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Supine position and nonmodifiable risk factors for ventilator-associated pneumonia in trauma patients

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Abstract

BACKGROUND: We studied trauma-specific conditions precluding semiupright positioning and other nonmodifiable risk factors for their influence on ventilator-associated pneumonia (VAP).

METHODS: We performed a retrospective study at a Level I trauma center from 2008 to 2012 on ICU patients aged ≥ 15, who were intubated for more than 2 days. Using backward logistic regression, a composite of 4 factors (open abdomen, acute spinal cord injury, spine fracture, spine surgery) that preclude semiupright positioning (supine composite) and other variables were analyzed.

RESULTS: In total, 77 of 374 (21%) patients had VAP. Abbreviated Injury Score head/neck greater than 2 (odds ratio [OR] 2.79, $P = .006$), esophageal obturator airway (OR 4.25, $P = .015$), red cell/plasma transfusion in the first 2 intensive care unit days (OR 2.59, $P = .003$), and 11 or more ventilator days (OR 17.38, $P < .0001$) were significant VAP risk factors, whereas supine composite, scene vs emergency department airway intervention, brain injury, and coma were not.

CONCLUSION: Factors that may temporarily preclude semiupright positioning in intubated trauma patients were not associated with a higher risk for VAP.

Ventilator-associated pneumonia (VAP) is a prevalent problem in trauma intensive care units across the United States.[1] Multiple risk factors for VAP have been identified, some of which are modifiable through interventions employed by the healthcare team, and others are not modifiable. Three practices that are demonstrated to reduce VAP rates through reduction or avoidance of aspiration of oral or gastric secretions (the principal modifiable risk factor) are semi-upright positioning (elevating the head of the bed [HOB] to more than 30°),[2,3] keeping endotracheal cuff pressures at greater than 20 cm H_2O,[4] and continuous subglottic aspiration for intubated patients.[5]

Some conditions that are specific to the trauma patient population preclude elevation of the HOB to 30° or more (HOB > 30°), thereby depriving these patients of one of the few proven VAP prophylaxis interventions available to them. Patients with unstable spine fractures need to be kept flat in bed until spine stabilization, to avoid potential spinal column movement or spinal cord compression. In addition, patients for whom further imaging and evaluation are necessary to determine spinal stability are kept flat until

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that determination is made. Presence of an open abdomen, for which HOB elevation exacerbates evisceration and lateral retraction of the fascia, is another relative prohibition to bending the HOB. Patients with these conditions may be placed flat and in reverse Trendelenburg position to ameliorate the risks of supine positioning, but this does not achieve the minimum recommended angle of 30°.

In addition to the primary preventable risk factor of aspiration of oropharyngeal secretions while intubated, trauma patients are exposed to several nonmodifiable risk factors (NRFs). Non-modifiable factors are those whose effect persists despite implementation of the best current practices, or which cannot be modified except at the expense of other practices which provide greater benefit. Aspiration in the prehospital setting predisposes injured patients to VAP,[6,7] although many trauma centers do not call these infections VAP because the ventilator is practically incidental to the causative event.[1,8] Other NRFs include emergent intubation in the prehospital setting or upon initial presentation,[9] blood transfusion for hemorrhage resuscitation,[10,11] coma or severe traumatic brain injury (TBI),[1] and lack of early mobility due to injuries or non–weight-bearing status.[12]

In this study, we sought to determine the association of injury-related factors that may preclude semiupright positioning, as well as potential NRFs, with the occurrence of VAP. We hypothesized that conditions which make patients ineligible for HOB greater than 30° are associated with an increased risk of VAP in intubated trauma patients, and that VAP in trauma patients is linked to several NRFs that are inherent to this patient population when other factors are considered.

Methods

This study was approved with a waiver of informed consent by the Inova Institutional Review Board. Data were retrospectively collected on patients admitted from the emergency department (ED) to the trauma intensive care unit (TICU) at Inova Fairfax Medical Campus's Level I trauma center from 2008 to 2012. Inclusion criteria were age greater than or equal to 15 years, presence of traumatic injury, and being intubated on mechanical ventilation for more than 2 days. Prehospital, ED, and TICU patient variables were studied including a composite of 4 discrete factors ("supine composite" = open abdomen, acute spinal cord injury, spine fracture, or spine surgery) that each preclude HOB greater than 30° either upon admission or at some point during the TICU course at our institution. Patients with the presence of at least one of the 4 factors were included in the supine composite group.

"Open abdomen" refers to patients whose abdominal fascia is left open after trauma laparotomy as part of the damage control sequence, with plans for subsequent peritoneal washout and closure when anatomically feasible. "Spinal cord injury" was defined by International Classification of Diseases-9 (ICD-9) codes 806.00 to 806.9 and 952.00 to 952.9. "Spine fracture" was defined by ICD-9 codes 805.00 to 805.18. "Spine surgery" refers to any spinal column operation that was performed during the index hospitalization for a traumatic spine injury. TBI was defined by ICD-9 codes 850.00 to 854.19. Blood transfusion data were obtained from the blood bank database. Patients with VAP were identified prospectively through the hospital's Infection Control database, using standard Centers for Disease Control and Prevention (CDC) definitions that were contemporaneous with the study period.

The supine composite group's degree and timing of HOB elevation while intubated was decided on an individual basis by the attending trauma surgeon in conjunction with the neurosurgical consultant as applicable, based on our standard practices as follows: patients admitted with acute spinal column or spinal cord injuries are initially placed in flat supine position, with or without slight reverse Trendelenburg (maximum angle of 10° to 15°) until their injury is either deemed stable for HOB elevation by the consulting neurosurgeon, or definitive treatment is achieved with bracing or surgery. Patients who require surgery for traumatic spinal injuries usually have, by definition, unstable injuries that preclude HOB greater than 30° for a period of time. Patients with an open abdomen after damage control surgery are kept in flat supine position with reverse Trendelenburg to avoid the exacerbation of evisceration and lateral retraction of the fascia edges that occurs with HOB elevation. In such cases, the reverse Trendelenburg tilt does not reach 30° to prevent patients from sliding downward. HOB level is routinely monitored via nursing assessments every 4 hours. Unless a patient has one of the specific contraindications mentioned, they are kept in semiupright position.

Endotracheal tubes with subglottic suction were used in the ED but not at the scene. Esophageal obturator airways (EOAs) are breathing tubes designed for blind placement that usually lodge in the esophagus but allow ventilation of the airway through side holes, in conjunction with inflatable cuffs above and below the holes that isolate the laryngeal orifice.

Differences in NRFs for VAP and non-VAP patients were assessed using Student t test or Wilcoxon–Mann Whitney test for continuous variables and the chi-square test or Fisher's exact test for categorical variables, where appropriate. NRFs with a P value less than .20 in univariate models were entered into a full multivariable logistic regression and stepwise backward selection was used to determine a reduced model of independent NRFs associated with VAP. Duration of mechanical ventilation was dichotomized to less than 11 days or greater than or equal to 11 days for modeling. The association between the supine composite and VAP was then tested in univariate and multivariable models, with the multivariable model including the NRFs significantly associated with VAP. Supplemental analyses evaluated the relationship between the individual components of the supine composite and VAP. A P value less than .05 was considered statistically