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Research Article

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Prototype of Video Laryngoscope: Wi-Mac-Multivision

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Abstract

Introduction: *The management of the airway is a constant challenge for anesthesiologists, there are devices that facilitate orotracheal intubation, among which videolaryngoscopes can be mentioned, in view of their high costs it is difficult to access them. The following study is a prototype of a low cost and highly in the Central Hospital of Maracay (HCM).*

Materials and Methods: *Non-experimental, prospective and observational design, under the modality of a special project with an evaluative scope. The population consists of 32 patients who required orotracheal intubation by the anesthesiology and resuscitation service of the HCM with a video-laryngoscope prototype from a Macintosh laryngoscope.*

Results: *The use of Wi-Mac-Multivision showed 100% of orotracheal intubations without presenting any type of complication in them, only one of the patients deserved a second attempt to achieve orotracheal intubation. It was possible to visualize the vocal cords according to the classification of Cormack-Lehane in CL-I 93.7% and CL-II 6.3%. In only 3 cases (9.4%) was it necessary to use external maneuvers that improved visualization of the vocal cords (Maneuvers of B.U.R.P.) The average time needed to achieve orotracheal intubation was 29.62 ± 7.53 seconds.*

Conclusions: *Wi-Mac-Multivision manages to prove to be an alternative to be used by the staff of the central hospital to achieve orotracheal intubations, its low cost makes it easy to replicate this device and benefit more patients. Such a device would have advantages over the learning and training of HCM personnel. It remains to evaluate the number of intubations to achieve a good degree of training, indications and if it can be used in difficult airway patients, that is why there is a line of research open in our institution, which is expected to continue.*

Keywords: Intubation, Technology, Video Laryngoscope, Airway.

Introduction

The management of the airway is a constant challenge for the doctor and very particularly for the anesthesiologist since in his daily work he commonly faces situations in which he may have difficulties to access it and achieve endotracheal intubation of the patient.

Endotracheal intubation remains the most effective measure to ensure a permeable airway, which requires experience to perform this procedure. Approximately 30% of all deaths attributable to anesthesia are due to difficulty in managing the airway [1].

The difficult airway is the clinical situation in which personnel with conventional training experience difficulty in ventilating the upper airway with facial mask, or difficulty in orotracheal intubation or both [2].

Frequently the physical findings in the exploration of the airway discriminate poorly between potentially easy and difficult intubations, so it must always be prepared to approach a difficult airway not predicted, since many of these patients have had a physical examination considered as "Reassuring" [3, 4].

In addition, emergent intubation outside the operating room is associated with a much greater risk of difficult laryngoscopy. In such a way that techniques that can improve successful intubation can be especially useful in these environments [5].

The English anesthesiologist Sir Robert Reynolds Macintosh presented in 1943 the laryngoscope with curved blade, which allows a better vision of the vocal cords and consequently facilitates endotracheal intubation, since then direct laryngoscopy has been for anesthesiologists the gold standard for orotracheal intubation [6].

Occasionally direct laryngoscopy produces poor laryngeal visualization, which makes it more likely that multiple and prolonged intubation attempts are required, which may or may not be associated with complications such as oxygen desaturation, dental and airway injury, neurological damage and even death [7].

The development of video laryngoscopes represents the greatest

advance in the management of the airway in recent decades. Which is a device that uses a video camera to visualize the structures of the airway. Videolaryngoscopy allows you to easily learn the techniques of airway management when visualizing the glottis without the need to obtain a direct line [7].

The fact that the VDL have the image sensor in the distal part of the leaf makes it possible to have a panoramic view of the glottis without the need to "align the axes". VDLs have a visual field between 45° and 60 ° unlike 15 ° tubular and distant vision that provides a classical laryngoscopy [8,9].

Video laryngoscopy, compared to direct laryngoscopy for difficult intubations, provides significantly better vision of the vocal cords, a higher success rate, faster intubations and less need to optimize maneuvers. Therefore, it is considered that videolaryngoscopy leads to a clinically relevant improvement in intubation conditions and can be recommended for the management of difficult airways [10].

