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Research Article

Comparison of the Intubation Success Rate in Video Laryngoscopy versus Direct Laryngoscopy in Patients with Philadelphia Collar: A Randomized Clinical Trial

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ABSTRACT

Background: Video laryngoscopy (VL) and direct laryngoscopy (DL) are two approaches to provide secure airway for patients with compromised airways. This study aims to compare the intubation success rate in video laryngoscopy versus direct laryngoscopy in patients with Philadelphia collars.

Methods: 172 patients with cervical collars who have undergone general anesthesia were enrolled. After induction of anesthesia for all patients, an oral airway was used to facilitate the ventilation. A VL approach in Group A and DL approach in Group B were used. In order to evaluate the effectiveness of each method, we considered related parameters, including intubation time, the number of intubation attempts, Cormack-Lehane (CL) score, orodental injuries, heart rate, and blood pressure 3 minutes after intubation, oxygen saturation, neck circumference, and BMI.

Results: The ratio of first-attempt intubations was not different among the two groups (P = 1.00). The mean [SD] time for intubation was shorter with DL vs VL (p<0.0001). There were almost equal rates of CL grades 1 and 2 (67.5% and 29%) using the VL than with the. The mean [SD] mean arterial pressure in VL vs DL was 86.17 mmHg vs 90.88 mmHg (p = 0.086).

Conclusion: According to our results, there was no significant difference in complications and hemodynamic changes after intubation in both groups, but the intubation duration was significant shorter in DL group.

The ability to provide safe airway management is an essential skill for proper and safe anesthesia management [1]. Failure in airway management is the main cause of mortality and morbidity, such as dental injury, pulmonary aspiration, airway trauma, unexpected tracheostomy, anoxic brain injury, pulmonary arrest [2-5]. Failure to maintain a patent airway for a few minutes can lead to permanent brain damage. It has been shown that more than 73% of individuals with airway obstruction treated inappropriately experienced death and brain damage [6]. Furthermore, it has been shown that a significant cause of anesthesia-related mortality is due to critical airway incidents [7]. Difficulty in tracheal intubation is defined as more than three attempts or taking more than 10 minutes to administer a tracheal tube which may occur in 1.1% to 3.8% of patients [8]. In difficult tracheal intubations, there is a possibility of damage to the trachea causing serious complications and even death.

Neck fixation with collar is a basic emergency method for cervical spine fixation of patients with definite or suspected spinal cord injury [9-10]. In an unstable

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cervical fracture, using a collar can prevent neural damage caused by neck movement. However, when using a collar in a patient, there is a need for advanced airway management. In addition, tracheal intubation may be difficult due to limited opening of the mouth and cervical extension [11-14].

Video laryngoscopy (VL) has emerged as a capable assist in tracheal intubation and managing airways. VL enables clinicians to control difficult airway intubation in expected and unexpected clinical settings [15-16]. Nowadays, VL is utilized in many clinical centers as a part of standard airway management procedures. Administering a VL enables the clinicians to observe the vocal cords and glottis indirectly. This view is achieved without the necessity of aligning the oral, pharyngeal and tracheal axes, on the other hand it does not need manipulating the position of head and neck [17]. Nowadays duo to the covid-19 break out, it can be considered to use video laryngoscopy duo to relatively greater safety as a result of less exposure to the virus [18].

The purpose of this study was to compare the intubation success rate in video laryngoscopy versus direct laryngoscopy in patients with Philadelphia collar and the complications of direct laryngoscopy and video laryngoscopy in these patients. This issue, which has not been clinically examined so far, is important because there is a significant difference between the intubation success rate and the complications of the two methods. Finally, it can be used to save the patient's life and reduce complications from intubation.

