

USE OF VIDEO LARYNGOSCOPES BY INEXPERIENCED PERSONNEL IN DIFFICULT INTUBATIONS

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ABSTRACT

The current gold standard in securing airway patency remains to be endotracheal intubation. It is the only method, which allows for nearly 100% protection of the bronchial tree from aspiration of gastric contents as well as providing the most ideal circumstances for control of ventilation parameters. Endotracheal intubation, although in many aspects superior to other methods of securing airways, can only be performed by skilled and experienced personnel in ideal conditions. An example of such conditions are in an operating room in the preoperative period when an anesthesiologist is able to proficiently perform the task with all of the tools and equipment needed at hand. However, in many situations, especially in emergencies, such ideal conditions are difficult or impossible to achieve. One of the many reasons behind this is often the lack of experienced personnel at the scene of an emergency. Another significant difficulty arises from trauma patients who must maintain an immobilized cervical spine, as well as those patients who are undergoing active cardiopulmonary resuscitation when providing high quality chest compressions is the highest priority. Therefore, it seems reasonable to look for the methods which on one hand will secure an airway with a tube inserted directly into the larynx, and on the other hand will make the procedure more accessible to less experienced personnel by maintaining the proper patient safety throughout the whole procedure. A noteworthy method, which achieves this goal, is the use of the video laryngoscopes for endotracheal intubation. The participation in a short introductory training, regarding the use of the device itself, is sufficient to allow for the efficient intubation. The parameters which can be used to compare these different intubation methods include the ease of use, the rate of effectiveness of the first intubation trial as well as the total time needed for the procedure. The authors of this article attempt to compare classic laryngoscopes to video-assisted laryngoscopes.

KEY WORDS: video laryngoscopy, macintosh laryngoscope, endotracheal intubation, airway management, patient safety.

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INTRODUCTION

Endotracheal intubation is regarded as the best method of securing an airway in both the hospital and prehospital setting [1, 2]. According to the recommendations of the European Resuscitation Coun-

cil (ERC), endotracheal intubation is the best method to maintain an airway during sudden cardiac arrest, where a patient's oxygen reserves can be as short as 3–5 minutes [3]. However, this is not a simple procedure, therefore performing it causes a high degree

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of stress even amongst experienced staff, and any delays in delivering adequate ventilation can cause life-threatening complications to the patient [4]. Obstructed airways as well as airways at high risk of obstruction are very commonly encountered in the prehospital setting. There are many indications for when the patient requires instrumental airway production often without the use of anesthetics or full sedation. These indications include;

- Airway protection against aspiration and regurgitation,
- Providing mechanical ventilation in the treatment of respiratory failure,
- Head injuries with a GCS < 8 points,
- Trauma patients with flail chest injury [5].

The definition set out by the American Society of Anaesthesiology for a difficult intubation is the one, which takes more than three attempts with a conventional laryngoscope to be successful, or the one which takes more than 10 minutes to perform by an experienced person. The occurrence of difficult intubations in the prehospital settings varies from 1.5– 8% of all intubations [6], and the effectiveness of direct laryngoscopy performed by emergency medical personnel assessed in many studies is inconclusive [7]. These results significantly exceed the number of difficult intubations performed in the hospital setting in the emergency department or the operating room [8]. To compare, the incidence of difficult intubations in the emergency department is 3–5.3%. The potential complications associated with intubation which may harm a patient are mainly related to injuring the respiratory tract caused by improper usage of the laryngoscope blade, incorrectly introducing the endotracheal tube into the esophagus, as well as intubating the right main stem bronchus. It is also important to note the complications directly felt by the patient, such as hoarseness, throat pain and injury causing bleeding from the oral cavity [9]. When endotracheal intubation is being performed during ongoing cardiopulmonary resuscitation, many additional unfavorable factors may present themselves such as the movement of the victim's body during chest compressions or restricted access to the patient's head [10]. A confirmation of the fact that endotracheal intubation in the prehospital setting performed with a classic laryngoscope is extremely difficult, is that up to one third of attempts are unsuccessful [11], along with a significantly increased risk of hypoxia, aspiration or cardiac arrest after two intubation attempts [12, 13]. When performed by inexperienced users, initial suc-



FIGURE 1. Macintosh Laryngoscope

cess rates of the first-time intubation vary from 35–65% [14].

