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THE FINDINGS OF SPUTUM CULTURE OF INTUBATED MECHANICALLY VENTILATED PATIENTS VERSUS NON-INTUBATED PATIENTS IN THE ICU

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Abstract

A prospective clinical study was carried out in the ICU at Al-Basrah & Al-Tahreer General Hospitals to determine the percentage of positive sputum culture among intubated & mechanically ventilated patients compared to non-intubated patients, reflecting the impact of intubation and mechanical ventilation on increased risk of nosocomial infection and subsequent increased frequency of morbidity and mortality in ICU patients.

One hundred & twenty patients were admitted to these ICUs during a 6-months period (November 2008 to April 2009), they were 55 Females and 65 Males with mean age of 44.14 year (range 4-86year). Among 60 intubated ventilated patients, 25 (41.7%) had positive sputum culture. The bacteriology of positive sputum culture was caused predominantly by Pseudomonas aeruginosa in 36% followed by Klebsiella species in 28%, streptococcus pneumonia 24% and Escherichia coli in 12%. Among 60 non intubated patients, 8 (13.3%) had positive sputum culture. The bacteriology of positive sputum culture was caused predominantly by Streptococcus pneumonia in 50% followed by Pseudomonas aeruginosa in 25% and Klebsiella species in 25%.

This study confirmed that intubation and mechanical ventilation (mechanical interference) are risk factors that lead to increase the rate of nosocomial infection and subsequent increased frequency of morbidity and mortality in ICU patients.

Introduction

A working definition of nosocomial pneumonia (NP) is that of a new pulmonary infiltrate that occurs after one week of hospitalization and that resembles a bacterial pneumonia on the chest radiograph. Although most patients have fever and leukocytosis, these findings are neither uniformly presents nor they are a requisite for the presumptive diagnosis of NP[1]. Some hospitalized patients develop pneumonia in less than 5 days, a condition called early hospital-acquired pneumonia (HAP), which is better known as incubating community-acquired pneumonia (CAP). Since NP is defined as occurring a week or more after hospitalization, the early cases should not be regarded as NP but as CAP. Both early HAP and CAP have the same etiology in that the main pathogens are *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, although atypical pathogens also may cause the conditions[2].

NP is caused by different pathogens, the aerobic gram-negative bacilli (excluding *H. influenzae* & *Pseudomonas aeruginosa* are not the most common causes of NP but they are the most important organisms in terms of mortality and morbidity. *Staphylococcus aureus* (*methicillin-susceptible S.aureus* [MSSA], methicillin-

resistant *S.aureus* [MRSA]) and anaerobic organisms are not significant contributors to NP[3].

Mortality& Morbidity: As the patients in the ICU are critically ill so their mortality and morbidity are high. Intubation and ventilatory support which bypass the normal defense mechanisms of the host, leads to increase their mortality and morbidity.

Causes:

1-Aspiration pneumonia occurs when the patient aspirates colonized upper respiratory tract secretions. The stomach appears to be an important reservoir of gram-negative bacilli that can ascend & colonizing in the upper respiratory tract.

2- Hematogenously acquired infections originate from a distant source and reach to the lungs via the blood stream. In bacteremic NP, blood cultures are frequently positive if obtained in the early stages of disease process and if the patient is not already receiving antimicrobial therapy.

3- Mechanical interference (intubation and mechanical ventilation) Ventilator-associated pneumonia (VAP) is a major threat that delayed the recovery of patients on mechanical ventilation and is the one of the most important intensive care unit (ICU) acquired infections in mechanically ventilated patients that prolongs the length of stay (LOS)[4]. Nowadays there is no standard test for the diagnosis of VAP and no standard method to exclude pulmonary infections in mechanically ventilated patients with fever and systemic inflammatory response syndrome (SIRS) or multi-organ failure (MOF), even the post-mortem histological diagnosis of VAP is uncertain[5].

This study aimed to evaluate the frequency and bacteriology of positive sputum culture in intubated ventilated patients versus non-intubated patients.

Patients and methods

In this prospective study, one hundred &twenty patients were admitted to the ICU at Al-Basrah & Al-Tahreer General Hospitals during a 6-months period (between November 2008 and April 2009). The Characteristics of these 120 patients are demonstrated in table I. Demographic data of sputum were collected for culture and sensitivity. A sputum culture is a test to detect and identify bacteria or fungi that are infecting the lungs or airway passages. Sputum is a thick secretion produced in the lungs and in the airways. A sample of sputum was collected in a tube contains preservative that promote the growth of bacteria or fungi. If there is no growth, the culture is negative while if there is an identified growth definitely the culture will be positive. The type of bacteria or fungus will be identified with a microscope or by chemical tests6. Other tests may be done to determine which kind of antibiotic will be the most effective in treating infection. This is called susceptibility or sensitivity test.

