dynamic collapse, and at least 1 mobile vocal cord. Maintaining spontaneous respirations is crucial to visualizing the dynamics of the airway; it allows the surgeon to better predict how the airway will respond to decannulation. Direct laryngoscopy with rigid telescopic visualization is sometimes performed to better inspect the peristomal airway or when flexible bronchoscopy cannot provide adequate visualization. Peristomal granulomas are removed via laser, cautery, or cold knife technique. If the airway is then deemed adequate for decannulation, the tracheostomy tube is removed in the operating room or in the immediate postoperative setting (within 24 hours). The stoma site is temporarily covered with a small gauze dressing or left uncovered. The child is monitored overnight in an inpatient monitored setting. Staff available for these patients includes 24-hour in-house physicians trained in pediatric critical care and a pediatric otolaryngologist (out-of-house night call). The support staff consists of nursing with critical care backgrounds and respiratory therapists. The patient is then considered for discharge the following day if no complications arise. No routine capping or downsizing is performed in the perioperative period before decannulation.

**Results**

Thirty-five patients fit the criteria and were decannulated per the protocol within 24 hours of endoscopy. Ages at decannulation ranged from 5 months to 17 years. Primary indications for tracheostomy were airway obstruction, chronic lung disease, and trauma. The median duration of tracheostomy was 18 months (range, 41 days to 11 years). Of the 35 patients, 9 (26%) had airway procedures performed during their airway endoscopy; 8 required suprastomal granulation excision; and 1 required adenoidectomy. Other patient characteristics are described in Table 1.

There were no immediate failures, defined as the need for recannulation or intubation within 1 week. Readmissions were evaluated for the 90-day period following decannulation. In total, there were 4 readmissions among 3 patients. Two of these patients ultimately failed decannulation in the long term. One patient had severe obstructive sleep apnea following the tracheocutaneous fistula closure 49 days after decannulation and ultimately required retracheostomy and mandibular distraction for micrognathia. The second patient

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required recannulation 30 days after decannulation and underwent laryngotracheal reconstruction soon thereafter. The third patient was readmitted 8 days after decannulation with respiratory distress and underwent further excision of suprastomal granulation tissue; emergent airway intervention or recannulation was never required. This latter patient was admitted again 3 days later for observation due to noisy breathing and was discharged the following day after clinical improvement with no significant concerns or further procedures performed.

The majority of these patients were stable for discharge on the day following decannulation (54%, n = 19). Another 37% (n = 13) were discharged on postdecannulation day 2. Of the remaining subjects, 1 was taken back to the operating room for further excision of a suprastomal granuloma (discharged on postdecannulation day 3); another was kept for further monitoring due to suprastomal collapse (discharged postdecannulation day 5 without further intervention); and 1 was kept inpatient for non-airway-related issues with no complications relating to the airway or decannulation (discharged on postdecannulation day 5). The average total hospital stay was 1.8 days for all subjects.

Discussion

Evaluating decannulation failure rate is a simple way to assess the success of our methods. Decannulation failure rates vary in the literature from 6.5% to 21.4%, with multiple recent studies quoting between 5% and 10%. Our study showed no acute decannulation failures resulting in intubation or recannulation within the first week; 1 patient (3%) did require an additional operative procedure to further remove suprastomal granulation tissue 1 day after removal of the tracheostomy tube. There were 2 patients in the study who exhibited long-term tracheostomy failure presenting as severe obstructive sleep apnea after tracheocutaneous fistula closure and gradual increasing respiratory distress from subglottic stenosis. These 2 cases presented nonemergently. It can be concluded that this protocol demonstrated a comparable safety profile in the selected study population.

Numerous decannulation protocols in the literature vary widely in methods. Operative endoscopy prior to decannulation is a common component of the majority of these protocols, and its importance is not disputed. This is necessary for not only diagnostic evaluation but also therapeutic treatment of the airway. Suprastomal granulation tissue often needs to be addressed prior to tracheostomy tube removal, as evident by the 23% (n = 8) of patients requiring endoscopic intervention in our study. The importance of spontaneous ventilation during endoscopy should be emphasized, as this allows one to better assess any dynamic collapse or obstruction.

