Usefulness of magnetic bougie in comparison to a normal bougie for endotracheal placement in Cormack Lehane grade IV cadavers

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Abstract

Background: Incidence of adverse events following endotracheal intubations was around 12%. Bougie helps to eliminate this problem by acting as aid to intubation. Magnetic bougie is latest introduction and needs to confirm its usefulness.

Objective: To study usefulness of magnetic bougie in comparison to a normal bougie for endotracheal placement in Cormack Lehane grade IV cadavers

Methods: Institution based comparative study was carried out among five cadavers at Department of Anatomy of a medical college. Six personnel attempted insertion of normal and magnetic bougie separately in each cadaver making 30 attempts each for normal and magnetic bougie. Time taken for insertion of bougie was noted in seconds and compared between bougies. Success rate for single attempt insertion of bougie was noted as success or failed attempt for each cadaver. Chi square test was applied for proportions and t test for mean values. P value < 0.05 was considered as statistically significant.

Results: Success rate for single attempt insertion of normal bougie was only 60% compared to 80% success in magnetic bougie and this difference was statistically significant ($p < 0.05$). It was found that in all five cadavers mean time taken to insert endotracheal tube was significantly less ($p < 0.05$) in normal bougie group compared to the magnetic bougie group.

Conclusion: Magnetic bougie is more useful than a normal bougie in difficult intubation situations like Cormack Lehane grade IV but time taken is much more than regular bougie placement.

Key words: cadaver, endotracheal, bougie, intubation, magnetic.

Introduction:

In emergency departments in 2014 of United States of America, 310000 endotracheal intubations were performed. For critically ill cases, endotracheal intubation is lifesaving. But it has got its own side effects. Incidence of adverse events in those undergoing endotracheal intubation was around 12% as per data from 10 years multi-centre study of endotracheal intubations. Repeated attempts of endotracheal intubation in a patient is said to have increased risk of adverse events following endotracheal intubation and single attempt insertion is related with none or reduced risk of adverse events following intubation. Even with the use of video laryngoscopy the success rate for single attempt insertion of the endotracheal tube was around 85%. Remaining 15% failure throws light on importance of improving the skills of intubation or finding some method which will guarantee single attempt insertion[1].

Bougie is a device which is simple and inexpensive which aids in introducing the tracheal tube. Macintosh[2] first described it in 1949. The aim was to increase the success rate on first attempt and to facilitate orotracheal intubation. But very commonly we see anaesthetist using it only for those cases in which they find it difficult to view the larynx properly or in cases where second attempt is required.[3]

Bougies are usually made from the “resin-coated, braided polyester” and as described before are used

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an aid in emergency situations to intubation. Bougies used for adults are generally 60 cm long with angled tip and diameter is 5mm. For children, small sizes are available. They are used where there is a problem in the glottic visualization ("Cormack-Lehane Grade III") or some other factors of the patients (like obesity, distortion of the upper airway or limited mobility of the cervical spine) are obstructing the view. The use of bougie guided intubations results in more successful endotracheal intubations. It has been found that the first attempt success rate with bougie range from 74-99%[4].

A laryngoscope is used to obtain the best view of the glottic structures. This is the first step in using the bougie or doing an intubation with assisted bougie. Visualization can be achieved using video assisted or direct laryngoscopy. The utility of bougie has also been described in assisted blind digital intubation in difficult scenarios.[5]

With this background, present study was carried out to study the efficacy of the magnetic bougie compared to normal bougie for assistance in endotracheal intubation.

Material and Methods:

An Institution based comparative study was carried out over a period of six months from January 2016 to June 2016. Five cadavers from Department of Anatomy, Mamata medical college, Khammam were taken for the study. Six trained personnel who have been practicing anesthesia in Mamata medical college for more than three years carried out the procedure.

There were five cadavers and six trained personnel attempting placement with each type of bougie on each cadaver. Thus, the sample size came out to be 30 trials for each type of bougie.

