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Research Article

A study of the correlation between ventilator associated pneumonia and mortality rate of traumatic in patients in intensive care units

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ABSTRACT

Background: Ventilator-associated pneumonia (VAP) is the most common nosocomial infection among the traumatic in-patients in Intensive Care Units (ICUs). Trauma is a risk factor for the incidence of VAP, yet, the association between VAP and outcome is not clear in traumatic in-patients in ICUs. This study investigated the correlation between ventilator-associated pneumonia and mortality rate of traumatic in-patients in ICUs in Be'that Hospital in Hamedan, western Iran.
Methods: This observational prospective study was conducted in the ICU of Be'that Hospital, Hamedan, Iran, during 1 year (March 2013 until February 2014). The population under study included traumatic in-patients aged less than 18 year who were in need of invasive mechanical ventilation for more than 48 h with APACHE SCORE II of less than 25. They were studied for the incidence or lack of incidence of VAP.
Results: Of 154 patients under study, 114 cases (74%) suffered from multiple traumata, 32 cases (20.8%) were affected with head trauma, 5 cases (3.2%) sustained spinal cord injury, and 3 cases (1.9%) suffered from thoracic trauma. Also, 47 cases (30.5%) were affected with VAP. Compared to the non-VAP group, the patients in VAP group had longer ICU stay (18.5±6.21 days vs. 9.21±2.91 days, P<0.001), longer intubation time (13.7±4.7 days vs. 6.06±2.05 days, P<0.001), longer mechanical ventilation time (12.9±5.1 days vs. 5.7±1.9 days, P<0.001), and more repeated intubations (1.2±0.50 vs. 1±0.0, P<0.001). There was no statistically significant difference between the two groups with respect to APACHE SCORE II (14.8±2.3 vs. 14.9±2.9). Additionally, there was no significant difference between the two groups regarding mortality rate (10.6 vs. 5.6, P=0.215).
Conclusions: VAP caused longer ICU stay, increased intubation time, increased mechanical ventilation time, and more repeated intubations in traumatic in-patients, yet, it did not increase mortality rate in these patients. Patients with spinal cord and thoracic traumata are at risk for affliction with VAP.

Keywords: Pneumonia, Trauma, Mortality

INTRODUCTION

Ventilation-associated pneumonia (VAP) is the most common nosocomial infection in Intensive Care Units (ICUs). VAP is, in fact, a subcategory of hospital-acquired pneumonic infections which occurs in patients under mechanical ventilation for more than 48 h through intra-tracheal intubation or tracheostomy.[1,2] VAP, as the name suggests, is limited to patients under mechanical ventilation.[3] It occurs in 25% of patients in need of mechanical ventilation.[4,5] It may occur at any time during ventilation; however, it mostly happens during the first few days of intratracheal ventilation, since the passage of the tube is itself responsible for the incidence and progress of VAP. The intratracheal or tracheostomy intubation predispose to the free transmission of bacteria into the deeper segments of the lungs in patients with pulmonary or immunological problems. Transmission of

bacteria is done through the inside part of the tube or the surrounding of the cuff. Colonization of bacteria is often completed within the intratracheal or tracheostomy tube and embolized within the lungs with each inspiration. Moreover, the bacteria may be taken into the lungs with procedures such as deep suctioning or bronchoscopy. After arrival into the lungs, the bacteria divide and multiply rapidly in the case of immunodeficiency or chemotherapy. A combination of bacterial injury and immunodeficiency would lead to disturbances in gas exchange and the related symptoms.[6,7] In the studies conducted so far, the rate of VAP-associated mortality is reported to be 33-50%.[1] Pneumonia is the second common cause of nosocomial infection after UTIs (urinary tract infections) and the most common cause of mortality among the in-patients of medical wards. Regarding the prevalence and high mortality rate of VAP, the early identification and prompt diagnosis of this disorder is of utmost importance. This is because the prompt and suitable treatment can lead to the saving of lives of many in-patients in ICUs. Trauma is a risk factor for the development and progress of VAP. Nonetheless, the association between VAP and prognosis in traumatic in-patients in surgical ICUs is unclear. Hence, it is mandatory to determine vividly the rate of incidence and the relation between VAP and mortality in ICUs, specifically surgical ICUs, so that with prompt and suitable diagnosis and treatment, the rate of mortality could be reduced in critical wards and the time of ICU stay and costs would be decreased.[8-11] Considering the significance of the issue , the researchers decided to determine the correlation between VAP and mortality rate in traumatic in-patients in the ICUs of Be'that Hospital in Hamedan, Iran.