Currently, there are around 10 different types of video laryngoscopes available on the market. The goal of this study was to compare the currently available video laryngoscopes with the aid of the literature surrounding them. A few of these devices were compared based on the available studies. The factors considered were the ease of use, successful intubation among experienced professionals as well as among novices and the rate of the first successful attempt of intubations. These factors were compared to the currently standard Macintosh laryngoscope (Fig. 1).

Endotracheal intubation techniques in literature

Endotracheal intubation of trauma patients, especially those with suspected cervical spine injuries is often the procedure of choice to maintain a patient's airway [15]. These patients are at greater risk of vomiting and losing their airways as a result of central nervous system injury and altered mental status [16]. These victims require constant stabilization of their cervical spine. As shown in many studies, the use of an orthopedic collar limits the opening of the patient's oral cavity [17, 18], as well as limits head movement which results in markedly lower rates of first-time intubation success with the use of direct laryngoscopes [19, 20]. In a study by Kłosiewicz et al., the use of a standard Macintosh laryngoscope was compared to the use of the TotalTrack VLM device (Fig. 2). In the case of intubation of a patient in which the cervical spine is stabilized by hand, the intubation procedure was performed in 18.7s vs 22.9s, with the first successful breath being delivered in 19.0s vs 12.1s and a first attempt intubation success rate of 81% vs 98% while using the Macintosh laryngoscope vs the TotalTrack VLM respectively. Furthermore, when the patient's cervical spine was stabilized by the use of an orthopedic collar, the total time of the proce-



FIGURE 2. Endotracheal intubation with TotalTrack VLM system

dures was 24.7s vs 23.7s, with the first breath being delivered in 25.2s vs 13.3s and a first attempt intubation success rate of 49% vs 97% [21].

Shravanalakshmi D et al. compared the King Vision video laryngoscope with the C-MAC video laryngoscope in patients with a cervical spine stabilized with an orthopedic collar. For the purposes of the study, the anterior portion of the collar was removed, and the patient's chin was stabilized by hand. The first attempt intubation success rate was 93.3% vs 100% respectively, while the total procedure time was comparable at 24.9 ± 7.2 seconds [17]. Meanwhile, Smereka et al. compared the C-MAC video laryngoscope with the Macintosh laryngoscope. The participants of this study were 70 paramedics each with a minimum of 5 years of experience who performed endotracheal intubation on patients in three scenarios; without cervical spine stabilization, with manual cervical spine stabilization, and with stabilization achieved with an orthopedic collar. With different partial results for the individual scenarios, intubation with the use of an orthopedic collar showed first attempt success rates of 100% utilizing the C-MAC vs 51.4% using a Macintosh laryngoscope and a total time of intubation being 20.5s vs 27s respectively [20]. Many other studies also focused on evaluation of video assisted laryngoscopes in the inexperienced personnel. In the study carried out by Sierzantowicz et al. the effectiveness of the ETVIEW laryngoscope was assessed during the ongoing cardiopulmonary resuscitation. Following a 10-minute practical training on the usage of the ETVIEW device (Fig. 3), first attempt of intubation success rates were 100% [21]. A similar group of inexperienced personnel was studied by Wolf et al., evaluating the teaching of intubation methods using a Macintosh laryngoscope and King Vision video laryngoscope at courses run by the American Heart Association.

