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The use of tracheostomy speaking valves in mechanically ventilated patients results in improved communication and does not prolong ventilation time in cardiothoracic intensive care unit patients☆,☆☆,★

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ABSTRACT

Purpose: The aim of this study was to assess the effect of the introduction of in-line tracheostomy speaking valves (SVs) on duration of mechanical ventilation and time to verbal communication in patients requiring tracheostomy for prolonged mechanical ventilation in a predominantly cardiothoracic intensive care unit (ICU).
Materials and methods: We performed a retrospective preobservational-postobservational study using data from the ICU clinical information system and medical record. Extracted data included demographics, diagnoses and disease severity, mechanical ventilation requirements, and details on verbal communication and oral intake.
Results: Data were collected on 129 patients. Mean age was 59 ± 16 years, with 75% male. Demographics, case mix, and median time from intubation to tracheostomy (6 days preimplementation-postimplementation) were unchanged between timepoints. A significant decrease in time from tracheostomy to establishing verbal communication was observed (18 days preimplementation and 9 days postimplementation, $P < .05$). There was no difference in length of mechanical ventilation (20 days preimplementation-post) or time to decannulation (14 days preimplementation-postimplementation). No adverse events were documented in relation to the introduction of in-line SVs.
Conclusions: In-line SVs were successfully implemented in mechanically ventilated tracheostomized patient population. This resulted in earlier verbal communication, no detrimental effect on ventilator weaning times, and no change in decannulation times.
Purpose: The purpose of the study was to compare tracheostomy outcomes in mechanically ventilated patients in a cardiothoracic ICU preintroduction and postintroduction of in-line SVs. It was hypothesized that in-line SVs would improve communication and swallowing specific outcomes with no increase in average time to decannulation or the number of adverse events.

1. Introduction

An in-line speaking valve (SV) is a 1-way valve that blocks airflow from returning to the ventilatory circuit and redirects it through to the upper airway enabling functional use of the glottis [1] in a tracheostomized patient. The valve is designed to be inserted in line with the ventilator tubing and requires the tracheostomy cuff to be deflated allowing air to bypass the tracheostomy cannula and be exhaled through the larynx. In-line SVs have the potential to improve the quality of life of tracheostomized mechanically ventilated patients by enabling verbal communication and improved swallowing. However, the impact of the valve on respiratory mechanics remains unclear. Cuff deflation alongside placement of the SV in line creates a leak in the ventilatory system. This has led to concerns that lung derecruitment could occur reducing end-expiratory lung volumes leading to alveolar collapse and atelectasis. This may be deleterious to liberating patients from the ventilator and prolong their length of stay in intensive care. There is currently no published research documenting the effect of talking

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with a deflated cuff (leak speech) or SV on end-expiratory lung volume and limited research documenting the effect of leak speech or SVs on weaning from mechanical ventilation.

1.1. Communication

Communication in mechanically ventilated patients is extremely restricted and in many cases is reliant on nonverbal modes (eg, mouthing, gesture, and communication boards). The inability to use verbal communication results in decreased exchange of diagnostic information between staff and patient leading to decreased adherence to recommendations and poor patient satisfaction with the health care service [2]. Patients report a preference for verbal communication [3] and have associated the inability to verbally communicate with depression, social withdrawal, and reduced motivation to participate in care [4-7]. In addition, poor sleep and increased anxiety and stress levels have been associated with the mechanically ventilated patients' inability to effectively communicate [8].

1.2. Swallowing

There are inconsistencies reported as to the effect a tracheostomy tube (TT) has on swallowing physiology [9-19]. By restoring the airflow through the upper airway, return of subglottic pressure during swallowing is facilitated [20]. Improved taste and smell have also been reported [1,21]. However, it is unclear if this is necessary for a successful swallow. Practice in some intensive care units (ICUs) for tracheostomized patients is for them to be nil by mouth, until they are able to tolerate cuff deflation with or without an SV. This might unnecessarily delay return to activities of daily living and could also lead to increased costs with enteral feeds. Furthermore, tracheostomized patients often report extreme dryness of mouth, thirst, and discomfort, when left nil by mouth [22-24].

