



Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Brief Report

Utilization of a gum elastic bougie to facilitate single lung intubation ☆☆☆

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ARTICLE INFO

Article history:

Received 25 May 2016

Received in revised form 24 August 2016

Accepted 25 August 2016

Available online xxxxx

ABSTRACT

Introduction: Patients with severe pulmonary hemorrhage due to unilateral trauma or a bleeding cancer often present to the emergency department in acute respiratory distress. Although it is generally recommended to perform single lung intubation, most emergency department providers do not have access to or are not familiar with double-lumen endotracheal tubes, and blind insertion of an endotracheal tube to maximum depth does not ensure that the proper (nonhemorrhagic) lung is ventilated. Therefore, single lung intubation may be significantly delayed in these patients. The purpose of this study was to assess the accuracy of using a gum elastic bougie (“bougie”) to facilitate single lung intubation.

Methods: We conducted a prospective, randomized, blinded pilot study assessing the accuracy of bougie-guided single lung intubation in a fresh human cadaveric model. Two investigators each inserted a bougie under video laryngoscope guidance. After passing the vocal cords, the intubator would be randomized to turn the bougie 90° clockwise (for right mainstem intubation) or 90° counterclockwise (for left mainstem intubation). The bougie was then advanced until resistance was met, and the endotracheal tube was subsequently advanced over the bougie. After intubation, a board-certified pulmonologist investigator who was blinded to the initial lung selection used a fiberoptic bronchoscope to confirm placement by assessing endotracheal tube location with respect to the carina. The primary outcome was the accuracy of correct lung placement.

Results: Two providers performed a total of 45 placements. There were 22 right mainstem and 23 left mainstem intubations. The overall accuracy was 100% (95% confidence interval, 90.2%–100%) for both right and left mainstem intubations.

Discussion: In our cadaveric model of mainstem intubation, bougie-guided single lung intubation was highly accurate for both left and right mainstem intubations. Future studies should assess the accuracy of this technique among different providers and bodies, as well as live patients.

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Introduction

Severe pulmonary hemorrhage necessitating intubation is a rare and potentially deadly complication of numerous conditions, including lung cancer, unilateral pulmonary trauma, and infections [1,2]. These patients often require emergent intubation due to worsening respiratory distress from the blood occluding the airspace. When the causative side is known (eg, lung mass, unilateral trauma, unilateral lung opacities), it is recommended to perform isolated intubation of the contralateral lung to protect the nonaffected airspace [1,3,4]. However, this is typically delayed until the operating room, where a double-lumen endotracheal tube (ETT) may be placed with bronchoscopic guidance and confirmation [1,3,4]. Double-lumen ETTs are not available

in most emergency departments, and most emergency physicians are not familiar with their placement. In addition, bronchoscopy can be very challenging in patients with significant pulmonary hemorrhage. As a result, most providers will either intubate the trachea only (leaving the contralateral lung unprotected) or attempt right-sided intubation by blindly advancing the tube past the normal depth [5].

The gum elastic bougie (“bougie”) is a straight plastic tube with a curved coudé tip, which has been used as a guide for ETT placement when visualization is limited [6,7]. We hypothesized that, after entering the trachea, the bougie could be used to guide the ETT selectively into the preferred bronchus without requiring bronchoscopy.

Methods

We conducted a prospective, randomized, blinded pilot study assessing the accuracy of bougie-guided single lung intubation in a single fresh human cadaveric model. The local institutional review board approved this study for exempt status. There was no funding provided for this study.

☆ Financial support: none.

☆☆ Meetings: none.

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Two investigators each independently inserted the 15 French 70-cm bougie with coude tip (SunMed, Largo, FL) under video laryngoscope guidance (McGrath MAC Enhanced Direct Laryngoscope; Minneapolis, MN). One intubator was a board-certified emergency physician with greater than 10 years of experience, whereas the second intubator was a senior emergency medicine resident physician. After passing the vocal cords, the intubator was randomized using a computerized random number generator to turn the bougie 90° clockwise (for right mainstem intubation) or 90° counterclockwise (for left mainstem intubation) (Fig. 1). The bougie was then advanced until resistance was met, and a size 6.0 cuffed ETT was subsequently advanced over the bougie. The bougie was removed, and the ETT was left in place (Fig. 2). A board-certified pulmonologist with extensive bronchoscopic experience who was blinded to the placement then entered the room and confirmed placement using a video bronchoscope. The ETT was subsequently removed and the procedure repeated. The primary outcome was accuracy of correct unilateral placement. Results were recorded in Microsoft Excel (version 15.22; Santa Rosa, CA). Descriptive statistics were used to analyze the data with 95% confidence intervals included where appropriate.

