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PREVENTION OF EARLY VENTILATOR- ASSOCIATED PNEUMONIA AFTER CARDIAC ARREST

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Abstract:
Heart patients face various complicated issues. It was frequently observed that patients who had cardiac arrests and were put on the ventilator, developed pneumonia. This development of pneumonia was a serious condition and lead to other complex illness disorders and even death. This paper is based on the research carried out on the number of patients in a hospital of Lahore. Patients were held under observation after complete analysis of their medical history to inspect the complexity of situation and risk factors associated with this condition.

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INTRODUCTION:

Pneumonia is an infectious disease of the lungs, which is caused by bacteria, viruses and sometimes fungi. This infection causes inflammation of alveoli in the lungs, which are air sacs. These alveoli, after inflammation, fill with pus or fluids and makes it very difficult and painful to breathe. The development of pneumonia was observed in patients with cardiac arrest that was leading to severe uncontrollable issues.

Patients who suffer from cardiac arrest are put on ventilators to maintain their breathing rhythm. In these patients, if proper antibiotics are not given, then pneumonia is developed. In order to study the effect of these antibiotics to prevent this ventilator associated pneumonia, a survey was conducted.
Multicenter, random, double- blind, controlled trial was held, including adult patients with age above 18 years. These patients were on mechanical ventilators after they had cardiac arrest and treated with temperature management at the specific target levels between 32 to 34 °C.

Patients who were having antibiotic therapy, morbid status or chronic colonization with multi-drug resistant bacteria were not added to the survey. Those patients were in the list in which only placebo or intravenous amoxicillin drugs were administered 3 times/ day for two days. This administration was started after 6 hours of cardiac arrest. The early outcome was observed was ventilator associated pneumonia, during the first 7 days stay in hospital.

195 patients were in the survey list. After proper adjudication, it was confirmed that 61 cases developed pneumonia out of which 50 had early ventilator associated pneumonia. This incidence showed that patients who were given antibiotic prophylaxis were less at risk in comparison to those who were administered with placebo. These results were for early ventilator associated pneumonia and not for late ventilator risks.

Procedure and Methods

Despite all the care and management, the survival rate of patients did not exceed 20% who had cardiac arrest out of hospital.[1] With some exceptions and controversies, the targeted temperature management was recommended at 32 to 34 °C, [2] because this temperature range has positive impacts on morbidity and mortality. However, it was observed that this temperature leads to other secondary infections and constitutes high risks for early ventilator associated pneumonia.[3,4]

- **Trial Design**

This research paper includes randomized, placebo, double- blind controlled study carried out in a hospital of Lahore. This study and survey was approved by the Ethical Committee of the hospital and written consent was taken by the patients. The doctors were asked for careful observation, accuracy of data, the fidelity of trial and protocol.

- **Patients**

Patients with age above 18 years were added in the survey chart. These patients had out-of-hospital cardiac arrest and shockable rhythm. They were treated with 32- 34 °C targeted temperature management based on their previous controlled and randomized trials. Those who had out-of-hospital cardiac arrest with manageable rhythm, in hospital cardiac arrest, pregnancy, previous lung disorders, already existing pneumonia, chronic aspiration during laryngoscopy for intubation of trachea, ongoing antibiotic therapy, use of extracorporeal life support, inclusion of multidrug-resistant bacteria in form of chronic colonization, amoxicillin use, moribund status and those with allergic reactions to beta lactam antibiotics, were excluded from the survey list.

Patients had to undergo randomization within 6 hours after the return of spontaneous circulation to uniformly start antibiotics early enough to prevent early ventilator-associated pneumonia.

- **Blinding and Randomization**

Patients were randomly selected. Groups were stratified randomly and the sequence was arranged by the computer. The data were organized by secure, computer based, web response system in the ratio 1:1 to avoid any mistakes.

- **Upshots**

Patients were daily checked for nosocomial infections, specifically for early ventilator associated pneumonia. The vital status and rates on the Cerebral Performance Category Scale of the patients were recorded for 1 year/ 12 months. The primary upshot was the development of early ventilator associated pneumonia during the first 7 days stay in hospital. As, there is no proper research study that differentiates the early pneumonia development from late development [6], so trial of 7 days was finalized instead of 5 days. The purpose of this increase in days was to carefully analyze the potential benefit of antibiotics, a 2 day treatment. The main secondary upshot was the development of late ventilator associated pneumonia, urinary tract and bloodstream infections, high death rate on the 28th

day, acquisition of multidrug-resistant bacteria from intestine which was resistant to multiple third generation antibiotics like cephalosporins, methicillin, carbapenemase, vancomycin and many more.

RESULTS:

Specific care and attention like a daily oral check-up, deep vein thrombosis prophylaxis, elevation of the head of the bed, sedation vacations, was given to standardize patients. [7] In suspected cases of patients that could develop early ventilator associated pneumonia, Sequential Organ Failure Assessment score, clinical Pulmonary Infection score, chest radiography, blood gas analysis, quantitative sampling of the lower chest, and blood culture tests were performed before administrating them with any antibiotics.

An adjudication committee which was composed of professional, senior intensivists was formed. These professionals had experience in handling early ventilator associated pneumonia. They thoroughly reviewed all trial charts and medical history of the patients. They defined that if infection is developed within 7 days then it comes under the category of 'early ventilator associated", and if it is developed after 7 days of hospitalization then it false under the category of 'late ventilator associated'. As per Supplementary Appendix (adjudication charter).