As of 2013, the American Society of Anaesthesiology (ASA) includes in its algorithm of difficult airway the use of VDL, they propose to use them when ventilation with facial mask is effective and a previous attempt has been made of intubation with direct laryngoscope. In this algorithm several VDL models were mentioned in a generic way, without specifying or evaluating which instrument should be used [2].

Similarly, the Difficult Airway Society (DAS) in the latest update of its guidelines in 2015 for the management of unanticipated difficult airways can be seen that the VDL finally enter Plan A, in the routine approach of the Airway [11].

Publications on VDL demonstrate the effectiveness of these optical devices in situations of Difficult Prevented Airway and in Morbid Obese, where when compared with the standard Macintosh laryngoscope, they have been shown to be easier to use for beginners, besides useful in the teaching of the aerial route, since the monitor shares the vision obtained by the student [12].

VDL are extremely expensive devices and difficult to access, which is a limitation in our country and in many developing countries, so they are not available in our hospitals [13].

However, despite the aforementioned, Dr. Grünberg at the Clinical Hospital in Montevideo in 2012, faced with the need to solve a difficult airway that required nasotracheal intubation for maxillofacial surgery, used an "artisanal videolaryngoscope" for the which modified a conventional laryngoscope by adding a mini camera attached with adhesive to the Macintosh sheet which reproduced under indirect vision on a screen [14].

In 2016, the anesthesiologist Velásquez-Murillo in Mexico was able to produce a hand-held videolaryngoscope at a cost of US $ 20 practically in a series of cases of difficult airways in different daily clinical scenarios, using an endoscopic camera, which would allow the use of monitors (mobile or not mobile), simple to clean and reusable. Adapting said camera with a tempered stainless steel clasp which adjusted to the conventional blade so that the vision was aligned without moving parts that could come off during the exploration [1].

In 2015, students of the anesthesiology graduate of the Dr. Luis Razetti Hospital in Barinas designed the first hand-made videolaryngoscope with proven effectiveness in Venezuela, which is in operation for the benefit of the local population. Which had a low cost and being a light device is easy to move [15].

Based on the aforementioned antecedents and the constant need to acquire new alternatives, knowledge and skills to ensure the airway, there is the concern of having a VDL making use of available resources in order to solve frequent and sometimes unexpected problems of the airway in the anesthesiology service of the Central Hospital of Maracay (HCM), from which the following question arises: Is there really a need for a videolaryngoscope in the anesthesiology and resuscitation service of the Central Hospital of Maracay? Is it possible to improve the previous proposals of artisanal video laryngoscopes? What elements are necessary for such modification? Is the realization of this proposal feasible?

Materials and Methods

The study was conducted between the period April - November 2017, and the research was conducted in the operating room area of the Central Hospital of Maracay.

To carry out the diagnosis about the need to have a videolaryngoscope in the anesthesiology and resuscitation service, a questionnaire was carried out to the majority of the members of the anesthesiology and resuscitation service, where so many resident physicians were included (24) and specialists in anesthesiology (25) in which we will proceed to know the opinion of each member in order to know the existence or not of the need.

Once the diagnosis was made, the design proceeded. For which we need as a basic element a Macintosh laryngoscope with leaves of different sizes (3 and 4). Additionally an endoscopic camera (Approximate cost: 30 USD), which is water resistant, with a diameter of 7mm, with own cold light (6 LED bulbs), easy to clean secretions which allows reuse and disinfection, additionally has a viewing angle of 62º and has a 15-meter image transmission range via Wi-Fi for up to 4 devices simultaneously. This camera was fixed with two sheets of moldable aluminum right next to the light source of the laryngoscope and 2 cm holding the cable, thus providing better firmness and coupling (Figure 1 & 2), with an angle that allows visualize the tip of the laryngoscope and that it is aligned with the anatomical structures for better reference when performing orotracheal intubation. This chamber deserves electric current for its operation, which is why a connection to a portable battery (Powerbank) is used by means of USB cable, which supplies said electric source and allows its use.