Institutional Ethics Committee permission was obtained for carrying out the study. Appropriate respect was delivered to each cadaver included in the present study. Permission from Anatomy Department was obtained to conduct the study.

In the difficult to intubate situations like in Cormack Lehanegrade IV we often use bougie to slide it below the epiglottis blindly. The curved tip of bougie is directed upwards and is passed into the glottic opening. Patient positioning and technique of doing laryngoscopy also plays a major role and varies with person to person. After knowing the exact difficulty of situation, an automatic force can be used to direct modified bougie anteriorly towards the glottic opening and can be passed into trachea, manipulating the external force as needed. Here we used a magnetic force to achieve our task. Three cube magnets are attached to the straight end of bougie making a slight angle with it. Another powerful ON and OFF electromagnet placed exactly above the thyroid cartilage. The force of the electromagnet pulls and direct the magnetic tip of bougie into glottic opening.

Cadavers which were less than 3days old were selected for the study. Skin on the anterior neck was dissected to facilitate head extension. Incisions were given on both the angle of the mouth to make the mouth opening from <1cm to 4cm.A horizontal incision was given at the level of C_3 C_4 tracheal rings to visualize the inside of trachea. This was done for confirmation of passage of bougie. The same transtracheal incision used above was utilized to inject 10ml of glycerin retrogradely to wash the sub glottis region and glottic opening to decrease the friction on inner surface of the trachea and glottis opening. Injecting glycerin facilitated the smooth passage of the bougie. A wooden log of 10cm height was placed under the shoulder of cadaver during the procedure where the stiff neck was hanging by the wooden log and making it easier for little head extension during laryngoscopy. Laryngoscopy is performed prior to the study to check for the glottic visualization. Those cadavers with no glottic visualization labelled as Cormack Lehane grade IV are taken into the study.

Three 5mm diameter neodymium cube magnet attached to tip of bougie making a slight angle with it (1.5cm magnet with 5mm wide). A large powerful ON and OFF electromagnet able to attract the smaller magnet attached to bougie from a distance of 14cm. Laryngoscope and McIntosh blade no. 3 & 4. Endotracheal tubes 6 & 6.5mm I.D sizes [used as guiders]

Trained personnel performed laryngoscopy and tried to pass the normal bougie into the trachea using the curved end of bougie. Time was noted from starting of holding the laryngoscope to the passage of bougie. Confirmation of successful tracheal placement of bougie was either by direct visualization through tracheostomy slit or by palpating the tip of bougie with a finger placed in the tracheostomy slit. The technique was considered to be failed when bougie could not be passed or when it could not be visualized or palpated in the trachea.

The magnetic bougie was passed into an endotracheal tube (ET) tube of 6mm size such that the magnetic tip of bougie is placed exactly at the tip of ET tube. This ET tube acts as a guide to pass the magnet tip safely until laryngopharynx. This was done to prevent laryngoscope blades attracting to magnets of the bougie. A trained person performed laryngoscopy

and tried to pass the magnet bougie while another person held the electromagnet on the thyroid cartilage aligning it in the direction of the magnetic tip being passed through laryngopharynx to get maximum force of attraction. After passing the tube along with the bougie till epiglottis, the electromagnet was then switched ON and slowly ET tube was withdrawn. When the magnetic tip on inner side and electromagnet on outside have come in contact, there was a feel of impact appreciated by the assistant holding the electromagnet. At this point the person performing laryngoscopy stabilized the bougie and advanced the bougie forward. The electromagnet was then switched OFF and then bougie was passed completely inside. Time was noted from holding the laryngoscope to passage of magnetic bougie. The technique was considered to be failed when bougie could not be passed or when it could not be visualized or palpated in the trachea.

Part I and part II technique was repeated with all the six trained personnel given one trial each (total 30 trials) on all the five cadavers and time was noted for each trial.