Methods

After approval from the Ethics committee, informed written consent was obtained from 176 adult patients. Therefore, 176 patients with cervical collars undergoing surgery under general anesthesia aged 18- 60 were enrolled. American society of anesthesiologists physical status 1, 2, and surgery under general anesthesia were inclusion criteria. Exclusion criteria consisted of rheumatoid arthritis, anticipated difficult airway, obstructive sleep apnea, history of surgery on the head and neck, radiotherapy on the head and neck, musculoskeletal disorders, poor oral health, gastroesophageal reflux and having beard [19]. The evaluation before operation and anesthesia was prepared by the anesthesiologist responsible for the patient and according to the hospital standard protocols.

Neck circumference (measured at the level of the thyroid cartilage) and body mass index (BMI) were measured and recorded before the intervention. After entering the operating room, patients were divided into two groups named A and B based on the table of random numbers. Standard monitoring was performed for all the patients entering the operating room. After mask ventilation with100% oxygen for three to four minutes, induction of anesthesia was given with 2.5 mg/kg of propofol, and 2 µg/kg fentanyl, and 0.5 mg/kg atracurium as a neuromuscular blockade was used to facilitate the intubation [20]. After induction of anesthesia for patients, an oral airway was used to facilitate a ventilation mask. A tracheal tube was used for intubation. After monitoring the Train of Four that was zero for the ulnar nerve, video laryngoscope in Group A and laryngoscope with a curved blade in Group B were used for intubation. All 176 patients were intubated by the same skilled anesthesiologist, who was well familiar with laryngoscope. Every intubation attempt with the video laryngoscope and direct laryngoscope was recorded. Initially, the anesthesiologist got the chin and lower incisors with fingers and the left thumb to open the mouth wide enough (scissors maneuver). When the anesthesiologist entered the endotracheal tube downward to watch the video display, the endotracheal tube was inserted via the vocal cords. Intubation time, defined as the time required for intubation (from the onset of laryngoscopy until confirmation of intubation), was computed with a chronometer by the research assistant confirming the proper position of the tracheal tube by looking at the capnography and the end-expiratory CO2 curve on it. The number of intubation attempts were also recorded.

After intubation, oral and dental injuries were determined, and Spo2 (Oxygen saturation) was recorded after intubation and before connecting the patient to the ventilator. In addition, after the intubation, evaluation of the laryngeal vision and Cormack–Lehane score at video laryngoscopy and direct laryngoscopy were recorded.

Results

In this study, 176 individuals (74 men and 102 women) were enrolled, 38 men were in the video laryngoscope group (A), and 36 men were in the direct laryngoscope

Group (B). In addition, 48 women were in the video laryngoscope group and 54 women in the direct laryngoscope group. Comparison of gender in these two groups was calculated with $\alpha = 0.05$, P-value was calculated to be 0.647, so the difference between these two means is not statistically significant.

The mean age of patients was 39.69 years with a standard deviation of 14.722. The mean age of patients in the video laryngoscope group (A) was 40.69 years with a standard deviation of 13.612, and the mean age of patients in the direct laryngoscopy group (B) was 38.73 years with a standard deviation of 15.726. In order to compare the age of patients in these two groups, considering $\alpha = 0.05$, the P-value was calculated to be 0.38, so the age difference between these two groups was not statistically significant.

The mean size of neck circumference (A) was 38.13 cm in the video laryngoscope group with a standard deviation of 4.732 and in the direct laryngoscope group (B) of 37.28 cm with a standard deviation of 4.203. Comparing these two groups with $\alpha = 0.05$, P-value was calculated to be 0.21, so the difference between these two groups is not statistically significant.

The mean BMI in the video laryngoscope group was 27.2 kg/m^2 with a standard deviation of 4.23 and in the direct laryngoscopy group was 27.56 kg/m^2 with a standard deviation of 5.75. Comparing these two groups with α= 0.05, P-value was calculated to be 0.63, so the difference between these two groups is not statistically significant. The demographic data are shown in (Table1).

The mean oxygen saturation in the video laryngoscope group was 99.1395% with a standard deviation of 1.11843, and in the laryngoscopy group, 99.3556% with a standard deviation of 0.78341. Comparing these two groups with α= 0.05, P-value was calculated to be 0.489, so the difference between these two groups is not statistically significant.

