Chinese Medical Journal®

Thyroid cartilage elevation maneuver: a novel and easy-to-perform method to insert a supraglottic airway device

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To the Editor: A supraglottic airway device (SAD) can be used instead of an endotracheal tube (ET) in emergency situations. There are two types of SAD, cuffed and non-cuffed, the ease of use and success rates of which are similar. Compared to ET insertion, SAD insertion is quick and simple, while providing comparable ventilation. The 2019 American Heart Association guideline recommends SAD insertion in emergency situations, such as out-of-hospital cardiac arrest.[1,2] However, the success of SAD insertion is not easily ascertained. According to one study, when a SAD was used in an emergency medical service (EMS) setting, airway failure was not recognized in 13.8% of patients.[3] Incorrect positioning of a SAD is evidenced by bite block malalignment with the incisors and ineffective gas exchange (characterized by thoracic and "front of neck" excursions, inadequate tidal volume, low arterial oxygen saturation [SpO_2], poor capnograph trace, high airway pressure, and air leak).[1,4] Failure to insert a SAD to the proper depth typically results from the resistance of structures around the hypopharynx.[5] In this study, we introduce the thyroid cartilage elevation (TCE) maneuver, a simple and novel method that facilitates correct insertion of a SAD.

A 57-year-old man weighing 71 kg complained of severe chest pain, suddenly lost consciousness while working at a computer in his office. Witnesses called the EMS and performed bystander cardiopulmonary resuscitation. The EMS provider arrived on the scene with an automatic external defibrillator and found the man to be apneic, with ventricular fibrillation. The paramedics performed two rounds of cardiopulmonary resuscitation with 200 J defibrillation, and after 4 min, the patient gained a return of spontaneous circulation. A size 4 I-gel™ SAD (Intersurgical Ltd., Wokingham, UK) was inserted by paramedics and the patient was transferred to the hospital. Upon arrival, his mental status was semicomatose and his vital signs were as follows: blood pressure, 103/58 mmHg; heart rate, 101 bpm; respiratory rate, 18 breaths/min; body temperature, 36.1°C; and peripheral capillary oxygen saturation (SpO_2), 86%, as determined by pulse oximetry. The patient had no specific medical history and no signs of trauma around his face and neck. His end-tidal carbon dioxide ($EtCO_2$) level was low, at 5 to 15 mmHg, and his SpO_2 did not rise despite the administration of 15 L of oxygen per minute via a silicone resuscitator. When seeking to establish the cause of hypoxia, the I-gel™ position guide was found to be 3 cm above the incisor line. Despite the application of gentle pressure to better position the I-gel™, it could not be inserted to sufficient depth due to resistance at its tip arising from the hypopharyngeal area. The position of the SAD was checked by using fiberoptic scope, and the clinician found that the distal tip of the SAD was folded over backward due to blockade of the arytenoid cartilage. A further attempt was made, in which the thyroid cartilage was elevated by the clinician with one hand while the I-gel™ was pushed with the other [Supplementary Figure 1, http://links.lww.com/CM9/A557]. This resulted in deeper I-gel™ insertion, such that it was positioned along the incisor line in accordance with the guideline. Breathing sounds from both lungs were confirmed by auscultation, and the rising of both sides of the chest was visually evaluated. The patient's SpO_2 level increased to 99%, the waveform on capnography had a normal shape (four-phase waveform), and the $EtCO_2$ was >35 mmHg. The patient then underwent percutaneous coronary intervention due to left anterior descending coronary artery occlusion and was admitted to the intensive care unit, with targeted temperature management. He was discharged from the hospital after 8 days with a cerebral performance category score of 2.

Ideally, a SAD is positioned such that the tip of its distal cuff is located in the esophagus; however, artificial ventilation is often performed even when the SAD has not been inserted to the proper depth.[4] Improper SAD insertion can occur due to the blind nature of the technique

Access this article online

Quick Response Code:

Website: www.cmj.org

DOI: 10.1097/CM9.0000000000001523

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Chinese Medical Journal 2021;134(18)
Received: 22-10-2020 **Edited by:** Jing Ni

and the dependence on the clinician's skills for correct insertion of the device into the hypopharynx.[4]