The data was entered in the Excel sheet. Chi square test was used to compare the proportions in two groups. Independent samples T test was used to compare means between two groups. P value less than 0.05 was taken as statistically significant. Openepi statistical software (version 3.01) was used for statistical analysis of data.

Results:

Figure 1 shows number of failed attempts of intubation in each cadaver by bougie type. in cadaver 1 and 3; the number of failed attempts were double while using the normal bougie compared to the magnetic bougie. While in cadaver 4; there were no failed attempts. But in cadaver 5; the number of failed attempts was four times more using normal bougie compared to magnetic bougie

Figure 1: Number of failed attempts of intubation in each cadaver by bougie type

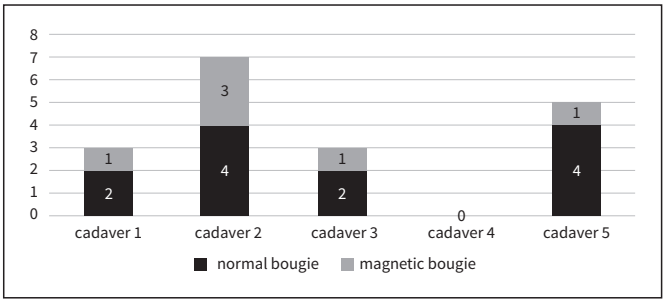

Table 1: Comparison of number of success rate in two bougie groups

Outcome	Normal bougie		Magnetic bougie		Total		Chi square	P value
	N	%	N	%	N	%		
Success	18	60	24	80	42	70	2.857	0.0454 Significant
Failed	12	40	06	20	18	30		
Total	30	50	30	50	60	100		

Table 2: Comparison of mean time (in seconds) to place the bougie in each cadaver

Cadaver	Number of attempts	Normal bougie	Magnetic bougie	T value	P value
Cadaver 1	6	18.5+2.3	40.2+4.1	11.3068	< 0.001
Cadaver 2	6	14+1.95	36.6+3.28	14.5074	< 0.001
Cadaver 3	6	21.5+2.98	30.6+3.12	5.1664	< 0.001
Cadaver 4	6	18+2.41	35+3.65	9.52051	< 0.001
Cadaver 5	6	20+2.57	38.6+3.95	9.66807	< 0.001

Table 1 shows comparison of number of success rate in two bougie groups. The success rate for normal bougie was only 60% compared to 80% success in magnetic bougie and this difference was found to be statistically significant ($p < 0.05$).

Table 2 shows comparison of mean time taken to insert the endotracheal tube in two groups. It was found that in all five cadavers the mean time taken to insert the endotracheal tube was significantly less ($p < 0.05$) in normal bougie group compared to the magnetic bougie group.

Discussion:

In this study we observed that magnetic bougie is more effective in the success of first attempt of insertion compared to the normal bougie but the time taken was more in case of magnetic bougie than the normal bougie.

The first pass success rate of normal bougie was 60% and 80% in case of magnetic bougie. The magnetic force applied externally directs the magnetic tip bougie into the glottic opening. Though the success rate is clearly high in case of magnetic bougie, it required much longer time for placement.

The time required with magnetic bougie may be reduced with the use of plastic laryngoscopic blades as it eliminates the use of endotracheal tube introducer which we have used in this study. This was used to prevent magnets of bougie attracting to laryngoscopic blades. The time can be further reduced with use of more powerful electromagnet. Since cadavers lack smooth mucous membrane, the resistance to passage of bougie would be much higher prolonging the time to passage. The injection of glycerin permits easier passage to some extent. However, we cannot comment at this time how well resistance to passage of bougie in this study closely mimics biological mucosal surface.

The time to place normal bougie will also be reduced with above mentioned customizations. The time to place normal bougie successfully in this study ranged between 10-30 seconds among six trained personnel. A mannikin study by I. Hodzovic et al[6] observed a median of10.5seconds with interquartile range 8 -12 seconds in placement of curved bougie with curved tip.

