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INCIDENCE AND RISK FACTORS OF VAP IN TETANUS PATIENTS

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Abstract

BACKGROUND:

Tetanus is a disease that is becoming increasingly infrequent in developed countries., but it is still a leading cause of death globally, with a significant mortality rate, particularly in developing countries(1) . Tetanus necessitates a large number of ICU resources, as well as a six-week course of tetanus that necessitates ICU admissions and prolonged mechanical breathing(2). .

Ventilator associated pneumonia is a kind of nosocomial infection that develops in individuals who have been on mechanical ventilators for more than 48 hours and is linked to longer hospital stays, greater morbidity, and mortality(3)(4) .The most prevalent consequence in ICU patients is ventilator-associated pneumonia, which affects 9 percent to 68 percent of patients(5).

Ventilator associated pneumonia is linked to Tetanus severity, dysautonomy, neuromuscular blockers, a greater diazepam dose, intravenous sedation, the use of a paralytic agent, less oxygen in the blood and a reduced oxygen percentage, co morbid factors, mechanical ventilation for a long time, endotracheal intubation, Re- intubation, ,tracheostomy, emergency intubation, as well as the primary trauma diagnosis, past episodes of gastric aspiration, microaspiration of colonised orophyangeal secretion, antibiotic pretreatment, nasogastric tubes, supine body posture, dialysis, and higher APACHE II scores) (6)(7)(8)(9)(10)(5)(11)(12)(13).

Several elements have an impact on incidence of ventilator associated pneumonia, the most important of which are the host, the duration of mechanical breathing, the confidence interval, enteral feeding, and a low degree of consciousness (5). VAP can be divided into two types: early on set (less than five days) and late on set (more than five days). The total incidence of VAP ranges from 9% to 70% on average (20% to 25%), with the majority of episodes occurring within the first five days. (13).

Tetanus is a potentially lethal condition(14), and VAP, a consequence of tetanus, increases ICU patient mortality by 30 to 70%(15) , therefore we addressed incidence and risk factors of VAP to reduce its mortality and morbidity.

METHOD

From December 2019 to June 2021, we undertake a systematic review using data from Google Scholar and PubMed. Incidence and risk factors of VAP in tetanus patients were discovered as a consequence of the search. We analyze following risk factors as mentioned above in the background.

RESULT

Four investigations, both prospective and retrospective, with varying sample sizes and settings, yielded results that met our eligibility criteria. The risk factors in all four researches were the same, but the incidence varied.

CONCLUSION

We find that tetanus is a potentially deadly disease based on the information presented(14). VAP is a tetanus consequence that increases ICU patient mortality by 30 to 70 percent (15). Patients with tetanus had a higher rate of VAP than those with meningitis or other neurological disorders. (5), here we wish to undertake a systemic review to gain a better understanding the prevalence of ventilator associated pneumonia and the risk factors linked with it so that more effective preventative measures may be developed and used to reduce mortality and morbidity.

INTRODUCTION

Tetanus is a neurological illness that was originally documented in Egypt three thousand years ago. In 2000, WHO (World Health Organization recorded) 18,833 instances of tetanus, with the possibility that the number is higher. This is because many high-risk countries refuse to report any cases to the World Health Organization
(9). Because of the toxin's activity, tetanus is a dangerous acute infectious disease with a high death rate. Based on respiratory failure, hemodynamic instability induced by dysautonomia, and the risk of mortality and morbidity, almost all cases of tetanus are brought to the intensive care unit (ICUS) (16)(14). Invasive intervention and probable nosocomial infection, such as VAP, are risks for these tetanus patients in ICUS (6) .

Mechanical ventilation (MV) is an effective intervention method used in intensive care units to preserve the lives of severely ill patients (ICU) (6).VAP is a form of nosocomial infection described as pneumonia that develops within 48-72 hours of endtracheal intubation and indications of infection throughout the body (fever, changed white blood cell count) Changes in sputum characteristics, the presence of new or advancing infiltrates, , and the identification of the causal agent are all factors to consider. Despite advancements in diagnostic and treatment techniques, , ventilator-associated pneumonia continues to be the leading cause of hospital morbidity and mortality (9).