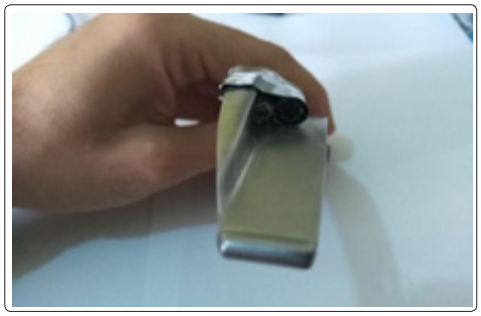

Figure 1: Front view of Macintosh blade No. 3 with camera held by previous brooch

It is worth a medium to reproduce the images captured by the camera, so we need a smartphone with Wi-Fi technology that has an Android or IOS operating system. Additional to this said camera includes a free application for both operating systems mentioned above called WIFI_EYE which allows the link between the endoscope camera and the connected smarthphone (s).

Figure 2: Side view of Macintosh sheet No. 3 with camera held by front and back brooch

The videolaryngoscope was manipulated by a single operator at the time of orotracheal intubation, and therefore it was important to have a fixation medium for the Smarthphone that will reproduce the image so that a fixation base used to anchor phones to handlebars was used. of bicycle which will adapt to the end of the handle of the laryngoscope, said base rotates in 360° which allows to place the telephone in different angles of inclination so that it is more comfortable the visualization on the part of the operator. (Fiure 3)

Figure 3: Bike handlebar base adapted to attach smarthphone to laryngoscope handle

Once the videolaryngoscope was designed (Figure 4), the next step was the application, which will be used by the researcher as follows: Prior to 100% oxygenation for three minutes, anesthetic induction is carried out intravenously.

ventilation test which should be positive for the application of the video laryngoscope, once the time of action of the drugs used has passed and with the patient in a good anesthetic plane, proceed with the video laryngoscopy, in such a way that the patient's head in the 'sniffing' position, mouth opening is performed, and the Macintosh sheet is inserted in the middle line, it will descend at the base of the tongue observing the anatomical structures at all times by the Smartphones, locating the epiglottis and positioning the tip of the Macintosh blade in the vallecula and making a slight force on the handle of the laryngoscope upwards and towards the patient's feet, thus achieving visualization of the vocal cords.

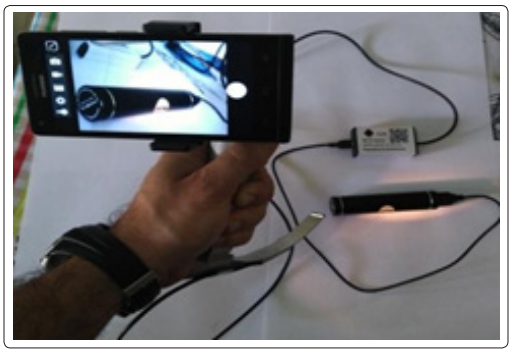

Figure 4: Fully integrated Wi-Mac-Multivision Videolaryngoscope prototype. (Handle and Macintosch blade + Bicycle base + Camera + PowerBank + Smartphone)

Once the glottis was visualized, the endotracheal tube was introduced, which, to facilitate intubation, was introduced with a guider or stylet with an angulation of up to 90º. The introduction of the tube must be followed under indirect vision in the Smartphone (s) in such a way that once the tip of this tube passes through the vocal cords, the guider is removed and the tube is introduced until the ball completely passes the vocal cords (Figure 5 & 6)

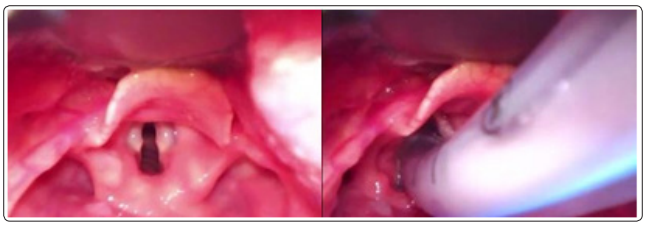

Figure 5 & 6: Image obtained from orotracheal intubation with VDL Wi-Mac-Multivision: Visualization of vocal cords and passage of the tube through them

The study population consisted of 32 patients admitted to the anesthesiology and resuscitation service of the Central Hospital of Maracay, who required orotracheal intubation. Patients scheduled for elective and emergency general surgery with a minimum age of 18 years, physical states ASA I, II, and III were chosen according to the classification of the American Society of Anesthesiology and who could be ventilated by facial mask. We excluded patients who were hemodynamically unstable and / or presented risk of bronchial aspiration at the time of orotracheal intubation.

