Archives of Anesthesiology and Critical Care (Autumn 2021); 7(4): 278-284.

Available online at http://aacc.tums.ac.ir

Review Article

Direct Laryngoscopy or Video Laryngoscopy: Which Is Better for Performing Endotracheal Intubation?

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ARTICLE INFO

Article history:
Received 06 January 2021
Revised 29 January 2021
Accepted 12 February 2021

Keywords:
Direct laryngoscopy;
Videolaryngoscope;
Endotracheal intubation;
Glottis visualization

ABSTRACT

Background: Endotracheal intubation is known as the best and challenging procedure to airway control for patients in shock or with unprotected airways. Failed intubation can have serious consequences and lead to high morbidity and mortality of the patients. Videolaryngoscope is a new device that contains a miniaturized camera at the blade tip to visualize the glottis indirectly. Fewer failed intubations have occurred when a videolaryngoscope was used. Other types of videolaryngoscopes were then developed; all have been shown to improve the view of the vocal cords. It may be inferred that for the professional group, including emergency physicians, paramedics, or emergency nurses, video laryngoscopy may be a good alternative to direct laryngoscopy for intubation under difficult conditions. The incidence of complications was not significantly different between the C-MAC 20% versus direct laryngoscopy 13%.
The main goal of this review was to compare the direct laryngoscopy with the (indirect) video laryngoscopy in terms of increased first success rate and good vision of the larynx to find a smooth induction of endotracheal intubation.
Methods: Currently available evidence on MEDLINE, PubMed, Google scholar and Cochrane Evidence Based Medicine Reviews, in addition to the citation reviews by manual search of new anesthesia and surgical journals related to laryngoscopies and tracheal intubation.
Results: This review of recent studies showed that the laryngoscopic device design would result in smooth approach of endotracheal intubation by means of good visualization of glottis and the best success rates in the hands of both the experienced and novice. Video laryngoscopes may improve safety by avoiding many unnecessary attempts when performing tracheal intubation with DL compared to VL as well as easy learning of both direct and indirect laryngoscopy.
Conclusion: The comparative studies of different video laryngoscopes showed that DL compared with VL, reveal that video laryngoscopes reduced failed intubation in anticipated difficult airways, improve a good laryngeal view and found that there were fewer failed intubations using a videolaryngoscope when the intubator had equivalent experience with both devices, but not with DL alone. And therefore, knowledge about ETI and their skills, are crucial in increasing the rate of survival.

Endotracheal intubation is known as the best and challenging procedure to airway control for patients in shock or with unprotected airways. Therefore, knowledge, skills about ETI and their status are crucial for increasing the rate of survival [1]. Failed intubation can have serious consequences and lead to high morbidity and mortality of the patients [2]. Video laryngoscope (VL), is a new device that contains a

The authors declare no conflicts of interest.

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miniaturized camera at the blade tip to visualize the glottis indirectly. This method was developed at the beginning of the 21st century [3]. The VL compared with, DL reduced failed intubations, including in participants with anticipated difficult airways, reduced laryngeal/airway trauma, increased easy laryngeal views, and reduced failed intubations amongst experienced users [4]. Each clinician will have a preference, but all clinicians should become familiar and proficient in using different types of intubation devices [5]. Cochrane also found that there were fewer failed intubations using a videolaryngoscope when the intubator had equivalent experience with both devices, but not when the intubator was experienced with the Macintosh but not the videolaryngoscope [6].

Main Goal:

General over view to compare the direct laryngoscopy with the (indirect) video laryngoscopy to find a smooth induction of endotracheal intubation through a good vision of the larynx.

Specific Goal:

To assess the best visualization of glottis and the first attempt success of endotracheal intubation in normal and anticipated difficult laryngoscopy, and to define the factors that encourage the intubators to select the direct over (indirect) video laryngoscopy.

