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Assessment of the effectiveness of a ventilator associated pneumonia prevention bundle that contains endotracheal tube with subglottic drainage and cuff pressure monitorization

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ABSTRACT

The effectiveness of prevention bundles on the occurrence and mortality of ventilator associated pneumonia (VAP) was evaluated in many studies. However, the effectiveness of endotracheal tube with subglottic secretion drainage (ETT-SD) and cuff pressure monitorization in VAP bundles have not been adequately assessed. In this study, we aimed to evaluate the effectiveness of VAP bundle containing ETT-SD and cuff pressure monitorization. This was a prospective, controlled study that was carried out between March 2011 and April 2012 including intubated patients. The study was conducted at the Anesthesiology Intensive Care Unit 1 and 2 (10 beds each) in a 898-bed university hospital. Occurrence of VAP and compliance with the parameters of the VAP prevention bundles were assessed daily. Patients intubated with the standard endotracheal tube were recruited as controls, mainly in the first six months of the study as ETT-SD and cuff pressure monometer had not yet been implemented. In the second term, patients intubated with ETT-SD were included as cases. Occurrence of VAP, mortality, and compliance with VAP prevention bundles were monitored. A total of 133 patients, 37 cases and 96 controls were recruited. VAP incidence declined from 40.82 to 22.16 per 1000 ventilator days among controls and cases, respectively ($p < 005$). On average, VAP occurred 17.33 ± 21.09 days in the case group and 10.43 ± 7.83 days in the control group ($p = 0.04$). However, mortality of cases and controls at the 14th and 30th days was not different. VAP prevention bundles including the utilization of ETT-SD, monitoring cuff pressure, and oral care with chlorhexidine were efficient in reducing the rate of VAP.

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Introduction

VAP is a preventable nosocomial infection with high mortality and morbidity associated with medical instruments and health care, and increases hospital costs.[1] Ventilator associated pneumonia (VAP) incidence is 1–4/1000 ventilator days, but it can be high as 10/1000 ventilator days.[2]

Considering the risk factors associated with VAP, evidence-based guidelines have been published for many years aiming to reduce VAP incidence.[3,4] VAP is mainly caused by pathogens to lower respiratory tract that colonizes the oropharynx and trachea. Therefore, restraining this colonization is the first step in the prevention of VAP. Prevention strategies of VAP includes surveillance, hand hygiene, isolation measures to reduce cross contamination of resistant bacteria, keeping the head position elevated, oral care with chlorhexidine, and utilization of endotracheal tube which allows the aspiration of subglottic secretions (ETT-SD) and monitoring the cuff pressure. In recent years, it has been observed that the application of these measures individually is not sufficient. The target is zero infection with a synergistic effect by creating the "VAP prevention bundle" of preventive measures.[5] Thus, VAP prevention bundles may include many possible measures and the Institutions usually select three to six of them. The inclusion of ETT-SD and cuff pressure monitorization in bundles brings about additional economic burden to hospitals. However, the importance of these two parameters have been evaluated in just a few studies.[6,7] This study was carried out to assess the effectiveness of VAP prevention bundles that contain ETT-SD and cuff pressure monitorization in terms of incidence and mortality of VAP.

Material and methods

Hospital setting and study design

This was a prospective, controlled study carried out at the two 10-bed Anesthesiology Intensive Care Units (ICU-1 and ICU-2) of a 898-bed University Hospital between March 2011 and April 2012.

Patients aged 18 years and more referred from the emergency room, clinical or surgical wards who were intubated for more than 48 h at the participating ICUs were recruited for the study.

Patients were followed up until hospital discharge or death even if transferred to another clinic. Patients with chronic tracheostomy and those intubated for more than one day in another center were excluded from study.

The included patients were assessed daily in terms of VAP occurrence and compliance with the measures of the VAP prevention bundle and recorded at the standardized follow-up form.

The study consisted of two periods: the first period lasted six months and the second seven months. As there were no ETT-SDs and cuff pressure monometer in our hospital and in order to avoid ethical problems related to randomization, the patients recruited in the first 6-month period were considered the control group. In the second period ETT-SDs and cuff pressure monometers were obtained with the support of the Scientific Research Projects Unit (SRPU) of Inonu University. ETT-SDs (Coviden, Mallinckroth™) and manual cuff pressure monometers (Coviden, Mallinckroth™) were made available to the Emergency Services and ICUs. The health professionals of these units were trained in the use of these two parameters that were recently added to VAP prevention bundle of the ICUs. To evaluate the effectiveness of this VAP prevention bundle, the patients intubated with ETT-SD, considered cases, were compared to the patients intubated with standard ETT, the control group.

VAP was diagnosed according to the nosocomial PNU 1 criteria in line with the suggestions of the Centers for Disease Control (CDC).[1]

Pneumonia diagnosed in the first four days after the intubation were classified as early onset pneumonia and those pneumonias diagnosed after four days were classified as late onset pneumonia.[1,4,8]

VAP bundle included the following interventions:

1. Utilization of subglottic secretion drainage endotracheal tube (ETT-SD);
2. Monitorization of endotracheal cuff pressure and maintenance at 20–30 cm H_2O;
3. Oral care with chlorhexidine (0.12–0.2%);
4. Semi-recumbent position, head position at 30–45°;
5. Daily sedation break;
6. Prophylaxis of peptic ulcer;
7. Utilization of orogastric (OG) feeding catheter instead of nasogastric (NG) feeding catheter;
8. Prophylaxis of deep vein thrombosis (DVT).

Identity, underlying diseases, risk factors, compliance with the components of the VAP prevention bundle, clinical and laboratory information, and APACHE II scores were used. APACHE II scores were calculated according to the worst parameters within the first 24 h of patients admission to the ICUs.

Occurrence of VAP and compliance with the components of the VAP prevention bundle were monitored daily. Bundle compliance was recorded as positive or negative for each bundle component and the compliance ratio was calculated for each component in every patient. "The compliance ratio" for each component was calculated as the percentage of the patient' hospitalization days with positive compliance.

Compliance ratio: [the number of days with full compliance/hospitalization time (days)] × 100.[9]

VAP rate: (number of VAP/ventilator days) × 1000.

VAP attack rate: total VAP attacks/number of patients with VAP.

Crude mortality and mortality rate in the first 14 and 30 days were recorded for cases and controls.

Statistical analyses

Data were entered in SPSS 16.0 for Windows for statistical analysis. Arithmetic mean and standard deviation (mean ± SD) were used for numeric variables, and number (*n*) and percentage (%) parameters were used for categorical