ICU MANAGEMENT & PRACTICE

ICU Volume 13 - Issue 4 - Winter 2013/2014 - Cover Story: Severe Pulmonary Infections

Prevention of Ventilator-Associated Pneumonia (Matthieu Boisson, Olivier Mimoz)

Authors

Matthieu Boisson, *MD*

Chief Resident of Department of Anesthesiology and Intensive Care, University Hospital of Poitiers Poitiers, France

Inserm U1070, Faculty of Medicine and Pharmacy University of Poitiers, Poitiers, France

matthieu.boisson@chu-poitiers.fr

Olivier Mimoz, *MD, PhD*

Co-Head Department of Anesthesiology&Intensive Care

University Hospital of Poitiers Poitiers, France

Inserm U1070, Faculty of Medicine and Pharmacy , University of Poitiers, Poitiers, France

Introduction

Healthcare-associated infections have become a challenge in public health policy. In critically ill patients, ventilatorassociated pneumonia (VAP) is the most frequent healthcare- associated infection. Depending on studies, 10% to 30% of ventilated patients will develop a VAP during their ICU stay (Chastre et al. 2002). VAPs account for heightened morbi-mortality, lengthened stays in intensive care and increased treatment costs. These infections also trigger a rise in the consumption of antibiotics, which favours the development of bacterial resistance.Therefore, decreasing VAP incidence must be a priority in the management of critically ill patients.

Physiopathology of VAP

Enhanced knowledge of the complex physiopathology of VAP has led to the development of effective preventive strategies (see Figure 1). Colonisation of the upper and digestive airways by micro-organisms originating in the patient or coming from another patient through crosstransmission is the predominant mechanism of initiation. Fostered and favoured by the presence of a tracheal tube, it is at the origin of tracheal colonisation through the bacterial aspiration resulting from the passage, around the tube cuff, of oropharyngeal secretions in the vicinity of the trachea and the lower respiratory tract (Kollef 2004).

General Rules

Prevention measures are primarily based on the universal principles of standard hygiene. They are meant to prevent cross transmission of pathogens. These measures include basic hygiene: alcohol-based hand rubbing, wearing gloves for one patient - one activity. Screening for carriage of methicillin- resistant Staphylococcus aureus(MRSA) and other multi-drug resistant bacteria according to local ecology, and the use of contact precautions should be utilised to prevent cross-contamination(Siegel et al. 2007). Staff training with regard to these measures helps to ensure respect of their application.

More recently, universal decolonisation with intranasal mupirocin and daily bathing with chlorhexidine-impregnated cloths has been shown to be more effective than screening and isolation to prevent healthcare-associated infections (Huang et al. 2013). However, the lack of impact on the incidence of non-staphylococcus infections and the risk of the development of resistance to mupirocin and/or chlorhexidine with their wide use are limitations to the generalisation of this practice.

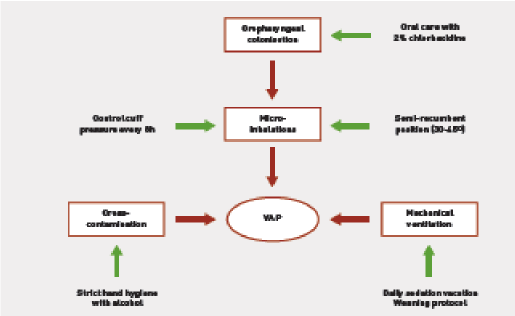

Figure: Diagnostic key for Vendilator-Associated Events

Avoiding Mechanical Ventilation Whenever Possible

While intubation and mechanical ventilation are major risk factors for VAP, recourse to non-invasive ventilation (NIV)is a safe and interesting alternative means of risk reduction. Indeed, its use is safe and effective to prevent VAP compared to the use of invasive mechanical ventilation (Hess 2005; Squadrone et al. 2005).

If intubation and duration of mechanical ventilation are among the most recognised risk factors for VAP, the first days of ventilation are the riskiest of all. As a result, early weaning from the ventilator and extubation should be considered as soon as the clinical situation allows for them. Excessive sedation/analgesia prolongs the duration of mechanical ventilation. Application of a sedation/ analgesia algorithm integrating daily interruption of sedative drugs and daily spontaneous breathing trials is to be recommended (Girard et al. 2008). Conversely, failure of weaning leading to reintubation has been identified as a risk factor for VAP, of which incidence is heightened in the event of accidental extubation (de Lassance et al. 2002).