Results

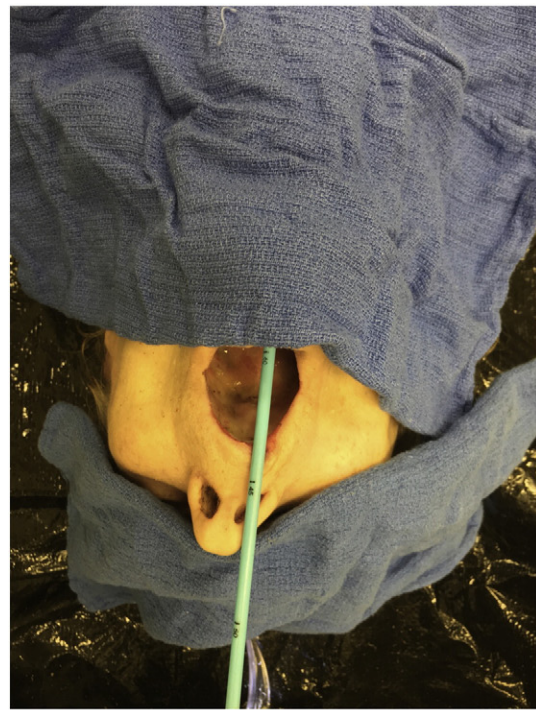
Two providers performed a total of 45 placements in a fresh human cadaveric model. There were 22 right mainstem and 23 left mainstem intubations performed. The overall accuracy was 100% (95% confidence interval, 90.2%–100%) for both right and left mainstem intubations.

Discussion

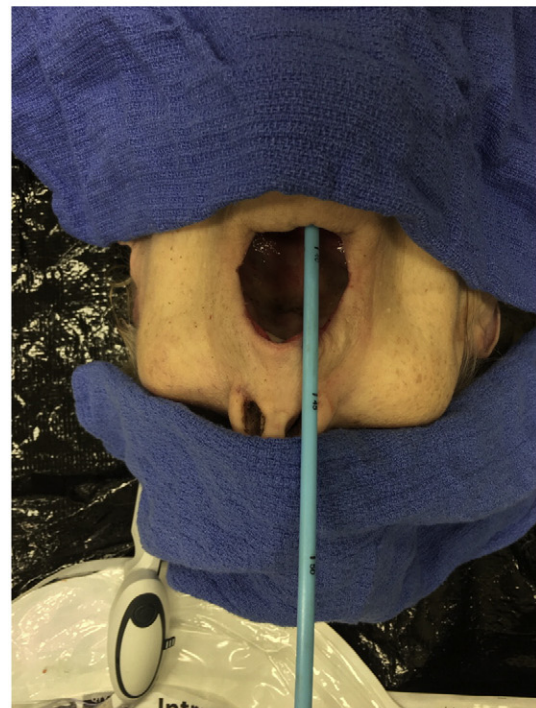
Given the significant morbidity and mortality associated with severe pulmonary hemorrhage, as well as the challenges associated with bronchoscopic visualization and availability of a double-lumen ETT, it is important for the emergency provider to have alternative techniques available for single lung intubation. One prior cadaveric study demonstrated that blind ETT placement with 90° rotation of the ETT alone was associated with 94% accuracy with right mainstem intubation but only 72% accuracy with left mainstem intubation [8]. Another study of the same technique in live adult patients demonstrated similar accuracy with 90% success for right mainstem intubation and 70% accuracy for left mainstem intubation [9]. Our pilot study demonstrated that, using the bougie, we were able to direct the ETT into the correct lung with 100% accuracy for both right and left mainstem intubations.

The use of the bougie allows for improved guidance for unilateral ETT placement, as the curved coude tip gently directs the ETT into the targeted lung after gliding off of the carina. This may be particularly valuable when the bleeding site is known and mainstem intubation is advantageous or to assist with lung decompression prior to emergency department thoracotomy. This may also be valuable when bronchoscopic visualization is limited by significant hemoptysis or when a bronchoscope is in the airway and is being used to tamponade hemorrhage from a bleeding lesion while awaiting definitive surgical intervention. In the latter scenario, we suggest that the bougie be inserted parallel to the bronchoscope and turned 90° toward the unaffected lung with subsequent intubation over the bougie. After placement, the ETT should be confirmed using a portable chest radiograph, bronchoscopy, or ultrasonography [10].

It is important to note that this was a pilot study performed in a single human cadaveric model, so it is possible that this may not completely replicate live patients. However, a fresh human cadaveric model was used to more accurately replicate a live patient. In addition, as only 1 cadaver was used, it is possible that this may not apply to other models. This was limited by cadaver availability, and future studies using a variety of cadavers should be performed to determine the reproducibility of this technique in additional models. Finally, only 2 providers performed this technique, so it is possible that this may not



a



b

Fig. 1. Bougie placement after 90° rotation counterclockwise (a) for left mainstem and clockwise (b) for right mainstem.

apply to other providers. However, each intubator had different levels of experience and both were equally accurate.

Conclusion

In our cadaveric model of mainstem intubation, bougie-guided single lung intubation was highly accurate for both left and right mainstem intubations. Future studies should assess the accuracy of



Fig. 2. Endotracheal tube placement after mainstem intubation.

this technique among different providers and bodies, as well as in live patients.

Acknowledgments

We would like to thank James Williams, PhD; Anthony Serici; and the Rush cadaver laboratory for their assistance with this study. We would also like to thank Errick Christian for his statistical assistance.

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