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General Medicine

"STUDY OF PREVALENCE OF VENTILATOR ASSOCIATED PNEUMONIA BEFORE AND AFTER INTERVENTIONS IN MEDICINE INTENSIVE CARE UNIT PATIENTS"

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ABSTRACT **Background:** VAP is the most frequent ICU acquired infection, occurring in most of patients intubated longer than 48 hrs. This study was conducted to determine the incidence, clinical pattern of VAP and organisms causing it & role of non-pharmacological intervention and pharmacological intervention to reduce incidence of VAP. **Materials & Methods:** Present cross sectional study was conducted in Government Medical College & Hospital, Aurangabad during the period from December 2018 to July 2020. All the diagnosed cases of VAP admitted in medicine Intensive Care Unit (MICU) were included in the study. Total 906 study subjects were included in this study. The analysis of cases was done according to three phases. Phase A: Before intervention (group A), Phase B: Pharmacological & Non pharmacological interventions (group B), Phase C: After intervention (group C). **Results:** VAP rate in Group A (before interventions) was 57.7/100 cases. Non-pharmacological intervention such as propped up position, change of suction catheter or use of closed suction catheter system, education of staff and relatives and weaning sedation trials were carried out and after these interventions VAP rate reduced to 53.33/100 cases. Pharmacological intervention such as hand hygiene and oral Chlorhexidine mouth wash were given to MICU patients which decreased the VAP rate further to 51.3/100 cases. In Group C (After interventions) VAP rate was reduced to 40.93/100 cases **Conclusion:** combined interventions both non-pharmacological & pharmacological help to reduce prevalence rate of VAP to 37.25/100 cases; thus combined interventions were effective than when applied alone.

KEYWORDS : Ventilator Associated Pneumonia, Incidence, non-pharmacological & pharmacological interventions.

INTRODUCTION:

Intensive care units create potential for recovery in patients who otherwise may not have survived. However, they are associated with problem of nosocomial infections. Nosocomial infections are those which manifest in patients 48 hours after admission to hospital.[1]

Intensive care unit (ICU) hospitalizations impose a high risk of acquiring healthcare-associated infection (HAIs), most commonly nosocomial pneumonia (PNEU). In many cases, the patient's underlying disease and critical condition necessitates invasive procedures and diagnostics, which may contribute unavoidably to the patient's risk of colonization by the exogenous microbes[2].

One of the most common invasive procedures is intubation, and an artificial respiratory tract eliminates the physiological functions (heating, humidification and purification) of the upper respiratory mucosa, thus increasing the risk of ventilator-associated PNEU (VAP) [3]

Ventilator-associated pneumonia (VAP) is a major cause of hospital morbidity and mortality in Intensive Care Unit (ICU) patients despite recent advances in diagnosis and accuracy of management. VAP is the most frequent ICU acquired infection, occurring in 25% of patients intubated for longer than 48 h. The incidence of VAP ranges from 13 to 51 per 1000 ventilator days[4].

By keeping in view the present study was conducted to determine the incidence, clinical pattern of VAP and organisms causing it, non-pharmacological intervention and pharmacological intervention to reduce incidence of VAP and also post interventional surveillance of VAP cases in MICU settings.

MATERIALS & METHODS:

Present cross sectional study was conducted in medical intensive care unit in department of medicine of Government Medical College & Hospital, Aurangabad during the period from December 2018 to July 2020. All the diagnosed cases of VAP admitted in medicine Intensive Care Unit (MICU) were included in the study. For sample selection non-probability convenient sampling technique was used.

Patients receiving mechanical ventilation in MICU of age more than or equal to 12 years were included in the study. Patient who had acquired Pneumonia prior to hospitalization or prior to intubation, Patients suffering from pre-existing lung pathology, Immunocompromised patient & Patient not willing to participate in the study. Total 1192 cases got admitted in MICU during study period. After applying exclusion criteria 906 cases were selected.

The total score of CPIS scoring system was 0-12 used in diagnosing patient with other investigation. It includes the following 6 clinical assessments namely fever, leukocyte count, quantity and purulence of tracheal secretions, oxygenation, radiologic abnormality and results of sputum culture and gram stain. Each clinical assessment was given a score of 0-2 and the total score amounting to 12. A score of > or =6 implies that VAP was present.

