Section: Anaesthesiology & Critical Care

Research

THE CAUSATIVE ORGANISM AND THEIR ANTIBIOTIC SENSITIVITY PATTERN CAUSING VENTILATOR-ASSOCIATED PNEUMONIA WITH OPEN SUCTION TECHNIQUE– A RETROSPECTIVE STUDY

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Abstract

Background: Ventilator associated pneumonia is a serious condition. It is important to know the pattern of antibiotic sensitivity among ventilator associated pneumonia (VAP). The study is conducted with the aim to understand the antibiotic sensitivity of patients who suffered with VAP. **Materials and Methods:** All patients from various critical care units like medical, surgical and cardiac were included in this study. The study period was 1st of January 2019 till 31st December 2021. The patients who were on ventilator for more than 48 hours were included. A total of 240 patients whose age of 18 years and above, both genders and intubated for more than 48 hours were included in this study. The patients were diagnosed as having VAP based on clinical pulmonary infection score (CPIS) criteria. The organism isolated and the antibiotic sensitivity is noted from the records. **Result:** In this purposive sampling, we could identify a total of 21 patients who developed VAP. 20(95.24%) patients were affected by gram-negative organisms and 1(4.76%) patient was affected by gram-positive organisms. The organisms most commonly isolated in our study were Acinetobacter species in 9(38.09%) patients and Pseudomonas aeruginosa in 9(38.09%) patients each followed by E. coli in 2 (9.52%) patients and klebsiella species in 2(9.52%) patients each and Staphylococcus aureus in 1(4.76%) patient. **Conclusion:** Gram-negative bacterial infections are on higher side in our rural tertiary critical care where open suction technique is practiced. Antibiotic sensitivity pattern in a hospital setup has to be studied on regular basis which will guide us for the early initiation of antibiotic therapy.

INTRODUCTION

In the modern medicine practice with various innovations, the patients will be treated and monitored with various equipment. The outcome of the patients, however, linked to some factors like severity of patient illness, length of exposure to invasive devices and procedures, increased patient contact with healthcare personnel, and length of stay in hospital. Ventilator-associated pneumonia (VAP) is one of the common problems that are seen in critical care units. Ventilator- associated pneumonia is the second most common nosocomial infection in the intensive care unit (ICU) and is most commonly seen in mechanically ventilated patients.[1,2] VAP is usually classified either as early onset, occurring within the first four days of mechanical ventilation; or late onset, developing five or more days after initiation of mechanical ventilation.[3] It affects one-third of patients that require mechanical ventilation during a non-infectious admission. The incidence of VAP varies among different studies, depending on the definition, the type of hospital or ICU, the population studied, and the level of antibiotic exposure.[3,4] VAP contributes approximately to half of all cases of hospital-acquired pneumonia.[4,5] The average rates of VAP reported in Indian studies range from 8.9 to 46 VAP episodes per 1000 mechanical ventilation days.[6] The incidence of VAP varies among different studies, depending on

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the definition, the type of hospital or ICU, the population studied, and the level of antibiotic exposure.[7,8]

Several risk factors may predispose patients to either colonization of the respiratory tract with pathogenic microorganisms or aspiration of contaminated secretions.[9,10,11,12] The presence of an endotracheal tube (ETT) is probably the most relevant factor responsible for the development of VAP. The ETT may acts as an obstacle to host defenses by inhibiting the action of cilia, swallowing and spontaneous coughing by the patient.[13]

In spite of advances in the diagnosis, treatment, and prevention of VAP, it continues to be a major cause of morbidity and mortality among critically ill patients.[12] Treatment of VAP has been difficult, despite the availability of newer antimicrobials. As a result, early diagnosis, identification of type of organisms involved in it and type of antibiotic sensitivity are crucial and having knowledge of these will reduce patient morbidity and mortality. One should know the commonest causative pathogens for VAP and their antibiotic sensitivity pattern in their set up so that early treatment initiation will improve the outcome of the patients. Thus; we conducted this study to know the causative organisms of ventilator-associated pneumonia and its sensitivity to antibiotics among where patients were receiving with open suction technique.

MATERIALS AND METHODS

After obtaining institutional ethical clearance (PIMS/DR/RMC/2022/527), this retrospective was conducted in our rural tertiary care hospital. All patients from various critical care units like medical, surgical and cardiac were included in this study. The study period was 1st of January 2019 till 31st December 2021. The patients who were on ventilator for more than 48 hours were included. A total of 240 patients whose age of 18 years and above, both genders and intubated for more than 48 hours were included in this study. Patients who were referred to or from other center and taken discharge against medical advice were excluded from the study. In this purposive sampling, we could identify a total of 21 patients who developed VAP. The patients were diagnosed as having VAP based on clinical pulmonary infection score (CPIS) criteria. The organism isolated and the antibiotic sensitivity is noted from the records.

