



# EARLY TEACHING AND ADOPTION OF VIDEOLARYNGOSCOPY IN EMERGENCY MEDICINE TRAINING

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**SUMMARY** – The aim of this paper is to gather and evaluate available literature about using videolaryngoscopy as a training tool for novice learners and compare it to direct laryngoscopy. Search of the available literature was performed using the MEDLINE database, through the PubMed searching tool. The inclusion criteria were that papers had to be original research and participants had to be novices in the field of airway management. The studies also had to pertain to the topic of using videolaryngoscopy as a training tool, therefore all papers that evaluated performance of videolaryngoscopy in clinical applications or did not pertain to using videolaryngoscopy as a training tool were excluded from this review. Five studies were identified that fitted the inclusion criteria, all of which showed a statistically significant difference in first attempt success at endotracheal intubation in favor of videolaryngoscopy when compared to direct laryngoscopy. One of the studies also demonstrated a faster skill acquisition rate when using videolaryngoscopy. The use of videolaryngoscopy in teaching airway management to trainees (emergency medicine residents included) is a viable option and should be encouraged and researched further.

**Key words:** *Airway management; Endotracheal intubation; Emergency medicine; Residency; Teaching*

## Introduction

Airway management is one of the core components of an emergency physician's skillset. Among the various airway management techniques, endotracheal intubation is an essential part of every emergency medicine residency curriculum. Since most clinical centers use direct laryngoscopy (DL) as a regular everyday working method for performing endotracheal intubation, it is also traditionally used as a teaching method of choice for residency training. However, with videolaryngoscopy (VL) becoming more widely available<sup>1</sup>, coupled with the option of using standard

geometry blades which allow for direct visualization of the glottis even when using a videolaryngoscope, the question of viability of using VL as a primary teaching tool for trainees arises. This paper aims to gather and evaluate the available literature on using VL as a primary teaching tool for airway management novices when compared with using DL for the same purpose and answer the question of potential viability of VL as a teaching tool in the emergency department.

## Methods

Search of the available literature was performed using the MEDLINE database, through the PubMed searching tool. The following combinations of keywords were used: "videolaryngoscopy" + "teaching", "videolaryngoscopy" + "training", and "videolaryngoscopy" + "emergency medicine training". The inclusion

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criteria were that papers had to be original research and participants had to be novices in the field of airway management, either medical students or nurses and residents without prior airway management experience, in order to minimize the possible confounding effects of having participants with various degrees of prior experience and knowledge on the study results<sup>2</sup>. The studies also had to pertain to the topic of using VL as a training tool, therefore all papers that evaluated performance of VL in clinical applications or did not pertain to using VL as a training tool were excluded from this review.

## Results

Results of this review are summarized in Table 1. Five papers were identified that fitted the inclusion criteria and are described in more detail in the following section. A study by Ray *et al.* examined the success rates of medical students with no prior experience in airway management using both DL and VL<sup>3</sup>. Each of the 25 students enrolled was given eight intubation attempts on a manikin with both modalities. The participants demonstrated a significantly higher success rate using VL (97%) as compared with DL (90%). The rates of esophageal intubation were also significantly lower with VL (0% *vs.* 8%) and there was less dental trauma with VL (5% *vs.* 35%). However, the most important finding of the study was the learning curve and skill acquisition rate, i.e., after only six attempts with the videolaryngoscope, all of the participants intubated with consistent success, which was not true for the direct laryngoscope. Also, participants who used VL before DL achieved greater success with DL. A study by Malito *et al.* performed with medical students without prior experience reports similar findings<sup>4</sup>. The participants, 204 students, were divided into 2 groups, one using VL and the other using DL. The VL group had a statistically significantly higher first pass success rate (97% *vs.* 89.4%). The rate of esophageal intubation was lower in the VL group (3% *vs.* 7.7%), but the difference was not statistically significant. Intubation times were significantly lower in the VL group in the first, second and third attempt. Another important finding was that the VL group had acquired optimal views of the glottis (Cormack-Lehane classification) in 75% of cases on the first attempt *versus* 33.7% in the DL group. A study by Miki *et al.* enrolling 31 nurses with

