Significance of a clean-tip catheter closed suctioning system in a high-setting ventilated, super morbidly obese patient with profuse respiratory secretions

Mohd Zulfakar Mazlan, MBBS IIUM, MMed USM (Anesthesia) *, Rhendra Hardy Mohd Zaini, Shamsul Kamalrujan Hassan, Saedah Ali, Saniahah Che Omar, Wan Mohd Nazaruddin Wan Hassan

Department of Anesthesiology and Intensive Care, School of Medical Sciences, Health Campus, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia

Introduction: Closed suctioning is commonly used in the context of high-setting mechanical ventilation (MV), given its ability to prevent lung volume loss that otherwise accompanies open suctioning. However, closed suctioning systems (CSS) are not equivalent regarding components and capabilities, and thus this technique may be differentially effective to adequately clear patient secretions from an endotracheal tube (ETT), which is of paramount importance when the tube size makes the ETT particularly vulnerable to block by patient secretions.

Case presentation: A 25-year-old super morbidly obese female (body mass index = 55 kg/meter²) presented with worsening shortness of breath. For MV, pairing of a 6 mm (mm) diameter ETT to accommodate the patient's vocal cord edema, with a CSS not designed to maintain a clean catheter tip, precipitated ETT blockage and respiratory acidosis. Replacement of these devices with a 6.5 mm ETT and a CSS designed to keep the catheter tip clean resolved the complications. After use of the different ETT and CSS for approximately one week, the patient was discharged to home.

Discussion: The clean-tip catheter CSS enabled a more patent airway than its counterpart device that did not have this feature. Use of a clean-tip catheter CSS was an important care development for this patient, because this individual's super morbidly obese condition minimized tolerance for MV complications that would exacerbate her pre-existing tenuous respiratory health status.

Conclusion: Special attention should be given to the choices of ETT size and CSS to manage super morbidly obese patients who have a history of difficult airway access.

© 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Endotracheal tube (ETT) blockage is common among mechanically-ventilated (M-V) patients in the intensive care unit (ICU). Closed suctioning is recommended in patients who develop severe acute respiratory distress syndrome (ARDS), and are ventilated in the ICU to prevent loss of lung volume and limit environmental, personnel, and patient contamination [1,2]. Optimal positive-end expiratory pressure (PEEP) is necessary to maintain open alveoli during respiration, and the greatest lung volume loss occurs during disconnection of the ETT during open suctioning (OS) [3]. Given the advantages of closed suctioning (CS) compared to OS [2], it may be within the best interest of the healthcare provider and patient to use the former technique for the management of M-V individuals. However, the duration of ETT blockage by patient secretions can be prolonged if the secretions are inadequately removed from the airway by a closed suctioning system (CSS) that is insufficiently equipped to handle such clinical challenges.

This case report describes initial use of an ETT tube and CSS that, based on observable outcomes within the ETT and patient, were not optimal for managing the respiratory distress of a super morbidly obese patient. Subsequent replacement of the ETT and CSS were advantageous for the patient, in that they enabled proper care of
the original respiratory illness, and facilitated the patient’s eventual discharge from the hospital.

2. Case summary

The evaluations, treatments, and procedures described in this report were standard-of-care for the patient. No protocols were exercised that would have required appropriate informed consent or approval by an Institutional Review Board (IRB).

A 25-year-old, super morbidly obese female Malay patient (body mass index (BMI) = 55 kg/meter\(^2\) (kg/m\(^2\))) presented to the hospital with shortness of breath lasting two weeks, and had progressively worsened three days prior to admission. Upon examination, she had tachypnea, with reduced breath sounds in both lungs and basal crepitation. She had bilateral leg edema and high peak airway pressure, ETT blockage was suspected. Given the worsening respiratory acidosis, reduced tidal volume, and by maintaining a more patent airway compared to a CSS, the patient was extubated after one week of intubation with use of the ET and CSS replacements, and was discharged with prescribed noninvasive ventilation in the ICU.

3. Discussion

To our knowledge, this is the first report to demonstrate that a clean-tip catheter CSS can be clinically advantageous to treat a super morbidly obese patient. As suggested in this study, a relatively small ETT is susceptible to blockage by patient secretions. In this instance, the reason for choosing an ETT of 6 mm was to accommodate vocal cord edema, which was visualized though the video laryngoscope during the patient’s emergency intubation. The cause of the vocal cord edema was unknown, though it was thought to be a result of multiple attempts to intubate in the ward prior to successful fiber-optic intubation in the operating room.

This current report adds to an expanding bibliography that provides evidence-based suggestions for, and observations during, management of respiratory issues concerning various levels of obesity [4–7]. This growing list of citations is a testament to the challenging respiratory issues that obesity can present. Indeed, bariatric surgery can improve vital capacity, peak expiratory flow, functional residual capacity, total lung capacity, and forced expiratory volume in one second (FEV1)/forced vital capacity (FVC) [8,9]. Furthermore, compromised breathing ability associated with severe obesity (BMI > 40 kg/m\(^2\)), referred to as malignant obesity hypventilation syndrome (MOHS) [10], introduces multi-system organ dysfunction [5]. Mechanical ventilation (MV) may be indicated for obese patients to assist them through their respiratory distress and avoid MOHS, or for those with MOHS already. In either instance, effective removal of patient secretions by suctioning is especially critical to maximize the benefit of MV.

