



Original Contributions

SUCCESS OF THE GUM ELASTIC BOUGIE AS A RESCUE AIRWAY IN THE EMERGENCY DEPARTMENT

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Abstract—Background: The gum elastic bougie (GEB) is a rescue airway device commonly found in the emergency department (ED). However, data documenting its efficacy are lacking in the emergency medicine literature. **Study Objectives:** To determine the success rate of endotracheal intubation using a GEB and the reliability of “palpable clicks” and “hold-up” in the ED setting. **Methods:** The GEB was introduced at our two affiliated urban EDs with a 3-year residency training program and an annual census of 150,000. Physicians were trained in the use of the GEB before initiation of the study. Over the course of 1 year, we conducted a prospective, observational study of GEB practices in the ED. The study population included all adult patients on whom intubation was attempted with a GEB. All emergency physicians attempting intubation completed a structured data form after laryngoscopy, recording patient characteristics, grade of laryngeal view (using the modified Cormack-Lehane classification), and presence of “palpable clicks” and “hold-up.” Indications for GEB use in our ED include a difficult or rescue airway and for training purposes. Data were analyzed using standard statistical methods and 95% confidence intervals. **Results:** In our study period, there were 26 patients on whom intubation was attempted with a GEB. The overall success rate was 20/26 (76.9%; 95% confidence interval [CI] 60.7–93.1%). Among cases where the GEB was used for training purposes (all grade 1 or 2a laryngeal view), six of seven (85.7%) intubations were successful. When the GEB was used for clinically indicated purposes, 14 of 19 (73.7%; 95% CI 53.9–93.5%) intubations were successful. Palpable

clicks were appreciated in 11/20 successful intubations (sensitivity 55.0%; 95% CI 33.2–76.8%); there was one false positive (specificity 80%; 95% CI 40.9–98.2%). Of 20 successful intubations, hold-up was deferred in five cases; of 15 remaining cases, hold-up was appreciated in 5/15 (sensitivity 33.3%; 95% CI 9.5–57.2%); there were no false positives (specificity 100%; 95% CI 60.7–100%). **Conclusions:** In our ED setting, the GEB had a success rate of 73.7% when utilized as a rescue airway after failed attempts. The characteristics of “palpable clicks” and “hold-up” were unreliable. © 2008 Elsevier Inc.

Keywords—intubation; rescue airway; gum elastic bougie; bougie; laryngoscopy

INTRODUCTION

The gum elastic bougie (GEB), also known as the Eschmann tracheal tube introducer, is a rescue airway device for difficult airways that is increasingly utilized in the emergency department (ED). MacIntosh first described the utilization of intubation over a GEB in 1949 (1). Successful endotracheal intubation with the GEB involves cannulation of the trachea using the GEB, followed by threading and placement of the endotracheal tube via the Seldinger technique. Signs that reportedly indicate successful tracheal placement include “palpable clicks” as the GEB rubs against the tracheal rings, and

“hold-up” as the GEB abuts the carina or encounters the narrowing bronchus (2).

Although the incidence of failed airways in the ED is quite low (approximately 1%), use of the GEB is generally indicated when vocal cords are not fully visualized (3). In addition, the incidence of airways that are difficult to manage varies greatly, including estimates as high as 20% (4). Successful use of the GEB as an intubation aid for difficult airways has been well documented in the anesthesia literature, however, the documentation of successful utilization of the GEB in the emergency medicine literature is sparse and limited to subject reviews and case reports (2,5–10).

We conducted a study to determine the overall success rate of endotracheal intubation using the GEB, and to determine the utility of “palpable clicks” and “hold-up” (signs of tracheal placement of GEB) in the ED setting.

MATERIALS AND METHODS

Study Design

This was a prospective, observational study of success rates of endotracheal intubation using the GEB. The study was approved by our local institutional review board.

Study Setting and Population

The study was conducted at our two affiliated urban EDs with a 3-year residency training program and an annual census of 150,000. The population included all adult patients (18 years of age and older) on whom intubation was attempted with a GEB over the course of 1 year, from August 2005 to August 2006.

Study Protocol

All resident and attending physicians at our facility were trained in the use and features of the GEB before onset of the study. All physicians received a 5-min didactic presentation and practiced on two mannequins, including one in which “difficult intubation” conditions were partially simulated by placement of a cervical-spine immobilization collar. Physicians attempted intubation of mannequins with a GEB until successful. Pamphlets were also distributed throughout the ED for easy reference and review, and periodic updates and reminders from the study team on the use and purpose of the GEB were sent by e-mail and announced in weekly conferences.

Indications for GEB use in our ED include a difficult or rescue airway and for educational training purposes. If a difficult or rescue airway was encountered where the vocal cords were not visible, training sessions and literature suggested that the intubating physician consider “palpable clicks” and “hold-up” to be measures indicating successful intra-tracheal placement of the GEB. If the vocal cords were visible (i.e., GEB used for educational training purposes), it was requested that the intubating physician be aware of “palpable clicks” when present, but forgo assessment of “hold-up.” This was a precautionary measure to avoid potential complications in cases where the GEB was passed into the trachea under direct visualization. Table 1 outlines the GEB Protocol.

