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RESEARCH ARTICLE

ROLE OF SUCTION ABOVE THE CUFF ENDOTRACHEAL TUBE IN PREVENTION OF VENTILATOR ASSOCIATED PNEUMONIA: A COMPARATIVE STUDY

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ABSTRACT

Background: Ventilator associated pneumonia is associated with use of unsterile methods of intubation and contamination of lungs by oropharyngeal secretions accumulated around the cuff. We wanted to compare efficacy of SACETT in reduction of VAP in our ICU. **Methods**: Out of total 82 patients enrolled, 70 patients requiring mechanical ventilation for ≥48 hours were divided into two equal groups and randomized to get intubated with SACETT (group S) or ETT (group E). The rest of the preventive measures against VAP, and the mode of ventilation were similar between two groups. **Results**: The incidence of VAP was 25.71% in group E and 5.71% in group S; (P = 0.0457). The duration of intubation, mechanical ventilation and Intensive Care Unit stay were not significantly different between the two groups. (p>0.05) **Conclusions**: In this study of our institute there was a significant reduction in incidence of VAP with use of SACETT. The rest of the outcomes were similar with use of either type of endotracheal tube in the patients.

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INTRODUCTION

Ventilator associated pneumonia (VAP) is defined as a pneumonia that occurs after more than 48 hours of intubation and mechanical ventilation (Koenig *et al*., 2006). The contaminated secretions from the oropharyngeal space leak around the cuff of the endotracheal tube (ETT) and get aspirated into the patient's lungs. Once the initially sterile lower airway becomes colonized by bacteria, VAP develops. The prime reason behind this is that an ETT compromises the defense mechanisms between the upper and lower airways (Vincent *et al.*, 2009). This occurs by impairment of mucociliary clearance and disruption of cough reflex, which creates a direct pathway for implantation of exogenous and endogenous bacteria into the lower airway. It is only the ETT cuff that separates the contaminated upper airway from the sterile lower airway in the ventilated patient. This cuff provides a platform where the contaminated secretions can collect and pool. These subglottic secretions on aspiration by the patient cause VAP.

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Removal of these secretions from the subglottic space is recognized as a VAP prevention measure by American Thoracic Society (ATS) and the Centers for Disease Control and Prevention (CDC) (Seckel, 2007). Subglottic secretion drainage has been recommended to minimise accumulation of secretions above the endotracheal tube cuff (Dodek *et al*., 2008). This decreases the incidence of VAP by approximately 50%, but requires the use of a suction above the cuff endotracheal tube (American Thoracic Society and infectious disease society of America, 2005). Suction above the cuff endotracheal tube (SACETT) comprises of a dedicated suction port located just above the inflated cuff and that can be connected to continuous or intermittent suction device to remove secretions that accumulate in the subglottic space (Depew *et al.*, 2007). The duration for which the patient remains mechanically ventilated, correlates directly to the risk of development of VAP. *Pseudomonas aeruginosa* and *Staphylococcus aureus* both have drug resistant strains which have now increased the morbidity and mortality associated with VAP (Bartlett, 2008). By culturing endotracheal aspirates, lower airway secretions, bronchoalveolar lavage or pleural fluid, an appropriate antibiotic can be selected. This decreases the risk of creating drug resistant organisms through the use of broad spectrum antibiotics (Davis, 2006). Therefore we decided to compare the conventional ETT with SACETT in

our ICU patients because this was the first time that such a study was conducted at our institute.

MATERIAL AND METHODS

This prospective comparative observational study was conducted on the patients admitted at the general intensive care unit of IGMC Shimla, with approval of the research and ethics committee, between 1st May 2016 to 28 Feburary 2018. The inclusion criteria comprised of - (i) patients above the age of 18 years; (ii) patients who required mechanical ventilation for more than 24 hours; and (iii) patients who underwent orotracheal intubation. Whereas, the exclusion criteria comprised of (i) patients under the age of 18 years; (ii) patients who were tracheostomised; and (iii) pregnant females. 82 patients were enrolled for this study, 9 got referred to higher institute within one day of admission, whereas attendants of the other 3 patients refused to give their consent for this study. The remaining 70 patients were randomized and allocated into two equal groups:- group E patients were intubated with a conventional ETT, whereas group S patients were intubated with SACETT.