METHODS

In this prospective cross-sectional qualitative study, 154 in-patients with mild to moderate multiple traumata were investigated in the ICUs of Be'that Hospital in Hamedan, Iran, during March 2013 until February 2014. Having obtained informed written consent from all patients, the study was carried out after approval by the Committee of Ethics at Hamedan University of Medical Sciences. Sampling was done using the consensus method. The inclusion criteria were patients aged 18+ years, intubation for more than 48 h under mechanical ventilation, patients with APACHE SCORE II less than 25 on entering the ICU, and patients who used H_2 blockers for prophylaxis. The exclusion criteria included traumatic patients who used corticosteroids, patients under intubation for less than 48 h, and patients with APACHE SCORE II more than 25. The culled data were given to SPSS 16 and analyzed using statistics such as X^2 (chi-square), T-test, and Mann-Whitney test.

RESULTS

In this prospective cross-sectional study, 154 in-patients were investigated at the ICUs of Be'that Hospital in Hamedan, Iran. Of 154 patients, 117 cases (76%) were male and 37 cases (24%) were female. Also, 47 patients were afflicted with VAP and 107 patients (69.5%) were placed in the non-VAP group. The mean age of the VAP group was 35.55 years and that of the non-VAP group was 35.63 years. There was no significant difference between the two groups regarding age. Further, in the VAP group, 33 cases (70.2%) were males and 14 cases (29.8%) were female. Also, in the non-VAP group, 84 cases (78.5%) were male and 23 cases (21.5%) were female. There was also no significant difference between the two groups regarding gender. Demographic information of the patients including age, gender, and APACHE SCORE II is given in Table 1. As indicated, 114 cases (74%) were afflicted with multiple traumata, 32 cases (20.8%) with head trauma, 5 cases (3.2%) with spinal cord injury, and 3 cases (1.9%) with thoracic traumata. The total rate of mortality was 11 cases (7.1%) of which 5 cases (10.6%) belonged to the VAP group and 6 cases (5.6%) were in the non-VAP group (Table 2). Furthermore, there were 9 cases (7.9%) of death in the multiple traumata group, 1 case (3.1%) of death in the head traumata group, and 1 case (20%) of death in the spinal cord injury group. There were 11 cases (70.1%) of multiple traumata, 8 cases (17%) of head injury, 1 case (8.5%) of spinal cord injury, and 2 cases (4.3%) of thoracic traumata in the VAP group. In the non-VAP group, 81 cases (75.7%) were affected with multiple traumata, 24 cases (22.4%) with head injury, 1 case (0.9%) with spinal cord traumata, and 1 case (0.9%) with thoracic traumata.

There were 14.87 in the VAP group and 14.92 in the non-VAP group, the difference between the two not being statistically significant.

The mean time of ICU stay was 18.55 days in the VAP group and 9.12 days in the non-VAP group which was significantly higher in the VAP group (P<0.005) (Table 3). The mean time of intubation was 13.76 days in the VAP group and 6.06 days in the non-VAP group which was significantly higher in the VAP group (P<0/005) (Table 3). The mean time of mechanical ventilation was 12.91 days in the VAP group and 5.71 days in the non-VAP group which was significantly higher in the VAP group (P<0/005) (Table 3). Of all the patients under study, 43 cases (27.9%) needed repeated intubation of whom 24 cases (51.1% of the VAP patients) were in the VAP group and 19 cases (17.8% of the non-VAP patients) were in the non-VAP group. Of these patients, 40 cases needed 1 repeated intubation, 2 cases needed 2 repeated intubations, and 1 case needed 3 repeated intubations. Repeated intubation was significantly higher in the VAP group (P<0/005) compared to the non-VAP group. Moreover, of all the patients under study, 5 cases (3.2%) underwent tracheostomy. Also, 4 cases (8.5%) were in the VAP group and 1 case (0.9%) was in the non-VAP group; however, the difference between the two was not significant. The mean time of onset of symptoms in the VAP group was 5.78 days after intubation and

