Comparative study between Modified William's Airway (Fekry Airway) versus the U Shaped Guedl's Airway as assisted device for fiber optic intubation: A Randomized controlled trial.

Running title: Modified William's versus U shaped Guedl's Airway for Fiber optic intubation.

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- Manuscript word count: 2,438
- Abstract word count: 249
- Text 2189
- Tables count: 4
Declaration of interests

The authors declare that they have no conflict of interest with this work.

Funding

This work was funded by Cairo university.

Availability of data and materials

The data that support the findings of this study are available from Cairo university hospitals, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Cairo university hospitals.

Authors’ contributions

Ahmed Abdalla was responsible for the conception and design of the study, analysis of the data, and writing the manuscript.

Maha Ismail, Sherin Refaat, Hany Elhady, Naser Dobl, Ahmed Sleem, Mohamed Belita, Ahmed Essam, Ahmed Elbadwy and Ehab Atta shared in data collection, writing the manuscript.
Maha Ismail, Sherin Refaat, Hany Elhady, Naser Dobl, Ahmed Sleem, Reham Ali and Tamer Khair made substantial contribution in the design of the study, writing and revising the manuscript.

Maha Ismail, Sherin Refaat, Ahmed Abdalla, Naser Dobl Ehab Atta, Mohamed Belita, Ahmed Sleem and Ahmed Essam, shared in writing and revising the manuscript.

Ahmed Abdalla, Maha Ismail and Sherin Refaat, have read, revised and approved the final manuscript.

**Competing interests**

The authors declare that they have no competing interests.

**Consent for publication**

Not applicable.

**Ethical approval and consent to participate**

Ethical approval from Cairo university hospitals research committee was obtained (N- 18-2016).

Written informed consents were obtained from participants before inclusion.

**Clinical Trial registry** on ClinicalTrials.gov ID: NCT02850757
Publisher's Note

Springer Nature remains neutral about jurisdictional claims in published maps and institutional affiliations.

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Acknowledgment: Many thanks to Professor Dr. Abdullah Fekry for his scientific support.

Declaration of interests

The authors declare that they have no conflict of interest with this work.

Comparative study between Modified William's Airway (Fekry Airway) versus the U Shaped Guedl's Airway as
assisted device for fiber optic intubation: A Randomized controlled trial.

Abstract:

Background: In the last few years fiber optic bronchoscope (FOB) played a major role in management of difficult airway. Usage of oropharyngeal airways allow easy visualization of vocal cords by fiber optic bronchoscope.

Methods: Fifty patients undergoing elective surgeries under general anesthesia were enrolled in this study. Intubation was done using the fiber optic bronchoscope assisted by one of the airways. The patients were classified into 2 groups: \(G_w\) (n=25) intubation assessed by modified William's airway and \(G_u\) (n=25) intubation assessed by U shaped Guedl's airway.

Results: The bronchoscopic view was better in modified William's airway than U shaped Guedl's airway (grade 1 was in 44%, 36% of patients) respectively. Time to reach vocal cords was (5 ± 0.84 s, 6.2 ± 0.90 s) and the total time of intubation was (17.6 ± 1.8 s, 20.7 ± 1.5 s) both were shorter in Modified William's airway than U shaped Guedl's airway respectively and both were statistically significant. Complications recorded from both airways was minimal.

Conclusion: We conclude that both Modified William's and U shaped Guedl's airway allow a good assisted device for F.O intubation as it allow intubation of the patient while the airway still in place. While the Modified
William's airway show better time to reach the VC, total intubation time and need less manipulation to allow tube insertion. Further studies needed to assess the efficacy of these devices in difficult intubation patients.

**Keywords**: Modified William's airway, U shaped Guedel's airway, Fiber Optic Intubation.

**Introduction:**

In the last few years fiber optic bronchoscope (FOB) took the upper hand in difficult airway management. Several oropharyngeal airways and supraglottic devices have been invented to facilitate the art of fiber optic intubation. These devices allow minimal manipulation through upper airway till reaching the vocal cords, and reducing the total intubation time.