A proforma of detailed clinical history, risk factors, physical examination, investigations was prepared. Clinical history was taken from patients. Complete physical examination and the required investigations were done. Selection of patients was by using the CDC national health care safe network guidelines. [5]

The analysis of cases was done according to three phases. Phase A: Before intervention (group A), Phase B: Pharmacological & Non pharmacological interventions (group B), Phase C: After intervention (group C).

The non-pharmacological interventions used in present study were propped up positioning, changing suction catheter or use of closed suction catheter system, education of staff and relatives and weaning off &off sedation trials in order to assess readiness for extubation and as per the details provided under. The pharmacological intervention implemented among the VAP cases were hand hygiene and oral chlorhexedine mouth wash.

Analysis of data is done using SPSS software trial version 20. Variables were expressed as mean, standard deviation (SD), range, frequencies (number of cases) and percentages. For qualitative data chi square test were applied & for quantitative data t test was applied p value < 0.05 was considered statistically significant.

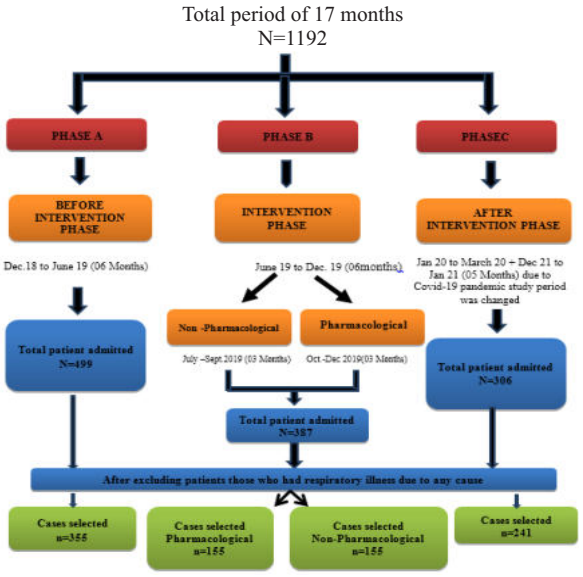


Fig.1: Flow Chart Of Sample Selection

RESULTS:

Total 1192 cases got admitted in MICU during study period. After applying exclusion criteria 906 cases were selected. The analysis of cases was done according to three phases. Phase A was before intervention group (group A). Phase B consist of Pharmacological &Non pharmacological interventions (group B) & Phase C was after intervention (group C).

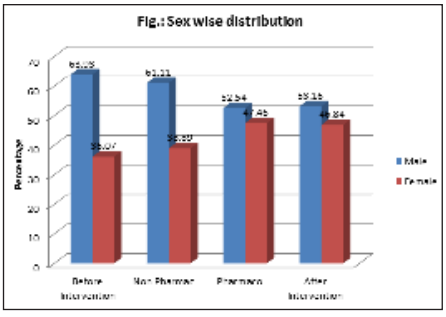
Table 1: Age distribution among VAP cases

N = 906

Age (years)	Group A (Before Intervention) n=355	Group B		Group C (After Intervention) n=241
		Non Pharmacological n=155	Pharmacological n=155	
≤ 20	40 (21.86%)	25 (34.72%)	09 (15.25%)	13 (16.46%)
21 – 30	56 (30.60%)	18 (25.00%)	26 (44.07%)	22 (27.85%)
31 – 40	33 (18.03%)	11 (15.28%)	11 (18.64%)	14 (17.72%)
41 – 50	23 (12.57%)	09 (12.50%)	08 (13.56%)	10 (12.66%)
> 51	31 (16.94%)	09 (12.50%)	05 (08.47%)	20 (25.32%)
TOTAL VAP Cases	**183 (51.54%)**	**72 (46.45%)**	**59 (38.06%)**	**79 (32.78%)**
Mean ±SD	37.31± 17.69	33.79 ± 15.76	34.39 ± 16.54	37.25 ± 16.54
P value	0.171	0.207	0.372	0.586

- **Note: Excluding all cases of previous respiratory diseases**

Most of the cases were found in age group 21-30 years followed by less than 20 years of age.