Methods

In this review, we searched the best currently available evidence on MEDLINE, PubMed, Google scholar and Cochrane Evidence Based Medicine Reviews, in addition to the citation reviews by manual search of new journals related to laryngoscopies and tracheal intubation. Electronic searches have been started by date 10 Jun 2020. We searched using both medical subject headings (MeSH) (or equivalent structured vocabulary in other databases) and free text. The keywords that were searched for the literature review; videolaryngoscopy, direct laryngoscope, endotracheal intubation and glottis visualization. Only English resources were searched. The data that were compiled from articles and measurements and analyses of these variables with their confounders, have all been performed by the single effort of researcher.

Exclusion criteria; Children, extreme geriatrics, limited mouth opening, primary mass effect and/or anatomical distortions secondary to radiation, or distortion of airways, excessive facial trauma and wirings, and patients with head and neck pathology and/ or neck immobility. Two references have been excluded because of outdate of research period.

The importance of endotracheal intubation of airway management

Tracheal intubation remains the gold standard for emergency airway management, from aspiration [7]. Difficult laryngoscopy and difficult tracheal intubation occur in 1.5% to 13% of patients undergoing general anesthesia, and have always been a concern for anesthesiologists. Failed intubation can have serious consequences and lead to high morbidity and mortality of the patients [2]. When considering the anatomical structure of the airway, it is important to make a quick airway assessment to help determine the best route of airway management [5]. Many clinical criteria have been introduced with regard to evaluation of the patient's airway before induction of anesthesia. One of them is, the Cormack-Lehane Grading (CLG) which assists in predicting difficult intubation performed under direct laryngoscopy. Failure to view any portion of the glottis is classified CLG 4 and is considered as a difficult airway [8].

The Cormack- Lehane grading (CLG) score

Grade I: Full view of the glottis.
Grade II: Partial view of the glottis
Grade III: Only epiglottis visible
Grade IV: Neither glottis nor epiglottis
is Visible CLG scores I and II were
grades III and IV were classified as difficult
intubations [9]

In this review we try to discriminate the most convenient and smooth endotracheal intubation comparing the DL and VL done for anesthetized patients in operative room, emergency department and in critical care units. Esophageal intubation is of great clinical significance. The C-MAC was associated with a lower incidence of esophageal intubation than a direct laryngoscope [10]. It should be noted that successful airway management is dependent on a comprehensive understanding of pathophysiological processes and high competence in advanced interventions, and is not equivalent to good technical skills in ETI alone [1]. A recent Cochrane review found that, DL compared with VL, reduced failed intubations, in participants with anticipated difficult airways, reduced laryngeal/airway trauma, increased easy laryngeal views, and reduced failed intubations amongst experienced users [4]. The percentage of patients with a difficult airway view (Cormack-Lehane grade III or IV) was statistically significantly higher in the presence of each of the HEAVEN criteria with both direct and video laryngoscopy.

"HEAVEN criteria"

By Nausheen et al. include the following:

- Hypoxemia- oxygen saturation value≤ 93% at the time of initial laryngoscopy.
- Extremes of size clinical obesity, defined by the operator as anticipated to interfere with either bag-

valve-mask ventilation and/or visualization of glottic structures during laryngoscopy.

- Anatomic challenge- any structural abnormality that is anticipated to limit laryngoscopic view; to the airway structures themselves, limited oral aperture, large tongue, short neck that limits laryngoscopy or obstructs visualization.
- Vomit/blood/fluid- clinically significant fluid in the pharynx/hypopharynx prior to laryngoscopy that is anticipated to interfere with visualization of glottis structures during laryngoscopy.
- Exsanguination- suspected anemia, either chronic or acute.
- Neck mobility issues- limited cervical range-of motion [7].

The controlled and uncontrolled environments:

A-The controlled environment is a situation in which most if not all factors (i.e., patient position, availability of high oxygen supply, or assistance evoked from other medical providers) can be precisely manipulated and modified. The example of a controlled environment would be a surgical suite. The situation that occurs most often.