How it is done: Usually, the sputum sample was collected early In the morning before the patients eat or drink anything. the non intubated patients are asked to take a deep breath, and then asked him to cough forcefully to produce a sample of sputum while in the intubated ventilated patients, a disposable sterile 50ml syringe is attached to a disposable suction catheter and the sputum suction under aseptic technique from endotracheal or tracheostomy tube was performed. The samples were sent to the laboratory as soon as possible. Once the sputum sample is collected, it will be placed in a container with substances (growth medium or culture medium) that promote the growth of infecting organisms (bacteria or fungi). Bacteria usually need 2 to 3 days to grow while fungus often takes a week or may be longer to grow. Any bacteria or fungi that grow will be identified under a microscope or by chemical tests. Sensitivity testing, to determine the best antibiotic to use against the organism that grows, often takes 1 to 2

additional days. If the test is positive, the sensitivity testing may be done to determine the best antibiotic to eradicate the bacteria or fungus. Factors that can interfere with test and accuracy of the results include:
Recent use of antibiotics,
Contamination of the sputum sample by bad handling during the time of sputum collection.
An inadequate sputum sample.
Waiting too long to deliver the sample to the laboratory.

Results

One hundred twenty patients were included in the study, 55 Females and 65Males with mean age of 44.14 year (range 4-86year). Among 60 intubated ventilated patients, 25 (41.7%) had positive sputum culture. The bacteriology of positive sputum culture was caused predominantly by Pseudomonas aeruginosa in 36% followed by, Klebsiella sp. in 28%, streptococcus pneumonia in 24%, and Escherichia coli in 12%. Among 60 non ventilated patients, 8 (13.3%) had positive sputum culture. The bacteriology of positive sputum culture was caused predominantly by streptococcus pneumonia in 50%, followed by Pseudomonas aeruginosa in 25%, Klebsiella sp. in 25%. See tables II & III.

The count and percentage of sex distribution among both groups (case and control group) Chi square (x) =0.583, p value >0.05 of no significance this table shows there is no significant difference in the count and percentage of sex distribution among both groups (case and control group).See table IV

The mean and SD difference of age among both groups Chi square (x)=O.673, p value >0.05 of no significance This table shows there is no significant difference in the age as risk factor among both groups(case and control group).See table V

Intubated versus non-intubated

The frequency distribution of sputum culture among both groups (case and control). Fischer exact test=O.OOI. P value less than 0.05 (significant value) This table shows there is significant difference among both groups (case and control group), There is threefold increase in percentage of positive sputum culture among intubated ventilated patients compared to non-intubated patients, reflecting the impact of intubation and mechanical ventilation On increased risk of nosocomial infection and subsequent increased frequency of morbidity and mortality in ICU patients .See table VI

Discussion

Pneumonia is a leading cause of death from hospital-acquired infections, with an associated crude mortality rate of approximately 30 percent[7]. Ventilator-associated pneumonia refers specifically to nosocomial bacterial pneumonia that has developed in patients who are on the mechanical ventilation. Ventilator-associated pneumonia that occurs within 48 to 72 hours after tracheal intubation is usually termed early-onset pneumonia; it often results from aspiration, which complicates the intubation process8. Ventilator-associated pneumonia that occurs after this period is considered late-onset pneumonia. Early-onset ventilator-associated pneumonia is almost due to antibiotic sensitive bacteria (e.g., omxicillin-sensitive Staphylococcus aureus, Haemophilus influenzae, and Streptococcus pneumoniae), whereas late-onset ventilator-associated pneumonia is frequently caused by antibiotic-resistant pathogens (e.g. omxicillin resistant Staph.aureus, Pseudomonas aeruginosa, acinetobacter species, and enterobacter species)[9,10]. The pathogenesis of ventilator-associated pneumonia usually requires that two important processes take place: bacterial colonization of the aer odigestive tract and the aspiration of contaminated secretions into the lower airway (Fig. 1)[11].

Therefore, the strategies aimed to prevent ventilator-associated pneumonia usually focusing on reducing the burden of bacterial colonization in the aero digestive tract and/ or decreasing the incidence of aspiration. The presences of invasive medical devices are important contributing factors to pathogenesis and development of ventilator-associated pneumonia. Many patients have nasogastric tubes that predisposed them to gastric reflux and increase the potential for aspiration. Endotracheal tube facilitate bacterial colonization of the tracheobronchial tree and lower-airway aspiration of contaminated secretions through mucosal injury & pooling of contaminated secretions above the cuff endotracheal tube worsen by elimination of the cough reflex[11].