In group A among 183 cases of VAP patient maximum no. of cases 117/183 (63 %) were males and 66/183 (37 %) were females.

Among the 72 cases of VAP in the group of Non pharmacological intervention maximum no. of cases 44/72 (61.11%) were males and 28/72 (38.89%) were females. In pharmacological intervention group of 59 cases of VAP were there; maximum no. of cases 31/59 (52.54%) were males and 28/59 (47.46%) were females.

In group C among 79 cases of VAP, maximum no. of cases 42/79 (53.16%) were males and 28/79 (46.84%) were females.

Among the VAP cases male preponderance was seen in all the groups. Further there was no significant correlation found except in group C where p=0.03.

Table 2: VAP rate IN ALL GROUPS

	GROUP A	GROUP B		GROUP C
		Non Pharmacological	Pharmacological	
VAP rate	57.73	53.33	51.30	40.93

Note: All cases of previous respiratory disease were excluded

VAP rate were 57.73 per 100 patients in before intervention phase apart from routine treatment of specific disease. In phase 2 after the non-pharmacological intervention the VAP rate observed were 53.33 per 100 patients and after pharmacological intervention the VAP rate observed were 51.30 per 100 patients. Further in phase 3 i.e. after intervention VAP rate become 40.93 per 100 patients where non-pharmacological and pharmacological interventions were carried out.

The data suggest that after pharmacological interventions VAP rate reduced more than that of non-pharmacological interventions. Also combined intervention in group C, the VAP rate decreased further suggesting that combined effect of non- pharmacological and pharmacological interventions was more effective than either one.

Table 3: Prevalence of ventilator associated pneumonia (VAP) before intervention

Total patients admitted in ICU Before intervention	No. of VAP cases	VAP /1000 total admitted patients	VAP (%)
499	256	513.03	51.30

In the present study total 1192 cases were admitted in medical intensive care unit (MICU) during study period of 17 months, out of that during pre-intervention period among 499 cases 256 cases had developed VAP including both old and new cases. Among all selected cases 256 (51.30%) patients had developed ventilator associated pneumonia (VAP) so the prevalence rate of VAP before intervention per 1000 admitted cases in MICU was found to be 513.03/1000 cases (51.30/100 cases)

Among 1192 cases admitted during study period among them after applying exclusion criteria 906 cases selected for study. Total 393/1192 cases developed VAP giving overall incidence rate of 43.37% (per 100 cases).

Table 4: Prevalence of ventilator associated pneumonia (VAP) after intervention

Total patients admitted in ICU during after intervention	No. of VAP cases	VAP /1000 Total admitted patients	VAP (%)
306	114	372.55	37.25

In the present study during post intervention phase 306 cases were admitted in medical intensive care unit (MICU) out of that 114 cases (both old and new cases) had developed VAP. The prevalence rate of ventilator associated pneumonia (VAP) after intervention per 1000 admitted cases in MICU was found to be 372.55/1000 cases (37.25/100 cases)

Table No.5: Ventilator associated pneumonia (VAP) before after intervention (excluding cases of respiratory diseases)

N=906

VAP	Before intervention	After Intervention	t value	p value
Yes	183	79	4.03	0.0001
No	172	162		

After doing comparison between ventilator associated pneumonia (excluding cases of respiratory diseases) before the intervention 183 (51.54%) and after the intervention 79 (32.78%) among the selected

cases admitted in medical intensive care unit (MICU), it was found that the association was statistically significant (p=0.0001). It suggests that the both non-pharmacological and pharmacological intervention were effective in reducing number of VAP cases admitted in Intensive care settings.

