



Ventilator-Associated Pneumonia: The Effect of Bacterial Resistance

Authors

Yousry Elsaeed Risk¹, Mohamed Abd Elmohsen Elmahdy², Ahmed Hamdy Abd Elrahman³, Bassem Mefreh Aglan⁴, Mohamed Ossama Mohamed Abd Elsadek⁵

¹Professor of Critical Care Faculty of Medicine Benha University

²Assist. Prof. of Chest Disease Faculty of Medicine Benha University

³Lecturer of Anesthesia and Intensive Care Faculty of Medicine Benha University

⁴Lecturer of Cardiothoracic Surgery Faculty of Medicine Benha University

⁵Resident of Critical Care Faculty of Medicine Benha University

Abstract

Background: *there have been many study in preventing ventilator-associated pneumonia (VAP), Although it VAP remains the most diffuse Hospital aquired infection in intensive care units (ICU)⁽¹⁾. VAP worse patient recovery and increasing length of hospitalization, duration of mechanical ventilation, and hospitalization costs.⁽²⁾*

Moreover, VAP is lead to increase mortality rates (14–70%), due to resistant bacteria, inappropriate antimicrobial therapy use, and incorrect antimicrobial prescription or de-escalation therapy.^(3, 4)

Patients and Methods: *This study was done on 40 patients in ICU at Benha University Hospital in the period from august 2017 to march 2019. who were put on mechanical ventilation and diagnosed to have VAP.19 patients died in our study and 21 patients were discharged alive.*

Results: *This study observed that error in maintenance dose treatment, error in treatment duration and delay in starting antimicrobial therapy followed by the interval between doses, error in loading dose and inappropriate adjustment for renal function. were found increased in patients who died. de-escalation therapy compared to maintenance therapy lead to low mortality rates and higher mortality rates in older patients with more comorbidities..*

Keywords: *ventilator-associated pneumonia; mechanical ventilation; antimicrobial prescription.*

Introduction

Many risk factors have been demonstrated to be associated with VAP. generally, these factors can be divided into several broad categories: intrinsic host factors such as age, underlying medical disorders such as pulmonary disease, and nutritional status, hospital factors such as abdominal or thoracic operations, antibiotic use, immunosuppression, and treatment in an ICU,

equipment and device use, especially intubation with mechanical ventilation and increase the risk of aspiration by many factos such as depressed consciousness.

VAP is often caused by multidrug resistant organisms, which may decrease therapeutic options and lead to bad prognosis.⁽⁵⁾

because of VAP is associated with significant morbidity and mortality, the proper choice of

initial empiric treatment will be associated with significant decrease in rate of morbidity and mortality in infection with VAP. and perform appropriate prescription of antimicrobial therapy should also consider as the type, dosage, and duration of drug administration.

Although many trials for study of VAP prophylaxis and treatment are available, therapy still varies significantly between institutions and the presence of incorrect prescription is quite high, ranging from 10% to 73%.⁽⁶⁾

Patients and Methods

This study was done on 40 patients who were admitted to the adult ICU of Benha University Hospital. Patients presented in our study were diagnosed to have VAP. Diagnosis was established on many criteria decided by the American Thoracic Society and the Infectious Diseases Society of America⁽⁷⁾ including mechanical ventilation for at least 48 h and appearance of new or progressive pulmonary infiltrate on chest radiographs associated with at least two clinical signs and/or laboratory changes suggesting an ongoing infection, including fever ($>38^{\circ}\text{C}$) or hypothermia ($<35^{\circ}\text{C}$); leukocytosis ($>10,000/\text{mm}^3$) or leukopenia ($<4000/\text{mm}^3$); purulent tracheal secretions and oxygenation changes.

Data on drug prescription of antimicrobial therapy were obtained, including whether treatment was given after obtaining the results of sensitivity profiling using quantitative culture, as:

1. De-escalation (Discontinuation of antimicrobial therapy or replacement with antimicrobials with limited spectrum coverage).
2. Escalation (Add new antimicrobial or replace with broad-spectrum antimicrobial).
3. Maintenance (Preserve the antimicrobial described initially or replace the antimicrobial with the same cover profile).

Errors in antimicrobial prescription were classified as follows: inappropriate choice:

- 1- Inappropriate adjustment for body weight (the dose not corrected according to patient weight).
- 2- The dose not adjusted according to renal function.
- 3- Errors in treatment duration (prescription for shorter or longer duration than period indicated).

To analyze the adequacy of treatment based on literature, we used guidance recommendations for management and health care for adults with pneumonia associated with mechanical ventilation from the American Thoracic Society and the Infectious Diseases Society of America⁽⁷⁾ The Sanford Guide to Antimicrobial Therapy⁽⁷⁾ were used as criteria for decisions about starting time:

1. Dose adjustments when necessary for weight and renal function.⁽⁸⁾
2. Error in starting of antibiotic therapy was defined by the Surviving Sepsis Campaign⁽⁹⁾ as more than one hour between prescription of the first antibiotic dose and administration of it to the patient.

Results

This study was done on patients and subjects in ICU at Banha University Hospital. in the period from August 2018 to March 2019. Out of 100 patients were mechanically ventilated, 40 patients developed episode of VAP. in this study 19 patients died and 21 patients were discharged alive.

