Intubation of a Pediatric Manikin in Tongue Edema and Face-to-Face Simulations by Emergency Medical Staff: A Comparison of the Glidescope, Airtraq and Direct Laryngoscopy

Pediatrik Maketin Acil Sağlık Personeli Tarafından Dil Ödemi ve Yüz-Yüze Simülasyonlarda Entübasyonu: Glideskop, Airtraq ve Direkt Laringoskopinin Karşılaştırılması

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ABSTRACT Objective: Trauma victims occasionally cannot be intubated by emergency staff via conventional techniques. We sought to evaluate the efficacies of the application of the Glidescope and Airtraq in normal airway, tongue edema and face-to-face tracheal intubation models as used by emergency medical staff. **Material and Methods:** Following approval from the local human research ethics committee, 14 emergency medical staff enrolled in this study. The participants attempted to intubate pediatric manikins in three different airway models (in a random order) with a Glidescope, Airtraq and Direct Laryngoscope. **Results:** All emergency medical staff intubated the normal and tongue edema models successfully with the three devices. The intubation success rates for the Airtraq and Glidescope were 93% with the face-to-face approach (entrapped). The intubation time with the Glidescope was longer than that for the other devices in three models (p=0.001, p=0.02, p=0.02). When compared within groups, the intubation time for the Glidescope was increased relative to the normal face-to-face approach (16 [14.0-21.5] seconds vs. 31 [18.8-34.3] seconds, 57 [43.0-71.0] seconds; p<0.001). This was not the case when we examined the other devices. **Conclusion:** The emergency medical staff was able to intubate the pediatric manikin in the tongue edema and face-to-face models with the Glidescope and Airtraq with similar rates of success. In the Glidescope group, tracheal intubation required much more time, but this prolongation was clinically negligible. This study has been registered at www.clinicaltrials.gov.tr (NCT02478203).

Key Words: Intubation; pediatrics

ÖZET Amaç: Travma mağdurları, acil çalışanları tarafından bazen konvansiyonel tekniklerle entübe edilememektedir. Biz pediatrik maketin acil çalışanları tarafından entübasyonunda Glideskop ve Airtraq'in etkinliğini; normal hava yolu, dil ödemi ve yüz yüze trakeal entübasyon modellerinde araştırmayı amaçladık. **Gereç ve Yöntemler:** İnsan Araştırmaları Etik Komitesinden onay alındıktan sonra, bu çalışmaya 14 acil çalışanı dahil edildi. Katılımcılar, pediatrik maket üzerinde üç değişik modelde (sırayla; normal havayolu, dil ödemi ve yüzyüze) entübasyon uyguladılar. **Bulgular:** Acil çalışanları normal havayolu ve dil ödemi modellerini üç havayolu aracı ile de başarıyla entübe ettiler. Yüz yüze yaklaşımda Airtraq ve Glidescope'un entübasyon başarı oranları %93 bulundu. Glideskop ile entübasyon süresi üç modelde de diğer havayolu araçlarından daha uzundu (p=0,001, p=0,02, p=0,02). Grup içi karşılaştırmada, Glideskop'un entübasyon süresinin normalden yüzyüzeye gidildikçe göreceli olarak uzadığı tespit edildi (16 [14,0-21,5] saniye vs. 31 [18,8-34,3] saniye, 57 [43,0-71,0] saniye; p<0,001). Bu, diğer havayolu araçları için söz konusu olmadı. **Sonuç:** Acil çalışanları, Glideskop ve Airtraq ile pediatrik maketi dil ödemi ve yüzyüze modellerde benzer başarı oranları ile entübe edebilmişlerdir. Entübasyon Glideskop grubunda daha fazla zaman gerektirmiş ancak bu uzama klinik açıdan önemli bulunmamıştır.

Anahtar Kelimeler: Entübasyon; pediatri

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Trauma victims often need to be intubated at the scene of the trauma. Such intubation is occasionally difficult due to limited access to the patient, cervical spine injury or some factor that makes it difficult to

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acquire the patient's airway data. When conventional techniques fail, anesthetists needed more effective airway devices that provide rapid and safe tracheal intubation. Both the Glidescope and Airtraq devices were designed to facilitate difficult intubations. These devices are useful for understanding the airway anatomy and tracheal intubation procedure. Additionally, their superiorities to Macintosh laryngoscopy in situati ons involving tongue edema and cervical trauma have been validated.[1-6]

In this article, we aimed to compare the tracheal intubation successes by emergency staff with these two video laryngoscopes in normal airway, tongue edema and face-to-face intubation models in a pediatric manikin.