In the clinical market there are several oropharyngeal airways used to facilitate FOB intubation like: Ovassapian, Williams, Berman, LMA MADgic, modified Guedel’s and modified William's airways. In this study we discussed two types of these airway with some modifications, the Modified William's Airway and the modified Guedels Airway (U shaped Guedel's Airway).

The modification made to the William's airway (Fekry's airway) was removal of the proximal cylindrical tunnel roof and opening of its concave part to allow one step insertion of the tube. There is no need to disconnect the tube connector after tube insertion to remove the airway. (Figure 1).
Modification of Guedl’s airway (The U-shaped Guedl’s airway) done by making an inverted Y shape cut in convex part of the airway keeping only the proximal Y wings with slight elevation of them and removing the distal convex part. (Figure 2)

It was hypothesized that U-shaped Guedl's airway would have the same efficacy of modified William's (Fekry's airway) when used to facilitate endotracheal intubation by FOB. However Gudl's airway is available in different sizes, cheap and easily to be modified in to U-shaped.

The aim of this study was to compare the modified William's and the U shaped Guedl's airway when used as a conduit for FO intubation regarding the bronchoscopic view grades, the time to reach the vocal cords by FOB, the total time of intubation and complications (sore throat and blood stained mucous over the device).

Methods

This study was conducted at Kasr AL-Ainy Hospital Faculty of Medicine Cairo university Egypt. After approval of Institutional Research Ethical committee (N-18-2016) The study was registered at clinical trials registry system with trial number: NCT02850757 and taking written informed consents from the patients. Fifty Patients aging 18-56 years old, ASA I and II, with Ganzori Airway Score less than 4 were presented to the hospital for elective surgery under general anesthesia were included in the
Patients were randomly allocated into 2 equal groups 25 each using random computer allocation with numbered closed opaque envelopes:

- $G_w$ (n=25) the fiber optic intubation was done through Modified William's airway.
- $G_u$ (n=25) the fiber optic intubation was done through U shaped Guedel's airway.

In the pre-operative preparation room, 20 gauge cannula was inserted in a peripheral vein. 0.02 mg. Kg$^{-1}$ midazolam and 0.01 mg.Kg$^{-1}$ atropine were given to the patient. In the operating room the patient lied in supine position and with head and neck in the classic sniffing position. Standard monitors (ECG, noninvasive Blood pressure and pulse oximetry) were established to the patient. After 3 minutes pre-oxygenation with 100% O2 induction was started using 1µg.Kg$^{-1}$ fentanyl, 2mg.Kg$^{-1}$ propofol and 0.05 mg.Kg$^{-1}$ atracurium. The patient ventilated by facemask and bag with 100% oxygen and 1-2% isoflourane. Complete neuromuscular block was confirmed using nerve stimulator (train of four zero). After complete muscle relaxation the selected airway according to group randomization was inserted into the patient mouth (size selection and technique of insertion was done according to manufacturer recommendations). Blinding was impossible as the investigator had to see the airway during fiber optic bronchoscope insertion. Once the airway was properly inserted endotracheal intubation by the FOB through the oropharyngeal airway was started. The bronchoscopic view grade was recorded when the
bronchoscope hit the tip of the oropharyngeal airway according to table (1)\(^{(5)}\). Time to reach the vocal cords (VC) by fiber optic bronchoscope was recorded in seconds (defined as the time elapsing from the entry of fiber optic bronchoscope through the airway till touching the vocal cords by the tip of bronchoscope). The FOB was inserted till reach the carina, the endotracheal tube was slide through vocal cords into the trachea. the FOB was removed and the patient was ventilated through the endotracheal tube using intermittent positive pressure ventilation (IPPV). the total Time of intubation (primary outcome) was recorded in seconds (defined as time elapsing from stop mask-bag ventilation till connecting the ETT to the ventilator circuit). Adequate ventilation was confirmed by chest expansion, bilateral equal air entry using stethoscope and the appearance of 6 successive capnographic waves. During any step of endotracheal intubation if SPO\(_2\) dropped to ≤ 93% the trial was aborted and the patient was ventilated again using mask – bag until SPO\(_2\) increase to 100% ). After removal of the airway; blood stained mucous was noticed over the airway and recorded as complication. After full recovery a questionnaire for sore throat was done for the patient by a blind investigator who didn’t know which airway used.