The ventilator circuit and respiratory-therapy equipments may also contribute to the pathogenesis of ventilator - associated pneumonia if they contaminated by bacteria which are usually originated from patient's secretions[11,12]. The etiological pathogens found in our study represented the microbiological situation of our ICU. Comparison with the results of other authors is difficult because each ICU has a certain type of patient population and also a specific antibiotics guideline. The vast majority of our patients were not on antibiotics at the time of sputum sampling.

Conclusion

This study showed that there is threefold increase in percentage of positive sputum culture among ventilated patients compared to non ventilated patients, reflecting the impact of intubation and mechanical ventilation On increased risk of nosocomial infection and subsequent increased frequency of morbidity and mortality in ICU patients.

This study is supported by "Steven M Yentis "Who stated that "Ventilator-associated pneumonia (VAP) causes 50% of ICU infections[13].

Recommendations to decrease the incidence of nosocomial infections in ICU.

A- Nonpharmacologic strategies

1. Frequent changing of patient`s position& chest physiotherapy[11].
2- Effective Hand Washing and Uses of Protective Gowns and Gloves[14].
3- Semi recumbent Positioning of Patients to making head up &decrease the risk of aspiration[15].
4- Avoidance of Large Gastric Volumes[16].
5- 0ral (Non-Nasal) Intubation[16].
6- Routine Maintenance& sterilizations of Ventilator Circuits[17].
7- Continuous Subglottic Suctioning[11,18].
8- Humidification with Heat and Moisture Exchangers[19].

B-Pharmacologic strategies

1-Stress-Ulcer Prophylaxis[20].
2-Administration of Antibiotics according to the cultures & sensitivity.
Previous exposure to antibiotics is an important risk factor for ventilator associated pneumonia because of the presence of antibiotic - resistant bacteria[21].
3-Combination Antibiotic Therapy more effective than single[22].
4-Prophylactic Antibiotic Therapy
The use of aerosolized antibiotics for the prevention of ventilator-associated pneumonia has been abandoned because of its lack of efficacy and the subsequent emergence of antibiotic-resistant infections[12].
5-Chlorhexidine Oral Rinse to maintain good oral hygiene[23].
6-Administration of Immune Globulin[24].
7-Prophylactic Treatment of Patients with Neutropenia[25,26].
The presence of neutropenia is associated with an increased risk of both community-acquired and nosocomial infections. Granulocyte colony stimulating factor has been found to amplify the immune response by regulating the number and function of neutrophils[25,26].
8- Vaccines

Various vaccination programs in adults and children have reduced the incidence of pneumonia caused by specific pathogens, including H.influenzae type B strains, Strep. pneumoniae, and influenza virus[27,28].

Table (I): Characteristics of the 120 patients

Variables	Ventilated Intubated Patients (n=60)	Non Intubated Patients (n=60)
Sex (M/F)	31/29	34/26
Age(mean)/(years)	43.1	45.1
Cause of admission(n):		
Surgical cause	42	38
Medical causes	18	22
Mortality	10	4

Table (II): Bacteriology of positive sputum culture in ventilated intubated patients

Species	Number of cases n=25 out of 60
Gram-positive: Streptococcus pneumonia	6(24%)
Gram-negative:	
Pseuomomonas aeroginosa	9(36%)
Klebsiella sp.	7(28%)
Escherichia coli	3(12%)

Table (III): Bacteriology of positive sputum culture in non-intubated patients

Species	Number of cases n=8 out of 60
Gram-positive: Streptococcus pneumonia	4(50%)
Gram-negative:	
Pseuomomonas aeroginosa	2(25%)

Klebsiella sp.	2(25%)

Table (IV): The count and percentage of sex distribution among both groups (case & control group)

Gender	Case	Control	Total
Female	29 48.3%	26 43.3%	55 45.8%
Male	31 51.7%	34 56.7%	65 54.2%
Total	29 48.3%	60 100%	120 100%

Table (V):The mean and SD difference of age among both groups

Group	Mean	Number	SD
Case	43.1	60	20.43
Control	45.1	60	18.18
Total	44.1	120	19.30

Sputum culture	Case	Control	Total
Positive	25 41.7%	8 13.3%	16 8%
Negative	35 58.3%	52 86.7%	184 92%
Total	60 100%	60 100%	120 100%

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