In the case of the evaluation of the video laryngoscope, the following information was collected in a file: success in orotracheal intubation, number of attempts that I merit, intubation time, classification according to Cormack-Lehane, use of external maneuvers: B.U.R.P. (Backward, Upward, and Rightward Pressure) and complications.

Figure 7: External view of Orotracheal intubation with VDL Wi-Mac-Multivision.

Statistical analysis: To analyze the data we used the statistical program called EpiInfo V3.5.4 and Microsoft Excel 2007.

Results

At the time of beginning the investigation, the anesthesiology and resuscitation service at the Central Hospital of Maracay only counted as an alternative device for orotracheal intubation of an Ambu® brand fiberoptic bronchoscope, which due to the characteristics of said device does not emit a sufficiently clear image, however, it is sufficient to achieve orotracheal intubations in the patients in whom it has been used.

A questionnaire was applied to the members of the Anaesthesiology and Resuscitation Service of the Maracay central hospital, where it was unanimously agreed (100% of the sample) that it was necessary to include new devices for the management of the airway, and in the same way The design of a video-laryngoscope prototype for orotracheal intubation and the benefit of the patients of this service was approved.

All of those questioned consider it important to develop skills in the use of alternative devices to the traditional laryngoscope for the management of the airway.

Once approved and made the design of the videolaryngoscope called Wi-Mac-Multivision, proceeded to apply said device in patients of said service to demonstrate its effectiveness. The studied group was of 32 patients which were classified by gender in 18 of the female sex (56.3%) and 14 of the male sex (43.8%). The average age of the studied population was 41.53 ± 19.30 years. The BMI had an average of 24.25 ± 2.61 Kg / m². The distribution according to the Mallampati scale was I (21), II (7), III (3), IV (1).

100% of the patients (32) were intubated successfully and in the same way none presented complications at the time of the procedure, of these only one patient (3.1%) deserved a second attempt to achieve orotracheal intubation.

Table 1: Distribution according to the Cormack-Lehane classification of the image obtained when performing laryngoscopy with VDL Wi-Mac-Multivision

Clasificacion Cormack-Lehane	Frecuencia	Porcentaje
I	30	93,7%
II	2	6,3%
TOTAL	32	100%

In only 3 cases (9.4%) was it necessary to use external maneuvers that improved visualization of the vocal cords (maneuvers of B.U.R.P.) and thus achieve orotracheal intubation.

The average time in which the orotracheal intubation was achieved was 29.62 ± 7.53 seconds with the Wi-Mac-Multivision VDL.

Discussion

As technology and medicine advances, new ways of applying and acquiring new knowledge will emerge, such as video laryngoscopes. There are many devices that make use of state-of-the-art technology to facilitate and make the orotracheal intubation process safer. But the acquisition of such devices is difficult for developing countries such as ours due to the high cost they can have (Airtraq 80 USD, STORZ C-MAC 7,980 USD, Glidescope 11,000 USD) and that in some cases it is necessary Acquire new sheets as they are designed for single use, or devices that have lifespan for a single patient [13].

The Wi-Mac-Multivision has an estimated total cost of 45 USD, the items used for its assembly makes it much easier to access when it comes to having a technological, economic, reusable device for orotracheal intubation.

This video-laryngoscope prototype had a 100% intubation success rate in the 32 patients in which it was used. In a study comparing different types of video laryngoscopes vs the Macintosh laryngoscope it was evidenced that the latter's successful intubation rate was 93% vs 100% success for the C-MAC STORZ vs 97% Glidescope [16].

