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Closed suction system versus open suction

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ABSTRACT

Background: Catheter suction is used to remove tracheal secretions through the endotracheal tube in mechanically ventilated patients, which may be either closed tracheal suction system (CTSS) or open one. In CTSS, the catheter is a part of ventilator circuit with no need to disconnect the ventilator. It seems that the CTSS prevent soiling and spraying of respiratory secretion into the ICU.

Objective: To compare CTSS system in comparison with an open tracheal suction system in adult patients receiving mechanical ventilation for more than 24 h in terms of VAP incidence, length of stay in the intensive care unit and mortality.

Methods: We prospectively recruited all mechanically ventilated patients in our general ICU, Dar El Shefa hospital between January 2012 and January 2013. Group A are those with open tracheal suction system (OTSS) and group B with closed tracheal suction system (CTSS), comparing VAP incidence, length of stay in the intensive care unit and mortality between the two groups.

Results: Group A (OTSS) where the incidence of VAP was 30.13/1000 ventilator days not statistically significant in comparison with patients in group B with CTSS with VAP incidence 17.48/1000 ventilator days.

Conclusion: There is no difference in the incidence of ventilator associated pneumonia and mortality rates between the two groups. The average length of stay declined in patients with OTSS group.

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Introduction

Mechanical ventilation (MV) and intervention manoeuvres such as endotracheal suction are contributing risk factors for ventilator associated pneumonia (VAP) [1]. VAP is defined as pneumonia that develops in an intubated patient after 48 h or more of MV support. It is associated with high morbidity and mortality and is considered one of the most difficult infections to diagnose and prevent [2].

Endotracheal intubation is required to establish mechanical ventilation [3]. The existence of endotracheal tube causes tissues irritation and increased secretion. It is essential to regularly clean and suction the artificial airway to maintain ventilation [4]. Although endotracheal tube suction is a device to remove secretions and keep the airways open, it causes many complications [5].

Major hazards and complications of endotracheal suctioning include hypoxaemia, tissue hypoxia, significant changes in heart rate or blood pressure, presence of cardiac dysrhythmias and

cardiac or respiratory arrest. Additional complications include tissue trauma to the tracheal or bronchial mucosa, bronchoconstriction or bronchospasm, infection, pulmonary bleeding, elevated intracranial pressure and interruption of MV [6].

The endotracheal suctioning technique is classically performed by means of the open tracheal suction system (OTSS), which involves disconnecting the patient from the ventilator and introducing a single-use suction catheter into the patient's endotracheal tube. During the late 1980s, the closed tracheal suction system (CTSS) was introduced to more safely suction patients on MV as a multiuse catheter is introduced into the airways by connecting an instrument to the ventilator which allows suction catheter enters into endotracheal tube through a one-way valve without disconnecting the patient from the ventilator [7].

The suggested advantages of CTSS compared to conventional OTSS are: improved oxygenation; decreased clinical signs of hypoxemia; maintenance of positive end-expiratory pressure; limited environmental, personnel and patient contamination; and smaller loss of lung volume. As a result the CTSS is currently being used to minimize hazards and complications associated with endotracheal suctioning [8]. Numerous studies have been conducted to test CTSS, compared with an OTSS, analyzing the prevalence of VAP, efficiency in secretion removal and mortality [9].

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One of the advantages of closed suction system is to reduce respiratory pollution and pulmonary infections. Another potential advantage is its easy application which only needs one nurse. In closed suction method, nurse would not be infected by patient's endotracheal tube secretions and suction catheter can be used frequently [10].

Aim of the study

The objective of this study is to assess the effects of suctioning with a closed tracheal suction system in comparison with an open tracheal suction system in adult patients receiving mechanical ventilation for more than 24 h in terms of VAP incidence, length of stay in the intensive care unit and mortality.

Subjects and method

Study design and patient data

This study was conducted on 141 patients who were mechanically ventilated from January 2012 to December 2012 in medical-surgical intensive care unit at Dar El Shefa hospital. ICU consisted of three centers: Center (A) with 6 beds and Center (B) with 5 beds and Center (C) with 3 beds.

Patients were divided into two groups:

- Group A:
Included mechanically ventilated patients admitted to intensive care unit during the period of January 2012 to June 2012 with open tracheal suction system (OTSS)
- Group B
Included mechanically ventilated patients admitted to intensive care unit during the period of July 2012 to December 2012 with closed tracheal suction system (CTSS).

Patients who required mechanical ventilation for more than 48 h at any time during their ICU stay were included in the study. Studied patients were prospectively followed for the occurrence of ventilator associated pneumonia.

Each patient was subjected to:

- thorough history taking,
- thorough general and chest physical examination,
- Chest X-ray antero-posterior view daily or every other day,
- Conventional bacteriological culture in patients with suspected VAP.

Data were collected from the patients sheets included:

- Length of ICU stay,
- Diagnosis,
- Date of admission
- Date of mechanical ventilation,
- Date of extubation
- Outcome.

VAP diagnosis depends on

Radiological signs

Two or more serial chest radiograph with at least one of the following.

- New or progressive versus persistent infiltrates
- Consolidation.
- Cavitations.

Microbiological criteria

At least one of the following:

- Positive growth in the blood culture not related to another source of infection.
- Positive growth in tracheal aspirate or pleural fluid.
- Positive culture from BAL.

Clinical signs

At least one of the following

- Fever (temperature >38 °C).
- Leucopenia (<4000WBCs) or leukocytosis (>12000WBCs).
- Altered mental status, for adults 70 years or older with no other recognized cause.

Plus at least 2 of the following

- New onset of purulent sputum or change in the character of sputum.
- Increased respiratory secretions or increased suctioning requirements.
- New onset or worsening cough or dyspnea, rales or bronchial sounds.
- Worsening gas exchange.
- Increased oxygen requirements.

Criteria for closed suction system

A. Equipment

1. Closed Suction System

- a) Closed suction system (colour coded by size). A set of "change stickers" is included in the package to label with date closed suction system is due to be changed.
- b) Rule of thumb: double the size of the endotracheal tube to determine catheter size.

2. Sputum Collection for Laboratory Examination

- a) Mucus specimen trap ("Leuken")
- b) Laboratory requisition.
- c) Biohazard bag to send sample to lab
- d) New closed suction system

B. Precautions

1. Bradycardia/desaturation may occur from either inserting the catheter too slowly or using a large catheter which occludes the internal lumen of the ETT. Close observation of the patient's oxygen saturation and heart rate was done during the procedure.
2. Limited duration of suctioning to no longer than 5–10 s per pass.
3. Overly forceful withdrawal of the catheter may pull the catheter tip out of the white PEEP seal located near the irrigation port. This will cause the bag around the suction catheter to inflate and sometimes pulse with air. Ventilation still occurs, but the peak pressures will be somewhat reduced and the patient may deteriorate. Fixation of this problem by simply feeding the catheter back through the PEEP seal was performed.
4. Accidental extubation may occur if the ETT is not properly supported during withdrawal of the catheter.
5. The CTSS set is used for one week with a date written on the sticker to identify the replacing date.

C. Procedure

A. Set-up

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