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Improving Tracheostomy Decannulation Rate in Trauma Patients

Michael S. Farrell, MD, MS[1]; Thomas M. Gillin, RRT[2]; John S. Emberger, RRT, FAARC[2]; John Getchell, RN[1]; Richard J. Caplan, PhD[3]; Mark D. Cipolle, MD, PhD, FACS, FCCM[1]; Kevin M. Bradley, MD, FACS, FCCM[1]

Objectives: Identify the effect of a multidisciplinary tracheostomy decannulation protocol in the trauma population.

Design: Single-center retrospective review.

Setting: American College of Surgeons level 1 trauma center; large academic associated community hospital.

Patients: Adult trauma patients who required a tracheostomy.

Interventions: A tracheostomy decannulation protocol empowering respiratory therapists to move patients toward tracheostomy decannulation.

Measurements Main Results: Tracheostomy decannulation rate, time to tracheostomy decannulation, length of stay, and reintubation and recannulation rates. A total of 252 patients met inclusion criteria during the study period with 134 presenting after the tracheostomy decannulation protocol was available. Since the tracheostomy decannulation protocol was implemented, patients managed by the tracheostomy decannulation protocol had a 50% higher chance of tracheostomy decannulation during the hospital stay ($p < 0.001$). The time to tracheostomy decannulation was 1 day shorter with the tracheostomy decannulation protocol ($p = 0.54$). There was no difference in time to discharge after ventilator liberation ($p = 0.91$) or in discharge disposition ($p = 0.66$). When comparing all patients, the development of a tracheostomy decannulation protocol, regardless if a patient was managed by the tracheostomy decannulation protocol, resulted in an 18% higher chance of tracheostomy decannulation ($p = 0.003$). Time to tracheostomy decannulation was 5 days shorter in the postintervention period ($p = 0.07$). There was no difference in discharge disposition ($p = 0.88$) but the time to discharge after ventilator liberation was shorter post protocol initiation ($p = 0.04$).

Conclusions: In a trauma population, implementation of a tracheostomy decannulation protocol significantly improves tracheostomy decannulation rates during the same hospital stay. A larger population will be required to identify patient predictive factors for earlier successful tracheostomy decannulation.

Key Words: airway; mechanical ventilation; respiratory therapist; tracheostomy; tracheostomy decannulation; trauma

Tracheostomy is one of the most commonly performed procedures in critically ill patients (1). Unlike the decision to place a tracheostomy, the decision and steps toward tracheostomy decannulation (TD) are less agreed upon (2, 3).

One area that is generally accepted is that TD should be considered only after a patient is deemed stable from a respiratory standpoint. Common criteria for determination of respiratory stability include the ability to maintain an adequate oxygen saturation level, the resolution of the initial inciting cause for intubation/tracheostomy, and the ability to protect the airway (4–6). Some institutions have established TD teams with the goal of developing TD protocols (TDPs) that are founded on patient safety and seek to provide more efficient care (7, 8).

The current available literature on the success of TDPs is relatively minimal. Most studies are small and are focused on identifying the critical criteria and optimal steps in the TDPs (9). Those studies that have reviewed outcomes have shown trends of improved TD rates. Unfortunately, the results are often not statistically significant and fail to address the specific changes in time

[1]Department of Surgery, Christiana Care Health System, Newark, DE.

[2]Department of Respiratory Therapy, Christiana Care Health System, Newark, DE.

[3]Value Institute, Christiana Care Health System, Newark, DE.

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Address requests for reprints to: Michael S. Farrell, MD, MS, Department of Surgery, 4755 Ogletown Stanton Rd, Suite 1320, Newark, DE 19713. E-mail: mfarrellmd@gmail.com

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to TD (10, 11). Despite the best efforts of TD teams, a 2–5% rate of TD failure may be anticipated (12).

In this study, we sought to evaluate the impact of a TDP in our trauma population requiring a tracheostomy. We hypothesized that by initiating a multidisciplinary designed TDP, we would increase our TD rate while decreasing the time to TD without increasing the rate of adverse outcomes during the initial hospitalization.