Table 6: Microbiological findings among VAP cases

N = 906

Tracheal Culture Examination	Group A	Group B		Group C
		Non Pharmac	Pharmac	
Klebsiella pneumoniae	39 (21.31%)	11 (12.08%)	15 (46.88%)	03 (3.80%)
Klebsiella Spp	30 (16.39%)	00	00	00
Pseudomonas Aeruginosa	12 (6.56%)	02 (2.19%)	05 (15.63%)	01 (1.26%)
Acinetobacter Baumanii	10 (5.46%)	06 (6.59%)	06 (18.75%)	02 (2.53%)
Klebsiella Aerogens	10 (5.46%)	00	00	00
Streptococcus	10 (5.46%)	01 (1.09%)	00	01 (1.26%)
Staphylococcus Aureus	09 (4.92%)	04 (4.40%)	02 (6.25%)	00
Coagulase Negative	09 (4.92%)	00	00	00
Pseudomonas (ps)	08 (4.37%)	06 (6.59%)	00	00
E coli	03 (1.64%)	02 (2.19%)	01 (3.12%)	00
Raoutella arnitholytica	01 (00.55%)	00	00	00
Non Fermenter	01 (00.55%)	00	00	00
No pathogen found	01 (0.55%)	18 (35.29%)	01 (3.12%)	13 (16.46%)
Sterile	38 (20.76%)	40 (43.96%)	02 (6.25%)	12 (15.19%)

Among all the phases the common pathogen found in ventilator associated pneumonia was Klebsiella pneumoniae. Numbers of pathogens isolated decreased during intervention phase and after intervention phase.

Table 7: Length of MICU stay among VAP cases

N = 906

Length of stay	Group A (Before Intervention)	Group B		Group C (After Intervention)
		Non Pharmac	Pharmaco	
≤ 5 days	68 (37.16%)	24 (33.33%)	25 (42.37%)	55 (69.62%)
6 – 10 days	56 (30.60%)	22 (30.56%)	16 (27.12%)	13 (16.46%)
11-15 days	29 (15.85%)	08 (11.11%)	04 (06.78%)	04 (05.06%)
≥ 16 days	30 (16.39%)	18 (25.00%)	14 (23.73%)	07 (08.86%)
Mean ± SD	12.4 ± 14.6	10.9 ± 9.5	10.2 ± 9.2	7.04 ± 9.3
P value	0.0001	0.0001	0.036	0.027

Mean duration of MICU stay of VAP cases decreased after the non-pharmacological and pharmacological intervention. Also significant correlation found between VAP cases and length of hospital stay in each phase of study period as p<0.05.

Table 8: Outcome among VAP cases

N = 906

Outcome	Group A (Before Intervention)	Group B		Group C (After Intervention)
		Non Pharmac	Pharmaco	
Transfer	108 (59.02%)	52 (72.22%)	43 (72.88%)	54 (68.35%)
Died	70 (38.25%)	19 (26.39%)	15 (25.42%)	21 (26.58%)
DAMA	05 (02.73%)	01 (01.39%)	01 (01.69%)	04 (05.06%)
TOTAL cases of VAP	**183**	**72**	**59**	**79**
P value	0.909	0.833	0.233	0.485

Most of the study (38.25%) subject died from group Group A i.e. Before Intervention, also it was found that there was no significant correlation between VAP cases and outcome of patient in each group.

DISCUSSION:

In the present study total 1192 cases were admitted in medical intensive care unit (MICU) during study period of 17 months out of that 906 were selected according to phase wise and after applying exclusion criteria. Among all selected cases 393 (43.37%) patients developed ventilator associated pneumonia (VAP) during study period. The rate of VAP per 100 admitted cases in MICU was found to be 43.37%.

In before intervention phase the incidence of VAP among cases selected was 51.54% which was very high. In second phase the interventions was carried out among the selected cases of VAP shows significant reduction cases of VAP. After the non-pharmacological intervention incidence was 46.45% and after pharmacological intervention it was further reduced to 38.06%. Further in phase three i.e. in post intervention phase the incidence of VAP was found 32.78% which was still higher in comparison to previous studies done in different settings. In study done by Patil HV et al.[6] on incidence, bacteriology, and clinical outcome of ventilator-associated pneumonia at tertiary care hospital found that among the 267 patients on mechanical ventilator, 74(27.71%) patients developed VAP. In an interventional study done by Saramma P.P. et.al.[7] on Alcohol-based hand rub and ventilator-associated pneumonia after elective neurosurgery found that the VAP rates in the control and intervention groups were 14.03% and 6.48%. Mathai AS. Et al.[8] conducted study on incidence, microbiological profile, and outcomes of patients with VAP found that a total of 95 (38%) patients developed VAP during the study with an incidence of 40.1%. This findings correlate with our findings.