These patients were nursed in head up position at 30 to 35 degrees. Intermittent subglottic suction was done at 4 hour intervals via the suction port in group S, whereas it was done by conventional ICU protocol in group E. The periodic decontamination of the subglottic space, larynx, pharyngeal space and oral cavity was performed by supracuff irrigation with 20 ml of normal saline. Oral care was performed with chlorhexidine. No oral antibiotic pastes were used on the patients under this study. Patients were ventilated on ASV mode of ventilation.

Periodic endotracheal tube cuff pressure was assessed and maintained with the use of Pulmodyne cuff check ™ manometer. VAP was defined as pneumonia that occurred after more than 48 hours of intubation and mechanical ventilation. It was diagnosed by the modified Clinical Pulmonary Infection Score (CPIS). A score of more than 6, correlated with microbiologically confirmed VAP (Table 1) Data was analyzed by SPSS using student- t test and Fisher's exact test.

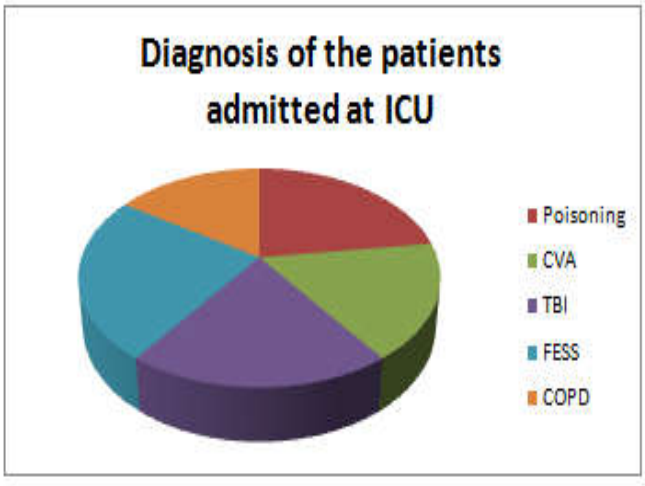

Figure 1. Diagnosis of the patients admitted at ICU

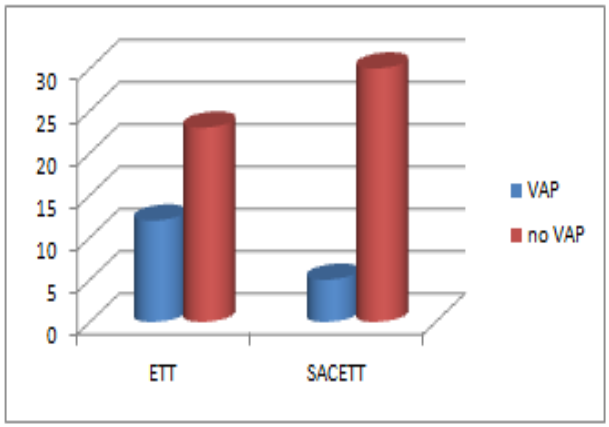

Figure 2. Incidence of VAP

RESULTS

The patients were comparable in age, demography and ideal body weight. (p-value >0.05) The results of analysis performed on 70 patients divided into two equal groups depict the incidence of VAP to be 9/35 (25.71%) in group E whereas 2/35 (5.71%) in group S. The mean duration of intubation, mechanical ventilation and ICU stay was not significantly different between the two groups.(p-value > 0.05) The absolute risk reduction in VAP was 20% whereas, the relative risk reduction was 77.77% with use of SACETT in our study.

DISCUSSION

The incidence of ventilator associated pneumonia dates back to 1930s when the iron lung ventilators were widely used on patients of respiratory failure poliomyelitis (Kenneth, 2011). Over 90% of pneumonias in ICU occur when the patient is on a ventilator. Mortality rate from VAP ranges from 5 % to 65% (Muscedere *et al*., 2008). Reduction in incidence of VAP by using suction above the cuff endotracheal tube has been demonstrated in the studies by Gentile *et al.* (2010), Lorente *et al.* (2010) and Pneumatikos *et al*. (2010).