To fix the SAD in the ideal position requires placement of the tip of its distal cuff into the esophagus.[4] However, in unconscious patients, such as those with cardiac arrest, muscle tension in the laryngeal area (eg, in the cricopharyngeal muscle) decreases, thus blocking the path to the esophagus.[6] In any (sub)comatose patient, the tongue falls backward, obstructing the entrance to the airway. The partial obstruction results in a noisy breathing, whereas complete obstruction results in "no sounds." SAD insertion is further complicated by the resistance of the epiglottis and the structures constituting the larynx (eg, the vocal cords and arytenoid cartilage).[4] If the SAD is pushed forcibly, ignoring the resistance, the epiglottis may fold downward and become caught in the bowl of the SAD, or the SAD may be impeded by laryngeal structures such as the arytenoid cartilage, resulting in inadequate ventilation [Figure 1A and 1B].[4]

To correctly position the SAD, its bowl should be located in the hypopharynx.[4] The hypopharynx extends superiorly from the hyoid bone inferiorly to the caudal part of the cricoid and contacts the structures of the larynx, that is, the arytenoid cartilage, thyroid cartilage, vocal cords, epiglottis, and cricoid cartilage. The arytenoid cartilage is located at the junction of the cervical esophagus, and the thyroid cartilage is connected by ligaments and muscle to several other laryngeal structures. The TCE maneuver, in which the thyroid cartilage is lifted, greatly facilitates SAD insertion by altering the positions of the structures around the hypopharynx, such that sufficient space is made for the bowl of the SAD [Figure 1C and 1D].

The TCE maneuver is performed as follows: (1) Select a tube size suitable for the patient. (2) Cross the first and second fingers of the left hand to open the patient's mouth, while tilting his or her head. (3) Hold the SAD with the right hand and push it in. (4) When resistance is felt, remove the left hand from the oral cavity, and then grasp the thyroid cartilage and pull it upwards. (5) At the same time, push the SAD until the guideline position (ie, along the incisor line) is located. (6) Fix the SAD. If the cuffed-type SAD is used, fix it after inflating the balloon.

Our novel maneuver takes into account two anatomical changes in the unconscious patient. First, due to the influence of gravity, the muscles, cartilage, and bones around the supraglottic areas fall in supine patients,