Baker JB et al[7] carried out a prospective study including 47 healthcare providers who attempted intubation on a cadaveric model. The success rate, time taken was compared between the two groups i.e. preloaded bougie and with standard bougie technique. Their perceived ease of intubation was also noted. The authors found that there was no difference in the success rate in either technique used. The mean time taken for standard bougie technique was 29.7 seconds compared to 29.4 seconds in preloaded technique ($p > 0.05$). The difference in the perceived perception of ease was also not significant. The authors concluded that both the techniques were equally effective.

Driver BE et al[8] conducted a randomized clinical trial in adults above 18 years of age in two groups of 376 patients who had endotracheal tube and stylet and second group of 381 with intubation aided by bougie. They found that the success rate of first attempt of insertion of the endotracheal tube aided by bougie was 96% compared to only 82% in endotracheal tube and stylet group. They also noted that hypoxia and mean time for intubation was similar in two groups ($p > 0.05$). They concluded with caution (after confirmation from all other sources) that use of bougie helps in higher success rate.

Messa MJ et al[9] compared bougie assisted intubation with normal endotracheal intubation by 35 participants in Cormack and Lehane grade III manikins. They noted that the success rate with bougie assisted intubation was 94% compared to only 77% with unassisted endotracheal intubation ($p <0.05$). The mean time taken for successful intubation was similar in two techniques ($p >0.05$). 41% of the participants rated the bougie assisted intubation as easier compared to only 9% of the participants rating endotracheal intubation as easier ($p <0.05$). The authors concluded that bougie assisted intubation is better than endotracheal intubation.

Kovacs G et al[10] compared time taken for intubation and success rate for bougie versus fiberoptic stylet as an aid to direct laryngoscopy. They briefly trained 103 laryngoscopists who did 533 intubations. They were asked to do intubation on manikins with simulated Cormack-Lehane grade IIIA view in maximum two attempts. The success rate for correct placement of the endotracheal tube was 100% in bougie assisted intubation compared to 98% with fibreoptic stylet-facilitated intubation. The time taken was similar with two devices. But with Cormack-Lehane grade IIIB view manikin the success rate was 98% with fibreoptic stylet compared to only 9% in bougie assisted and also the time taken was lesser with fibreoptic stylet. They concluded that fibreoptic stylet was better than bougie in grade IIIB view but requires validation in human subjects.

Thus, few authors have findings that bougie assisted intubation was better than plain endotracheal intubation but others show that bougie is not that effective. But to our knowledge no authors have used magnetic bougie in their study, thus making present study a novel one where we compared normal bougie versus magnetic bougie in cadavers.

Conclusion: Magnetic bougie is more useful than a normal curved tip bougie in difficult intubation situations like Cormack Lehane grade IV but time taken is much more than regular bougie placement. Although there are minor drawbacks in using magnetic bougie, if it can be tried in real practice might narrow the gap of difficult to intubate situations and successful attempts can be made before looking up to fiber optic equipment.

Limitations: Additional magnetic material was added to bougie and hence a chance of foreign body aspiration.

We have used bougie of 5mm thickness, so only ET tubes of 6mm and more can be used for intubation. We cannot extrapolate results for pediatric age groups where ET tubes of 5.5mm or less are necessary.

One assistant is required for a trial to hold external electromagnet.

The skill of the personnel does matter.

Guider is required to place magnet tipped bougie near glottic opening, otherwise the magnet may stick to blade of laryngoscope. Here we used ET tube as guider. This drawback can be avoided by using plastic blades

Time taken to place bougie is definitely more than regular way of intubation.

We cannot use it for the ones with implantable pacemakers.

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Conflict of interest: Nil
Source of funding: Nil

Date of submission: September 22nd 2020
Date of acceptance: December 16th 2020