Opinion

Comparison of KingVision videolaryngoscope channelled blade with Tuoren videolaryngoscope non-channelled blade in a simulated COVID-19 intubation scenario by non-anaesthesiologists and experienced anaesthesiologists: A prospective randomised crossover mannequin study

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ABSTRACT

Purpose: A videolaryngoscope has been recommended for intubation in the COVID-19 scenario but the videolaryngoscope providing optimal intubation conditions is not ascertained. We compared KingVision channelled blade with a non-Channelled videolaryngoscope for intubation times in a simulated COVID-19 intubation scenario by both anaesthesiologists and non-anaesthesiologists.
Methods: This prospective randomised cross over mannequin study was conducted in a skill training lab. 25 anaesthesiologists and 25 non-anaesthesiologists donned in standard personal protective equipment performed 100 intubations with KingVision and Tuoren videolaryngoscopes in a mannequin covered with a transparent plastic sheet. The total intubation time, percentage of glottic opening scores, first attempt success rates were assessed.
Results: The mean difference in intubation times in anaesthesiologists and non-anaesthesiologist less with KingVision videolaryngoscope (21.1s; 95% CI 9.6–32.6s vs. 35.9s; 95% CI 24.4–47.4 s; P = 0.001). Percentage of glottic opening score was significantly better with KingVision by non-anaesthesiologists (60; IQR 42.5 to 75 vs. 70; IQR 50 to 100; P = 0.019). KingVision provided superior first attempt success rate in non-anaesthesiologists (84% vs. 61.9%; P = 0.02) and anaesthesiologists (96% vs. 76%; P = 0.12).
Conclusion: KingVision channelled videolaryngoscope provided faster intubation times, glottic views and first attempt success rates in a simulated COVID-19 scenario in manikins and might be preferred over videolaryngoscopes with non-channelled blade. The findings need to be further verified in humans.
Trial registration: ctri.nic.in identifier: REF/2020/05/033338.

1. Introduction

COVID-19 has a wide spectrum of clinical severity and often leads to acute hypoxemic respiratory insufficiency that may necessitate intubation and ventilation [1,2]. Healthcare providers (HCPs), managing these patients need to perform the best practices for intubation and ventilation while ensuring strict self-protection measures.

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Intubation and ventilation are high-risk aerosol-generating procedures and increase the risk of COVID-19 infection to HCPs performing these procedures [3]. Hence, the use of full personal protective equipment (PPE) along with barrier enclosures has been recommended to prevent aerosol exposure. Moreover, because of the urgency of the situation, reduced oxygen reserves, need for rapid sequence intubation, limited time for airway assessment, use of barrier devices like a plastic sheet or intubation box, and restricted movements due to PPE makes intubation challenging in COVID-19 patients [4,5]. Furthermore, in the case of difficult intubation, summoning expert help may not be a realistic option. All these factors may increase the chances of intubation failure and associated morbidity.

Most consensus recommendations have suggested the use of a disposable videolaryngoscope for initial intubation attempts in the COVID-19 scenario. Videolaryngoscopes improve glottic visualisation but despite an improved glottic view, intubation may be difficult, and one may need additional manoeuvres and adjuncts like a stylet to facilitate intubation [6,7].

Channelled devices like KingVision videolaryngoscope have an embedded tube-guiding channel to guide the tracheal tube towards the glottis. This obviates the requirement of a stylet and additional manoeuvrings to navigate the tube through the upper airway. The KingVision videolaryngoscope Channelled blade has been shown to provide better intubation characteristics as compared to conventional direct laryngoscopy or non-channelled videolaryngoscopes for intubation in mannequins by non-anaesthesiologists [7,8]. However, in human, some differences were found when comparing channelled with non-channelled devices [9]. The non-channelled Tuoren videolaryngoscope device has a Macintosh type of blade. In the situation of the current pandemic, no study has been conducted to objectively compare the efficacy of these two categories of videolaryngoscopes for intubation success and ease of use by medical professionals donned in PPE. We aimed to establish the relative efficacy of the non-channelled Tuoren videolaryngoscope as compared to the channelled KingVision videolaryngoscope in a simulated COVID-19 intubation scenario on a mannequin by both anaesthesiologists and non-anaesthesiologists. We hypothesised that the use of videolaryngoscope with a tracheal tube guide channel would provide us with faster intubation times compared to a non-channelled videolaryngoscope blade. We recruited all health care personnel for our study, as the pandemic situation may necessitate HCPs from all specialties to take care of critically ill patients including the need to secure the airway in an emergency.