B- The uncontrolled environment is a situation in which most factors cannot be modified. Slight variations can complicate the overall procedure. An example of the uncontrolled environment is when a patient is far away from critical care personnel, equipment, and supplies. This situation proves to be a challenge because of limitations related to the help available and accessibility of equipment [5]. And also, Nausheen et al study, has shown that with the presence of HEAVEN criteria, laryngoscopic view, and intubation failure for direct and indirect VL and would portend a greater likelihood of a difficult airway view and higher rates of intubation failure for both direct and video laryngoscopy [7]. When analysis was carried out by type of videolaryngoscope, only the C-MAC Macintosh blade and the GlideScope, failed intubations were significantly fewer when a videolaryngoscope was used in participants with an anticipated difficult airway [6].

The Sniffing Position

A clear laryngeal view may be achieved by flexing the lower cervical spine and extending the upper cervical spine "a sniffing the morning air" position, enabling the laryngoscopists to create 'a line of sight' to the larynx to pass the endotracheal tube [6].

The Sniffing Position, is the best position to avoid tracheal tip impacting on the anterior subglottic space of the fauces. In Glidoscope videolaryngoscope, Parker Flex- Tip™ tracheal tube with posterior facing bevel is ideal tube because the curved tip slides along the anterior tracheal wall without the frequent problems of impaction that occurs with standard beveled tubes [11]. External laryngeal manipulations (ELM) could be used to improve the view of the glottis to achieve a C&L grade I or II. The size of the endotracheal tube and the size of the blade are dependent on the standard operating procedure of the hospital [12].

The laryngoscopy, laryngoscopes and classifications:

The aim of laryngoscopy is to obtain good visualization of the vocal cords to facilitate smooth endotracheal intubation [13]. Zeitels wrote that, Jackson designed a number of laryngoscopes, experimenting with a variety of shapes. Moreover, an important feature of Jackson's laryngoscopes was the ergonomic handle. A significant force was often required for DL due to it was done by means of local anesthesia [14-11]. Video laryngoscope (VL) is a new device that contains a miniaturized camera at the blade tip to visualize the glottis indirectly [3]. Videolaryngoscopes also differ in the method of display of the laryngeal view – some have an integrated camera that records images and displays them via a fibreoptic bundle attached video screen, while others use an external video camera that is connected to the scope and an external video screen [14].

The Gold Standard (Traditional) Laryngoscope (Macintosh), McCoy Macintosh-type laryngoscope, C-MAC videolaryngoscope, and the Glidescope videolaryngoscope™.

This design enables a lighted view of the larynx without direct 'line of sight' and can therefore assist when difficulty is encountered (or predicted) with direct laryngoscopy [6]. Certain VLs have a Macintosh-type blade similar to that of standard laryngoscopes; the difference is the inclusion of a camera. The blade is inserted into the oral cavity using the standard direct laryngoscopic technique, and the glottis can then be seen either under direct vision or on a video screen [15].

The main groups of videolaryngoscopes:

The videolaryngoscopes currently available could be divided into two groups:

1- The channeled group videolaryngoscopes
2- non-channelled videolaryngoscopes.

The non-channelled devices can be divided in angulated and non-angulated blade [4].

C-MA videolaryngoscope and Glidoscope® videolaryngoscope) in comparison:

By comparison of videolaryngoscopes (C-MAC videolaryngoscope and Glidoscope® videolaryngoscope) which were used as an alternative to direct laryngoscope in practice. The direct Laryngoscope (Macintosh) which is the traditional laryngoscope, and videolaryngoscopes which have a wide range of types that could be used worldwide in the different health settings. So, in this review, we compare the Macintosh

laryngoscope with the C-MAC videolaryngoscopes and Glidescope videlaryngoscopes in regard to the following:

1- The comparison between DL and VL of good glottic visualization

rate defined as Cormack-Lehane Grades (CLG).

2- The first pass success in normal airway and an anticipated difficult laryngoscopy GVL (Glidescope® and C-MAC video laryngoscope) compared with the traditional MDL (Macintosh direct laryngoscope.

3- Comparison of VL with DL by the hands of intubators; (the anesthesia house staff and novice, experienced nurses) and, assessment of their using; C-MAC videolaryngoscope and Glidoscope® videolaryngoscope) as alternatives to direct laryngoscope in practice.

4- The advantages and disadvantages of video laryngoscopy compared to the direct laryngoscopy.