Because ventilator-associated pneumonia is a kind of nosocomial infection with a high risk of morbidity and mortality (9), knowing the frequency and risk factors is essential for implementing preventive intervention to help these individuals live longers.

Ventilator associated pneumonia is linked to Tetanus severity, dysautonomy, neuromuscular blockers, a greater diazepam dose, intravenous sedation, the use of a paralytic agent, less oxygen in the blood and a reduced oxygen percentage, co morbid factors, mechanical ventilation for a long time, endotracheal intubation, Re- intubation, ,tracheostomy, emergency intubation, as well as the primary trauma diagnosis, past episodes of gastric aspiration, microaspiration of colonized orophyangeal secretion, antibiotic pretreatment, nasogastric tubes, supine body posture, dialysis, and higher APACHE II scores) (6)(7)(8)(9)(10)(5)(11)(12)(13).

Following risk factor are discussed in detail as given below;

1.1. Increased Mechanical Ventilation Time and Prolong Length of Hospital Stay

VAP remains a prevalent and serious cause of morbidity and mortality (incidence) in Patients who require a tracheostomy because of severe tetanus, during early stages, endotracheal intubation may be used, although tracheotomy is claimed to be a superior alternative because to the sluggish a long-term recovery necessity for artificial ventilation. Tracheotomies reduce respiratory tract (upper) spasms as well as respiratory problems including hypoventilation and hypoxia (6) (9). Tracheostomy has been discovered to be an independent risk factor, because pooled secretions around the tracheostomy tube are likely to flow into the trachea, and causing ventilator associated pneumonia. The clinical course of tetanus can persist 4 to 6 weeks with long-term ventilator support(9).

Long-term mechanical ventilation can increase the risk of infection and other problems. A typical mechanical ventilation problem is ventilator associated pneumonia. Patients with VAP had lasting higher ventilation periods and ICU stays than those who did not have VAP. Prolonged ventilation (more than 15 days) was revealed to be a major risk for VAP in ICU patients. it has been found that the incidence of VAP regularly increases from 5 % of the patient that are receiving 1 day ventilation and 65 percent of patients receiving 30 days of mechanical ventilation, according to an Egyptian study (6) (9)(17) (11)(5).

The regular air way's mucosal defense function altered by the artificial air way created by mechanical ventilation and it reduce the ability of swallowing and cilia's capacity of scavenging mucus when infection is caused by the entry of microorganisms directly in to lower respiratory tract or through the space between the tracheal tube and the air way . Prolong ventilation increases the risk of infection from humidifiers and ventilator loop as they produce bacteria. Large numbers of ICUS that have been closed units with circulation of poor air. Air is contaminated due to a huge number of germs found in exhaled gases and secretions in ICUS patient. Extending your stay increases your chances of contracting a hospital-acquired infection (6).

The most common nosocomial infection in the study was ventilator-associated pneumonia, because mechanical ventilation was performed in every patient , as a result prevalence of (VAP) increased.(6)(9)

1.2. Comorbidities

Chronic disease, such as coronary artery disease, diabetes, respiratory disorders, chronic renal failure, cardiac illness. It's possible that this is a significant predictor for VAP .In general, chronic malady affects the elderly and is generally accompanied by multiple co morbidities. These disorders work together to depress the immune system, affecting important organs, The patient's liver, kidneys, heart and lungs are all affected, making them more susceptible to infection. Chronically ill patients required additional mechanical breathing and spent more time in the hospital. VAP was 2.35 times more common in those with chronic obstructive pulmonary disease (COPD) than in people without COPD. COPD may act as a solitary factor of VAP. The presence of a spinal injury is a major determinant of VAP implementation. This could be because early trauma-induced cagulopathy raises the likelihood of nosocomial infection(6)(7)(9)(17) (11)(5).

1.3. Invasive Procedures

Nosocomial infection is linked to invasive mechanical ventilation, such as tracheostomy, re-intubation and other procedures, such as indwelling nasogastric tubes In ICUS. In a comparison of early and late VAP, Late VAP was associated with re-intubation and tracheostomy, both of which were independently related, While 's susceptibility to venous catheters was a significant predictor for VAP, it was an independent predictor. Prolonged intubation period and aspiration of endotracheal sputum potentially compromise the epiglottis membrane making aspiration more likely. Furthermore, using a significant volume of bronchoalveolar lavage may lower the rate of bacterial clearance. Aspiration occur as a result of indwelling gastric

tubes, may compromise the function of the cardiac sphincter and increase the risk of gastric fluid reflux. (6)(7)(9)(17) (11)(5).

