Endotracheal Cuff Undersize Diagnosed by Magnetic Resonance Imaging: Case Report

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Abstract

We report a case that the airway can be completely sealed, when the endotracheal tube cuff pressure is 100 cmH2O. The diagnosis was made by the patient's chest CT(X-ray computed tomography), This case illustrates that the real cross-sectional area of airway from the case obviously exceeds the normal population.

Introduction

Endotracheal tubes created a seal between the endotracheal tube and the trachea, preventing aspiration of fluids and pathogens from the pharynx to the lungs and ventilation leaks. Consensus suggests that cuff pressure in endotracheal tubes should range from 20 to 30 cmH₂O^[1], However, in clinical practice cuff pressures > 30 cmH₂O may be required to create a seal in the trachea^[2], The possible reason is that cuff size may be unsuitable.

In terms of oral endotracheal tube, the global guidelines for endotracheal tube lack clear guidance or consensus on the selection of endotracheal tube model^[3]. Foreign studies suggest that adult female patients choose (ID) 7.0 to (ID) 8.0mm cannula, and male patients choose (ID) 8mm and (ID) 8.5mm; In children, traditionally, the formula based on demographic data is used to predict the appropriate size of endotracheal tube, and the traditional formula based on age, such as Cole ^[4]formula of endotracheal tube without air bag (inner diameter [ID] [mm] = [age at 4 years] + 4.0); For example, Motoyama formula (inner diameter [mm] = [age in the fourth year] + 3.5) for endotracheal tube with air bag has been widely used in children's ETT selection^[5]. The above shows that there is no consensus on the choice of endotracheal tube for patients, and there is an urgent need for an accurate and feasible method.

Case Presentation

Compared with the female patient's tracheal cross-sectional area in T_3 vertebra, the endotracheal tube (ETT) cuff undersize was diagnosed in a 70-yr-old with 50kg body weight and 158cm height during the patient's chest CT(X-ray computed tomography). Endotracheal tube was intubated through the mouth with reinforced endotracheal tubes CT showed tracheal area in T2 vertebra is 584.2 mm²(Fig1A), T3 vertebra is 646.2 mm²(Fig1B), T4 vertebra is 498.8mm²(Fig1C). Endotracheal intubation for patients. ID of endotracheal tube:7.0 (Guangzhou Weili Medical Equipment Co., Ltd., Guangzhou, China). Cuff diameter: 22mm, cross-sectional area of cuff:380.13 mm². The above results are greater than cross-sectional area of cuff:380.13 mm² (Fig2). Cuff pressure was maintained with the minimum leak technique (MLT) and measured with a cuff pressure gauge^[6], Subsequent cuff manometer measurement demonstrated a pressure of **100cm H₂O**.

Yousef aljatlany et al demonstrated the formula for measuring cross-sectional area in tracheal, cross-sectional area $= -171.834 + (0.5850 \times \text{age}) + (86.8685 \times \text{sex}) + (2.3953 \times \text{height in com})$ (Sex will be denoted by "1" for

men and "0" for women)^[7], The final calculated tracheal cross-sectional area of the patient is 247.5734 mm². Height-based nomogram for endotracheal tubes (ETT) size selection derived from the Coordes et al CT imaging study^[8], The final predicted ETT size of the patient is 6.5 or 7.0mm. According to the above two selection methods, theoretically, the cuff of endotracheal intubation can effectively seal the airway, When the intracuff pressure is 30 cmH₂O. However, the true tracheal cross-sectional area of the patient is unusual.

Discussion

The cuff during mechanical ventilation seals the airway, the endotracheal cuff pressure of 20 to 30 cmH₂O is adequate for most patients, but lack of a tracheal seal still occurs in a small number of people^[9, 10]. Similarly, the airway in our case can be completely sealed when the cuff pressure of endotracheal intubation reaches 100 cmH₂O. The diagnosis was made by the patient's chest CT(X-ray computed tomography), Main findings that the real cross-sectional area of airway was significantly larger than cross-sectional area of cuff. This case illustrates that the real cross-sectional area of airway from the case obviously exceeds the normal population and the importance of rapid the patient's chest CT diagnosis to prevent mismatch cuff with airway, to select the cuff of endotracheal tube matching with the patient's airway.

Consensus suggests that cuff pressure in endotracheal tubes should range from 20 to 30 cmH₂O^[11]. Excessively high or low cuff pressures have been associated with complications such as tracheal stenosis, leaking of tidal volume, microaspiration of secretions, and ventilator-associated pneumonia^[12]. As can be seen from Fig1, Compared with cross-sectional area of cuff, the real cross-sectional area of trachea was significantly larger; so that the cuff pressure is 100 cmH₂O, the cuff of endotracheal intubation can seal the airway. Referring to the consensus of experts, patients are prone to ventilator-associated pneumonia.

Conclusion

Cross-sectional area of trachea should be periodically evaluated by the patient's chest CT during anesthesia to assure that mismatch is not present. When the intracuff pressure is 20 to 30 cmH₂O, the trachea of all patients can be effectively sealed.

Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the editor in chief of this journal.

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Authorship

Hong-Lei Wu and Pei-pei Ji: were actively involved in the clinical care of the patient. Hong-Lei Wu and Yan-Man Zhang: wrote the manuscript. Jia-hai Shi and Wang-Qin Shen: revised the manuscript.

Conflict of Interest

The authors declare that they have no competing interests.

Figure Legend

Fig1. Computed tomography images for measurements of different upper tracheal levels Crosssectional area about this special patient. A, T2 vertebra (584.2 mm²). B, T3 vertebra(646.2 mm²). C, T4 vertebra(498.8mm²).

Fig2. Comparison of cross-sectional area of endotracheal tube balloon cuff and patient trachea from T2 vertebra, T3 vertebra and T4 vertebra.

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