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Early tracheostomy in trauma patients saves time and money

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ABSTRACT

Introduction: Patients suffering traumatic brain and chest wall injuries are often difficult to liberate from the ventilator yet best timing of tracheostomy remains ill-defined. While prior studies have addressed early versus late tracheostomy, they generally suffer from the use of historical controls, which cannot account for variations in management over time. Propensity scoring can be utilized to identify controls from the same patient population, minimizing impact of confounding variables. The purpose of this study was to determine outcomes associated with early versus late tracheostomy by application of propensity scoring.

Methods: Patients requiring intubation within 48 h and receiving tracheostomy from January 2010 to June 2012 were identified. Early tracheostomy (ET) was a tracheostomy performed by the fifth hospital day. ET patients were matched to late tracheostomy patients (LT, tracheostomy after day 5) using propensity scoring and compared for multiple outcomes. Cost for services was calculated using average daily billing rates at our institution.

Results: One hundred and six patients were included, 53 each in the ET (mean day tracheostomy = 4) and the LT (mean day tracheostomy = 10) cohorts. The average age was 47 years and 94% suffered blunt injury, with an average NISS of 23.7. Patients in the ET group had significantly shorter TICU LOS (21.4 days vs. 28.6 days, $p < 0.0001$) and significantly fewer ventilator days (16.7 days vs. 21.9, $p < 0.0001$) compared to the LT group. ET patients also had significantly less VAP (34% vs. 64.2%, $p = 0.0019$).

Conclusion: In the current era of increased health-care costs, early tracheostomy significantly decreased both pulmonary morbidity and critical care resource utilization. This translates to an appreciable cost savings, at minimum $52,173 per patient and a potential total savings of $2.8 million/year for the entire LT cohort. For trauma patients requiring prolonged ventilator support, early tracheostomy should be performed.

Background

Predicting who will need a tracheostomy and when to operate is a fair illustration of the art and science of intensive care medicine. Historically, tracheostomy has been performed on patients requiring prolonged mechanical ventilation to prevent the occurrence of tracheal scarring [1,2]. Different benefits are evident in the current ICU era. Tracheostomy is felt to be more comfortable with a decreased risk of self-extubation and decreased sedation requirements [3]. Tracheostomy also removes the risk of damage to the endotracheal tube itself, which exposes the patient to the risk of endotracheal tube change [4]. The shorter, inflexible tracheostomy tube results in more favorable airway dynamics compared to the longer, more torturous endotracheal tube, resulting in diminished work of breathing for the patient [1,5]. Multiple studies have also demonstrated lower incidence of ventilator associated pneumonia (VAP) with trachestomy [6,7]. Despite these benefits, little consensus exists regarding the timing of tracheostomy [4,8–10]. This uncertainty is further compounded by the potential downsides of tracheostomy including the risk of tracheal erosion, laryngeal nerve or esophageal injury, pneumothorax and post-operative infection or hemorrhage.

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Not to be discounted is the permanent presence of scar at the site once the stoma is removed, often significantly impacting patient self-image.

Tracheostomy is a frequent adjunct in the trauma ICU. Two populations of patients primarily require this intervention – those suffering significant traumatic brain injuries and those sustaining chest wall and pulmonary injuries. The limited body of literature focusing specifically on the trauma population does little to define the best time to perform the procedure. Additionally, variability in these times further renders comparison of early tracheostomy (ET) to late tracheostomy (LT) imprecise [2]. In review of the current literature, ET definitions range from two days to two weeks [1,2,7]. With the clinical variations in patients and timing of tracheostomy, it is difficult to draw conclusions regarding use of this procedure.

With these limitations in mind, we chose to examine ET and LT at our institution, focusing solely on trauma patients suffering brain injury, thoracic injury or both. Our primary endpoint was evaluation of total ventilator days and incidence of VAP in these two patient populations. Secondary endpoints included mortality, hospital and ICU length of stay, as well as cost analysis. Our hypothesis was earlier tracheostomy in these high-risk populations would result in decreased incidence of ventilator-associated pneumonia and an overall survival benefit to the patient.

Methods

This retrospective study was approved by the Institutional Review Board at the University of Tennessee Health Science Center. Patients greater than 18 years of age requiring intubation within 48 h of hospitalization and ultimately receiving tracheostomy between January 2010 and June 2012 were identified from the trauma registry at a Level 1 trauma center. Complete records of 514 patients were retrieved and chart review was conducted to identify patients who were intubated secondary to traumatic injury of the chest and/or due to diminished mental status following traumatic brain injury.