RESULTS

A total of 240 patients were identified during the study period that was on mechanical ventilation for more than 48 hours. Out of whom, 21 patients were diagnosed as having VAP based on the CPIS criteria. Out of these 21 positive patients, 20(95.24%) patients were affected by gram-negative organisms and 1(4.76%) patient was affected by gram-positive organisms. The organisms most commonly isolated in our study were Acinetobacter species in 9(38.09%) patients and Pseudomonas aeruginosa in 9(38.09%) patients each followed by E. coli in 2 (9.52%) patients and klebsiella species in 2(9.52%) patients each and Staphylococcus aureus in 1(4.76%) patient [Figure 1] respectively. In early onset VAP-positive patients which were isolated on the culture and gram staining, the majority of these cases showed organism(s) like Acinetobacter species in 3(27.20%) patients followed by klebsiella species in 1(18.2%) patient, Pseudomonas aeruginosa species in 4(36.4%) patients and E. coli in 1(9.10%) patient and Staphylococcus aureus in 1(9.1%) patient. In late onset VAP positive cases, majority of these cases had shown up organism(s) like Acinetobacter species in 5(50%) patients, followed by Pseudomonas aeruginosa in 3(40%) patients followed by E. coli in 1(10%) patient [Figure 2]. Out of 21 VAP positive patients, 18 patients showed sensitivity to antibiotics with majority of 3(14.29%) patients being towards Amikacin and Cefepime each followed by Amoxicillin and Tobramycin with 2(9.52%) cases and to Ciprofloxacin, Colistin, Doxycycline, Gentamicin, Meropenem, Polymyxin B and Tetracycline with 1(4.76%) case respectively whereas 3(14.29%) patients showed no sensitivity to any antibiotic [Figure 3].

Table 1: Age Distribution among the Study Subjects

Age (in Years)	Number	Percentage
<12	253	50.4%
>13	247	49.6%
Total	500	100

Table 2: Severity of Anemia

Anemia stage	Total no of participants =500 (%)
Normal (11-14 g/dL)	180(29.4%)
Mild (9-10.9 g/dL)	129(47.4%)
Moderate (7-8.9 g/dL)	141(15%)
Severe (< 7 g/dL)	50(8%)

Table 3: distribution of symptoms of anemia among the adolescent girls

Symptoms	Present	Absent	Total
Breathlessness	0	500	500
Palpitation	0	500	500

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Pedal edema	0	500	500
Fatigue	0	500	500
Loss of appetite	27	473	500

Table 4: distribution of pallor in various sites among the adolescents girls

Presence of Pallor	Present	Absent
Nail	19	481
Conjunctiva	134	366
Palm	21	479
Tongue	39	461

Table 5: distribution of age at menarche among the adolescent girls

Age at Menarche (in years)	Number	Percentage
9	3	1.2
10	12	4.8
11	24	9.7
12	75	30.1
13	120	48.2
14	15	6.0
Total	249	100

Table 6: age-wise distribution of anaemic status in the study subjects

Age	Anemia				Total	
	Present		Absent			
	No.	%	No.	%	No.	%
<12 years	110	43.5	143	56.5	253	50.6
>13 years	182	73.7	65	26.3	247	49.4
Total	292	58.4	208	41.6	500	100

Table 7: mean and standard deviation of hb level between the girls who attained menarche and not attained

Hb Level	Number	Mean	Standard Deviation
Girls not attained menarche	251	11.879	1.2245
Girls attained menarche	249	11.086	1.7015

Table 8: anaemia status versus duration of post-menarcheal period

Post menarche Duration	Anemia Status				Total	
	Present		Absent			
	No.	%	No.	%	No.	%
1 year	128	72.7	48	27.3	176	70.7
2 years	34	73.9	12	26.1	46	18.5
>3 years	22	81.5	5	18.5	27	10.8
Total	184	73.9	65	26.1	249	100

Table 9: distribution of anaemia status based on body mass index

Body Mass Index	Anemia Status				Total	
	Present		Absent			
	No.	%	No.	%	No.	%
Under weight	25	69.4	11	30.6	36	7.2
Normal	231	59.7	156	40.3	387	77.4
Over Weight and Obese	36	46.8	41	53.2	77	15.4
Total	292	58.4	208	41.6	500	100

DISCUSSION

Hospital acquired infections are shown to be associated with substantial morbidity, mortality and also lead to increased hospital stay and expenses. Being a rural set up it is very challenging to provide cost effective treatment to the patient without compromising the quality of care. For the same reason the open suction technique was practiced in our set up as most of the patient admitted were of poor patients. In the selected duration of the study, a total of 240 patients were on ventilator for morethan 48 hours out of which 21 were VAP positive and diagnosed was based on CPIS scoring system.