Limiting Micro-Inhalations

Intubation should preferably be orotracheal. Keeping a sufficient level of pressure in the tube cuff of the tracheal tube is of fundamental importance in limiting micro-aspirations. Ideally, pressure should be maintained between 20 cmH2O (15 mmHg) and 30 cmH 2O (22 mmHg). If it is too low, there exists a risk of inhaling the subglottic secretions accumulated from the oropharynx, which is known to take on a preponderant role in VAP incidence. Regular monitoring of tube cuff pressure is consequently recommended, but its optimal frequency has yet to be clearly determined. To reduce these risks, automatic devices allowing for continuous regulation of tracheal tube cuff pressure have been developed. In a randomised study, the percentage of patients with a micro-inhalation of gastric contents was half lower in the group of patients where tube cuff pressure was maintained by a pneumatic system than in the control group where tracheal tube cuff was maintained by verification and adjustment 3 times a day with a manual manometer (Nseir et al. 2011). Moreover, the microbiologically confirmed VAP percentage had significantly diminished in the intervention group compared to the control group (9.8% vs. 26%; p = 0.032).

The interest of the semi-recumbent position has been assessed in several studies. The randomised and pioneering study by Drakulovic et al. compared the strictly supine rest position to the semi-recumbent position (objective 45°). Whether diagnosis was clinical or microbiological, the authors found a significant VAP reduction. Nevertheless, a recent multicentre prospective study compared the semi-recumbent position (objective 45°) to a position characterised as 'standard'(Van Nieuwenhoven et al. 2006). Notwithstanding monitoring more than once a day by a dedicated staff, the objective of 45° was reached in only 15% of the patients; mean angulation oscillated over the first week between 23° and 29°, while in standard position patients, its oscillation ranged from 10° to 15°. Given these clinical conditions, VAP incidence did not differ from one group to the other. It would consequently appear that even if the principle of a head-up position is accepted, the level of elevation to be reached remains undetermined; either an objective of 45°, which is difficult to attain, or else an objective ranging from 30° to 45°, which is more realistic, should be preferred.

Closed tracheal suction systems have been proposed to limit the risk of VAP. Unfortunately, threemeta-analyses have not found the closed system to be preferable in terms of lower VAP incidence, mortality or duration of stay in intensive care; as a result, it is not recommended(Subirana et al. 2007). The potential benefits of diminished crossed transmissions through this suction system have likewise failed to be demonstrated (Jongerden et al. 2007).

Subglottic secretion drainage is possible through use of a tracheal tube equipped with an orifice located above the cuff. Numerous studies have been conducted, and their findings have been summarised in a meta-analysis

(Muscedere et al. 2011), showing that the use of subglottic aspiration is associated with a reduction of VAP risk. In parallel, duration of ventilation and stay in intensive care were significantly reduced, but without any effect on mortality and duration of hospital stay.

Limiting Oropharyngeal Colonisation

In intubated patients the modifications of saliva, with reduction of both its amount and the immune factors concentration, facilitates oropharyngeal microbial proliferation (Bonten et al. 1996). To limit this phenomenon, several ways have been proposed. Selective digestive decontamination (SDD), when associated with systemic antibiotic therapy, brings down VAP incidence (D'Amico et al. 1998) and mortality (Vandenbroucke-Grauls et al. 1991), while SDD alone reduces nothing other than the incidence of VAP. In spite of the interest of the aforementioned results, this preventive method is only marginally used and has not been included in the most recent recommendations. The probable reason for this reluctance resides in an ecological risk along with the potential emergence of multi- resistant bacteria(Daneman et al. 2013).

Oropharyngeal decontamination through local application of an antiseptic(chlorhexidine or povidone-iodine) for the purposes of limiting local flora represents another interesting method of VAP prevention. A metaanalysis involving 2481 patients showed some VAP diminution (Labeau et al. 2011). The benefits of chlorhexidine are more substantial in cardiothoracic surgery patients or when a high concentration (2%) is used.

Conclusion

Many specific preventive measures have been studied to reduce the incidence of VAP. The most important include oro-tracheal intubation, maintaining tube cuff pressure between 25 and 30 cmH2O, use of a sedationanalgesia algorithm allowing for early weaning from ventilation, privileging use of non-invasive ventilation, the semi-recumbent position at 30-45°, and regular nasal and oro-pharyngeal decontamination with

chlorhexidine. All these measures must be used in bundles.

Published on : Wed, 25 Dec 2013