5- The impacting factors that encourage intubators to select DL over VL.

1- The comparison between DL and VL of good glottic visualization

rate defined as Cormack-Lehane Grades (CLG):

Video laryngoscopy appears to improve the Cormack-Lehane grade of view obtained during laryngoscopy, but is conversely associated with lower rates of successful intubation on the first laryngoscopy attempt and longer time to intubation for a given grade of view [12]. According to Aziz et al, there were a similar number of tracheas in each group that could not be intubated despite an adequate laryngeal view (Cormack-Lehane grade I or II). These failures were associated with achieving an adequate laryngeal view in the C-MAC (54%)group as compared with the DL (35%)group [16].

2- The first pass success:

The first pass success of tracheal intubation of the normal airway and an anticipated difficult laryngoscopy; comparing GVL (Glidescope® and C-MAC) video laryngoscopes were compared with the traditional Macintosh MDL direct laryngoscope. In case of an anticipated difficult airway, the complication rate increases with the number of intubation attempts [12]. Two outcome measures were used in (laryngoscopic view with the endotracheal intubation) to define intubation performance:

(a) failure to place a tracheal tube on the first attempt.

(b) failure to place a tracheal tube without oxygen desaturation SpO2< 90%. Studies show increasing attempts are associated with higher complication rates. Thus, the success of GVL in failed DL may have avoided the deleterious consequences associated with multiple attempt intubations [17].

3- Comparison of VL with DL by the hands of intubators;

(The anesthesia house staff and novice, experienced nurses) and, assessment of their use; C-MAC videolaryngoscope and Glidoscope® videolaryngoscope) as alternatives to direct laryngoscope in practice. It may be inferred that for professional laryngoscopists, including emergency physicians, emergency nurses and paramedics, the video laryngoscopy may be a good alternative to direct laryngoscopy for intubation under difficult conditions and associated with higher efficacy in comparison with direct laryngoscopy, but this difference was not statistically significant [18]. Although providers were experienced with direct laryngoscopy, their exposure to the C-MAC videolaryngoscope was recent. the blade designs are resembling the Macintosh blades, the concept of the laryngoscopy technique using the C-MAC was axiomatic familiar to providers. And although, the limited use to the C-MAC videolaryngoscope, its use resulted in a higher success rate as managing a difficult airway, suggests easy adaptability of the C-MAC device into the routine clinical practice [19]. A Cochrane Systematic Review found that there were fewer failed intubations using a videolaryngoscope when the intubator had equivalent experience with both devices, but not when the intubator was experienced with the Macintosh but not the videolaryngoscope [6-4]. Accordingly, there is strong evidence that expertise in video laryngoscopy requires prolonged training and practice, and a minimum of 76 attempts are considered necessary to achieve proficiency [20]. Other factors that contribute to tracheal tube placement such as the mechanics of laryngoscope and intubator's skills. For example, the use of DL, compared to a certain type of VL, may have allowed the intubator to better manipulate the tracheal tube regardless of glottis visualization. In addition, it is possible that the use of VL enabled less-experienced intubators to achieve a better visualization but they failed to intubate patients [21].

4- The advantages and disadvantages of video laryngoscopy compared to the direct laryngoscopy:

Table 1- Advantages and disadvantages of videolaryngoscopes

Advantages	Disadvantages
Improvement of glottic visualization, by the position of (the camera eye) within A few centimeters from the glottis, whereby alignment of the oral, pharyngeal - laryngeal axes is	Airway soiling can obscure the camera lens, requiring that the device is removed and cleaned before repeated use, favoring DL in such circumstances [4-28]