Antibiotic-susceptibility testing (AST) is a widely used method for evaluating antibiotic resistance and determining patient treatment plans for further clinical settings. In Asian countries like India, most isolates which were obtained from ICU patients were gram-negative organisms such as E.-coli, Klebsiella, and Acinetobacter, followed by gram-positive organisms like Staphylococcus which are comparable to our study.[14] Out of 21 patients culture reports, (20) 95.24% had gram negative organisms and 1(4.76%) had gram positive organisms isolated on their culture medium. Amongst them, the most common organism isolated was Acinetobacter in 9 (38.10%) patients and Pseudomonas aeruginosa in 9 (38.10%) patients,

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followed by E.-coli in 2(9.52%) patients and Klebsiella species in 2 (9.52%) patients, and Staphylococcus aureus in 1 (4.76%) patient. Out of 21 VAP positive patients, 18 patients showed sensitivity to antibiotics, amongst whom 3 patients each (14.29%) showed sensitivity to Amikacin and Cefepime respectively, 2 (9.52%) patients each had sensitivity to Amoxicillin and Tobramycin and 1 (4.76%) patient showed sensitivity to Ciprofloxacin, Colistin, Doxycycline, Gentamycin, Meropenem, Polymyxin B and Tetracycline, respectively whereas 3(14.29%) cases showed no sensitivity to any antibiotic. In general, Klebsiella was commonly isolated from ETT aspirate culture followed by Acinetobacter and Pseudomonas. In majority of studies conducted in respiratory ICU, Acinetobacter was commonly isolated, followed by Klebsiella and Pseudomonas.[15]

In a study conducted by Sneha S Savanur et al, out of 127 patients, the most common organisms isolated were E. coli in 32(18.6%) patients, Acinetobacter in 25(14.5%) patients, Klebsiella in 20(11.6%) patients and Pseudomonas in 17(9.8%) patients who showed high resistance to second and third-generation cephalosporins followed by piperacillin–tazobactam. Their results were found to be similar to our study, where the most common organisms found to be isolated were gram negative.[14]

In the study conducted by Pattanayak C et al out of 182 patients, the most common organisms isolated were Escherichia coli in 96(52.7%) patients, followed by Proteus mirabilis in 28(15.4%) patients, Pseudomonas aeruginosa in 24(13.2%) patients, Candida albicans in 12(6.6%) patients, Staphylococcus aureus in 10(5.5%) patients, Klebsiella pneumoniae in 6 (3.3%) patients, Enterococcus fecalis in 4(2.2%) patients of which E. coli showed sensitivity to Polymyxin B, Gatifloxacin, Ceftriaxone and completely resistant to Cephalexin, Cefadroxil, Tobramycin and Prulifloxacin. Their results were found to be similar to our study, where the most common organisms found to be isolated were gram negative.[16]

In the study conducted by Trinain Kumar et al, the most frequently isolated organisms were gram negative species like Pseudomonas aeruginosa (20.1%), followed by E. coli in 83 (18.4) patients, Klebsiella pneumoniae in 76 (16.8%) patients and Acinetobacter species in 59 (13.0%) patients whom showed higher resistance to amoxycillin, ceftazidime, amoxiclav, ciprofloxacin and cotrimoxazole. Their results were found to be similar to our study, where the most common organisms found to be isolated were gram negative.[17]

In the study conducted by Iffat Javeed et al, out of 379 patients the most common micro-organisms isolated were E. coli in 121(31.9%) patients, Staphylococcus aureus in 88(23.2%) patients, Klebsiella species in 62(16.4%) patients and Pseudomonas species in 59(15.6%) patients whom showed high level resistance to ampicillin, amoxicillin / clavulanic acid, and trimethoprim /sulphamethoxazole. Their results were found to be similar to our study, where the most common organisms found to be isolated were gram negative.[18]

In the study conducted by Kaushal V Sheth et al, out of 80 patients, the most commonly gram-negative organisms like Klebsiella pneumoniae in 14(28.6 %) patients and Pseudomonas aeruginosa in 8(16.3 %) patients were isolated more than gram-positive organisms, in which gram-negative isolates were shown sensitive to levofloxacin, imipenem and meropenem. Their results were found to be similar to our study, where the most common organisms found to be isolated were gram negative.[19]

In the study conducted by Zaveri Jitendra R et al, out of 128 patients, the most common isolated organism were E. coli in 32(25%) patients followed by Acinetobacter species in 20(15.62%) patients, Coagulase negative staphylococci in 21(16.40%) patients, Klebsiella species in 18(14.06%) patients, Pseudomonas species in 17(13.28%) patients, and Candida species in 6(4.68%) patients which showed high level resistance to polymyxin B, gatifloxacin and ceftriaxone and showed high degree of resistance to cephalexin, cefadroxil, tobramycin and prulifloxacin. Their results were found to be similar to our study, where the most common organism found to be isolated were gram negative.[20]

Antibiotic resistance is an emerging problem in critically ill cases, which affects the prognosis and survival of patients. It also results in prolonged stay in hospital, increasing the cost of treatment.

Limitation of the Study

This is a single center study hence the results cannot be extrapolated however our study gives a message that every center should do such study and analyze the organism profile and their sensitivity to antibiotics. We did not include the outcome of the study as the outcome depends on multiple factors.

CONCLUSION

Gram-negative bacterial infections are on higher side in our rural tertiary critical care where open suction technique is practiced. Antibiotic sensitivity pattern in a hospital setup has to be studied on regular basis which will guide us for the early initiation of antibiotic therapy and also keeps a close watch on resistance pattern.

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