**Sample size**

Our primary outcome was the total intubation time. Power analysis was performed using unpaired t test for independent samples. Previous studies showed that the standard deviation of endo-tracheal intubation time was about 43 seconds (sec) on modified William’s airway (Fekry’s airway)\(^{(1)}\) with a mean 11 seconds\(^{(1)}\). A pilot study was done for U-shaped Guedl's airway and the
standard deviation of endo-tracheal intubation time was 55.5 sec with mean 5.5 sec. Taking power 0.95 and alpha error 0.025, a minimum sample size of 22 patients was calculated for each group using Medcalc software. A total 25 patients were included to compensate for possible drop out.

**Statistical method**

Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Sciences) version 24. Data was summarized using mean, standard deviation, median, minimum and maximum in quantitative data and using frequency (count) and relative frequency (percentage) for categorical data. Comparisons between quantitative variables were done using the non-parametric Mann-Whitney test *(Chan, 2003a)*. For comparing categorical data, Chi square *(\(\chi^2\)) test was performed. Exact test was used instead when the expected frequency is less than 5 *(Chan, 2003b)*. P-values less than 0.05 were considered as statistically significant.

**Results:**

Seventy-five patients were screened for eligibility. twenty-five were excluded due to refusal and did not meet the inclusion criteria, fifty patients underwent randomization and were available for final analysis. (Figure 3)

The bronchoscopic view grades results showed that, there was no statistical significant difference in the view grades between both devices *(p = 0.702)* . (Table 3).
Regarding The time to reach the VC by fiberoptic bronchoscope was shorter in Gw than in Gu (4.96 ±0.84 S, 6.16 ±0.90 S) respectively and that was statistically significant (p = 0.001). (Table 3). (Figure 4).

The total intubation time was shorter in Gw than in Gu respectively and that was statistically significant (p = 0.001). (Table 3) (Figure 5).

The complications recorded during usage of both airways was minimal and statistically non-significant. (Table 4)

**Discussion:**

The usage of different oropharyngeal airway as a conduit for fiberoptic endotracheal intubation had many benefits to the anesthesiologist such as easy and rapid visualization of the vocal cords to facilitate endotracheal intubation.

In this study we compared two airways with modification in their original shape to allow easy fiber optic endotracheal intubation. Both Modified William's airway and U shaped Gedul's airway showed good results in the compared points although Modified William's airway showed better bronchoscopic view and total intubation time.

The Modified William's airway available in only size (3, 4) that limit its usage for adults but it has a double wings that rest on patient teeth to allow its stability in position, while the U shaped Guedl's airway modification can be easily applied to different sizes of original Guedl's airway. The pink colour of the modified William's airway may be confused
with the colour of mucosa that the investigator cant recognize the end of the airway.

Regarding the bronchoscopic view grade in $G_W$ Grade 1 view was detected in 44% of patients and $G_U$ showed grade 1 view in 36% of patients, in consistence to our study results study done by K.B Greenland, et al comparing William's airway versus Breman airway for F.O.Intubation [6] showed bronchoscopic view grade 1 in 80% of patients, 15% show partial obstruction (grade 2, 3) and only 5% of patient showed total obstruction (grade 6). with better results of Williams airway than Breman airway.

Another study by K.E Greenland [5] comparing William's airway versus ovassipian airway. the William's airway group showed the unobstructed view(grade 1) was in 68.3% of patients. partial obstruction (grade 2, 3) in 25% of patients and total obstruction (grade 6) in 6.7% of patients.

Also Study done by Dina N. Abbas, et al [1] comparing Modified William's airway versus Air Q for F.O intubation showed unobstructed view in 92% and complete obstruction in 8% of patients similar to our study although they didn’t use grading for bronchoscopic view only obstructed or not.