Patients suffering cervical spinal cord injuries and those with elevated intracranial pressures were excluded due to difficulty liberating from the ventilator and inability to tolerate the intervention, respectively. Additional exclusion criteria included baseline pulmonary disease (asthma, COPD), previous tracheostomy, preexisting neurologic dysfunction affecting respiratory function (such as Multiple Sclerosis or Amyotrophic Lateral Sclerosis), incarcerated patients, patients under the age of 18 and pregnant women. After meeting inclusion and exclusion criteria, 206 patients remained in the study cohort.

Data collection included demographic variables, admission laboratory values, vital signs and microbiologic data. Injury severity was quantified using the new injury severity score (NISS), in addition to quantification of individual abbreviated injury scores (AIS) for the head and chest. Timing of tracheostomy was calculated, with date of admission coded as day 0. Collection of outcome variables included occurrence of ventilator-associated pneumonia (defined as greater than 10^5 organisms cultured following bronchoalveolar lavage), hospital and ICU length of stay and death during admission.

Patients were then subdivided into early and late tracheostomy groups. All patients received an open tracheostomy performed in the operating room. Patients in the ET group underwent tracheostomy on or before hospital day 5. Day 5 was chosen as a clinical target as most patients would be outside the acute resuscitation phase and five days would provide the ICU team ample opportunity to counsel families, as well as schedule and execute the procedure. LT groups included all patients who underwent tracheostomy after day five. None of the original 206 patients died prior to day 6 of hospitalization.

Chi-square analysis was used to analyze differences in categorical variables between groups. Student's *t*-test was used to analyze continuous variables. Overall, 53 patients were identified as ET patients, while the remaining 153 were classified as LT patients.

Propensity scoring was utilized to create matched ET and LT groups in this analysis. Propensity scoring is a statistical method used to match cases and controls while reducing selection bias in observational studies. For this study, the propensity score was estimated using logistic regression based on variables including gender, age, mechanism of injury, head and chest AIS, total blood requirement over the first 24 h, admission base deficit, admission heart rate and systolic blood pressure, lactate levels at days 1 and 3 and positive end expiratory pressure requirement at day 1. A 1:1 matching method without replacement was used with a best match approach.

Case and control groups equaled 53 each after propensity scoring. Chi-square and Student's *t*-test was used. Cost measurements were calculated off average daily billing rates obtained from the billing department at the Presley Regional Trauma Center at the Regional Medical Center, Memphis TN. All statistical analyses were performed using SAS version 9.3 for Windows (SAS Institute, Cary, NC).

Results

All patients in this study were treated at a level 1 trauma center between January 2010 and June 2012. All patients suffered either primary head or chest injuries and required intubation within 48 h of admission with subsequent tracheostomy. Of the 514 charts identified from the trauma registry, 206 patients met criteria for inclusion in this study. Fifty-three patients met criteria for ET and were matched to 53 patients in the LT group using propensity scoring to provide a total sample for outcomes analysis of 106 patients (Fig. 1).

The average age for all patients was 47 (SD 17.9) years with males comprising 71%. Ninety-four percent suffered blunt injury, with an average NISS of 23.6 (SD 9.2). The mean day of tracheostomy in the ET group was day four (SD 1.1), while day 10 (SD 3.6) was the mean in the LT group. Prior to propensity scoring, ET and LT groups were well-matched, with no significant

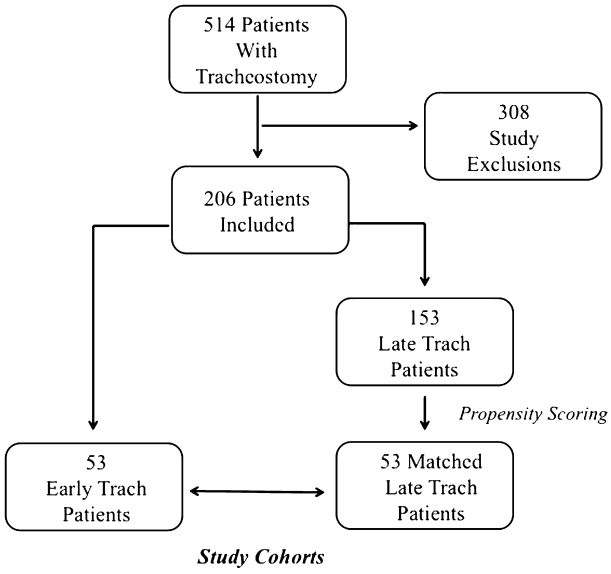

Fig. 1. Study design and patient selection.