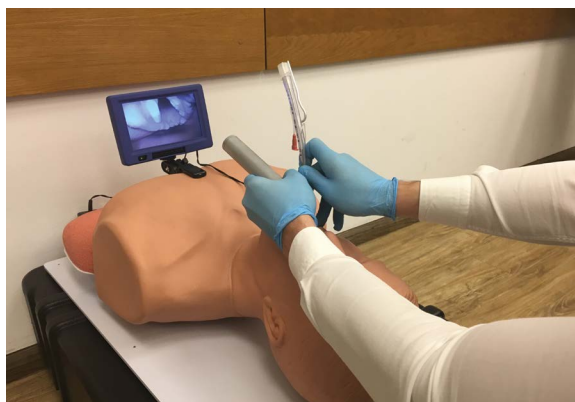


FIGURE 3. Using a technique of Videolaryngoscopy

The study examined the effectiveness of students utilizing direct intubation after practical exercises using a video laryngoscope and vice versa, intubation with the King Vision video laryngoscope after practical exercises with a classic laryngoscope. The rate of successful first attempt intubations was 48% and 52% respectively, in which 17% of students utilizing direct intubation intubated the esophagus compared to the 4% of students who had done the same using the King Vision video laryngoscope [22]. In the study performed by Alvis BD et al. usage of McGrath MAC (Fig. 4) and King Vision video laryngoscopes was tested in those not previously familiar with the equipment. The results showed that the group using the McGrath MAC achieved a quicker time of intubation at 17s vs the 38s it took for the group using the King Vision. Furthermore, the rate of the first attempt successful intubation was 100% and 89% respectively [23].

Similar results were achieved in a study conducted by Eismann H et al. The study focused on surgeons who were previously inexperienced in video



FIGURE 4. Intubation using McGrath MAC videolaryngoscope

laryngoscopy. After taking part in different workshops regarding such video laryngoscopy devices as the C-MAC, King Vision as well as the Macintosh laryngoscope, the surgeons were given both simple and difficult airways to intubate. The results show that video laryngoscopy was much more effective in achieving successful endotracheal intubation, especially in difficult airways with diminished oral cavity opening or limited neck movement. The video laryngoscopes allowed for much better visualization of the airway than the standard Macintosh laryngoscope [24]. A comparison of the use of several video laryngoscopes by a group of 50 inexperienced in intubation medical students, was also undertaken by Rendeki et al. Participants tested a few different devices including King Vision, Airtraq and the Macintosh laryngoscope. The study measured time to successful intubation, number of intubation trials, the rate of first-time intubation success, esophageal intubations as well as tooth damage. Following 15 minutes of training and a period of 30 minutes following this training, participants achieved a rate of successful first intubations of > 90% and a time of intubation of < 25 seconds. These inexperienced participants favored the use of video laryngoscopes in the setting of both simple and difficult airways [25]. The group of difficult airways were patients who were morbidly obese (BMI > 50kg/m²). Ndoko



FIGURE 5. Airtraq

et al. evaluated the efficacy of obtaining an airway with the use of the Airtraq video laryngoscope and the Macintosh laryngoscope. The intubation time with the Airtraq was 24 (16) vs 56 (23)s with the Macintosh laryngoscope, as well as a favourable SpO₂ saturation index result for the Airtraq [26].

Intubation of overweight patient groups was also studied by Gaszysnski who analyzed the use of the TotalTrack video laryngoscope and the Macintosh laryngoscope. In all cases in which the TotalTrack was used the Cormack-Lehane the score was 1, and intubation was successfully performed in 11/12 patients. In the cases where a Macintosh laryngoscope was used there was a 100% success rate for intubation, however in four cases the Cormack-Lehane the score was 2 and in three cases the score was 3 [27].

CONCLUSION

The results of the studies examined showed that all authors reached similar conclusions. Intubation performed by using a Macintosh laryngoscope by inexperienced users in unfavorable circumstances, i.e. an immobilized cervical spine with an orthopedic collar, during ongoing CPR or in overweight patients is an extremely difficult task. A short introductory training to video laryngoscopy gives a higher rate of first-time intubation success as well as shortens the time needed for successful intubation. Video laryngoscopy provides very good visualization of the larynx, therefore making it an ideal solution for intubating difficult airways with limited mouth opening, a stabilized cervical spine or in patients with an elevated risk of hypoxemia and aspiration. On the basis of the above analysis it can be concluded that the use of video laryngoscopes by inexperienced users is a legitimate method which may bring many benefits as well as increases patient safety.

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