Every emergency physician completed an anonymous structured data form after laryngoscopy, recording patient characteristics, grade of laryngeal view (using the modified Cormack-Lehane classification), presence of “palpable clicks” and “hold-up,” and whether the GEB was used for difficult or rescue airway or for educational training purposes. Research assistants were present 16 h per day in the ED, and a consecutive sample of patients was sought during these hours.

Definition of Terms

“Palpable clicks” were defined as perceptible snaps of the GEB, presumably occurring as it passes along the rings of cartilage in the trachea. “Hold-up” is the

Table 1. Intubation with GEB Protocol

If vocal cords are visible:	
●	Pass the bougie through
●	Check for “palpable clicks”
●	Slide/“railroad” ETT over bougie (do not remove laryngoscope blade)
●	Rotate ETT 90° counter-clockwise before passing through cords to prevent bevel from catching on arytenoids or vocal cords
●	Pull bougie out while holding ETT securely
●	Confirm tracheal ETT placement
If vocal cords are NOT visible:	
●	Pass the bougie as anteriorly as possible and check for “palpable clicks”
●	Advance the ETT until “hold-up” or a maximum distance of 45 cm
●	If neither “clicks” nor “hold-up” appreciated, GEB is likely in the esophagus
●	If “clicks” or “hold up” are present, slide, or “railroad” the ETT over the bougie
●	Rotate ETT 90° counter-clockwise before passing through cords to prevent bevel from catching on arytenoids or cords
●	Pull bougie out holding ETT
●	Confirm tracheal ETT placement

GEB = gum elastic bougie; ETT = endotracheal tube.

resistance encountered during insertion of a GEB; it occurs as a result of the tip abutting a small bronchus preventing further advancement, and therefore occurs at a significantly more distal point of insertion than palpable clicks.

Data Analysis

Data were analyzed using standard statistical methods of descriptive measures and diagnostic tests (sensitivity, specificity, predictive values, and likelihood ratios) with corresponding 95% confidence intervals (CIs).

RESULTS

The GEB was used on 26 patients during the study period. The overall success rate was 20/26 (76.9%; 95% CI 60.7–93.1%). Among cases where the GEB was used for training purposes (all grade 1 or 2a laryngeal view), 6 of 7 (85.7%) intubations were successful; the sole unsuccessful intubation (#6 in Table 2) was due to inability to pass the endotracheal tube (ETT) over the GEB, likely because the laryngoscope blade was withdrawn prematurely (a breach of the study protocol). When the GEB was used for clinically indicated purposes as a rescue during cases of “difficult airway” (90% unable to visualize cords), 14 of 19 (73.7%; 95% CI 53.9–93.5%) intubations were successful, after a median of 2 (range 0–4) prior unsuccessful intubation attempts (Figure 1).

Of the six cases where GEB use was unsuccessful, the GEB could not be advanced past the hypopharynx in two cases; there were no signs of tracheal placement in two cases (ETT was never passed). The esophagus was intubated in one case (palpable clicks appreciated but hold-up was not) and the ETT could not be passed

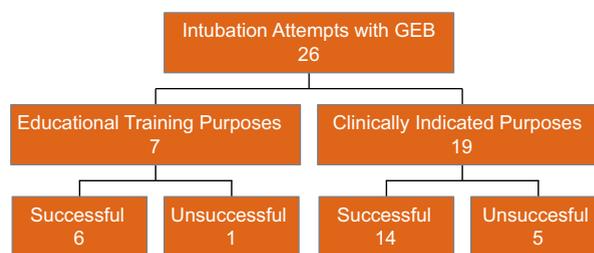


Figure 1. Success rate of the gum elastic bougie.

over the GEB (possibly due to premature withdrawal of the laryngoscope blade) in the remaining case (Table 2).

In calculating the utility of “palpable clicks” and “hold-up,” one case where the ETT could not be passed over the GEB (#6 in Table 2) was omitted because there was no objective confirmation that the GEB was actually in the trachea. Palpable clicks were appreciated in 11/20 successful intubations (sensitivity 55.0%; 95% CI 33.2–76.8%). Of the five unsuccessful intubations, there was one incident of false-positive “palpable clicks” (specificity 80%; 95% CI 40.9–98.2%) with esophageal intubation. Positive predictive value (PPV) and negative predictive value (NPV) of palpable clicks were 91.7% (95% CI 68.1–99.5%) and 30.8% (95% CI 11.5–56.4%), respectively. The positive likelihood ratio (LR+) was 2.75 and the negative likelihood ratio (LR–) was 0.56.

Of 20 successful intubations, hold-up was deferred in five cases (four in which cords were directly visualized and one stopped at definitive clicks); of 15 remaining cases, hold-up was appreciated in five (sensitivity 33.3%; 95% CI 9.5–57.2%). Of the five failed GEB intubations, there were no false positives (specificity 100%; 95% CI 60.7–100%). PPV and NPV were 100% (95% CI 60.7–100%) and 33.3% (95% CI 14.2–57.4%), respectively. The LR+ was incalculable and the LR– was 0.67.