The mean MAP (mean arterial pressure) 3 minutes after intubation in the video laryngoscope group was 86.17 mmHg with a standard deviation of 19.77, and in the direct laryngoscopy group was 90.88 mmHg with a standard deviation of 16.26, which was calculated with α= 0.05, P-value was calculated to be 0.086. Therefore, the difference between these two groups is not statistically significant.

The mean heart rate 3 minutes after intubation was 80.14 video laryngoscope group with a standard deviation of 14, and in the direct laryngoscopy group was 84.13 with a standard deviation of 14.73, which was calculated with α= 0.05, P-value was calculated to be 0.067, so the difference between these two groups is not statistically significant.

Three cases of oral-dental injuries in the video laryngoscope group were observed from 86 cases. In the direct laryngoscopy group, one case of oral-dental injury was observed in 90 cases. Considering α= 0.05, P-value was calculated to be 0.36, the difference between these two groups is insignificant.

Four patients in the video laryngoscope group had two intubation attempts, and 82 cases had one intubation attempt, and in the direct laryngoscopy group, four patients had two intubation attempts, and 86 cases had one intubation attempt. Considering α= 0.05, P-value was calculated to be 1.00, the difference between these two groups is insignificant.

In the video laryngoscope and direct laryngoscope group, no cases of hematoma were seen.

The mean time needed for intubation in the video laryngoscope group was 22.31 seconds with a standard deviation of 6.31, and in the direct laryngoscopy group, 17.46 seconds with a standard deviation of 9.78. With α= 0.05, P-value was calculated to be 0.000, so the difference between these two groups is statistically significant. The details of post-intubation assessments and complications of interventions are shown in (Table 2).

There were 58 cases in the video laryngoscope group and 60 cases in the direct laryngoscopy group with Cormack-Lehane grade 1. There were only 25 cases in the video laryngoscope group and 26 in the direct laryngoscopy group with Cormack-Lehane grade 2. There were three cases in the video laryngoscope group and four cases in the direct laryngoscope group with Cormack-Lehane grade 3. There is no one with Cormack-Lehane grade 4 in these two groups. To compare Cormack- Lehane in these two groups, with α = 0.05, P-value was calculated to be 0.95, so the difference between these two groups is not statistically significant. The assessment of Cormack-Lehane classification of laryngoscopic view taken with a video laryngoscope or direct laryngoscope is shown in (Figure 1).

Table 1- Demographic features of patients

Variable	Total	Video laryngoscope group	Direct laryngoscope group	P value
Gender (men)	74 (42.05%)	38 (44.19%)	36 (40.00%)	0.647
Age (year)	39.69 (14.72)	40.69 (13.61)	38.73 (15.73)	0.381
Neck circumference (cm)	37.69 (4.48)	38.13 (4.73)	37.28 (4.20)	0.209
BMI (Kg/m^2)	27.38 (5.05)	27.20 (4.23)	27.56 (5.75)	0.630

Data are presented as number (percent) or mean (standard deviation).

Table 2- Post intubation assessments and complications of interventions

Variable	Total	Video laryngoscope group	Direct laryngoscope group	P value
Mean arterial pressure after 3 min (mmHg)	88.58 (18.16)	86.17 (19.77)	90.88 (16.26)	0.086
Heart rate after 3 min (beat/min)	82.18 (14.47)	80.14 (14.00)	84.13 (14.73)	0.067
Oral dental injuries	4 (2.3%)	3 (3.5%)	1 (1.1%)	0.360
Cough	7 (4.0%)	0 (0%)	7 (7.8%)	0.014
Hematoma	0 (0%)	0 (0%)	0 (0%)	

Data are presented as number (percent) or mean (standard deviation).