ventilation (a minimum of 2 days and a maximum of 12 days). Of all the VAP patients studied, 4 cases (8.5%) showed positive blood culture. Gram negative bacteria (72.4%) and gram positive bacteria (17%) were isolated

Table 1: Demographic information of patients in terms of age, gender, and APACHE SCORE II.

Variable	VAP	Non VAP	All	P-value
Number	47 (30.5%)	107 (69.5%)	154	-
Male	33 (70.2%)	84 (78.5%)	17 (76%)	0.267
Female	14 (29.8%)	23 (21.5%)	37 (24%)	0.267
Age	35.55 ± 16.2	35.63 ± 15.7	35.61	0.97
APACHE II	14.87 ± 2.3	14.9 ± 2.9	14.90	0.91

Table 2: Frequency of VAP among different trauma groups.

	VAP	Non VAP	Total
Multiple trauma	33 (28.9%)	81 (71.1%)	114 (74%)
Head trauma	8 (25%)	24 (75%)	32 (20.8%)
Spinal cord injury	4 (80%)	1 (20%)	5 (3.2%)
Thoracic trauma	2 (67.7%)	1 (33.3%)	3 (1.9%)

from the trachea. The results of tracheal culture in 47 VAP patients demonstrated 28 cases (59.6%) of pseudomonas aeruginosa, 8 cases (17%) of staphylococcus aerus, 3 cases (6.4%) of actinoobacteria, 3 cases (6.4%) of cabecila, and 5 cases (10.6%) of miscellaneous organisms (Table 4). Among the VAP patients, 25 cases (53.2%) were early VAP, and 22 cases (46.8%) late VAP. Acintobacter had grown only in the tracheal culture of late VAP group and there was no case of acintobacter in the early VAP patients.

DISCUSSION

In this study, of 154 patients under investigation, 47 cases (30.5%) were VAP patients. A similar study conducted in 16 ICUs in Canada in 1998 by Cook et al. showed that VAP developed in 26.1% of the traumatic patients who underwent mechanical ventilation.[12] Koulenti et al. reported the prevalence of VAP to be 36.2% in their study carried out in 27 ICUs in nine European countries.13 Additionally, Croce et al. (2001) reported the incidence rate of VAP in traumatic in-patients in ICUs to be 31%.[14] Nonetheless, unlike our study, Ozkurt

Table 3: ICU stay, mechanical ventilation time, and intubation time in VAP and non-VAP patients.

	Total (154 day)	VAP (47 day)	Non VAP (107 day)	P-value
ICU length of stay	12.0 ± 6	18.55 ± 6.2	9.12 ±2.91	<0.001
Total days of mechanical ventilation	7.9 ±4.7	12.91 ± 5.1	5.71 ±1.9	<0.001
Total days of intubation	8.41 ±4.7	13.76 ± 4.7	6.06 ±2	<0.001

Table 4: Results of tracheal culture in VAP patients on the basis of the time of onset of VAP symptoms.