no prior experience in airway management compared participant performance with VL and DL in intubating a manikin<sup>5</sup>. The VL group had significantly lower intubation times (16.7 *vs.* 23.2 seconds), lower rates of esophageal intubation (0% *vs.* 6.45%), lower rates of dental damage (0% *vs.* 12.9%) and higher success rates (91.3% *vs.* 79.4%). Nouruzi-Sedeh *et al.* went beyond manikins and performed a study with untrained, inexperienced medical personnel on real patients scheduled for general anesthesia<sup>6</sup>. In total, 200 intubations were performed, 100 by VL and DL each. There was a significantly higher success rate (93% *vs.* 51%) and a significantly lower intubation time (63 *vs.* 89 seconds) using VL. This study showed that the improvements and benefits of using VL were seen not only on manikins but also on real life patients. A study by Maharaj *et al.* compared the Airtraq to DL in a participant population of 40 medical students without prior airway management experience<sup>7</sup>. The Airtraq was shown to be significantly superior, with the users requiring less time *per* successful intubation, less repositioning maneuvers, and inflicting less dental trauma.

## Discussion

One of the largest pitfalls in emergency medicine residency training is teaching emergency medicine residents skills and mindsets pertaining to various specialties practiced by wards they are rotating on, without taking into consideration that their future job as emergency medicine, and their patient population by extension look significantly different than the populations on the wards. An emergency medicine patient is often undifferentiated, with poor, if any, patient history provided, and a wide range of possible differential diagnoses. Furthermore, these patients are often hemodynamically compromised, unstable and close to cardiorespiratory failure. As such, they can require prompt, agile and reliable airway management, with definitive airway being secured as soon as possible. The airway management training that emergency medicine residents receive is in most cases inadequate for achieving these goals. Most of the emergency medicine residency programs delegate resident education on airway management to anesthesiologists, by sending the resident to an anesthesiology rotation usually 3-6 months long. During the rotation, residents learn and practice endotracheal intubation while instructed

Table 1. Summary of studies included in this review

Study	Modalities compared	Models	Participants	First pass success rate	Esophageal intubation	Intubation time	Additional comments
Ray <i>et al.</i> (2009)	Macintosh (DL) <i>vs.</i> McGrath (VL) laryngoscope	Manikins	25 medical students, 16 intubation attempts each (8 with DL, 8 with VL) in randomized order	97% VL <i>vs.</i> 90% DL	0% VL <i>vs.</i> 8% DL	N/A	Participants using VL before DL had a higher success rate with DL
Malito <i>et al.</i> (2021)	Macintosh (DL) <i>vs.</i> McGrath (VL)	Manikins	204 medical students randomized to either VL or DL	97% VL <i>vs.</i> 89.4% DL	3% VL <i>vs.</i> 7.7% DL (not significant)	38.25s (VL) <i>vs.</i> 43.01s (DL) on first attempt	75% of first attempts with VL graded as Cormack-Lehane I <i>vs.</i> 33.7% with DL
Miki <i>et al.</i> (2007)	Macintosh (DL) <i>vs.</i> Airway Scope (VL)	Manikins	31 nurses, 20 intubation attempts each (10 with DL, 10 with VL).	91.3% VL <i>vs.</i> 79.4% DL	0% VL <i>vs.</i> 6.45% DL	16.47s VL <i>vs.</i> 23.2s DL	Airway Scope was rated by participants as easier to use than Macintosh ( $p < 0.001$ )
Nouruzi-Sedeh <i>et al.</i> (2009)	Macintosh (DL) <i>vs.</i> GlideScope (VL)	200 live patients in operating theater (100 intubated with DL, 100 with VL)	20 participants: 8 paramedics-in-training, 4 first year residents, 4 nurses and 4 medical students	93% VL <i>vs.</i> 51% DL	N/A	63s VL <i>vs.</i> 89s DL	Participants were trained on manikins before performing intubation on patients, but were 'intubation-naïve' before the study
Maharaj <i>et al.</i> (2006)	Macintosh (DL) <i>vs.</i> Airtraq (VL)	Manikins	40 medical students randomized to either VL or DL, 3 attempts on each of the 5 different simulation scenarios	95% VL <i>vs.</i> 82.5% DL	N/A	18.7 s VL <i>vs.</i> 40.8 s DL	The authors also compared the need for using optimization maneuvers used: 0 used in 97.5% of VL group and 60% of DL group