MATERIAL AND METHODS

Following approval from the local human research ethics committee approval (KOU KAEK 2014/108), written informed consent was obtained from 14 emergency residents and paramedics who were at least 1 year experience in their field (also with Macintosh laryngoscope) but has no experience with the Glidescope or Airtraq or the face-to-face tracheal intubation model. The participants performed real intubations on the 2 years of aged pediatric manikin (Nasco Plastics, Fort Atkinson WI, USA) using the Glidescope (Verathon Medical Inc., Bothell, WA, USA), Airtraq (Prodol, Vizcaya, Spain) and a direct laryngoscope in a random order. Age, gender, the years of their experience in their field, their assignements were recorded.

In situation 1 (control), the participants intubated the pediatric manikin with the normal airway via the traditional approach. In situation 2 (tongue edema), they intubated the manikin with simulated tongue edema via the traditional approach. In situation 3 (face-to-face), the participants intubated an entrapped manikin via face-to-face approach. The participants were told that they could attempt each intubation only three times, that they could perform maneuvers if they wanted to, and that they could reinsert the devices. To determine the optimal glottis visualization, handling force and reinsertion maneuvers were used in the Glidescope and Airtraq groups. And crcoid pressure in the Macintosh group if needed.

To remove the differences due to the abilities of the operator, we decided that each person should apply the three methods using the three devices. Another person, who was not blinded to the devices being used, recorded the number of insertion and intubation attempts, the insertion and intubation times, the need for optimization maneuvers and occurrence of dental, mouth mucosal damage or esophageal intubation. The insertion time was defined as the time that elapsed from the device entering the oral cavity until the optimal glottis visualization. The intubation time was defined as the time that elapsed from the device entering the oral cavity until the endotracheal tube entering the vocal cords was viewed. A 4.5-mm diameter un-cuffed polyvinyl chloride endotracheal tube was used for the intubations of the pediatric manikin. Failed intubation was defined as those in which the trachea could not be intubated within 2 minutes (120 seconds) or in three intubation attempts. The values were recorded by an unblinded independent observer.

We calculated our sample size as 13 instructors and decided to enroll one more (for possible exclusion) to detect a 60% difference in tracheal intubation times between Macintosh and Glidescope devices and for a power of 0.9 in terms of the intubation times. The values are provided as the numbers or medians [25-75 percentiles] because they were not normally distributed. We used the Kruskal-Wallis test for the three group comparisons. Mann-Whitney U tests were used for the comparisons of the continuous data between the two groups. To compare the data between the groups, we used the related-samples Friedman's two way analysis of variance by ranks. To compare the data between two groups, we used Wilcoxon-Signed ranks tests. P values <0.05 were considered statistically significant.

RESULTS

Fourteen emergency medical staff attempted tracheal intubations on a pediatric manikin.

Table 1 Demographic variables of the instruc tors. Values were given as numbers or as mean±SD.

In the normal and tongue edema models, the intubation success rates of the emergency staff were 100% with the Glidescope, Airtraq and direct laryngoscopy. In the face-to-face model, the success rates for the Airtraq and Glidescope were approximately 93%. The Cormack-Lehane grading of the three simulations of them was given at Table 2.

No significant differences between the groups detected in terms of the numbers of intubation attempts in the normal, tongue edema or face-to-face intubations (Table 3).

The insertion time in the normal model with the Glidescope was longer than that of direct laryngoscopy (8.0 [6.0-9.3] seconds, 5.0 [4.0-6.0] seconds, p=0.01). The insertion times in the tongue edema and face-to-face models were similar across the groups.