Bacteria Isolated	Early VAP (VAP < 5 day)	Late VAP (VAP > 5 day)	Total
Pseudomonas aeruginosa	17 (60.7%)	11 (39.3%)	28 (59.6%)
Staphylococcus aureus	3 (37.5%)	5 (62.5%)	8 (17%)
Acinetobacter	0	3 (100%)	3 (6.4%)
Klebsiella species	2 (66.7%)	1 (33.3%)	3 (6.4%)
Pathogen unidentified	3 (60%)	2 (40%)	5 (10.6%)

reported the prevalence rate of VAP to be 5.93% in their study carried out in the ICU of the Internal Ward.[1] This smaller prevalence rate may be attributed to the differences among the in-patients and type of patient selection as we excluded the patients with APACHE SCORE II greater than 25 to match the patients. The prevalence of nosocomial infections in ICUs varies from 10% to 65%. In the present study, there were 11 cases of mortality in the VAP and non-VAP groups which was associated with a prevalence rate of about 7.1%. Of these, 5 cases (10.6%) were in the VAP group and 6 cases (5.6%) in the non- VAP group. In the studies conducted so far on the issue, the mortality rate in VAP patients has varied from 13% to 55%.[1,2] The studies conducted by Hedrick et al. (2008)[15] and Cook et al. (2010)[16] reported the rate of mortality of traumatic VAP in-patients to be 11.2%. In our study, however, this rate was 10.6%. The probable causes of lower mortality rate may include early diagnosis, prompt administration of wide-spectrum antibiotics, special attention to oral health (4-6 times irrigation of the oral cavity), and inclination for tracheostomy of the patients who were expected to need

long intubation (more than 10 days). It should be kept in mind that patients with low GCS and APACHE SCORE II greater than 25 were excluded from this study. In the present study, the VAP patients had significantly (P<0/005) longer ICU stay, longer mechanical ventilation time, and longer intubation time compared to the non-VAP patients, nevertheless, there was no statistically significant difference between the two groups regarding mortality rate, indicating that VAP has not caused any increase in the mortality rate of traumatic in-patients in ICUs. In the study by Josephson et al. (2009) conducted in ICU of neurology, VAP did not increase mortality rate of this group of patients, but it increased the length of ICU stay during mechanical ventilation.10 In our study, the VAP patients had greater repeated intratracheal intubation compared to the non-VAP group (51.1% vs. 17.8%) which was statistically significant (P=0.000). This may not be merely due to the nature of VAP; since the VAP patients have longer intubation and mechanical ventilation times, this may be attributed to this subject. In the study by Ozkurt et al. carried out in internal ICU, the rate of repeated intubation was higher in the VAP patients compared to the non-VAP patients.[1] In this study, 4 cases (8.5%) of VAP patients underwent tracheostomy, a rate which was greater than that of the non-VAP group in which only 1 case (0.9%) underwent tracheostomy. However, this difference was not significant (P=0.031). This may be attributed to the longer intubation and mechanical ventilation times in this group. Regarding the low number of patients undergoing tracheostomy, it could not be said with certainty what the role of tracheostomy is in the developlment or prevention of VAP. The results of tracheal culture in VAP patients revealed the presence of gram negative bacteria (pseudomonas aeruginosa, cabecila, and actinobacter, 72.4%) and gram positive bacteria (golden staphylococci, 17%). These findings are almost similar to those found in the internal ICU in Turkey in which there were 87.5% of gram negative bacteria and 12.5% of gram positive bacteria in the tracheal culture.1 Of course, in that study, the major strain of gram negative bacteria was actinobacter (62.5%), i.e., a very invasive strain, followed by pseudomonas ranking as second. In our study, the main strain of gram negative bacteria was pseudomonas (59.6%) and actinobacter ranked second (6.4%). Also, in our study, pseudomonas was the most common strain in both early and late VAP groups.

CONCLUSION

Regarding the type of sustained trauma and its correlation with the incidence of VAP, it could be said that based on what has been done so far on various types of trauma, most studied patients were multiple trauma and head injury patients for whom the prevalence of VAP could not be attributed to the type of sustained trauma (P=0.058). Nonetheless, regarding thoracic and spinal cord traumata, seeing the low number of the patients under study nothing could be said on the correlation between these traumata and the incidence of VAP. However, the higher prevalence of VAP in these traumatic patients may be attributed to factors such as the nature of these traumata, the need for longer mechanical ventilation, the need for more sedatives and tranquilizers, and more bed rest.

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