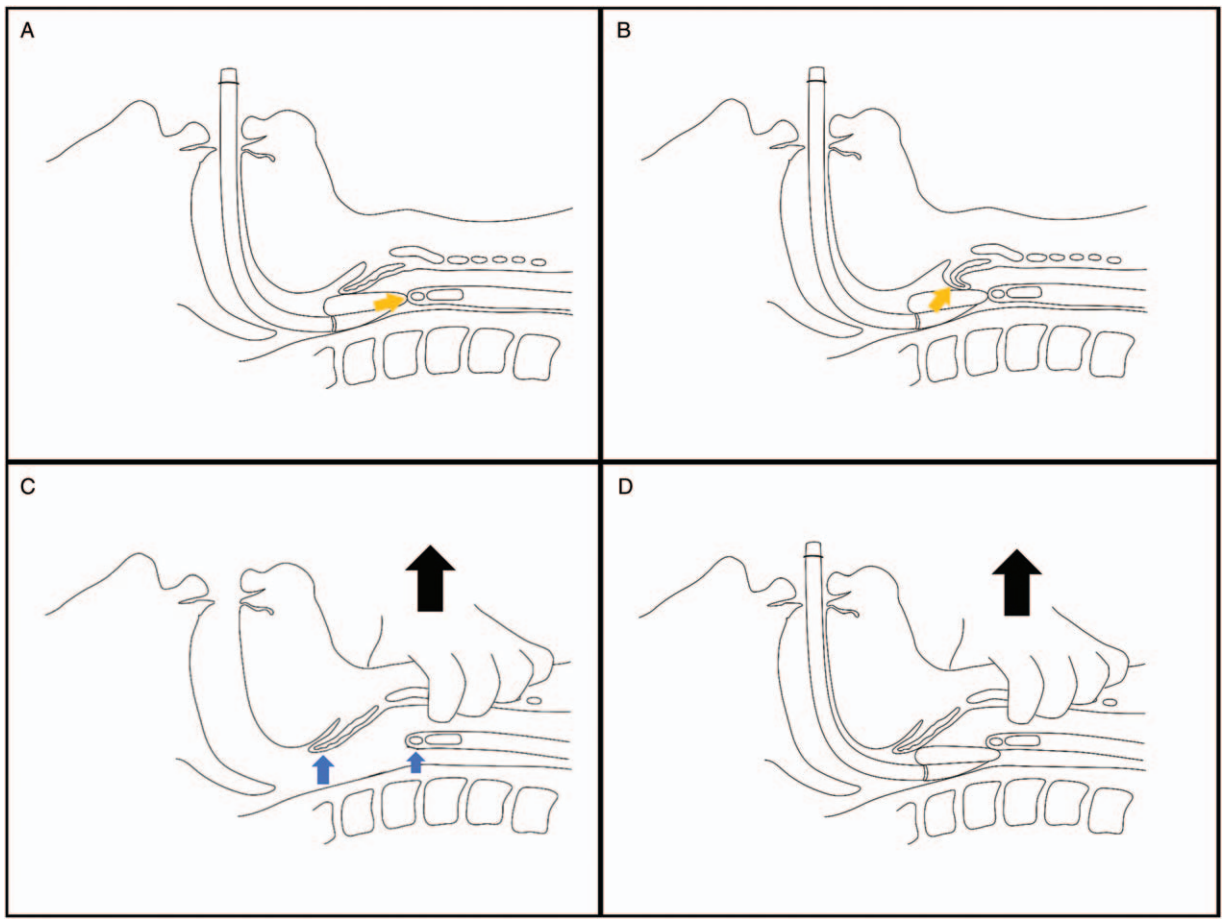

Figure 1: Illustration for inserting the SAD. (A) The SAD can be impeded by the arytenoid cartilage during insertion. (B) The SAD may be obstructed by the downfolded epiglottis during insertion. (C) Lifting the epiglottis and arytenoid cartilage using the TCE maneuver creates adequate space for the SAD. (D) The SAD was fixed in the ideal position following the TCE maneuver. SAD: Supraglottic airway device; TCE: Thyroid cartilage elevation.

preventing the SAD tip from entering the hypopharynx and esophagus.[6] Second, optimal SAD insertion may be prevented by resistance from laryngeal structures, such as the epiglottis, vocal cords, or arytenoid cartilage.[4] The TCE maneuver pulls the cricopharyngeal muscle; the arytenoid cartilage is moved upward, and the trachea and esophagus are effectively separated to create a space for the SAD tip to be placed in the esophagus through the cervical esophagus opening.[7] In a previous study, anterior thyroid cartilage traction, similar to our maneuver, prevented a nasogastric tube from being blocked by the arytenoid cartilage and facilitated insertion of the tube into the esophagus.[7]

However, among the various SADs that are available, we have tested the TCE maneuver only when using the I-gel™, and only in one patient, and there is a need to compare the jaw thrust maneuver, which can make similar result by lifting the epiglottis with the TCE maneuver in a manikin or later in patient studies. Further studies are required to validate this method.

It would be better to insert the airway device using a vision-guided insertion technique to protect the patient's airway. However, in emergency situations where blind insertion should be required, the SAD insertion will be an alternative method. In (sub)comatose patients, the upper airway and esophagus may be obstructed due to loss of muscle tension. Consequently, during SAD insertion, the tip may be malpositioned due to resistance from laryngeal structures, resulting in inadequate ventilation like air leakage or obstruction. By altering the position of structures around the hypopharynx, the TCE maneuver avoids malpositioning of the SAD and simplifies insertion. This easy-to-perform technique is an effective assistive maneuver that can be used by all clinicians as well as unskillful paramedics.

Declaration of patient consent

The authors certify that they have obtained the appropriate patient consent form. In the form, the patient's guardian has given consent for the patient's image and other clinical information to be reported in the article. The patient's guardian understands that patient's name and initials will not be published and due efforts will be made to conceal the identity of the patient.

Acknowledgements

The authors would like to thank Jiha Park for assisting with the production of the graphic figure.

Funding

This work was supported by the Soonchunhyang University Research Fund (No. 20200041).

Conflicts of interest

None.

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How to cite this article: Nah S, Kim GW, Han S. Thyroid cartilage elevation maneuver: a novel and easy-to-perform method to insert a supraglottic airway device. Chin Med J 2021;134:2266–2268. doi: 10.1097/CM9.0000000000001523