not necessary as in direct laryngoscopy [22]	
For, VL was superior to DL as an airway device for completing ETI without serious chest compression interruptions .e.g.; in arrest patients [23]	Routine intubation produces measurable airway injury, these effects are further exacerbated in the presence of inadequate of neuromuscular relaxation or anesthetic depth [29].
Higher endotracheal intubation rate with non-expert and expert laryngoscopists [23]	Expensive than Macintosh laryngoscope [14]
Can provide an official record of the tracheal intubation patient file as a 'digital airway footprint [24]	Good hand-eye coordination is required for intubation [14]
	Increased intubation time when compared to Macintosh laryngoscope in patients with normal airway [14]
the video-imaging technology of these new devices offers a good bit of shared view between trainer and trainee, so learning of airway anatomy could be facilitated, critical appraisal of technique, and feedback. leading to more momentary skill acquisition than is achievable with conventional training with direct laryngoscopy [25]	Microchips, screens and cables are easily damaged [14]
	Two-dimensional view with loss of depth perception can lead to significant injury to the upper airway [28]
An improved Macintosh laryngoscope blade, attached to a high-definition screen with antifogging system (Glidescope) [25]	Videolaryngoscopes routinely required either a stylet or bougie for tracheal intubation.Therefore, anesthetists should be aware while insertion of these ancillaries [28]
Tracheal intubation with the C-MAC required less external laryngeal manipulation or use of a gum-elastic bougie, than DL [16]	Challenges in the Use of Video Laryngoscope Intubation in the prehospital setting and emergency [28]
Amount of forces exerted during laryngoscopy is the key determinant for mechanical stimulation of supraglottic region and stretch receptors[26]	Difficulty in driving endotracheal tube forward, despite improved glottic visualization (especially with angulated blade), termed (laryngoscopy paradox) [28]
During management patients with COVID-19, in DL, mouth-to-mouth distance between the patient and laryngoscopist is reduced. While in VL,in a line from" the laryngeal inlet to the laryngoscopist's chest"is significantly high reduces the concentration of aerosolised and expelled droplets [27].	Potential weakening in development and maintenance of direct laryngoscopy skill set, especially when there is no expert in airway management [28].

5- Intubators to select DL over VL.

Direct laryngoscopy (DL) has traditionally been the most common approach for emergency endotracheal intubation, although its popularity has been declining since the widespread introduction of video laryngoscopy (VL) [30]. The videolaryngoscope was never used in (9%) of programs, despite being available. Other impediment versus using video laryngoscopy as primary devices included the need to train fellows on different devices and difficulties in getting cleaned video laryngoscopy equipment [28]. Brian et al, in their Randomized Controlled Trial study stated, "It is interesting that for (15%) of patients randomized to VL, the physician either did not use the C-MAC screen or used a direct laryngoscope. It is thinkable that certain patient's or device characteristics forced this decision, perhaps vomitus/ blood obscured the fiberoptic video camera or there was a device or battery failure. This may speak to the assurance that DL is a mandatory skill even in the era of VL, and in cases with a failed first attempt, a higher proportion of operators switched to a different device in the DL group (61.5%) compared with the VL group (25%) [30]. So, Marshall and Pandit have dedate, hospitals will probably need to provide a number of VLS to give their anaesthetists the option to choose the most suitable device [31].

Limitation of this review

The limitation is the low number of studies that included nonexperts, which markedly limits the ability to evaluate the effect of videolaryngoscopy in this important subgroup. small studies favoring direct laryngoscopy were not being published. However, by limiting their interpretability might cause in the presence of significant heterogeneity.

Results

Intubation with video laryngoscopes has become more commonly performed. It has been reported that video laryngoscopes can provide improved laryngeal visualization as well as increased intubation success rate, especially in difficult airway patients [32]. Differences in training, experience and approach with regard to advanced airway management, are most probably the main contributing factors to the discrepancy between studies [33].

Acknowledgement

God is the owner of grace and grace

I would like to thank my supervisor professor; Zahid Hussain Khan who taught me a lot and learned a lot from him, my sincerity and respect, He gave me a lot of support and guidance, and throughout the period of the pandemic, we may not see the door to his room, but we see his open heart to his students all day long who answered my many questions and guided me to the end of this research.

I would also like to extend my thanks and love to co-supervisor; Dr. Kasra karvandian, in whom I found a wonderful doctor, who taught me how to formulate my research goals and made it easy for many.

Last but not the least, I will like to thank my father, mother and siblings for their support and prayer. Not forgetting about my lovely wife and child for their love, support and inspiration during my studies which would have not been possible without their help.

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