2. Methods

Ethical approval for this study (Ethical Committee No. IEC-355/08.05.2020) was provided by the institute ethical committee of All India Institute of Medical Sciences, New Delhi, India (Chairperson Dr T.P. Singh) on 8 May 2020. Following ethical committee approval, the clinical trial registry of India registration (REF/2020/05/033338) was done prospectively from May 2020 to July 2020. 50 medical professionals (25 anaesthesiologists and 25 non-anaesthesiologists) were recruited in this prospective randomised crossover trial which was conducted in the skill lab facility of a tertiary care hospital. None of the study participants had any past clinical experience with the study devices. Written informed consent and consent for the publication of procedural images was obtained from all the participants.

The stratified random sampling was used for selecting the study participants. Within-group persons were selected using computer-generated random numbers from the list of anaesthesiologists and non-anaesthesiologists in our institute and these were maintained in opaque sealed envelopes.

Any anaesthesiologist with at least one-year experience in anaesthesia who had done more than 20 successful video-laryngoscope (other than the study devices) guided intubations was included in the experienced category. The non-anaesthesiologist group consisted of any medical personnel belonging to other clinical domains (medicine, cardiology, neurology, surgery, etc.) that were being deployed to take care of COVID-19 patients.

Before starting the study, all participants were briefed about the use of indirect laryngoscopes and specifics of study devices in a 30-min didactic education session by two of the authors (AG, NG) in small batches of five each. Following this, the intubation procedure was demonstrated using both the devices in the mannequin (Laerdal_ Airway Management Trainer, Laerdal, Stavanger, Norway). Subsequently, each participant donned in PPE including googles, headgear, coverall, and double gloves and attempted ten intubations with a size 7.0-mm cuffed tracheal tube using both the devices in a mannequin covered with a transparent plastic sheet to simulate the COVID-19 scenario (Fig. 1A). Thereafter, for the final session of recording the intubation characteristics, participants used one of the two videolaryngoscope s as the initial device for intubation as per their randomisation followed by the other device.

For intubation with the Tuoren videolaryngoscope (Fig. 1B; Henan Tuoren Medical Device, Zhengzhou, China) non-Channelled blade, a semi-rigid stylet was inserted in the tracheal tube and its distal end bent into a hockey-stick shape. While for intubation with KingVision videolaryngoscope (Fig. 1B; Ambu GmbH, Bad Nauheim, Germany), the tracheal tube was preloaded in the tube guide channel before the intubation attempts. The participants were allowed to orient the monitor for optimal viewing. An assistant applied optimum external manipulation if needed to obtain the best view, helped to remove the stylet from tracheal tube, inflated the tracheal tube cuff, and connected the self-inflating bag for ventilation. The time to glottic view and total intubation time (primary endpoint) was measured using a stopwatch by an independent observer.

The glottic view during the attempt was assessed using the Percentage of Glottic Opening (POGO) score and modified Cormack-Lehane grade during the intubation by an independent assessor [10,11].

The total time to tracheal intubation was defined as the total time taken from the insertion of the study device between the teeth until the first successful lung inflation. The time to glottic view was defined as the time from the introduction of the videolaryngoscope blade up to the visualisation of the glottis. Every time the device passed beyond the teeth and was fully taken out, an intubation attempt was counted. The intubation was considered as failed if intubation needed more than 120 s to perform or when the trachea could not be intubated.

At the end of each intubation scenario, the participant rated the overall satisfaction with the ease of device use on a visual analog scale (from '0' signifying extremely easy intubation to '10' implying extremely difficult ones). The participants were then given a questionnaire to rate the two devices based on ease of blade insertion, ease of obtaining a glottic view, ease of bringing the tracheal tube to the glottis, ease of passing the tracheal tube into the trachea (using a five-point Likert scale: 1- very easy; 2- easy; 3- neutral; 4- hard and 5- very hard).