1.4. Prior Antibiotic Therapy

Gram-negative bacteria such as Acinetobacter baumannii, E. coli, Klebsiella pneumoniae, and pseudomonas aeruginosa , and Gram-positive bacteria as Staphylococcus aureus, are the most prevalent pathogens VAP. The most prevalent pathogen causing VAP is Pseudomonas aeruginosa. The number of multidrug- resistant bacteria has been rising in recent years as a result of earlier antibiotic treatment. The major pathogens in early VAP were Enterobacteriaceae and Staphylococcus aureus, according to an investigation of VAP etiology in a tertiary hospital. The most common pathogenic species in late VAP were nonfermenting bacilli and Enterococci, with multidrug-resistant strains accounting for 60.8 percent of bacterial pathogens. Prior antimicrobial treatments as well as hospitalisation about more than five days were independent predictors for drug resistance in VAP therapy(6)(7)(9)(17) (11)(5).

1.5. Disorder of Consciousness

Patients on mechanical ventilation who are administered intravenous sedatives may have weakened cough reflexes, raising the chances of aspiration. As a result, they are susceptible to the occurrence of VAP. A common consequence in coma patients is VAP which has a poor prognosis. Consciousness abnormalities were found to be strongly linked to the development of early VAP.

Individuals with consciousness impairments had lower physiological reflexes such as expectoration, coughing, and swallowing, affecting the outflow of respiratory discharges. Those patient were in stealth mode who had difficulty of consciousness and were unable to work properly with medical personnel in order to do specific clinical procedures. As a result, during in the passive sputum suction phase contents of the stomach can reflux and induce aspiration(6)(7)(9)(17) (11)(5).

1.6. Supine Position

Multivariate analysis has shown several studies have found that supine position is an independent risk factor for VAP(16)(12)(11).

1.7. Other Risk Factors

Other risk factors, such as smoking, were the highest risk factor of the development of VAP, in contrast with the above risk factors, which have all been thoroughly examined. They discovered such as smokers had a 4.37 times greater incidence of VAP than nonsmokers or ex-smokers.. The explanation for this could be as prolong smoking reduces microbes removal, leaving the lungs vulnerable to harmful microorganisms by impairing respiratory immune cell activity (6).

1.8. Predisposing Factor

Age, sex, alcohol intake and smoking habits, past chronic host diseases, durations of incubation and development of tetanus, were all examined as predisposing variables for developing VAP, atelectasis, diaphragmatic paralysis or paresis, large doses of diazepam (5 mg/kg per day) continual infusion of paralytic drugs. The length of mechanical ventilation prior to the emergence of VAP, and the link between arterial oxygen and oxygen fraction, sinusitis diagnosis, mechanical ventilation, use of H2 blockers and nasogastric tube are the predisposing factor (7)(9)(5)(11).

A hospitalized tetanus patient,s stay is extended because to consequences such as infection (sepsis and VAP), atelectasis (diaphragm palsy), fluid and electrolytes imbalance, neurological abnormalities(5).