Regarding The time to reach VC by FOB was $5 \pm 0.8$ s in $G_W$ and was $6.1\pm0.9$ s in $G_U$. These results were similar to K.E Greenland[6] comparing William's airway versus Breman airway in $G_W$ which was 4 (1-16) seconds median (range) and in contrast to our study, another study by K.E
comparing William's airway versus Ovassipian airway the time was $9 \pm 4$ sec.

In study done by Elsa Varghes, et al.\(^7\) comparing F.O intubation via modified Guedl's airway versus via Laryngeal mask the results for $G_U$ was $108.66 \pm 52.43$ sec as they recorded the time from insertion of F.O.B through the airway till reach the carina.

The time to reach VC by FOB was shorter in $G_W$ as that reflect the ease of reach the larynx using the modified William's airway and we reflect that to change in the shape of the two airways as the lingual part of the modified William's is longer and straighter than U shaped Guedl's airway and the pharyngeal part of the modified William's is longer than the same size of Guedl's airway. Modified William's airway tip is directed upwards that direct the bronchoscope towards the larynx.

The total time of intubation in this study for $G_W$ was $17.56 \pm 1.8$ s and that was shorter than the time in a study done by Dina N. Abbas\(^1\) as their intubation time was $43 (11)$ sec.

Regarding the total intubation time in $G_U$, in this study was $20.7 \pm 1.51$ sec in contrast to our study, a study done Elsa Varghes, et al.\(^7\) the intubation time in Guedl's airway group was $142 \pm 55.37$ sec that big difference in time was due to they need to remove the airway before intubation and that increase the hypoxic time to the patient that’s why opening the lingual surface of Guedl's airway allow easy removal of it after the tube pass through it without rough manipulation.
On recording complications, the $G_U$ showed more hoarseness of voice than $G_W$. We refer that to more manipulation done during insertion of the tube to get the view. The blood over the device detected only in $G_U$ group.

**Limitations:**

The limitation of this study is that blindness was impossible for the investigator.

**Conclusion:**

We conclude that both Modified William's and U shaped Guedl's airway allow a good assisted device for F.O intubation as it allow intubation of the patient while the airway still in place. while the Modified William's airway show better time to reach the VC, total intubation time and need less manipulation to allow tube insertion. Further studies needed to assess the efficacy of these devices in difficult intubation patients.

**References:**

1. Dina N. Abbas, Ekramey M. Abdghaffar. Comparison of the air-Q intubating laryngeal airway versus the modified William's intubating airway as aids for training in fiberoptic tracheal intubation. Ain-Shams Journal of Anesthesiology 2013, 6:134-139.

2. Katherine S. L. GIL. Fiber optic Intubation; Tips from ASA Workshop. Anesthesiology news guide to airway management 2009;91:98.
3. Sang-Kyi Lee, A Ram Doo Lee. Fiberoptic intubating airway for facilitating orotracheal fiberoptic intubation. Korean J Anesth 2013; 65(4): 368-369.

4. EL-Ganzouri AR, McCarthy RJ, Tuman KJ, et al. Preoperative airway assessment: predictive value of a multivariate risk index. Anesth Analg 1996; 82(6): 1197-204.

5. Greenland KB, Lam MC, Irwin MG. Comparison of the Williams Airway Intubator and Ovassapian Fibreoptic Intubating Airway for fibreoptic orotracheal intubation. Anaesthesia 2004; 59:173-176.

6. K.B Greenland, I. D. Ha, M.G. Irwin. Comparison of the Breman Intubating Airway and the Williams Airway Intubator for fiber optic orotracheal intubation in anesthetized patient. Anesthesia, 2006;61(7):678-684.

7. Elsa Varghese, Nagaraj R, Shwethapriya R. Comparison of oral fiber optic intubation via a modified guedel airway or a laryngeal mask airway in infant and children. J Anasethiol Clin Pharmacol 2013;29:52-55.

**Figure Legends:**

Figure(1): Modified William's Airway (Fekry Airway).
Figure (2) : U shaped Guedl's Airway.

Figure (3): Follow chart of patients.

Figure (4) : Time to reach the VC by FOB (min) in both groups.

Figure (5) : Total intubation time (min) in both groups.