Research & Reviews of Pneumonia

Chapter 3

Measures for Prevention of VAP in ICU Patients

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1. Introduction

Ventilator associated pneumonia (VAP), the most commonly ICU acquired infection, affects 10-30% of ventilated patients and accounts for 25% ICU infections. Any patient on mechanical ventilation (MV) has the risk of developing VAP, and the risk is maximum during the first 5 days, being 3% per day [1]. After understanding the VAP pathogenesis, as described in the previous chapter, the designing of preventive measures in easier [2]. The Institute of Healthcare Improvement [3] developed the VAP prevention bundle which includes head end elevation by 30^0-45^0, daily sedation interruption, daily oral care, peptic ulcer prophylaxis and Deep Vein Thrombosis prophylaxis. Details of the various preventive measures and the various newer preventive measures available are explained below.

2. Methods to Reduce the Time at Risk for VAP Development

VAP prevention begins with avoiding MV or reducing the duration of MV. This can be achieved by

a) Non-invasive Positive Pressure Ventilation (NPPV) [4]: Use of NPPV significantly reduces the risk of VAP development and it is found to be as effective as invasive ventilation in improving gas exchange [5]. Thus, NPPV is recommended whenever possible.

b) Daily weaning trials [6]: Protocol directed sedation has been shown to reduce the duration of MV, ICU and hospital stay in various RCTs. Thus, daily weaning trial is a good validated strategy to reduce the time of MV.

c) Sedation vacation: *Schweickert et al* [7] demonstrated that daily sedation interruption, also called the Spontaneous Awakening Trial, reduced the duration of MV, ICU stay and decreased the chances of complications. Many studies have concluded that combining Spontaneous Awakening trial with Spontaneous Breathing Trial is the most effective [8].

3. Reducing the Chances of Aspiration

Microorganisms reach the ETT either by aspiration of oropharyngeal or gastroesophageal secretions. On reaching the ETT, they multiply, gain sufficient numbers and produce a biofilm. The biofilm produced can dislodge spontaneously and cause VAP [9].Various recent advances available for prevention of VAP in patients with ETT are as given below:

a) Semirecumbent position: Semirecumbency has been shown in various studies to reduce the chances of pulmonary aspiration. This has been proven by the instillation of radiolabelled compounds in the gastric contents [10]. The clinical practise guidelines recommend elevation of the head end of the bed by 30^0-45^0 [11].

b) ETT with subglottic suctioning: Intermittent or continuous suctioning of the secretions accumulated in the ETT prevents the microaspiration of secretions. This further reduces the duration of MV, ICU stay and chances of VAP development. But few studies have demonstrated that the rate of VAP development by aspiration of subglottic secretions is not statistically significant [12].

c) Mucus shaver [13]: Aspiration of the secretions does not completely remove the secretions, these can be removed completely using a mucus shaver. This is an inflatable silicon rubber balloon which shaves the lumen of the ETT.

d) Mucus slurper [14]: This is a modified tracheal tube with 2 shaving rings. This device is introduced into the distal ETT and inflated such that the shaver's edge comes in contact with the ETT interior. It is then withdrawn gradually over 3-6 sec to remove the accumulated secretions.

4. Reducing the Endogenous Source of Infection

- Selective digestive tract (SDD) and Oral (SOD) decontamination [15]: It consists of administration of non-absorbable broad-spectrum antibiotic preparation via enteral/parenteral/topical route. This helps eradicate the potential pathogenic bacteria. A large study conducted by Oostdijk et al in 2010 in 13 ICUs of Netherlands showed that the 28 day mortality was reduced by 3.5% and 2.9% by the use of SOD and SDD [16]. However, a follow up study conducted later showed that the use of SDD lead to increase in the antibiotic resistance [17]. Chlorhexidine is the most commonly used antibiotic for SOD [18]. Iseganan [19] and povidone iodine [20] are also been investigated for the same purpose.

- Use of probiotics: Probiotics are commercial preparation of living microorganisms which have various health benefits when administered in adequate doses. It was seen in a pilot study conducted in 2010 that critically ill patients receiving Lactobacillus rhamnosus had fewer microbiologically confirmed VAP cases. However, bigger studies with more liberal inclusion criteria are still needed [21].

5. Placement and Modifications in the Endotracheal Tube

Appropriately inflated cuffed ETT must be used in patients requiring MV. As per the American guidelines [22], a pressure of atleast 20 cm H2O must be maintained. Currently two cuff shapes are available in High Volume Low Pressure (HVLP) ET tubes, spindle or tapered [23].The tapered shape tubes were introduced with the view that they would reduce the pressure on the tracheal mucosa. However, no statistically significant difference in the rate of VAP was found.

5.1. Antimicrobial-coated endotracheal tubes

Various studies [24] demonstrated that use of silver coated ETTs reduced the VAP rate, duration of MV and ICU stay by reducing the biofilm formation. Though coated ETTs are more expensive (90$ versus 2$ of uncoated tubes). Few studies have also shown that treatment of the tubes with PVC and oxygen plasma, served as an antiadhesive and prevented the coating of ETT with biofilms [25].

6. Hospital Infection Control Policies and Education [26]

Various policies have to be laid down for the care of mechanically ventilated patients to control the VAP rate and the hospital staff needs to be well educated about all of them. These include [27]

- use of standard precautions eg hand hygiene, use of PPE etc
- use of transmission-based precautions
- following and monitoring hand hygiene practices
- nosocomial surveillance of VAP rate and pathogens causing VAP
- mechanical ventilation equipment sterilisation

Thus, various new recent advances have been developed in the past for the prevention of VAP but are still to be included in the VAP bundle od care. Many larger studies would be needed before these can be included.

7. Reference

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