Lacherade *et al.* (2010) conducted a randomized controlled clinical trial on 333 patients in ICU intubated by ETT with cuff pressures maintained between 20 to 30 cm H_2O. They performed intermittent manual suctioning with a syringe on the patients with ETT having a subglottic suction port and found reduced incidence of VAP in these patients when compared to those patients who were intubated with conventional ETT. We also periodicaly checked and maintained the cuff pressure within this range by Pulmodyne cuff check manometer ™ in all of the patients of our study groups. However we did not include a separate analysis of variation in cuff pressures over the course of admission in ICU in our study. O'Neal *et al.* (2007) conducted a study on 32 mechanically ventilated patients and found out that the thicker secretions of greater volume were more evacuated more effectively than the thinner low volume secretions. We too found a similar situation in the patients of our study group. However due to diurnal and daily variation in the secretion consistency of our patients, a separate detailed analysis was not made by us.

Table 1. CPIS score

Parameter	0	1	2
Temperature	≥36.5°C but ≤ 38.4°C	≥ 38.5°C or ≤38.9°C	> 39°C or ≤ 36.4°C
Total Leukocyte count (cells/mm^3)	≥ 4000 but ≤ 11000	< 4000 or > 12000	≥ 4000 but ≤ 11000 + Band forms ≥ 500
Tracheal Secretions	Rare	Abundant	Abundant & purulent
PaO_2/FiO_2 (mm Hg)	> 240 or ARDS		≤ 240 & no ARDS
Chest radiograph infiltrates	Absent	Diffuse	Localized
Microbiology cultures	Negative		Positive

Table 2. Data analysis

Parameter	Group E	Group S	p-value*
	Mean ± SD	Mean ± SD	
Age (yr)	43.03 ± 22.6	44.14 ± 22.4	0.4183
Weight (kg)	66.11 ± 13.0	63.03 ± 11.5	0.2962
Gender (M/F)	23/12	20/15	
Incidence of VAP	9/35 (25.71%)	2/35 (5.71%)	0.0457
Duration of intubation (days)	21.03 ± 13.1	17.37 ± 9.77	0.1899
Duration of ventilation (days)	19.17 ± 13.3	15.6 ± 9.64	0.2019
Duration of ICU stay (days)	23.86 ± 13.3	20.23 ± 10.1	0.2017

* p-value <0.05 is considered significant

Smulders *et al*. (2002) conducted a randomized trial on 152 patients in intensive care unit intubated with conventional ETT and ETT with supracuff device. They used intermittent suctioning and did not use any prophylactic antibiotics. They found that 10% of the patients developed VAP, out of which 16% were on conventional ETT while 4% were on ETT with supracuff suction ports. In our study the incidence of VAP in the group S (SACETT) was 5% (2/35) however in the group E it was 9/35 (25.71%). This was seen even after the use of prophylactic antibiotics as per our ICU protocol. But nevertheless, the absolute risk reduction of 20% in VAP by the use of SACETT tubes in our study advocates the use of such equipment in ICU. When compared to the subset of patients with neurological pathology in our study, which were 26 in all (12 of CVA and 14 of TBI), VAP developed only in 8 (30.76%) of these patients. This approximates with studies of Kasuya *et al*. (2011) (incidence of VAP to be 28% in stroke patients) and Prendergast *et al*. (2009) (incidence of 24% in patients with a stroke, trauma, and tumors). Orlikowski *et al*. (2006) had an incidence of VAP of 45% in the patients suffering from Gullian Barre syndrome. This was most likely due to the long course mechanical ventilation required in this disease which extends from 3 months to 1.5 years. We did not have such a patient in either of our study groups.

Limitation

The main limitation of our study was that we did not include a third group comprising of those patients who were received in ICU initially intubated with a conventional ETT, but subsequently undergoing an elective exchange with SACETT within 48 hours of admission. This was due to the enigma, that re-intubation itself can contribute towards the risk for development of VAP.

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