Closed suctioning is not routinely performed in our ICU to remove patient secretions associated with MV, due to its high cost compared to OS. The nurses in our facility have indicated that the possibility of removing all secretions is higher with the intermittent manual bagging and suctioning that is performed during OS. An advantage of CS, however, is that no manual bagging is performed, which prevents disconnection of the ETT and subsequent loss of lung volume. This loss of lung volume mostly affects the dorsal regions of the lungs, and results in very fast desaturation of super morbidly obese patients [11].

In this case study, we describe our experiences with two different CSS options. The significant difference in clinical care for this patient was accounted for by the healthcare choices made to select a replacement ETT and a different CSS than had been employed originally, during which the patient developed respiratory acidosis secondary to ET blockage by her oral secretions. Importantly, the second CSS includes design features to ensure that the tip of the catheter is completely clean after it is removed from the trachea. This tip cleaning feature may reduce the risk of introducing secretions into the trachea and lungs, thus also diminishing the risk of ventilator-associated pneumonia [12–14], and by maintaining a more patent airway compared to a CSS without this feature, worsening of obesity-related breathing difficulties to the point of developing MOHS [10].

4. Conclusions

Endotracheal tube blockage may occur in M-V patients who are managed with a small ETT and inadequate CSS, and be suspected in patients treated as such who develop sudden or progressive worsening respiratory acidosis. To manage these clinical challenges, healthcare professionals can exercise choices, including use of a larger ETT, and a CSS which can clean the tip of the suction catheter from any hard debris or thick secretions, such as the replacement one used for the patient in this case study. The favorable clinical outcomes enabled by these replacement devices illustrate that optimal ETT sizes and CSS are available for caregivers to choose to best manage super morbidly obese patients who have a history of difficult airway access.

Conflicts of interest

None.

Source of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration and verification

This case report has not been published previously, is not under consideration for publication elsewhere, and has been approved for submission by all authors and the institutional affiliate.
References

[1] S.M. Maggiore, E. Iacobone, G. Zito, C. Conti, M. Antonelli, R. Proietti, Closed versus open suctioning techniques, Minerva Anestesiol. 68 (2002) 360–364.
[2] M.C. Lavigne, Comparing suctioning techniques used to assist mechanical ventilation: protecting you and your patients, Int. J. Infect. Control 12 (2016) 12.
[3] K. Choong, P. Chatrikaw, H. Frndova, P.N. Cox, Comparison of loss in lung volume with open versus in-line catheter endotracheal suctioning, Pediatr. Crit. Care Med. 4 (2003) 69–73.
[4] X.Y. Hu, Effective ventilation strategies for obese patients undergoing bariatric surgery: a literature review, AANA J. 84 (2016) 35–45.
[5] M. Tatusov, J.J. Joseph, B.M. Cuneo, A case report of malignant obesity hypventilation syndrome: a weighty problem in our ICUs, Respir. Med. Case Rep. 20 (2017) 38–41.
[6] S. Fyneface-Ogan, D.S. Abam, C. Numbere, Anaesthetic management of a super morbidly obese patient for total abdominal hysterectomy: a few more lessons to learn, Afr. Health Sci. 12 (2012) 181–185.
[7] T. Salihoglu, Z. Salihoglu, A.K. Zengin, M. Taskin, N. Colakoglu, R. Bahazade, The impacts of super obesity versus morbid obesity on respiratory mechanics and simple hemodynamic parameters during bariatric surgery, Obes. Surg. 23 (2013) 379–383.
[8] L.-P. Boulet, H. Turcotte, J. Martin, P. Poirier, Effect of bariatric surgery on airway response and lung function in obese subjects with asthma, Respir. Med. 106 (2012) 651–660.
[9] R. Bennett, A. Manuel, Impact of bariatric surgery on respiratory function in obese patients, Eur. Respir. J. 42 (Suppl 57) (2013) P3352.
[10] P.E. Marik, H. Desai, Characteristics of patients with the “malignant obesity hypoventilation syndrome” admitted to an ICU, J. Intensiv. Care Med. 28 (2013) 124–130.
[11] S. Lindgren, H. Odenstedt, C. Olegård, S. Søndergaard, S. Lundin, O. Stenqvist, Regional lung derecruitment after endotracheal suction during volume- or pressure-controlled ventilation: a study using electric impedance tomography, Intensiv. Care Med. 33 (2007) 172–180.
[12] F. Wang, L. Bo, L. Tang, J. Lou, Y. Wu, F. Chen, J. Li, X. Deng, Subglottic secretion drainage for preventing ventilator-associated pneumonia: an updated meta-analysis of randomized controlled trials, J. Trauma Acute Care Surg. 72 (2012) 1276–1285.
[13] J. Muscedere, O. Rewa, K. McKechnie, X. Jiang, D. Laporta, D.K. Heyland, Subglottic secretion drainage for the prevention of ventilator-associated pneumonia: a systematic review and meta-analysis, Crit. Care Med. 39 (2011) 1985–1991.
[14] R. Scherzer, Subglottic secretion aspiration in the prevention of ventilator-associated pneumonia: a review of the literature, Dimens. Crit. Care Nurs. 29 (2010) 276–280.