and supervised by anesthesiology attendings. There are several problems with this approach. The first one is the high number of intubations necessary for achieving competence, with a German study finding that around 150 intubations are required to reach a 'success rate plateau' in further attempts and situations<sup>8</sup>. This number is not realistically achievable in the time

period allotted for learning intubation. Furthermore, the achievability of this number even later in clinical practice is highly questionable, as an analysis of a large German database of prehospital emergency medicine calls and cases showed that intubations occurred less than once a month *per* physician<sup>9</sup>. The second problem is the fact that, as previously mentioned, patients

in the emergency ward are different from patients in the operating theater, with success on the first intubation attempt being crucial in emergency medicine. There are several studies showing a significant increase in the rates of complications such as severe hypoxemia, regurgitation, aspiration and cardiac arrest correlating with an increase in the number of intubation attempts<sup>10-12</sup>, while one study showed a significant decrease in achieving return of spontaneous circulation with more than one intubation attempt in a prehospital emergency medicine setting<sup>13</sup>. A potential solution to these problems is using VL as the preferred method for every intubation, both during education and independent practice periods. There is a strong body of evidence in the current literature supporting the use of VL and its superiority to DL; a study from 2015 showed a 79% first-pass success rate with VL *versus* 54% with DL in the intensive care unit (ICU), with esophageal intubation occurring in 0.4% of cases with VL *versus* 19% with DL<sup>14</sup>. A prospective study comparing VL using GlideScope to DL in the management of difficult airways in the emergency department showed a statistically significant difference in the first-pass success: 78% with VL *vs.* 68% with DL ( $p=0.001$ ), with an odds ratio for first-pass success using VL being 3.07<sup>15</sup>. Another prospective study performed in the ICU showed a greater first-pass success rate with VL: 80.4% VL *vs.* 65.4% DL ( $p<0.001$ ), with an odds ratio for first-pass success using VL of 2.81, while also demonstrating a statistically significant lower rate of arterial oxygen desaturation during intubation (18.3% VL *vs.* 25.9% DL,  $p=0.04$ ) and a lower rate of esophageal intubation (2.1% VL *vs.* 6.6% DL,  $p=0.008$ )<sup>16</sup>. A randomized controlled trial (RCT) from 2015 performed in an ICU showed that first-pass success was achieved in 74% of intubations with VL *vs.* 40% with DL ( $p<0.001$ )<sup>17</sup>. Another RCT with experienced anesthesiologists as participants compared VL using C-Mac with DL in patients with a predicted difficult intubation; first-pass success rate was significantly higher with VL than DL (93% *vs.* 84%,  $p=0.026$ ), with a Cormack-Lehane grade I or II view achieved in 93.28% of intubations with VL and 80.95% of intubations with DL ( $p<0.001$ )<sup>18</sup>. A prospective study from 2014 compared the efficiency of VL with C-Mac to DL regarding the rate of successful 'rescue intubations' following a failed first attempt intubation with DL; VL was successful in 82.3% of cases *vs.* 61.7% of cases

with DL, with the odds ratio of successful 'rescue intubation' achieved with VL being 3.5 when compared to DL<sup>19</sup>. VL has been shown superior even in the context of cardiopulmonary resuscitation (CPR); a study comparing VL to DL for tracheal intubation during CPR showed that VL was significantly better at first-pass success (71.9% VL *vs.* 52.8% DL,  $p=0.003$ )<sup>20</sup>.