FIGURE 1

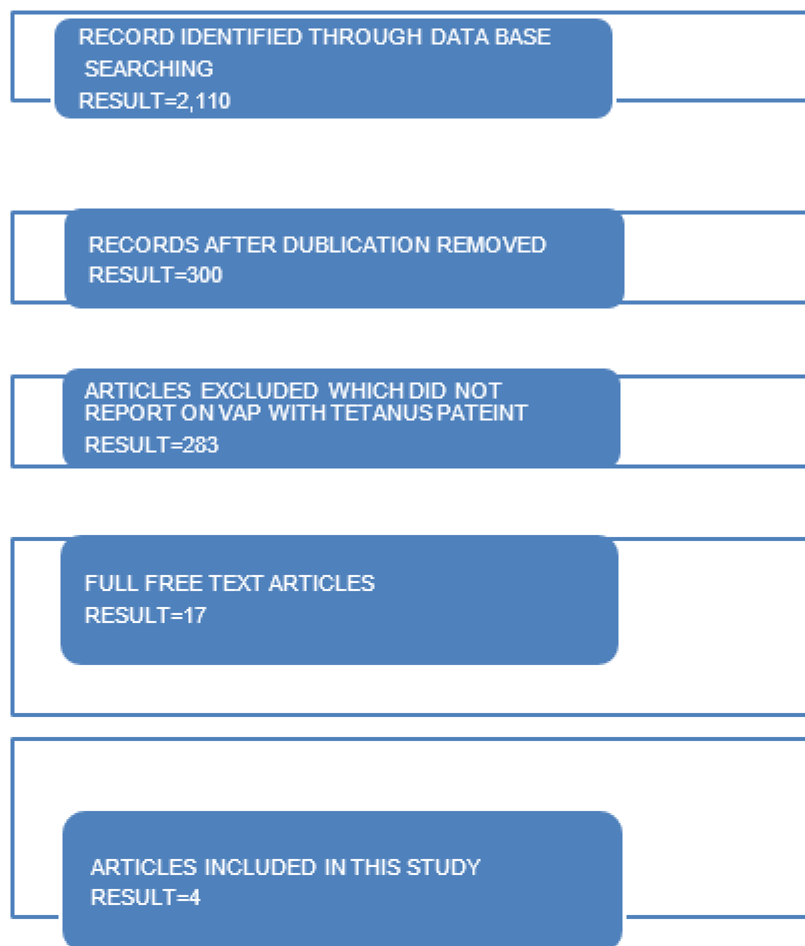

Figure 1 flow chart describes selection strategy and literature search .after the including excluding criteria four studies are n included in our systemic review

METHOD

From December 2019 to June 2021, we searched Google Scholar and PUBMED. The following key terms were used in the literature search: INCIDENCE, RISK FACTOR, VAP AND TETANUS. We also searched the references list of included studies and pertinent reviews by hand. Multiple combinations of the following search phrases were pre-defined search keywords chosen by the medical subject header (mesh) and key words: (tetanus or trismus lock jaw) and VAP and incidence or risk factor and risk factor or incidence. Only one study in our search database checked the title and abstract, and three studies provide information about our title in full text reviews.

2.1. Eligibility Criteria

The following criteria were used to select studies: participants, exposure, comparison, condition or outcome of interest, study design, and context.

2.2. Participants

We considered studies involving patients who were hospitalized for tetanus and to determine incidence and risk factor of VAP in tetanus patients.

2.3. Comparison

Hospitalize patient with the incidence and risk factor of VAP and without VAP in tetanus.

2.4. Condition

The principal condition associated with mortality and morbidity in hospitalized patients with VAP incidence and risk factors, as well as individuals with tetanus who are hospitalized but do not have VAP.

2.5. Study Design and Context:

Studies that meet the criteria there were retrospective and prospective research carried out. As inclusion criteria, the following incidence and risk variables of VAP in Tetanus patients were adopted.

RESULT

3.1. Known Studies

In figure 1 we identified a total of 2,110 researches through data base searching, out of these, after duplication 300 searches were remains, articles excluded based on eligibility criteria =283, full free text article were screened result = 17, we included 4 studies in our in our systemic review. the included studies were of variables designs and included a retrospective (2) and prospective studies (2).

3.2. The Incidence of VAP in First Study

Study 1 report the incidence of VAP is 52.6% in patient with tetanus on mechanical ventilation(5).

3.3. The Incidence of VAP in Second Study

In this study total patient of tetanus were 15 VAP develop only in 7 patient(7%) and estimated that its mortality rate are 30%(9).

3.4. The Incidence of VAP in Third Study

In this study total patient of tetanus were three, VAP develop in 2 patient and the incidence rate of their study report is 26 per 1000 ventilator days r (7).

3.5. The Incidence of VAP in Fourth Study

In study 2 total patient of tetanus were 6, VAP develop only in 1 patient , this study also report that 41.7% of cases were early onset of VAP (11).

3.6. The Overall Incidence of VAP in our Systemic Review

As incidence varies in different studies it depend upon several factor the incidence rate in our systemic review is 103.9%.