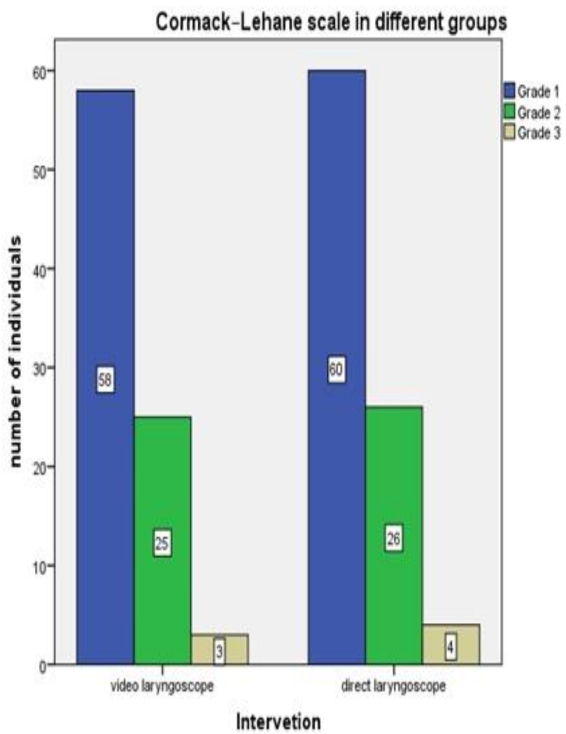

Figure1- Comparison of Cormack-Lehane classification of laryngoscopic view in two different interventions: video laryngoscopy or direct laryngoscopy

Discussion

This study is a clinical trial comparing intubation success rate in video laryngoscopy versus direct laryngoscopy in patients with Philadelphia collar. The design was Single-center and prospective randomized controlled trial. In this study, 176 individuals (74 men and 102 women) were enrolled, 38 men were in the video laryngoscope group, and 36 men were in the direct laryngoscope group. In addition, 48 women were in the video and 54 women in the direct laryngoscope group. As a result, these two groups follow normal gender distribution, which indicates that the gender factor is not interfering with the results of this study.

The mean age of patients was 39.69 years with a standard deviation of 14.722. The mean age of patients in the video laryngoscope group was 40.69 years with a standard deviation of 13.612, and the mean age of patients in the direct laryngoscope group was 38.73 years with a standard deviation of 15.726. The difference between these two groups was not statistically significant, indicating a normal age distribution. Accordingly, the demographic variables of age and sex are identical in groups.

As noted in the results, the mean size of neck circumference was 38.13 cm in the video laryngoscope group with a standard deviation of 4.732 and the direct laryngoscope group of 37.28 cm with a standard deviation of 4.203. The difference between these two groups is not statistically significant. Therefore, the size of neck circumference in these two groups follows the normal distribution, which indicates that the neck circumference factor is not interfering with the results of this study.

As noted in the results, the mean BMI of patients in the video laryngoscopy group was 27.2 kg/m^2 with a standard deviation of 4.23 and in the direct laryngoscopy group was 27.56 kg/m^2 with a standard deviation of 5.75. In comparison, the difference between these two groups is not statistically significant. Therefore, the BMI of patients in these two groups follows the normal distribution, which indicates that the BMI factor is not interfering with the results of this study.

There were 58 cases in the video laryngoscope group and 60 cases in the direct laryngoscope group with Cormack-Lehane grade 1. There were only 25 cases in the video laryngoscope group and 26 in the direct laryngoscope group with Cormack-Lehane grade 2. There were three cases in the video laryngoscope group and four cases in the direct laryngoscope group with Cormack-Lehane grade 3. There is no one with Cormack-Lehane grade 4 in both video laryngoscope and direct laryngoscope group. In comparison, the difference between these two groups is not statistically significant. Therefore, the classification of mallampati, which is one of the most important criteria for intubation success, has a normal distribution in these groups. Therefore, the results of time and counts of attempts to intubate in these two groups have high value and low error.

Based on this study, the mean oxygen saturation in the video laryngoscopy group was 99.1395% with a standard deviation of 1.11843 and in the laryngoscopy group 99.3556% with a standard deviation of 0.78341. In comparison, the difference between these two groups is not statistically significant. Therefore, following intubation in these two methods, there is no obvious difference in tissue oxygenation, which indicates that there is no advantage of one method over the other method based on the main critical outcomes after intubation.