There is consistent evidence demonstrating that VL can improve not only performance of trained and experienced staff but also drastically improve the success rate of novices and untrained medical personnel. More importantly, the learning curve for VL is much more favorable for beginners, improving their rates of learning and being easier to use. Taking these facts and the context of airway management in the emergency department into consideration, it is clear that VL can provide significant benefit to both patients and residents, as both a working and learning tool, potentially filling the gap in experience and time between emergency medicine and anesthesiology residents, and drastically improving first-pass success rates, therefore improving patient outcomes in general. In a minor digression, two more papers will be discussed in order to show that even the arguments of significant cost of videolaryngoscopes or their unavailability for training on manikins if the department has only one, can be easily disproved. A paper from 2016 demonstrated the possibility of assembling a videolaryngoscope using a traditional Macintosh blade direct laryngoscope and a 5\$ USB camera connected to a smartphone and providing a live feed<sup>21</sup>. While certainly not an optimal choice in real patients, the contraption described in the paper can certainly help in training residents on manikins in the context of unavailability of more conventional videolaryngoscopes. In support to this argument, another study<sup>22</sup> compared intubation time and success rate on manikins between a conventional videolaryngoscope and a USB camera attached to a Macintosh and smartphone, and showed that there was no significant difference.

## Conclusion

While the literature on using videolaryngoscopy as a primary teaching tool is still scarce, the available research shows consistent superiority of videolaryngoscopy in novice learners regarding first-pass success rate of endotracheal intubation and a lower rate



of complications such as esophageal intubation, with one study implicating a faster rate of skill acquisition by using videolaryngoscopy. The improved learning curve demonstrated when using videolaryngoscopy in contrast to direct laryngoscopy may help emergency medicine residents shorten the gap in clinical experience and exposure to intubation opportunities during their residency training between them and their anesthesiology resident colleagues. These promising results encourage further research of using videolaryngoscopy in airway management training and an initiative to start using videolaryngoscopy as a teaching tool in the emergency department more frequently, especially in the light of other clinical research showing superiority of videolaryngoscopy in real clinical scenarios with live patients.

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### Sažetak

## RANO PODUČAVANJE I PRIMJENA VIDEOLARINGOSKOPIJE TIJEKOM SPECIJALIZACIJE IZ HITNE MEDICINE

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Cilj ovoga rada bio je prikupiti i ocijeniti dostupnu literaturu vezanu uz primjenu videolaringoskopije kao alata za obuku početnika te ju usporediti s direktnom laringoskopijom. Pretraga dostupne literature je provedena koristeći bazu podataka MEDLINE preko tražilice PubMed. Kriteriji uključenja su bili da rad mora biti tipa izvornog istraživanja, a sudionici moraju biti početnici u polju zbrinjavanja dišnoga puta. Studije su se također trebale ticati primjene videolaringoskopije kao alata za obuku, stoga su svi radovi koji su ocjenjivali uporabu videolaringoskopije u kliničkim primjenama ili nisu opisivali primjenu videolaringoskopije kao alata za obuku isključeni iz ovoga preglednog rada. Pronađeno je pet studija koje ispunjavaju kriterije uključenja te su sve pokazale statistički značajnu razliku u uspjehu endotrahealne intubacije iz prvog pokušaja u korist videolaringoskopije u usporedbi s direktnom laringoskopijom. Jedna je od studija također prikazala bržu stopu stjecanja vještina uz primjenu videolaringoskopije. Uporaba videolaringoskopije za podučavanje zbrinjavanja dišnoga puta (među ostalim i u sklopu specijalizacije iz hitne medicine) je održiva mogućnost te bi ju se trebalo poticati i istraživati dalje.

*Ključne riječi: Izobrazba; Endotrahealna intubacija; Hitna medicina; Specijalizacija; Zbrinjavanje dišnoga puta*