Impact of a Low-pressure Polyurethane Adult Endotracheal Tube on the Incidence of Ventilator-Associated Pneumonia: A Before and After Concurrence Study

Rachel Karlnoski PhD[1,3], Katheryne Downes MPH[2], Devanand Mangar MD[1,3], Enrico M Camporesi MD[1,3], John Schweiger MD[1,3]
[1]Florida Gulf-to-Bay Anesthesiology, Tampa General Hospital, Tampa, Florida
[2]Department of Research, University of South Florida, Tampa, Florida
[3]Department of Surgery, University of South Florida, Tampa, Florida

BACKGROUND

Ventilator associated pneumonia (VAP) is a leading cause of morbidity and mortality in ICU patients; encompassing up to 15% of all hospital acquired infections · Our hospital implemented a facility wide conversion from a traditional polyvinyl cuffed endotracheal tube to a polyurethane cuffed endotracheal tube in an effort to reduce the incidence of VAP.

METHODS

An IRB approved, case-controlled, retrospective chart review was completed a year after a facility-wide conversion to a polyurethane cuffed adult ET tube (Microcuff) which occurred in July 2007. Data were obtained from patients admitted to adult ICUs the year before the conversion (July 2006 to June 2007) and the year after the conversion (July 2007 to June 2008), who received mechanical ventilation for >24 hours, and had hospital-acquired pneumonia diagnoses occurring ≥ 24 hours following intubation. During the two year study period there were 100 adult patients who developed VAP and 4162 patients that were mechanically ventilated for greater than 24 hours without any incidence of VAP. In order to complete the study in a timely manner, we opted to review a randomly selected cohort of case-matched patients from the 4162 patients that did not develop VAP. For the selection of the control cohort, a randomized, computer generated selection of cases was used. The number of controls were not split evenly between the two selected years but were selected proportionally to the number of VAP cases for each year. For the year before the conversion, we reviewed 275 charts. For the year after the conversion, we reviewed 196 charts.

We compared VAP rates from the year prior to the conversion (baseline) to the year following the conversion. Identical strategies for VAP prevention were implemented during the 2-year study period and were documented in the medical record on a standard daily checklist by an ICU nurse. All patients that were intubated or had a tracheostomy underwent a ventilator bundle protocol and epidemiological surveillance. The components of the ventilator bundle included head of bed elevated at 30 degrees unless contraindicated, oral care every two hours, and periodic verification of intracuff pressure, leaks, obstruction, or malposition. Patient demographics, comorbidities, total number of ICU days, length of mechanical ventilation, length of hospital stay, and mortality were examined in both patient series.

RESULTS

•Patient demographics and co morbidities are listed in Table 1.

•Among the adult patients intubated for 24 hours or longer, the rate of microbiologically confirmed VAP was reduced by 61% per vent day after the implementation of the polyurethane cuffed endotracheal tube.

•During the first year after the implementation of the Microcuff, our hospital had a VAP rate of 1.9 episodes per 1000 vent days versus 4.8 episodes per 1000 vent days the year prior.

•Polyurethane cuffed endotracheal tube was associated with a significantly lower incidence of VAP and significantly lower number of ICU days (Table 2).

Table 2. Ventilation Characteristics. Hospital Stay and Incidence of Microbiologically Confirmed Ventilator-Associated Pneumonia (VAP) [a]

Selected Study Patients	Before (n=275)	After (n=196)	Statistical Test	p-value
Total Ventilation Days (median)	6.5	6.3	Mann-Whitney U	0.221
Days Ventilated with ET Tube (median)	6	5	Mann-Whitney U	0.219
Patients with VAP	68 (24.7)	32 (16.3)	Chi-Square	0.028*
Days until VAP	13	17	Mann-Whitney U	0.709
VAP after 96 hours of intubation	67 (98.4)	30 (93.1)	Fisher Exact	0.228
ICU Days (median)	17	11	Mann-Whitney U	0.002*
Hospital Days (median)	21	20	Mann-Whitney U	0.369
Mortality	54 (19.6)	45 (23.0)	Chi-Square	0.383

[a] The diagnosis of pneumonia was established when all of the following criteria were met: new onset of purulent bronchial sputum, body temperature >38°C, white blood cell count >10,000/mm^3, chest radiograph showing new or progressive infiltrates, significant quantitative cultures or respiratory secretions by tracheal aspirate (>10^4 cfu/ml).
* p value < 0.05 is considered significant
Numbers in parentheses represent percentage of each group.
Before and after is relative to the introduction of the Kimberly-Clark Microcuff ET Tube

Table 1. Demographics and Comorbidities

Characteristic	Before (n=275)	After (n=196)	p-value
Male Sex (%)	174 (63.6)	116 (58.7)	0.275
Admit Age (median)	56	57	0.273
Race (white)	(69.1)	(67.7)	0.368
Height (inches) (median)	68	67	0.811
Weight (kg) (median)	80.7	76.9	0.016*
Immunodeficiency[a]	28 (10.2)	28 (14.3)	0.175
Evidence of Infection[b]	28 (10.2)	36 (18.4)	0.011*

[a]Defined as patients with a presence of human immunodeficiency virus, chemotherapy, or immunosuppression for organ transplantation.
[b]Defined as patients evidence of sepsis or urinary tract infection.
Numbers in parentheses represent percentage of each group.
Before and after is relative to the introduction of the Kimberly-Clark Microcuff ET Tube

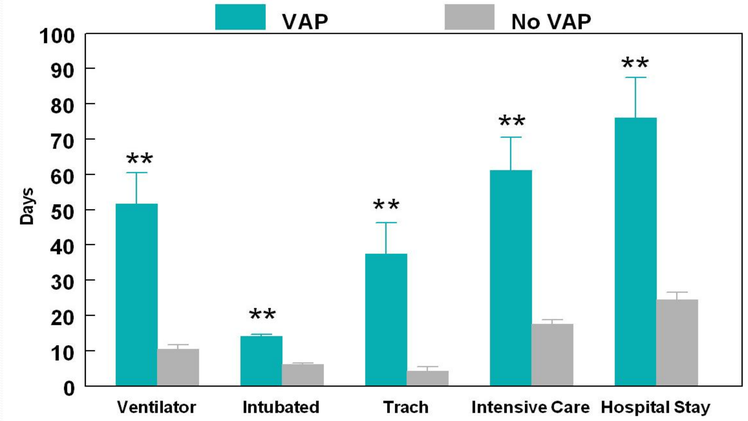

Figure 1: The effect of VAP on length of respiratory assistance and length of hospital stay. All data were collected at TGH and are represented of the time period of July 2006-July 2008. Ventilator Days include intubated plus Trach days. **p <0.01

CONCLUSION

After implementation of the polyurethane cuffed endotracheal tube, we observed a significant reduction in the incidence of VAP and length of stay in the adult ICUs.

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