Application of an Automatic Suction Device to a Patient with A Tracheostomy Tube in the General Ward: A Case Report

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ABSTRACT

The A-1000 (Elmeca, Co. Ltd., Seoul, Korea) electrical automatic airway suction device, was designed to operate as a customizable repeated closed suction device. It can be used for patients with intubation or tracheostomy tubes. This is the first recorded case of the use of the A-1000 in a general ward patient with a tracheostomy tube. A 91-year-old man presented having attempted suicide by hanging and was admitted to this institution. Although extubation was performed in the intensive care unit, the patient required 2 reintubations. The tracheostomy was performed, and the A-1000 was applied. After weaning from mechanical ventilation, the patient was transferred to the General Ward with a tracheostomy tube in place for effective removal of sputum by the A-1000. The tracheostomy tube was successfully removed, and the patient was discharged. The effectiveness and safety of the A-1000 needs further study by expanding the applications of this device.

Keywords: airway management, automation, case reports, patients' rooms, suction

Introduction

Airway suction is an essential treatment for patients receiving mechanical ventilation in an intensive care unit (ICU) or those patients in a General Ward who are unable to expectorate sputum by themselves [1]. Airway suction is a medical practice performed manually, primarily by a nurse or a caregiver, at the patient's bedside, using a closed or open airway suction catheter device [2]. Patients requiring airway suction need treatment every few hours depending on their medical condition [3], emphasizing the importance of airway management by individuals who can properly perform airway suction to meet the patient's medical needs.

The automatic electric airway suction device, the A-1000, is designed to repeatedly perform a closed suction operation according to the requirements set out by the medical staff (Figure 1). Approved by the Korean Food and Drug Administration, this device is marketed and sold as a medical device. The A-1000 device operates according to a programmed number of suction, suction pressure, and catheter insertion depth during aspiration for each suction. Therefore, airway suction can be performed at predetermined intervals without any intervention by medical personnel or caregiver. The suction catheter bundle also has a suction line exclusively used for subglottic suction. This device is primarily used in the ICU and is applicable to patients who are intubated or those with a tracheostomy tube, however, general ward patients with tracheostomy tubes can also benefit from its use.

In this report, we present the first documented use of an electric airway suction device, the A-1000, in a general ward patient with a tracheostomy tube.

The application of this automatic electric airway suction device enabled the early transfer of the patient to the General Ward, despite the initial concerns about the transfer due to the need for frequent suction in the ICU. In the General Ward, we could successfully manage airway suction without assistance from a nurse or caregiver. Hence, we achieved tracheostomy closure, and the patient was successfully discharged.
This report highlights that an automatic electric airway suction device was highly effective in the General Ward, suggesting that the application of an automatic electric airway suction device can be expanded from use in the ICU to improve the availability of ICU beds whilst safely managing patients in a General Ward.

Case Report

A 91-year-old man who attempted suicide by hanging was brought to the Emergency Room. He was discovered by his wife with a hanger entangled around his neck, and she called 911. Upon the arrival of the paramedics, the patient exhibited a pain response, he had a blood pressure of 120/70 mmHg and an oxygen saturation of 73%. Subsequently, 15 L of oxygen was administered via a mask, leading to an increase in his oxygen saturation to 85%. Upon arrival at the Emergency Room, his oxygen saturation was 96%-100%, and his mental status was noted as drowsy. Subsequently, the patient was admitted to the ICU for close monitoring.

An initial chest radiograph showed right upper lung field consolidation, suggestive of pneumonia, therefore, antibiotics were initiated. A high-flow oxygen supply was initiated to manage the sudden onset of desaturation, and intubation was performed because of acute respiratory failure. Considering the decreased blood pressure, a central intravenous line was inserted, and vasopressors were administered.

The patient underwent extubation in the ICU, but experienced difficulty sustaining respiration and exhibited ineffective expectoration due to loss of muscle strength. Reintubation was subsequently performed twice, on Days 2 and 6 following the initial extubation. In addition, a tracheostomy was performed for vocal cord protection because extubation of the patient was not expected. The A-1000 device was used for automatic tracheal suction. The suction settings were: a suction catheter depth of 15 cm from the end of the intubated tube; suction power of 200 mmHg; suction interval every 60 minutes; suction duration of 15 seconds for each suction; and a suction frequency of 3 times for each suction.

The patient attempted suicide because his general weakness had given him a pessimistic outlook on life. This emphasized the critical need for emotional support and continuous supervision. After mechanical ventilator weaning had taken place in the ICU, the patient was transferred to the General Ward on Day 32, with a tracheostomy tube in place. This move was possible, primarily, because of the placement of the automatic electric tracheal suction device, the A-1000. Tracheal suction was applied using the A-1000 for 4 days in the General Ward, during which the suction setting was changed according to the patient’s condition, including an extended suction interval from 1 to 2 hours. No adverse events occurred, such as tracheal mucosal hemorrhage or device malfunction. The tracheostomy tube was successfully removed, and the patient was discharged after receiving 45 days of in-hospital treatment, including 13 days of general ward management.