The intubation time was lowest with direct laryngoscopy, and the time for the Glidescope was the highest in the normal model (8.0 [7.0-11.3] seconds, 10 [7.0-15.0] seconds, 16 [14.0-21.5] seconds, p=0.001). The intubation time for direct laryngoscopy was the fastest, and the use of the Glidescope was again the slowest in the tongue edema model (13.5 [10.0-21.8] seconds, 19.5 [11.0-28.8] seconds, 31 [18.8-34.3] seconds, p=0.02). The intubation time with the Glidescope was longer than with the Airtraq in the face-to-face approach (24.0 [18.0-62.5] seconds vs. 57.0 [43.0-71.0] seconds, p=0.02).

The intubation times with the Glidescope were elevated compared with the normal to face-to-face model (16.0 [14.0-21.5] seconds, 31 [18.8-34.3] seconds, 57.0 [43.0-71.0] seconds, p<0.001). There were no significant differences in the intubation times for direct laryngoscopy and intubation with the Airtraq.

The rates of the requirements for optimization maneuvers were 29%, 43% and 7% with the Airtraq, Glidescope and direct laryngoscopy, respectively, in the normal model. In the tongue edema model, the rates of requirements for maneuvers were 57%, 64% and 29% with the Airtraq, Glidescope and direct laryngoscopy. In the face-to face approach, the Airtraq required maneuvers in 93% of the cases, and the Glidescope required 100% maneuvers in 100% of cases.

No esophageal intubations occurred in the normal model with any of these three devices. In the tongue edema model, esophageal intubations occurred in 21% of the cases with the Glidescope

TABLE 1: Demographic variables of the instructors. Values were given as numbers or as mean±SD.

Age (years)	28.4±5.3
Gender Female/Male	6/8
Paramedics/Resident	4/10
Years of experience	3.9±2.5

TABLE 2: The Cormack-Lehane grading of the three simulations. Values were given as numbers.

	Macintosh (n:14)	Airtraq (n:14)	Glidescope (n:14)	p
Normal airway Cormack-Lehane I/II	13/1	9/5	11/3	0.2
Tongue edema Cormack-Lehane I/II	9/5	4/10	8/6	0.1
Face-to-face Cormack-Lehane I/II	-	4/10	4/10	1.0

TABLE 3: Comparison of number of intubation attempts. Values were given as number.

	Direkt (n:14)	Airtraq (n:14)	Glidescope (n:14)	p
Normal Number of intubation attempts I/II	14/0	13/1	11/3	0.3
Tongue edema Number of intubation attempts I/II	11/3	8/6	9/5	0.6
Face-to-face Number of intubation attempts I/II	-	5/8/1	2/10/2	0.5

and Airtraq. In the face-to-face model, the incidences were 36% with the Airtraq and 43% with the Glidescope. No dental, mouth, mucosal damage occurred in any group.

DISCUSSION

The main result of this study was that the emergency medical staffs were able to easily intubate the pediatric manikin via the face-to-face approach with the Glidescope and the Airtraq.

Amathieu and colleagues published a study investigating the intubation success rates and intubation times with a manikin by emergency physicians using the Airtraq and Glidescope.[7] These authors reported that the face-to-face intubation success rates were higher with the Airtraq (100%) than with the Glidescope (70%). Additionally, the intubation times were shorter with the Airtraq than the Glidescope (14 (6) seconds vs. 27 (18) seconds). We also found that the intubation times in the face-to-face approach using the Glidescope were longer than those with the Airtraq in the present study; however, the success rates with these two devices were similar.

A study published in 2009 revealed that the use the Airtraq by paramedics was equivalent to laryngoscopy in normal, tongue edema and cervical spine immobilization models.[8] Novice physicians required longer intubation times with the Glidescope than with direct laryngoscopy, and the success rates for these techniques were similar.[9]

Tesler and colleagues compared rescuer positions on the ground in terms of tracheal intubation and found that the straddling (face-to-face) position afforded the intubator significantly more force than the other positions.[10] This position has advantages; for example, this position may provide better patient access without moving patients who are trapped in confined spaces, this position is less likely to expose the rescuer to hazardous materials on the ground, this position is helpful for the oxygenation of morbidly obese patients, and this position protects against aspiration by the patient. Additionally, these authors recommended that the straddling position become a part of the training of the emergency medical staff. Moreover, inverse intubation has been reported to be a useful skill for pre-hospital providers.[11] In 2010, one study demonstrated that intubation via the face-to-face approach required longer times than the standard technique.[12] Some authors have reported that face-to-face intubation generally requires 2 people, but single participants were able to execute this procedure in our study.[13] As in our study, previous reports in the published literature have described the single-person intubations with the face-to-face approach, and indicated that the right hand should be used to insert the blade, and the left hand should be used to tube.[11,14,15] We observed that little force was required to insert video laryngoscopes.