MATERIALS AND METHODS

A retrospective review was completed for trauma patients who required a tracheostomy. All patients were cared for at a single American College of Surgeons Committee on Trauma level I Trauma Center between January 2014 and December 2017. This 1,000-bed hospital system contains a high acuity 22-bed trauma/surgical ICU and evaluates approximately 4,000 trauma activations per year. Patients included were greater than or equal to 18 years old, trauma patients within our institution, who met the protocol inclusion criteria noted below. All patients were identified by cross-referencing an institutional trauma registry with an internal respiratory care data warehouse. Any patient who died before being decannulated was excluded from analyses.

The TDP was developed by a multidisciplinary team consisting of surgical intensivists, pulmonary intensivists, respiratory therapists, and speech therapists. It was made available for use in March 2016. Eligibility criteria included: no longer requiring mechanical ventilation, no planned procedures requiring an advanced airway, intact airway with a cough reflex, adequate oxygenation (peripheral oxygen saturation > 90% with fraction of inspired oxygen < 40%) with cuff deflated, and sleep apnea addressed, if applicable. Once eligible, the trauma provider may elect to manage a patient per TDP or to withhold the TDP based on clinical judgment. Once initiated, the respiratory therapists proceed through the TDP flow plan as highlighted in **Figure 1**.

Multiple analyses were completed to account for the effects of the TDP and for possible selection bias and hospital culture changes occurring after the institution of the TDP. The first, and primary analysis, considered patients who were treated since the TDP was available (March 2016–December 2017) and compared those treated by the TDP to those not treated by the TDP. The second analysis compared all patients treated by the TDP to all patients not treated by the TDP. In this assessment, the group not treated by TDP included patients from before and after the TDP was available (January 2014–December 2017). The third analysis compared all patients treated before (January 2014–March 2016) to all patients treated after (March 2016–December 2017) the TDP was available, regardless of whether they were ordered the TDP. The primary outcome was TD rate during the initial hospitalization. Secondary outcomes included time from ventilator liberation to TD, time from ventilator liberation to discharge, and the probability of being discharged to home.

Propensity scores were used to balance factors between groups with inverse probability weighting in which patients that more closely resemble the comparison group are given more weight in the analysis. The factors that were considered as follows: gender, age, injury severity score, and duration of mechanical ventilation. Only patients who met eligibility criteria to be considered for the TDP were included in the analyses. Linear regression was used for the time from end of ventilation to decannulation or discharge. Logistic regression was used for categorical outcomes. Separate propensity scores were calculated for each set of analyses as the target populations changed. An unadjusted alpha of 0.05 was used to indicate statistical significance. SAS Version 9.4 (SAS Institute, Inc., Cary, NC) was used for all statistical analyses.

This project was evaluated and approved by the Institutional Review Board.

