



## Original Article

Tracheostomy versus Endotracheal Intubation Prior to Admission to a Respiratory Care Center: A Retrospective Analysis<sup>☆</sup>Kuei-Ling Tseng<sup>1 †</sup>, Jiunn-Min Shieh<sup>1, 2, 3 †</sup>, Kuo-Chen Cheng<sup>1, 2, 4</sup>, Kuo-Hwa Chiang<sup>1, 2, 3</sup>, Shyh-Ren Chiang<sup>1, 2, 3</sup>, Shiann-Chin Ko<sup>1, 2</sup>, Ai-Chin Cheng<sup>1</sup>, Chin-Ming Chen<sup>5, 6 \*</sup>

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## ARTICLE INFO

## Article history:

Received 5 December 2013

Received in revised form

5 January 2014

Accepted 11 April 2014

Available online 31 August 2015

## Keywords:

outcome,  
prolonged mechanical ventilation,  
respiratory care center,  
tracheostomy,  
weaning

## SUMMARY

**Background:** This study was conducted to examine the hypothesis that a tracheostomy prior to admission to a respiratory care center (RCC) with a specialized weaning setting would improve the outcome of patients transferred from intensive care unit previously maintained on prolonged mechanical ventilation. **Methods:** A retrospective review of medical records from intubated adult patients admitted to the Chi-Mei Medical Center, a 16-bed RCC in Southern Taiwan from January 1, 2001 through July 31, 2012, was performed. The outcomes at weaning (without ventilator support within 120 hours), mortality, and expenditure at hospital discharge were compared between the tracheostomy group ( $n = 1216$ ) and the endotracheal tube group ( $n = 1187$ ), and the predictors of weaning in all patients were determined.

**Results:** The overall weaning rate and the in-hospital mortality rate were 68.2% and 16.4%, respectively. The tracheostomy group showed significantly higher weaning rate and shorter hospital stay (73.5% vs. 62.8% and 57.4 vs. 61.0 days, both  $p < 0.01$ ) compared with the endotracheal tube group. In-hospital mortality, total ventilator days, and cost of hospitalization were comparable between groups. Factors predictive of successful weaning were surgical origin [odds ratio (OR) 2.165], higher albumin (OR 1.937), tracheostomy group (OR 1.543), higher PaO<sub>2</sub>/fraction of inspired oxygen (OR 1.345), and lower blood urea nitrogen (OR 0.984).

**Conclusion:** Tracheostomy creation prior to RCC admission was associated with a significantly higher weaning rate and reduced hospital stays. The provision of assessment of the aforementioned markers may be helpful in the clinical setting to facilitate the optimal management and the accreditation of medical care quality of patients with prolonged mechanical ventilation.

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## 1. Introduction

Mechanical ventilation (MV) offers essential support in the care of critically ill patients during recovery from acute respiratory failure, but prolonged mechanical ventilation (PMV) leading to multiorgan dysfunction is frequently a consequence. The

continuous receipt of artificial respiratory support  $\geq 21$  days is defined as PMV<sup>1</sup>, patients generally suffer from a “chronic critical illness” with significant impairments to metabolism and neuro-endocrine and immunologic functions, and they often become ventilator-dependent<sup>2,3</sup>. Up to 40% of patients’ total time on MV is spent weaning off the ventilator<sup>4</sup>. The weaning rate may be as high as 90% in selected patients with planned extubation<sup>5</sup>. In Taiwan, the National Health Insurance Bureau (NHIB) designed the respiratory care center (RCC) to help manage PMV patients with attempted weaning and who have been ventilator-dependent for  $\geq 21$  days; it also acts as a downstream unit of the intensive care unit (ICU).

Tracheostomies have been used in an effort to shorten the time spent on MV if intubation time is anticipated to last more than

<sup>☆</sup> Conflicts of interest: All contributing authors declare that they have no conflicts of interest.

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several weeks<sup>6</sup>. A tracheostomy is performed in approximately 24% of patients in hospital ICUs<sup>7</sup>. The benefits of tracheostomy over translaryngeal intubation includes improved patient comfort, better oral hygiene, less dental damage and tracheal injury, easier and safer nursing care, and lower airway resistance, which may facilitate the weaning process and avoid ventilator-associated pneumonia<sup>8</sup>. However, infrequent complications such as stomal infection, hemorrhage, pneumomediastinum, tracheostenosis, and death may occur<sup>9,10</sup>. Studies evaluating the association of tracheostomy with patient outcomes are conflicting<sup>11–13</sup>. Currently, there is no specific information regarding individual characteristics associated with improved outcomes with either early or late tracheostomy by the heterogeneity of the studies<sup>14</sup>. In the 1980s, a tracheostomy was considered “early” if it was performed prior to 21 days of translaryngeal intubation, and this decision could be made within 7–10 days according to the recent literature<sup>15</sup>.

A recent study showed that the type of mechanical ventilation did not appear to be an important determinant of weaning success in an RCC setting<sup>12</sup>. Most studies have been conducted in the ICU. The aim of the present study was to test the hypothesis that a tracheostomy prior to RCC admission improved outcome as weaning and mortality rate at hospital discharge in PMV patients. The secondary endpoints included predictors of successful weaning and hospital mortality.