The use of capping and downsizing is also a common part of many protocols, although the implementation of these tools is not universal. The argument in favor of these practices is that the reduction and occlusion of tube diameter not only predict decannulation success but also acclimate the child to the changing airway physiology that accompanies tracheostomy tube removal (increased dead space, use of the mouth/nose). The argument against these methods being used routinely is that decreasing lumen size puts children at risk for mucous plugging, a potentially fatal complication. In addition, capping decreases the cross-sectional area of the airway to such a degree that those who do not tolerate capping may still tolerate decannulation. The current study protocol does not employ routine capping or downsizing for these reasons. This serves as a significant difference between our methods and those recommended by the previously published clinical consensus statement, which states that a child ≥2 years old should have his or her tracheostomy tube capped all day and the cap removed at night for several weeks. Routine daytime capping is not performed in our decannulation process, because it does not offer an accurate physiologic representation of the decannulated child due to the obstruction of the capped tube. We believe that the operative endoscopic examination of the spontaneously breathing patient is a superior evaluation for decannulation.

The utility of tidal flow measurements and polysomnography (PSG) has also been explored. Mallory et al studied peak inspiratory flow obtained through the tracheostomy cannula during tidal breathing and compared this with peak flow through the mouth. While this showed some promise in the predictability of successful decannulation, there was a high false-negative rate, and a prolonged admission was required. Although a potentially useful tool, it has not become a routine step in published protocols.

The role of capped PSG in decannulation has gained wider acceptance, although its routine use is debatable. The current literature is composed of retrospective reviews and case series, and there are discrepancies on what is termed a “favorable” PSG when determining candidates for tracheostomy tube removal. Many of those with mild and even moderate obstructive sleep apnea can be decannulated successfully. Gurbani et al compared the predictive value of operative endoscopy with that of PSG and found that PSG alone was inferior. In their study population, 26% of those with “unfavorable” PSGs were still decannulated successfully. They concluded that combining PSG with endoscopy offers superior predictive value than that of endoscopy alone, although the increase in sensitivity was only 5%. PSG is a resource-intensive examination that does not have a place in our routine decannulation protocol. It is a valuable tool, however, that can provide additional information in those more complex cases.

The duration of inpatient stay was another inconsistency across protocols. Hospital stays for various decannulation studies ranged from 3 to 10 days. Acute failures are typically noted within the first 12 hours, which means that monitoring beyond the first day in an otherwise stable patient may not be necessary. The financial burden of a prolonged hospital stay is significant. The average inpatient stay of our 35 decannulated patients was <2 nights, which is the lowest that we have come across in the literature. The shorter hospital stay is partially attributable to the protocol’s lack of inpatient downsizing, capping, or PSG.
There are several limitations to this study. First, it is a retrospective review that focuses solely on those who underwent our protocol for decannulation. This included only a select population at a single institution, and the results cannot be generalized widely. There was no control group; therefore, direct comparisons cannot be made to other methods. Second, a larger study population could allow for extrapolation of patient characteristics that would predict failure/success of decannulation. Third, the study included only those in which decannulation was attempted. In doing this, like all decannulation studies, we do not have the ability to know how many of those not deemed appropriate for decannulation would have tolerated removal of their tracheostomy tubes. The study protocol is not meant to supplant existing guidelines and methods but rather to serve as preliminary observations of a varied approach to decannulation.

The purpose of this study was to explore outcomes of a resource-conserving protocol for pediatric decannulation. The protocol exhibited failure rates among the lowest reported in the literature despite not employing capping, downsizing, or PSG. As a result of the efficient use of resources, peridecannulation days spent in the hospital were lower than what any other decannulation study has reported. This protocol breaks from the trends in the literature and offers a new perspective in the continuing discussion on the optimal management of these complex patients.

### Author Contributions

Nicholas Wirtz, designed study, completed chart review, compiled data, wrote manuscript, approved final version; Robert J. Tibesar, contributed to conception of study, provided patients, assisted with review and editing, approved final version; Timothy Lander, assisted with design of study, provided patients, assisted with review and editing, approved final version; James Sidman, contributed to conception of study, assisted with data interpretation, provided patients, assisted with review and editing, approved final version.

### Disclosures

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### References