Mortality	N	%
Discharge	21	52.5
Died	19	47.5
Total	40	100

Age in the studied groups were 22.5% less than 60 years with mortality 0% and 77.5% more than 60 years with higher mortality 100 ($p = 0.001$), sex in the studied groups were 45% male with mortality 26.3% and 55% female with higher mortality 73.7% ($p = 0.024$), Days of hospitalization in the studied groups were 45% less than 21 days with mortality 47.4% and 55% more than 21 days with

higher mortality 52.6% ($p = 0.775$), admission APACHE II prognostic index scores of 18.05 ± 2.11 in Discharge and 24.47 ± 3.03 in died and, admission APACHE II prognostic index scores of 38.81 ± 4.51 in Discharge and 57.68 ± 11.48 in died with ($p = 0.001$), Neurologic cases in the studied groups were 65% with mortality 73.7% and 57.1% discharge($p = 0.273$), trauma cases in the studied groups were 10% with mortality 0% and 19.0% discharge ($p = 0.045$), Respiratory cases in the studied groups were 25% with mortality 26.3% and 23.8% discharge ($p = 0.855$), Infectious cases in the studied groups were 32.5% with mortality 47.4% and 19% discharge($p = 0.056$), Cardiovascular cases in the studied groups were 45% with mortality 47.4% and 42.9%

discharge($p = 0.775$), Others cases(Burned and pancreatitis). in the studied groups were 10% with mortality 5.3% and 14.3% discharge ($p = 0.342$), Smoking in the studied groups were 25% with mortality 26.3% and 23.8% discharge ($p = 0.855$),systemic arterial hypertension cases in the studied groups were 90% with mortality 89% and 90.5% discharge($p = 0.916$), Alcoholism in the studied groups were 0% with mortality 0% and 0% discharge, DM patient in the studied groups were 80% with mortality 100% and 61.9% discharge ($p = 0.003$), Heart disease patient in the studied groups were 57.5% with mortality 73.7% and 42.9% discharge ($p = 0.049$), Lung disease patient in the studied groups were 75% with mortality 73.7% and 76.2% discharge ($p = 0.855$).

Table (1): Distribution of Prescription errors among the surveyed ICU patients

Prescription errors	Discharge (N=21)		Died (N=19)		X ²	P-value
	N	%	N	%		
Error in loading dose	5	23.8	0	0	5.170	0.023*
Error in maintenance dose	0	0	19	100	40.001	0.001*
Error in the interval between doses	4	19	9	47.4	3.647	0.056
Delay in starting antimicrobial therapy	0	0	10	52.6	14.737	0.001*
Inappropriate adjustment for renal function	3	14.3	1	5.3	0.902	0.342
Error in treatment duration	0	0	19	100	40.001	0.001*

This table shows that mean Prescription errors in the studied groups were

The most common error in antimicrobial prescriptions was Error in maintenance dose treatment, Error in treatment duration and the interval between doses followed by Delay in starting antimicrobial therapy, Error in loading dose and Inappropriate adjustment for renal function. Analysis of the influence of prescription

errors on mortality rate revealed increase in mortality in patients who received an Error in maintenance dose ($p = 0.001$), Error in treatment duration (0.001), Delay in starting antimicrobial therapy ($p = 0.001$), when the dosage was not adjusted for renal function ($p = 0.432$), Error in loading dose($p = 0.023$)and Error in the interval between doses ($p = 0.056$).

Table (2): Distribution of Conduct among the surveyed ICU patients

Conduct	Discharge (N=21)		Died (N=19)		X ²	P-value
	N	%	N	%		
De-escalation	8	38.1	0	0	9.048	0.003*
Escalation	8	38.1	14	73.3	5.105	0.024*
Maintenance	5	23.8	5	26.3	0.033	0.855

This table shows that mean Conduct in the studied groups.

Initial antimicrobial therapy was De-escalation in 38.1% of Discharged cases and 0% of died cases

with ($p = 0.003$), escalation in 38.1% of Discharged cases and 73.3% of died cases with ($p = 0.024$), and Maintained in 23.8% of Discharged cases and 26.3% of died cases with ($p = 0.033$)

Table (3): Distribution of Bacteria among the surveyed ICU patients

Bacteria	Discharge (N=21)		Died (N=19)		X ²	P-value
	N	%	N	%		
<i>Pseudomonas aeruginosa</i> Mr	0	0	10	52.6	14.737	0.001*
<i>Acinetobacter baumannii</i> MR	2	9.5	2	10.5	0.011	0.916
<i>Staphylococcus aureus</i> MR	0	0	9	47.4	12.835	0.001*
<i>Serratia</i>	0	0	0	0	-	-
<i>Stenotrophomonas maltophilia</i>	0	0	0	0	-	-
<i>Klebsiella pneumoniae</i> spp	5	23.8	0	0	5.170	0.023*
<i>Enterobacter</i> spp	0	0	0	0	-	-
<i>Escherichia coli</i>	4	19	5	26.3	0.302	0.583
<i>Staphylococcus epidermidis</i>	8	38.1	0	0	9.048	0.003*

This table shows that mean Bacteria in the studied groups.

Infections which were caused by *Pseudomonas aeruginosa* in 0% of Discharge cases and 52.6% of died case (p = 0.001), *A. baumannii* in 9.5% of Discharge cases and 10.5% of died case (p = 0.916), *S. aureus* in 0% of Discharge cases and 47.4% of died case (p = 0.001), *Klebsiella pneumoniae* in 23.8% of Discharge cases and 0% of died case (p = 0.023), *Staphylococcus epidermidis*, in 38.1% of Discharge cases and 0% of died case (p = 0.003) and *Escherichia coli* in 19% of Discharge cases and 26.3% of died case (p = 0.583).

Conclusions

Conclusion, this study observed that Error in maintenance dose treatment, Error in treatment duration and Delay in starting antimicrobial therapy. were more frequent in patients who died. de-escalation therapy compared to maintenance therapy lead to low mortality rates. The higher mortality rates in older patients with more comorbidities.

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