Discussion

Tracheal suctioning is an invasive medical procedure [4]. It warrants caution because the vacuum pressure generated by
airway aspiration frequently results in airway mucosal damage [5]. In patients requiring high oxygen concentrations, hypoxia and cardiac arrest have been reported during the process of ventilator disconnection and airway aspiration [6]. Therefore, to ensure patient safety, well-trained nurses or caregivers should perform tracheal aspirations.

In the General Ward, patients with chronic respiratory failure who have tracheostomy tubes experience difficulties in expectoration by themselves. Therefore, a caregiver needs to stay 24/7 to perform frequent manual airway aspirations. The absence of skilled caregivers or nurses to perform airway management complicates the transfer of patients from the ICU to the General Ward because proficiency in airway aspiration and management is a crucial factor in patient prognosis. Moreover, manual open airway suction increases the risk of aerial or droplet infection [7]. Once a ventilator is disconnected from the tracheostomy tube during open airway aspiration, a loss of positive end-expiratory pressure occurs, causing atelectasis of the lungs and leading to reduced ventilation [8]. Furthermore, the number of disposable consumables needed for manual tracheal suction increases the medical costs incurred by patients [9]. Therefore, the use of a closed-airway suction catheter is recommended. However, some factors must be considered carefully when using a closed-airway suction catheter. For instance, airway suction procedures should be repeated frequently and airway managers are at risk of causing cross-infection owing to direct patient contact during tracheal aspiration. In addition, nursing care overload can force the prioritization of other jobs and lead to the neglect of proper airway management in terms of the frequency and method of airway suction. This can lead to serious consequences for treatment outcomes and prognosis. To overcome these shortcomings of the current airway suction procedure on the General Ward, use of an automated electric suction device, A-1000, can be a good option.

The A-1000 is connected to an airway tube, such as an endotracheal or tracheostomy tube, and the essential settings include depth from the tip of the airway tube, suction power, suction frequency per suction, suction duration, and suction interval.

An automatic electric suction device confers several advantages: (1) it can replace manual tracheal aspiration, an important nursing care procedure, and reduce the workload of nursing staff and caregivers; (2) the reduced frequency of manual tracheal aspiration could decrease the occurrence of cross-infection of respiratory diseases such as coronavirus disease and tuberculosis; (3) maintaining a closed airway suction system can reduce the spread of contaminants and the likelihood of healthcare workers being exposed to infectious diseases; (4) it can also reduce the amount of disposable consumables used for airway suction, resulting in reduced medical expenses and environmental protection; and (5) by automatically conducting the tracheal aspiration procedure according to the settings programmed by the medical staff, this device can prevent aggravation of the patient's condition due to missed sputum aspiration.

Although there were no adverse events during this case, there are some disadvantages of using the device. Since utilizing this device in our institution we have experienced some complications, mainly related to mechanical problems: (1) unintentional disconnection between the device and airway tube can occur if they are not connected correctly. If this happens, the suction catheter can push the connection site and the entire device can detach from the airway tube, and this may induce hypoxia in the patient under oxygen therapy; (2) the size of the device may limit its use as a bedside care device. It might be a considerable problem if the medical facility has little space around the patient bed. To minimize the space occupied by the A-1000 device, it is usually placed next to the bed, or near to the wall adjacent to the nearside of the bed. Managing the device at the bedside was not difficult since the device can be manipulated without human manipulation, caregivers may not notice airway complications such as bleeding. Therefore, caregivers must check the canister frequently to identify abnormal discharge from the airway.

Given that the A-1000 is applicable to all patients with a secure airway, it can be used in ICU patients and general ward patients, overcoming the difficulties of transferring patients from the ICU to the General Ward. Furthermore, it could lead to earlier patient discharge, facilitate home care, and free up beds in hospital rooms.

This case holds significance as it represents the first successful use of the A-1000 electric airway suction device for tracheal aspiration in a general ward patient with a tracheostomy tube. Employing this automatic electric airway suction device allowed the transferal of the patient from the ICU to the General Ward sooner than expected, while ensuring safe patient management.

The application of the electric airway suction device requires further study to determine its effectiveness and safety in the General Ward. In the future, this device could potentially replace current airway suction procedures.
Author Contributions

Conceptualization: JML. Methodology: JML. Data curation: JML, HYL, and SHY. Writing - review & editing: JML, HYL, and SHY. All authors have read and approved the manuscript. HYL and SHY have equally contributed to this case report.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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Ethical Statement

All procedures were carried out in compliance with the principles outlined in the 1964 Declaration of Helsinki and its subsequent revisions, as well as the relevant guidelines. Consent for publication was obtained from all patients at the time of research enrollment and registration. All authors of this manuscript have agreed for publication.

Data Availability

All relevant data are included in this manuscript.

References