Under the criteria from 2010 Food and Drug Administration guidance, the reported events were defined with a standardized approach to confirm either it is early ventilator pneumonia or not. [8] The report included radiological, microbiological and clinical criteria. Under clinical criteria, fever was included i.e tympanic or oral temperature ≥ 38 °C, [9] hypothermia in which core body temperature is measured as 10,000 cubic millimeter/ >15% immature neutrophills and leucopenia with <4500/ cubic mm white cell count. Radiographic criteria included the presence of bacterial pneumonia with progressive or persistent infiltrate characteristics. Microbiological criteria involved a respiratory culture that was present at specific amounts as per lab standards (106 CFU/ mm, 104 CFU/ mm, bronchoalveolar- lavage specimen). [10]

Statistical Analysis

In controlled group, we found that chances of getting ventilator associated pneumonia on 7th day of hospitalization were 68% and other trials showed 63%. Patients in antibiotic group, who were administered with a 2 day pattern of antibiotics showed 25% less incidence of development of early ventilator pneumonia.

Table: Ventilator associated pneumonia in antibiotic group and controlled group. Total N= 195

Complications	Antibiotic Group N= 100	Controlled Group N= 95	Hazard Ratio 96% cl	P Value
Ventilator associated pneumonia	24 (24)	36 (38)	0.54 (0.32-0.92)	
Early	20 (20)	33 (36)	0.54 (0.32-0.93)	0.03
Late	5 (5)	4 (4)		
Bloodstream infection	1 (1)	1 (1)		
Urinary tract infection	5 (5)	4 (4)		
Other infections	0	3 (3)		

Cardiovascular Complications of Pneumonia

Every year ventilator associated pneumonia after cardiac arrest kills thousands of people. In addition to respiratory infections, disorders and complications, pneumonia also exacerbates the cardiovascular diseases through various mechanisms. A systematic review based on an analytical approach showed that 63% of patients are at higher risks of developing serious CVD issues following cardiac arrest and pneumonia.

The factor that exacerbates the risks of pneumonia development in older people is the pre-existing CVD disorders. The risk of early ventilator associated pneumonia development is 3 times higher in patients with already existing heart issues in comparison to those who have no such issues. The exact root cause of cardiac arrest pneumonia that triggers other CV complications is not known, but it is found that the demographic characteristics of patients like their age, obesity, comorbid conditions, play significant roles.

Once, the pneumonia developed in hospitalized patients, the host bacteria remain in hypoxaemic condition secondary to alveolar consolidation, which ultimately effects the normal perfusion state of the patient.

The research has found other mechanisms that can also influence the early ventilator associated pneumonia and heart attacks:

- Pneumonia is an inflammatory disease. This disease is characterized by increased levels of circulating cytokines and chemokines, excess of these can cause severe tissue damage in the lungs
- When endotoxins and bacterial pathogens circulates in blood, platelets are activated. This condition leads to procoagulant and ultimately causes acute coronary syndrome
- During infection, upregulation of sympathetic nervous system occurs. This irregularity leads to increased heart rate and vascular resistances, which in turn abruptly impacts the cardiac output.
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Elaboration of these severe issues is as follows:

- **Acute Coronary Syndrome**

Research has shown that early ventilator associated pneumonia after cardiac arrest icreases the risk of myocardial infarction (MI) by two times within 7 days of pneumonia development. It is also found that this pneumonia can also lead to atherosclerotic plaque destabilization.

Chlamydophila pneumonia, is often found in patients with early ventilator associated issues. This bacteria is responsible for plaque instability, atheromas and cardiotoxicity. Thrombus can also generate locally or spontaneously owing to exposure to rupture tissues and inflammatory lung walls.

- **Arrhythmias**

In patients with early ventilator associated pneumonia, arrhythmias become worse with time and leads to cardiovascular complications. The pathogen can generate microscopic lesions that were found linked with high levels of troponin and abnormal heart beat rhythm.

- **Heart Failure**

The risk of heart failure increases rapidly in patients who develop early ventilator associated pneumonia within 10 days after cardiac arrest. This risk continues even after 10 years of discharge from the hospital. The possible underlining reason found was the presence of Mycoplasma pneumonia.

- **Antibiotics**

It was found that some antibiotics were also playing a crucial role in worsening the situation because many patients were allergic to them. Microbiological trials of some patients also showed the presence antibiotic resistant bacteria in their system. These conditions add up to the risk factors of heart failure and thus increases mortality rate.

After carefully observing these conditions, it was found that controlling early ventilator associated pneumonia is extremely important in the decline of mortality rate. This early stage issues are far more dangerous for the patients as compared to late ventilator associated infections and issues.

CONCLUSION:

A deep research on controlled and antibiotic group of patients held in hospital after cardiac arrest revealed helpful results. A 2 day course of antibiotic therapy with amoxicillin in patients with targeted temperature management at 32 to 34 °C after having a cardiac arrest out of hospital with shockable rhythm showed less incidence of developing early ventilator associated pneumonia than those administered with placebo.

Careful observance of medical condition and history of the patient is extremely important before administration of any antibiotics for controlling pneumonia otherwise it will lead to other chronic issues and even death.

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