According to this study, the mean MAP (mean arterial pressure) 3 minutes after intubation in the video laryngoscopy group was 86.17 mmHg with a standard deviation of 19.77, and in the direct laryngoscopy group was 90.88 mmHg with a standard deviation of 16.26. In comparison, the difference between these two groups is not statistically significant. Therefore, following intubation in these two methods, there is no clear difference in vital signs, which indicates that there is no benefit of one technique over the other technique based on the hemodynamic changes after intubation.

According to this study, the mean heart rate 3 minutes after intubation was 80.14 in the video laryngoscopy group with a standard deviation of 14, and in the direct laryngoscopy group was 84.13 with a standard deviation of 14.73. In comparison, the difference between these two groups is not statistically significant. Therefore, following intubation in these two methods, there is no clear difference in vital signs, which indicates that there is no advantage of one procedure over the other procedure based on the main hemodynamic changes after intubation.

A study by Vivek B et al. aimed to compare intubation success using a Macintosh laryngoscope and video laryngoscope in patients with limitations of head and neck movements. Hemodynamic changes, air trauma, and postoperative complications of oropharyngeal were similar in both groups, which is in line with the results of this study [21].

There were three oral-dental injuries in the video laryngoscope group and 1 case in the direct laryngoscope group, which was not statistically significant. In the video laryngoscope and direct laryngoscope group, no hematoma was detected. Therefore, the oral and dental protection capability is equal in both groups.

The study by Silverberg MJ et al. aimed to compare the video laryngoscope with direct laryngoscope during intratracheal intubation, which was performed randomly on 117 patients under intubation by direct laryngoscope or video laryngoscope as an initial intubation device. There was no significant difference in intubation complications between direct laryngoscopes and video laryngoscopes [3]. Therefore, our study findings also are in line with this study.

Four patients in the video laryngoscopy group had two intubation attempts, and 82 cases had one intubation attempt. In the direct laryngoscopy group, four patients had two intubation attempts and 86 cases had one intubation attempt. In comparison, the difference between these two groups is not statistically significant. As a result, the success rate of intubation is the same in both methods. In a study by Guyette FX et al., the aim was to compare video laryngoscopy and direct laryngoscopy between 348 people with video laryngoscopes and 510 patients with the direct laryngoscope. This study showed that reducing the number of intubation attempts and improving intubation with video laryngoscopy did not occur compared to direct laryngoscopy [22]. These findings were similar to our study.

In a study by Guyette FX et al., the aim was to compare video laryngoscopy and direct laryngoscopy between 348 people with video laryngoscopes and 510 patients with the direct laryngoscope. This study showed that reducing the number of intubation attempts and improving intubation with video laryngoscopy did not occur compared to direct laryngoscopy [22]. These findings were similar to our study.

The mean time needed for intubation in the video laryngoscopy group was 22.31 seconds with a standard deviation of 6.31, and in the direct laryngoscopy group was 17.46 seconds with a standard deviation of 9.78. In comparison, the difference between these two groups is statistically significant.

A study by Lambert RC et al. aimed to compare direct laryngoscopy with video laryngoscopy in maxillofacial surgery. Comparison between video laryngoscopy and direct laryngoscopy showed that the time needed for intubation in direct laryngoscopy was lower [23], which is in line with our study results.

One of the limitations is that we investigated the study in non-emergency patients because the emergency patient has its own considerations.

Conclusion

In this study, there was no significant difference between age, sex, neck circumference, BMI, blood oxygen saturation, mean arterial pressure, heart rate in 3 minutes after intubation, orodental injury, the counts of intubation attempts, and Cormack-Lehane in these two groups of direct laryngoscopy and video laryngoscopy. However, the time required for intubation between these two groups of direct laryngoscopy and video laryngoscopy was significant. Therefore, according to the results obtained from this study, it is recommended that, in emergencies, due to the significant difference in the duration of time required for intubation, the direct laryngoscopy method maybe preferable.

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