DISCUSSION

We introduced the GEB, a rescue airway adjunct for difficult airways, in our institution in August of 2005, and prospectively studied our experience with the device. Our overall 76.9% success rate in achieving tracheal intubation is lower than the 100% rate often cited in the anesthesia literature; however, previous studies were not conducted in the ED setting (4).

We encountered a total of six cases of GEB failure, one of which we attributed to breach of protocol and failure to use the device properly. Of note, the five remaining cases of true GEB failure were found in truly difficult airway cases: four were eventually intubated by a more experienced clinician (two by emergency physi-

Table 2. GEB Failures

Number	Indication	Reason for Failure
1	Difficult airway	Unable to advance GEB past hypopharynx
2	Difficult airway	Unable to advance GEB past hypopharynx
3	Difficult airway	No signs of tracheal placement (no clicks/hold-up)
4	Difficult airway	No signs of tracheal placement (no clicks/hold-up)
5	Difficult airway	Esophageal intubation (palpable clicks/no hold-up)
6	Educational training	Unable to pass the ETT over the GEB

GEB = gum elastic bougie; ETT = endotracheal tube.

cians, and two by anesthesiologists) by traditional direct laryngoscopy, and one was intubated only with the aid of a fiberoptic intubating scope after multiple attempts at direct laryngoscopy by multiple operators.

We found the presence of signs of successful tracheal placement of the GEB (“palpable clicks” and “hold-up”) to be unreliable. Although the specificity and PPV of “hold-up” was 100%, we cannot conclude that it is more reliable than “palpable clicks” due to the small sample size. The sensitivities of “palpable clicks” and “hold-up” in this study (55.0% and 33.3%, respectively) are much less than those documented in the anesthesia literature (89.7% and 100%, respectively) (2). We believe that a large portion of this difference can be accounted for by the fact that the operating room and ED constitute very different practice environments. The vast majority of intubations in the ED are emergently or urgently indicated, in contrast to previously referenced anesthesiology study populations, comprised exclusively of healthy subjects undergoing elective surgery. The combination of situational stressors, patient acuity, cervical immobilization, lack of oxygen reserve, non-filtering of known difficult airways, ambient noise, and physiologic time pressures in ED patients with ongoing clinical deterioration all mean that substantially disparate populations and intubating conditions are represented by investigations in the elective operating room environment and the ED. In addition, the aforementioned study employed artificial “simulation” of a difficult airway, whereas our study represents a report of genuinely difficult airways encountered contemporaneously in the ED (2).

There are other rescue devices commercially and readily available designed to establish a protective airway. These include, but are not limited to, the intubating laryngeal mask airway (ILMA) and the lighted stylet. Similar to the GEB, these devices have enjoyed exceptional success rates in the anesthesia literature (99.3% for the ILMA and up to 99% for the lighted stylet) (11–13). However, like the GEB, emergency medicine literature documenting efficacy as a rescue airway in the ED is limited for these devices. One small ED study found the ILMA successful in 5/7 (71.4%) rescue intubations, and an extensive literature search we conducted yielded no studies evaluating the efficacy of the lighted stylet in the ED setting (14).

In light of our experience, it is reasonable to try the GEB in the ED as a rescue airway device and consider it an important addition to the armamentarium of the emergency physician. It should not be relied upon as a solitary back-up option and the physician should be prepared for further efforts to establish an airway in the event of GEB failure.

LIMITATIONS

This study was performed at an institution where the physicians were using the GEB for the first time. It is possible that a few of the missed intubations were due to inexperience. The results may be different if all the physicians had more experience with the GEB.

Although the data forms were completed by the emergency physicians anonymously immediately after intubation, it is possible that their reporting was biased by not wanting to report difficulties or problems with their intubation. We had to rely on self-reported information.

Although this is the largest, prospective ED-based study of the GEB as a rescue airway device, our sample size was very small. Repeating this study over a longer time period or at multiple centers would yield a more reliable success rate of intubation with the GEB and more reliable sensitivity of signs of tracheal intubation (“palpable clicks” and “hold-up”).

The intubating physicians in this study were predominantly residents at a teaching institution. They are likely not as skilled or experienced at intubation in general as an attending physician and there may be a higher level of anxiety with evaluating a new intubation tool such as the GEB.

CONCLUSIONS

In our ED setting, the gum elastic bougie had a success rate of 73.7% when utilized as a rescue airway after failed attempts. The characteristics of “palpable clicks” and “hold-up” were unreliable.

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ARTICLE SUMMARY

1. Why is this topic important?

The gum elastic bougie is a rescue airway device commonly utilized in the emergency department (ED). However, data proving its efficacy are lacking in the emergency medicine literature.

2. What does this study attempt to show?

This study attempts to document the success of the gum elastic bougie as a rescue airway device in the ED and to assess the utility of “palpable clicks” and “hold-up” in the ED.

3. What are the key findings?

We found that the gum elastic bougie has a success rate of 73.7% as a rescue airway device in the ED and that the characteristics of “palpable clicks” and “hold-up” are unreliable.

4. How is patient care impacted?

The gum elastic bougie is a viable option as an airway rescue device in the ED.