In a comparative study carried out in 2014 in Turkey, it was possible to evaluate the effectiveness of conventional C-MAC and the Macintosh laryngoscope (LM) in easy and difficult air ways, where it was possible to demonstrate in intubation easy airways that were achieved with the LM. successful at the first attempt in 89%, in a second attempt 11%, in the case the C-MAC was intubated at the first attempt in 96.2% and in the second attempt 3.8% [17]. The success rate at the first attempt with Wi-Mac-Multivision was 96.9% and at the second attempt 3.1%.

Regarding the maneuvers used to improve the visualization of the glottis and achieve intubation with the prototype presented, it was needed in 9.4% of the cases (3). Alper et al evidenced in his study that using the LM in 26 simulations, he used these maneuvers only in 7.7%, whereas with the use of C-MAC (26 simulations) this maneuver was not used at any time [17].

Myungju Shin found that of the 39 intubations performed in mannequins of practice with C-MAC achieved a visualization of CL I in 92.3% of cases and CL-II 7.7%, in the case of LM achievement in 46.15 % a CL-I display, 38.46% CL-II, and 10.26% and 5.13% for CL-III and CL-IV respectively. The average intubation time for the proposed device is 29.62 ± 7.53 seconds. In the intubation described by Velazquez-Murillo in Mexico (1) I achieved the intubation of patients with characteristics that made them possible difficult airways using a hand-held Macintosh videolaryngoscope in less than 120 seconds, in the case of Grünberg intubated with a Macintosh videolaryngoscope a patient with a difficult airway planned in 33 seconds [14].

Hodges et al compared in a study performed in 90 patients who underwent elective surgeries that required orotracheal intubation of the C-MAC vs. LM device, where they achieved intubations in 29.2 ± 18.6 seconds and 23.5 ± 9.4 seconds, respectively [18]. In the same way Myungju Shin et al achieved intubations with the C-MAC in an average of 23.2 seconds and MgGRATH MAC in 21.8 seconds [19].

In the same way Myungju Shin et al achieved intubations with the C-MAC in an average of 23.2 seconds and MgGRATH MAC in 21.8 seconds [20].

Jain in 2013 describes intubations performed by 33 residents with more than 100 orotracheal intubations each, in this study simulated cervical spine injury and as devices used C-MAC and LM achieving intubations in a time of 20.21 ± 7.9 seconds and 15.55 ± 2.69 seconds respectively.

During the use of the Wi-Mac-Multivision there were no complications, however Ruediger et al in a retrospective and comparative study in an intensive care unit in 113 (LM) and 117 (C-MAC) patients managed to demonstrate 17 and 14 complications, respectively, of which mention minor tissue injuries, bleeding, regurgitation / aspiration, among others [21].

The comparison made between devices in 2011 by McElwain et al in patients with cervical immobilization mentioned only as complications related to the use of C-MAC and LM minor lacerations [20].

Conclusions

The effectiveness of the Wi-Mac-Multivision videolaryngoscope prototype was demonstrated in order to achieve intubations of the patients treated by the anesthesiology and resuscitation service. This device emerges as a technological and effective alternative for the Central Hospital of Maracay, in addition to this its low Cost and easy handling makes it an easy device to replicate.

It is not enough with the aforementioned mentioned device would have advantages over the learning and training of personnel with little or no experience working in the Central Hospital of Maracay, as it is well known in this hospital specialists are trained in different areas that usually use traditional laryngoscopes for Orotracheal intubation of their patients. In this way it would be providing greater security by decreasing the rate of failed intubations and the possible complications that this entails.

It is necessary to arrive at a sufficient number of intubations in order to achieve a good degree of training, evaluate their indications with more certainty, and be able to determine if this system can be a valid option to be used in low-resource countries while they cannot access it. the original videolaryngoscopes, and in the same way evaluate if it can be used in patients whose anatomical characteristics are difficult airways, that is why there remains a line of research open in our institution, which is expected to continue.

This device is the first version made by the researchers, modifications are expected in the future that make its use more comfortable, practical and safe.

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