In-line SVs have the potential to improve the quality of life of tracheostomized mechanically ventilated patients through restoration of communication and eating/drinking capacity. However, it is important to ensure that this benefit is not lost through worsening of respiratory function. A team decision was made to trial implementation of in-line SVs for 1 year with a view to assess patient outcomes with tracheostomies and adverse events with the introduction of the in-line SVs. The aim of this study was to compare tracheostomy outcomes preimplementation and postimplementation of in-line SVs over 2 consecutive 1-year periods.

2. Materials and methods

2.1. Sample

The sample is composed of tracheostomized patients in a cardiothoracic ICU.

2.2. Setting

The study was conducted in a university-affiliated teaching hospital with 630 acute care beds. The ICU is a 27 bed mixed medical surgical adult ICU with a predominantly cardiothoracic case mix including thoracic organ transplantation and extracorporeal life support. Neurosurgical and trauma patients are not managed at the facility. The ICU is staffed by a multidisciplinary team (medical, nursing, and allied health) with speech pathology (SP) services provided as a part-time weekday service with an open referral system for tracheostomized patients. Speech pathology services for tracheostomized patients before January 2012 did not include the provision of in-line SVs. The SVs available in the unit (Portex; Orator) were not designed to be used in line with mechanical ventilation circuits and therefore could only be introduced with spontaneously breathing patients who did not need more than a couple of liters of oxygen via their TT for respiratory support. This was able to be administered via the side port of the SV. In January 2012, in-line SVs (Passy Muir SV) were introduced to the unit. These were seen as an option for enabling earlier verbal communication due to their design allowing these SVs to be used in the ventilator circuit.

2.3. Data collection

After human research and ethics committee approval (no. HREC/13/QPCH/95), a retrospective audit was conducted of all tracheostomized mechanically ventilated patients managed within the ICU from January 2011 to December 2012. During the period of January to December 2011, the ICU used a SV (Portex; Orator) that was not designed to be used in line with mechanical ventilation. Patients managed in the unit between January to December 2011 formed group 1 in the study. January 2012 saw the introduction of an in-line SV, designed to allow for use in line with mechanical ventilation tubing to the unit. Patients in the unit between January and December 2012 formed group 2. Data were obtained from the SP tracheostomy and ICU clinical information system and databases and supplemented by data from the medical record. Patients transferred from other ICUs with a tracheostomy in situ were excluded. One outlier with complications of severe pancreatitis leading to tracheostomy duration in excess of 217 days who was nil by mouth due to surgical reasons was excluded. In patients where tracheostomy was reinserted, total duration of time was recorded.

2.4. Outcomes

Data collected on all patients included demographics, tracheostomy/ventilation, communication, and swallowing information. Demographic information included age, sex, admission diagnoses, surgical interventions, Acute Physiology and Chronic Health Evaluation (APACHE) III and sequential organ failure assessment (SOFA) scores, and survival rates in ICU. Tracheostomy and ventilation information included length of endotracheal intubation (ETT), time to decannulation, and respiratory status/ventilation requirements at time of return to verbal communication. Communication and swallowing data collected included time to first verbal communication, time to return to oral intake, type of initial oral intake (ie, fluid and/or food consistencies), and cuff status at commencement of oral intake. All outcome measures that are documented as “time to…” or “length of…” were recorded in days.

2.5. Statistical analysis

Data were collated with subsequent data cleaning undertaken to check for data entry errors with correction of any such errors identified before data analysis. Descriptive analysis of the data collected for each year was undertaken to inspect for and report patterns using cross tabs in SPSS. Data were checked for normality of distribution. Comparison of key outcomes such as ETT duration, tracheostomy tube (TT) duration duration, days from ETT to TT, days from TT to SV, days from SV to decannulation, days from TT to first oral intake, and APACHE III and SOFA scores were completed using independent *t* tests (see Tables 1 and 2) for the groups 1 and 2 using SPSS version 21. An α level of less than .05 was used to indicate statistical significance.

2.6. Data specifics

Because of the nature of the research questions, different patient numbers were included for data analysis. For ETT and TT duration, all tracheostomized patients were included for group 1 and 2. For TT insertion to SV and SV to decannulation, only patients who were using an SV were included. For TT to first oral intake, only patients who were having oral intake while tracheostomized were included. The patients who died with TT in situ were included in statistical analysis, and their data were not censored.