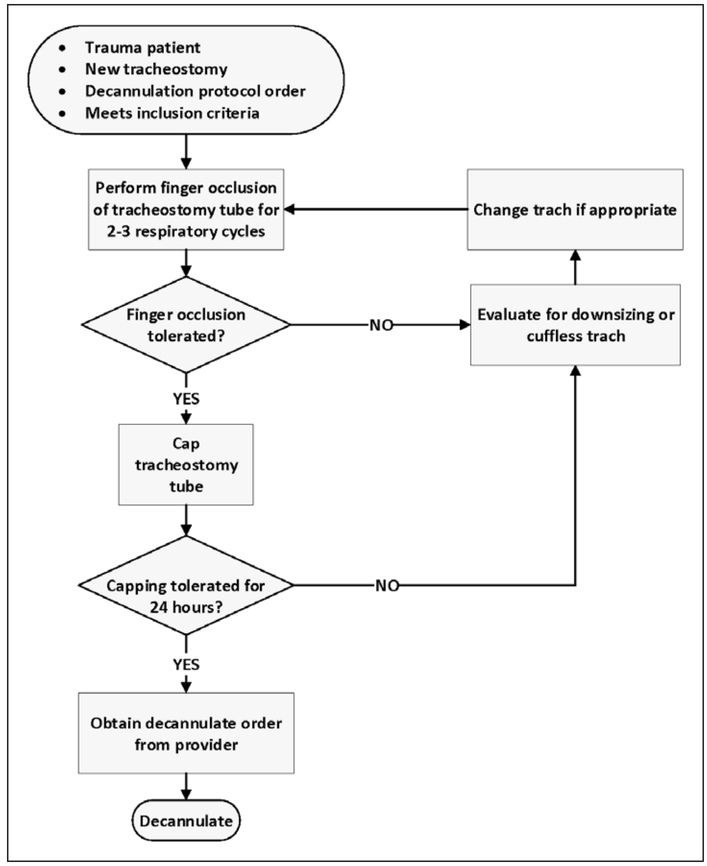

Figure 1. Outline of the tracheostomy decannulation protocol.

RESULTS

In total, 252 patients met inclusion criteria with 118 patients being treated before and 134 patients being treated after the TDP was available. After implementation of the TDP, 62 patients (46%) were managed by the TDP. Overall, 80% of the population was male. For a full breakdown of the population for each subgroup, refer to **Figure 2**.

The primary analysis looked at patients treated after the TDP was implemented between March 2016 and December 2017. Patients managed with the TDP ($n = 62$) compared with those not managed by the TDP ($n = 72$) were 50% more likely to be decannulated ($p < 0.001$) during their initial hospitalization with an odds ratio (OR) of 9.2 ([4.0–21.4]; $p < 0.001$). The mean time to TD was

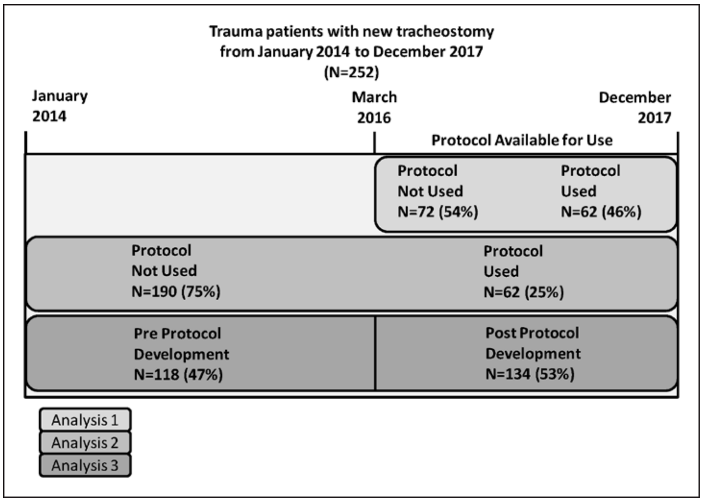

Figure 2. Patient count per treatment group.

1.1 days shorter in the TDP group (p = 0.54). There was no difference in time from ventilator liberation to discharge (p = 0.91). There was no difference in the probability of a patient being discharged to home (OR, 1.2; 95% CI, 0.5–2.8; p = 0.66) (**Table 1**).

The second and third analyses were focused on obtaining a more complete understanding of the population and checking the robustness of results. The second analysis looked at the entire study period between January 2014 and December 2017. It compared outcomes among all patients based on whether they were (n = 62) or were not (n = 190) treated via the TDP. Overall, these results were similar to those seen in the primary analysis. The third analysis also included all patients between January 2014 and December 2017. It examined all tracheostomy patients before (n = 118) and after (n = 134) the TDP was implemented, regardless of whether the patient was placed on the TDP. This analysis also showed similar results to those seen in the first analysis, although the time to discharge was significantly shorter (p = 0.04) in the third analysis. See Table 1 for complete details.

Only one patient required a reintubation and this patient ultimately was recannulated. This patient was treated with the TDP. There were no reintubations or recannulations required in the nonprotocol patients.

DISCUSSION

A patient-centered, multidisciplinary approach to patient care is an essential path to assessing and addressing complex medical decision-making. The decision to proceed with TD can be nuanced, often resulting in delayed treatment. The purpose of this study was to see if a TDP aimed at safe and timely TD could drive earlier TD without increasing the need for reintubation or recannulation.