3.7. The Risk Factor of VAP in our Systemic Review

Ventilator associated pneumonia is linked to Tetanus severity, dysautonomy, neuromuscular blockers, a greater diazepam dose, intravenous sedation, the use of a paralytic agent, less oxygen in the blood and a reduced oxygen percentage, co morbid factors, mechanical ventilation for a long time, endotracheal intubation, Re- intubation, ,tracheostomy, emergency intubation, as well as the primary trauma diagnosis, past episodes of gastric aspiration, microaspiration of colonised orophyangeal secretion, antibiotic pretreatment, nasogastric tubes, supine body posture, dialysis, and higher APACHE II scores) (7) (9)((5)(11).

TABLE 1
Characteristics of Four Studies Included in Our Systemic Review are:

AUTHORS	COUNTRY	SAMPLE SIZE	TETANUS PATEINT	AGE	ICIDENCE OF VAP	STUDY TYPE
NILTON JOSE FERMENDES CAVALCANTE	SAU PAUL,BARZIL	28 PATEINT	26	49.5+-14 YEARS	52.6%	RETROSPECTIVE COHORT
FILZKIBAR	TURKISH	15 PATEINT	15	60+=13 YEARS	7%	RETROSPECTIVE
PANWAR RAKISHT	INDIA	51 PATEINT	3	34 YEARS	41.7%	PROSPECTIVE COHORT STUDY
NOYAL MARIA	INDIA	200 PATEINT	6	-	2.6%	PROSPECTIVE STUDY

TABLE 2
Risk Factor of VAP In All Four Studies is

Risk Factor	Study (brazil)	Study 2 (Turkish)	Study3 _	Study 4 (India)
Prolong duration of mechanical	+	+	+	+
High AACHIII SCORES	+	+	+	-
Endotracheal intubation	-	+		+
Tracheotomy	+	+	+	+
Re-intubation	+	+	+	+
Emergency intubation	+	+	+	-
Comorbid Conditions	+	` +	+	+
Intravenous sedation	+	+	+	+
Use of neuromuscular blockers	+	+	+	+
Impaired consciousness	+	+	+	+
Naso gastric tubes	+	+		+
Aspiration of gastric content	+	+	+	+
Dialysis			+	
Trauma	+	+		+
Respiratory tract disease	+	+	+	-
Cardiac illness	+	+	+	-
Dysautonomy	+	+	+	-
Lower arterial oxygen and oxygen fractions	+	+	+	+
Gram negative micro organisms	+	+	+	+
Supine position	-	-	+	+

TABLE 3 Multi variate logistic regression analysis of risk factor for VAP(7)

Risk factor	p value	Estimated ratio	95% confidence interval Lower	Upper
Impaired consciousness	0.170	2.158	.720	6.469
Tracheostomy	0.035	2.669	1.073	6.634
Re-intubation	0.809	3.075	.841	11.235
Emergency intubation	0.006	25.051	2.571	244.055
Nasogastric tube	0.601	2.282	.963	5.406

TABLE 4

Risk factor significantly associated with early onset and late onset VAP by multivariate logistic regression.(7)

Early –onset VAP	P value	Adjusted odd ratio	95% confidence interval Lower	Upper
Emergency intubation	0.006	27.189	2.527	292.537
Intravenous Sedatives	0.007	7.248	1.712	30.694
Late-onset of VAP				
Tracheotomy	0.032	3.006	1.097	8.235
emergency inubation	0.043	11.853	1.087	129.289

TABLE 5

Ventilator associated pneumonia associated with micro organisms(7) (9) (5)(11)

Types of micro organisms	Study 1	Study2	Study3	Study 4	TOTAL
Acinetobacter Baumannii	3 (30%)	3	2 (8%)	21.3%	8 (59.3%)
Klebsiella pneumonaie	3 (30%)		7(29%)		10 (59%)
Pseudomonas Aeruginosa	1 (10%)	2	11 (46%)	21.3%	14 (77.3%)
Enterobacter Cloacae	1 (10%)	-	-	-	1 (10%)
E.coli	-	-	3 (12%)	-	3 (12%)
S.aureus	-	-	6 (25%)	27.8%	6 (52.8%)
MRSA	-	-	-	42.9%	42.9%

TABLE 6
FREQUENCY OF PREDISPOSING FACTOR FOR VENTILATOR ASSOCIATED PNEUMONIA AMONG WITH TETANUS PATEINT (5)