One study examined endotracheal intubations in trapped car accident victims using a manikin and 4 video laryngoscopes (i.e., the Glidescope, C-MAC, Pentax AWS, McGrath series 5, and Macintosh) by anesthetists. The intubation time with the Airtraq was shorter than that with the Glidescope, and direct laryngoscopy required the least time. Pentax AWS and Airtraq which have a tube channels, decreased the intubation times.[16] The same study group investigated 4 video laryngoscopes again in the ice-pick position (i.e., manikin was only accessible from the right side) by anesthetists. Again, the Macintosh is the most rapid followed by the Airtraq, which was as rapid as the Macintosh (38.1±13.4 seconds vs. 38.4±36.3 seconds). The Glidescope required the highest overall intubation times, and the success rate with the Airtraq was the greatest.[17]

Twenty-four trainee anesthesiologists attem pted tracheal intubation with the face-to-face approach (i.e., entrapped manikin was only accessible from the left anterolateral side). The success rates with the Airtraq and Macintosh were similar (84% vs. 88%), and the intubation times with the Airtraq were faster than those with Macintosh laryngoscopy (25 seconds vs. 34 seconds). According to the results of our study, face-to-face intubation with the Airtraq tended to be the fastest.[18]

Intubation times with the Glidescope have been reported to be higher than those with the Airtraq in many studies because the glottis cannot be viewed, and the insertion of the tube is the main problem with video laryngoscopes.[19]

In agreement with our results, the Glidescope has been found to increase the durations of intubation in normal and tongue edema simulations and also require increased numbers of maneuvers when intubations are performed by pediatric residents.[20] Glidescope need to be inserted in the midline of the mouth and the instructor must coordinate the tube, the monitor and the Glidescope blade together. However, Airtraq has a guidance channel if you see the image on the screen then you slightly push the tube deeper and then you can easily intubate. The prolongation of intubation time is probably due to that issue.

One study investigated the Glidescope compared to flexible fiber optics in awake upright laryngoscopy and found that all of the patients' glottises were visualized with the Glidescope. However, in this trial the authors employed only Cormack-Lehane grading and did not really intubate the trachea.[21] Thus, these results are different. As previously described, the main problem with the Glidescope is the inability to view the glottis during the insertion of the tube into the trachea.[16,17,22] Our medical staff complained that they occasionally experienced trouble with this issue.

Twenty anesthetists, 20 anesthesia nurses and 20 anesthesia residents intubated an adult manikin in three different difficult airway scenarios (i.e., pharyngeal obstruction, pharyngeal obstruction + cervical spine rigidity, and tongue edema). Tracheal intubation was found to require less time with the Macintosh and Airtraq devices than with the Glidescope, which is similar to our results.[22]

A systematic review and meta-analysis showed that, Airtraq superior to McGrath MAC, Glidescope, C-MAC and AirwayScope in terms of the first attempt intubation success rates, Cormack-Lehane grades and oro-pharyngeal com plications in difficult intubation.[23]

Our study has several limitations. First, a manikin airway cannot replicate the situation in real patients. Therefore, these results do not necessarily reflect the real-life scenarios. Second, we were unable to blind the participants during the collection of our study data. Third, emergency medical staff performed these intubations, and the results might have been different if novice personnel performed these procedures. Further comparisons of different devices in these settings are needed.

In conclusion, the manikin was easily intubated by the emergency medical staff in the tongue edema and face-to-face models with the Glidescope and Airtraq. In the Glidescope group, intubation required much more, but this prolongation was clinically negligible.

Disclosures:

Ethics: This study has been registered at www.clinicaltrials.gov.tr (NCT02478203).

Approval was obtained from the local human research ethics committee (KOU KAEK 2014/108).

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