## 2. Materials and methods

### 2.1. Study design and patient selection

A retrospective review of the medical records of all adult patients on MV admitted to the RCC of Chi-Mei Medical Center in Taiwan from January 1, 2002 to July 31, 2012 was performed. This study was approved by the Institutional Review Board of the Chi-Mei Medical Center. The 16-bed RCC, accepting patients >17 years of age, was a part of a program intended for general ICU patients experiencing difficulty in MV weaning. Patients expected to be maintained on MV  $\geq 3$  weeks at the time of RCC admission, and all previous weaning attempts that had failed were included in this study. The patients matched the requirements of the NHIB system in Taiwan: hemodynamic stability, no vasoactive drug infusion prior to transfer, stable oxygen requirements, or the attending physician deemed it beneficial to transfer the patient to the RCC. The RCC staff provided 24-hour patient coverage, and included in-charge respiratory and critical care medicine physicians, fellows, respiratory therapists, clinical nurse specialists, clinical dietitians, and clinical pharmacists. The nurse/patient ratio in the RCC was 1:4, and the respiratory therapist/patient ratio was 1:8. Indications for tracheostomy were based on the clinical consensus of all the physicians. Indications for continued translaryngeal intubation included the expectation of possible extubation in the near future, refusal of tracheostomy by the patient or relative(s), and delayed tracheostomy at RCC. The patients receiving tracheostomy creation prior to RCC admission formed the tracheostomy group, and those who were ventilated with an endotracheal tube comprised the endotracheal group. Overall, 2443 patients were eligible.

Each patient was assessed daily for readiness for weaning via tracheostomy or endotracheal tube using the following criteria: hemodynamic stability and recovery from the precipitating illness; and respiratory criteria consisting of an arterial blood gas with pH > 7.30, PaO<sub>2</sub> > 60 mmHg, minute ventilation <15 L/min, fraction of inspired oxygen (FiO<sub>2</sub>) < 60%, positive end-expiratory pressure  $\leq 10$  cmH<sub>2</sub>O, PaO<sub>2</sub>/FiO<sub>2</sub>  $\geq 200$  mmHg, and rapid shallow breath indices <120 (under continuous positive airway pressure

mode with positive end-expiratory pressure 5 cmH<sub>2</sub>O for >1 min). Patients were evaluated with these criteria on a daily basis by respiratory therapists. The weaning process was described in a previous study<sup>5</sup>. If there was poor tolerance at any time, MV was reinstated.

Successful weaning occurred if MV was not required for 120 consecutive hours. Patients were considered to be “ventilator dependent” (including nocturnal MV) if weaning efforts were discontinued after both the interdisciplinary team and the informed patient/family agreed that the efforts should cease.

### 2.2. Measurements

The following data were collected at RCC admission: (1) demographic and clinical variables, including age, sex, diagnosis of admission (Appendix 1), hemodialysis or not, ventilator duration, and ICU type; (2) severity of patient’s condition calculated as Acute Physiology and Chronic Health Evaluation II (APACHE II) score and Glasgow Coma Score; (3) laboratory data, such as blood, biochemistry, and blood gas data; (4) outcomes, including weaning success (without ventilator support  $\geq 120$  hours), tracheostomy at RCC discharge, RCC ventilator days and RCC stays, total hospital costs (expressed in US currency) and hospital mortality rate. Our primary endpoints were the comparisons of the outcome between the tracheostomy group and the endotracheal group, with a focus on weaning success and hospital mortality. Secondary endpoints were the predictors of successful weaning and hospital mortality.

### 2.3. Statistical analyses

Mean values, standard deviations, and group sizes were used to summarize the results for continuous variables. The differences between failed and successful weaning or hospital mortality were examined first using univariate analysis with a Student *t* test or a Chi-square test. A *p* value < 0.05 was considered statistically significant. Those significantly associated with failed extubation or hospital mortality in univariate analysis (*p* < 0.05) were tested for interaction with multiple logistic regression analysis. Odds ratios (OR) and 95% confidence intervals were calculated. All statistical analyses of the data were performed with SPSS 14.0 for Windows (SPSS, Inc., Chicago, IL, USA).

## 3. Results

A total of 2403 patients were admitted consecutively to the RCC during the study period. This included 1216 patients who received a tracheostomy (50.6%) and 1187 who received an endotracheal tube (49.4%) at RCC admission. The mean age of all patients was 69.5 years, and most of them were male (59.3%). The patients had a mean APACHE II and Glasgow Coma Score of 16.6 and 9.4, respectively. Surgical ICU origin was about 38%, and hemodialysis was required by 10.1% of patients. The most common cause was lung infection (42.7%), followed by neuromuscular disorder (31.2%), and heart disease (10.4%). The other data are shown in Table 1. The tracheostomy group was younger and had a longer duration of ICU ventilator use. The laboratory data are presented in Table 2; the tracheostomy group had a lower level of phosphate. The overall weaning and in-hospital mortality rates were 68.2% and 16.4%, respectively. The outcome is presented in Table 3; the tracheostomy group had a significantly higher rate of weaning and tracheostomies, shorter RCC ventilator days, RCC and total hospital stays as compared with the endotracheal group. However, in-hospital mortality, total ventilator days, and total cost were comparable between the two groups.

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