PREDISPOSING FACTORS	results
Incubation period of tetanus	10.4 +_78
Blecks scores Mild Moderate severe very sever	9 (32.1) 14(50.0) 4(14.3) 1(3.6)
Apache II on first day of ICU stay	8.3+-4.6
Length of ICU stay	20.4+-11.9
Autonomic disturbance	6 (21.4)
Diazepam greater than > than 5mg /kg per day	15(53.6)
Atelectasis 1 per patient	14.(50.0)
Diaphragmatic paralysis or paresis	4(14.3)
Invasive MV	19(67.9)
Length of MV before nosocomial Pneumonia ,days (mean +-SD)	6+-5.2
Nasogastric tubes	20 (71.4)
Use of H2 BLOCKERS	28(100.0)

DISCUSSION

4.1. Principle Finding

The consequences of our systemic review suggest that risk factor of VAP from all of our included studies are; Tetanus severity, dysautonomy, neuromuscular blockers, a greater diazepam dose, intravenous sedation, the use of a paralytic agent, less oxygen in the blood and a reduced oxygen percentage, co morbid factors, mechanical ventilation for a long time, endotracheal intubation, Re-intubation, ,tracheostomy, emergency intubation, as well as the primary trauma diagnosis, past episodes of gastric aspiration, microaspiration of colonised orophyangeal secretion, antibiotic pretreatment, nasogastric tubes, supine body posture, dialysis, and higher APACHE II scores) (6)(7)(8)(9)(10)(5)(11)(12)(13).

Iimpaired consciousness, tracheostomy, re-intubation, emergency intubation and nasogastric tubes were independent risk factor of VAP (Table 3).Emergency intubation and intravenous sedatives were the specific risk factor for development of early onset of VAP , tracheostomy and reintubation were found to be the independent risk factor of late onset of VAP (Table 4). A decline in pao2 /fio2 ratio can help in early suspicion of VAP(7).

In the hospital context, intubation and mechanical ventilation are linked to a 6- to -21-fold greater risk of ventilator associated pneumonia pneumonia(11). Nococomial pneumonia is the second most common reason for admission to the hospital, accounting for 15% to 18% of all nosocomial infections , VAP is the most prevalent complication, affecting 9 percent to 68 percent of patients and resulting in a 30% fatality rate(5).

The duration of mechanical ventilation is directly proportional to the incidence of VAP comorbid condition and (7) .However, the incidence of VAP varies based on the criteria, the type of hospital or ICU, population research, and the extent of antibiotic exposure in multiple researches (11).

The established evidence in this systemic review is associated with the incidence and risk factor of VAP in tetanus patient that highly correlates with mortality and morbidity. As a result, understanding the prevalence of VAP and the risk factors linked with it is critical for the development and implementation of more effective preventive strategies.

4.2. Strength and Limitation

This systemic review provides result of incidence and risk factor of VAP in tetanus patient also strengthens the established evidence of incidence and risk factor of VAP in tetanus patient that highly correlate with mortality and morbidity. Our study had several limitations we search only pub-med and Google scholar, pub –MED.

4.3. Comparison with Other Studies

Our systemic review study finding have same result from previously published reviews .suggestion with the greater incidence and risk factor of VAP in tetanus patient as mentioned above.

CONCLUSION

Our finding suggest that increased incidence of VAP in tetanus patient and of risk factor such as Tetanus severity, dysautonomy, neuromuscular blockers, a greater diazepam dose, intravenous sedation, the use of a paralytic agent, less oxygen in the blood and a reduced oxygen percentage, co morbid factors, mechanical ventilation for a long time, endotracheal intubation, Re-intubation, ,tracheostomy, emergency intubation, as well as the primary trauma diagnosis, past episodes of gastric aspiration, microaspiration of colonised orophyangeal secretion, antibiotic pretreatment, nasogastric tubes, supine body posture, dialysis, and higher APACHE II scores) most of these factor are seen in tetanus .(6)(7)(8)(9)(10)(5)(11)(12)(13) , are highly correlates with mortality and morbidity in tetanus patient.

Identification of significant risk variables that contribute to VAP can aid in the development of simple and effective prevention are non invasive ventilation, minimizing occurrence of reintubation and precautions during emergency intubation.

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