In this study, we completed three different analyses. The primary analysis compared outcomes between patients placed on the TDP to those not placed on the TDP in the time period after the TDP was available. The goal of this assessment was to evaluate the impact of the TDP in a focused time period. The consistency of results in the supporting analyses highlights the robustness of the conclusions. Specifically, we recognize that a selection bias exists since the trauma provider determined if a patient was to be treated by the TDP. The second analysis attempted to address this by increasing the population size of the patients not treated by the TDP but who met the inclusion criteria. Additionally, we felt that given the large study period and the large amount of tracheostomy education that took place during the TDP incorporation, that some of our results may have been related to a hospital refocusing rather than due to the TDP. In this approach, we did see significant improvement in all areas but not to the same degree as was attributed to the TDP.

In all three assessments, the same results occurred with a higher rate of TD in the hospital and a descriptively shorter time to TD. This suggests that a TDP may help expedite patient care and that some benefit may be gained simply by reevaluating and refocusing a team on TD goals. At our institution, we had full multidisciplinary support which undoubtedly contributed to a successful incorporation of the TDP. The largest change in practice was related to the empowerment of the respiratory therapist to drive the process. Within the variables of the protocol, the respiratory therapists could advance care without an additional provider order or direct communication. We believe that with team support, the improvement we have seen could be replicated at other institutions.

A concern with any TDP is the development of an avoidable emergent airway. Two safety measures were built into the TDP. First, a trauma provider must identify the patients who

TABLE 1. Outcomes Based on Analysis Performed

Outcome	Analysis 1 (TDP vs No TDP), $n = 62$ vs 72	Analysis 2 (TDP vs No TDP), $n = 62$ vs 190	Analysis 3 (TDP vs No TDP), $n = 118$ vs 134
Percent decannulated	82% vs 33% (OR, 9.2; $p < 0.001$)	82% vs 35% (OR, 8.8; $p < 0.001$)	52% vs 35% (OR, 2.1; $p < 0.001$)
Mean time to decannulation (d)	9.3 vs 10.4 ($p = 0.54$)	9.3 vs 14.3 ($p = 0.08$)	10.1 vs 15.2 ($p = 0.07$)
Time to discharge (d)	23.1 vs 22.6 ($p = 0.96$)	23.1 vs 26.6 ($p = 3.4$)	20.4 vs 27.7 ($p = 0.04$)
Percent discharge to home	24% vs 21% (OR, 1.2; $p = 0.66$)	24% vs 25% (OR, 1.0; $p = 0.91$)	22% vs 22% (OR, 1.0; $p = 0.86$)

OR = odds ratio, TDP = tracheostomy decannulation protocol.

Analysis 1 assesses use TDP vs no TDP since the TDP was available. Analysis 2 compares TDP vs no TDP, regardless of if the TDP was available. Analysis 3 compares all patients, regardless of if TDP was used, based on if TDP was available.

will be treated per the TDP. No prospective data were collected on this decision-making process, but generally, patients were excluded if they were felt to have "difficult airways" such as with significant head and neck trauma or if they were felt to be "high risk" for requiring reintubation. In these patients, direct physician oversight was used. Second, a provider order was required prior to TD. With these precautions, only one patient required reintubation, which is less than the accepted 2–5% noted in the literature (13).

This study does have limitations. It is a retrospective review of an internal respiratory data warehouse which does not include details of the decision-making. It is likely that provider comfort with early adoption of the TDP contributed to the large percent of patients withheld from the TDP but continued prospective monitoring of TDP usage will be necessary to determine specific areas of concern. Additionally, the data warehouse does not contain information on additional noninvasive respiratory interventions that may have been required.

A future goal of this study is to identify those patients who can progress more quickly while also identifying those who may require additional safety precautions. More studies are required to better understand which factors contribute to the time to discharge so that a patient can transition to the next stages of recovery sooner.

CONCLUSIONS

The development and implementation of a respiratory-therapist–driven TDP, within the trauma population, safely improves TD rates without increasing the adverse events of reintubation or recannulation.

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