Out of 155 cases after applying exclusion criteria in the non-pharmacological intervention group, 72 (46.45%) cases developed VAP. A multicentre prospective trial of ICU patients was conducted by Van Nieuwenhoven et al.[9] among patients receiving MV. The study compared patients in semi recumbent position (with a target backrest elevation of 45o) with the patients in supine position (with initial backrest elevation at 10°). They found that strict 0° supine position in patients with MV increases the risk of VAP.

Ardehali SH et.al.[10] conducted study to compare the effects of open and closed suction methods on the occurrence of ventilator associated pneumonia (VAP). 120 patients were randomly allocated to either closed tracheal suction system (CTSS) group or open tracheal suction system (OTSS) group. 22 (18.3%) cases developed VAP (12 (20%) in OSST group and 10 (16.7%) in CSST group; p = 0.637).

Yilmaz G.et.al.[11] conducted study to assess the effect of personnel training on the incidence of ventilator-associated pneumonia (VAP) prospectively in the ICU, was planned in two periods. Twenty-two cases of VAP developed in the pre-training period, an incidence of 31.2. Nineteen cases of VAP developed in the post-training period, an incidence of 21.0 (P<0.001). Training reduced development of VAP by 31.7%.

In this present study two types of pharmacological interventions were carried out i.e. oral Chlorhexidine mouth wash and hand hygiene. The VAP rate during the pharmacological interventions phase was 51.30 per 100 patients which were even though very high in comparison to other studies. But the incidence was significantly decreased in comparison to pre intervention phase 57.73 per 100 patients.

KocaçalGüler E. et al.[12] conducted systematic review to determine the effect of chlorhexidine at different concentration and frequency on ventilator-associated pneumonia and microbial colonization in mechanically ventilated patients. Ten studies were reviewed and found that Chlorhexidine with 0.2% concentration was found to be more effective than the control group (placebo dental gel and normal saline) in preventing the development of ventilator-associated pneumonia in three of the eight studies. Twice-daily application was found to be effective reducing the rate of ventilator-associated pneumonia in three studies using 0.2% and 2% chlorhexidine. Microbial colonization was found to be less in 2% chlorhexidine group than herbal mouth wash 0.9% NaCl and 0.2% chlorhexidine in three studies. Chlorhexidine is

an effective intervention in oral care for ventilator-associated pneumonia and microbial colonization.

Yilmaz G. et.al.[11] study was to assess the effect of personnel training on the incidence of ventilator-associated pneumonia (VAP). The study performed prospectively in the ICU. Twenty-two cases of VAP developed in the pre-training period, an incidence of 31.2. Nineteen cases of VAP developed in the post-training period, an incidence of 21.0 (P<0.001). Training reduced development of VAP by 31.7 %. Prior to training, compliance with hand washing (before and after procedure), appropriate aseptic endotracheal aspiration and adequate oral hygiene in particular were very low. An improvement was observed after training (P<0.001). Hand hygiene and other infection control measures must be emphasized in training programmes, and standard procedures in patient interventions must be revised.

In the present study most common pathogen among the cases of VAP was found to be Klebsiella pneumoniae. Similarly in a study conducted by Saramma PP. et.al.[7] the most common microorganism isolated from the tracheal culture in the control group as well as the intervention group was Klebsiella pneumoniae (58% and 75%).

CONCLUSION:

Prevalence of Ventilator Associated Pneumonia before intervention was 51.30% and after intervention was 37.25%. Both Pharmacological and non-pharmacological interventions helped to reduce prevalence of VAP. Pharmacological plus non-pharmacological interventions were more effective than alone of these interventions to reduce VAP. Outcome of patient is better in post intervention phase in terms of death rate percentage.

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