Additional measurements included the total number of intubation attempts, first attempt success rate, the number of optimization manoeuvres needed for tracheal intubation (re-adjustment of head position, need for applying optimal external laryngeal manipulation, videolaryngoscope repositioning), and the number of audible dental clicks. Repositioning of videolaryngoscope was defined as the need to readjust its blade position (without taking it
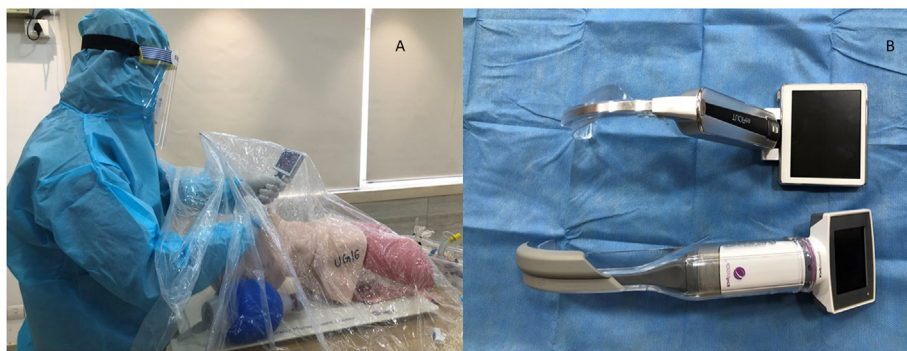
Fig. 1. A: Simulated COVID-19 intubation set up for the study; 1B: Study devices (KingVision Channelled Videolaryngoscope and Tuoren Non-Channelled Videolaryngoscope).

out of the oral cavity) once the optimal glottic view had been obtained to assist with tracheal intubation.

The sample size was based on the paired *t*-test design (since the same person intubated using both the devices). For detecting the difference of 15 s for time to intubation between KingVision videolaryngoscope channelled blade and Tuoren videolaryngoscope in a COVID setting by the anaesthesiologist and considering the standard deviation of difference as 25 s and a correlation of 0.6 between them, a sample size of 24 anaesthesiologists was needed at 80% power and 5% level of significance [7,8]. We decided to recruit 25 anaesthesiologists to factor for any dropouts. Assuming the similar parameters' values for non-anaesthesiologists, we decided to take an equal number of inexperienced operators (non-anaesthesiologists). Thus, a total sample of 50 (25 anaesthesiologists and 25 non-anaesthesiologists) was selected for the study.

Continuous data were reported as mean (standard deviation [SD]) and median (inter-quartile range) depending upon the normality, ordinal data with median (inter-quartile range), and categorical data were presented as frequencies and percentages. Data for the duration of the first and the successful intubation attempt, and the ease of intubation scores (Visual analogue scale (VAS) and Likert scales) were analysed using the paired *t*-test/ Wilcoxon signed-rank test and P-value adjusted as per Bonferroni correction between the two blades. The first attempt success rates, number of optimization manoeuvres used, number of intubation attempts, and the severity of dental trauma (dental clicks) was analysed using the Wilcoxon signed-rank and McNemar test between the blades for anaesthesiologist and non-anaesthesiologist. The comparison between the anaesthesiologist and non-anaesthesiologist for the individual blade was achieved using unpaired *t*-test, chi-square test, and Mann-Whitney *U* test with Bonferroni corrections. The p-value <0.05 was considered as significant. All analysis was accomplished using SPSS version 17 (SPSS Inc, Chicago, USA) statistical software.

3. Results

Fifty participants donned in PPE (25 anaesthesiologists and 25 non-anaesthesiologists) performed 100 intubations (50 with each device) in mannequin covered with a transparent plastic sheet after familiarisation training (Fig. 2).

The mean age of participants was similar in the two groups (Table 1). The time to glottic view [KingVision videolaryngoscope: 6s (IQR 5 to 8) vs. Tuoren videolaryngoscope: 10 s (IQR 7.5 to 15); P = 0.002] (Table 1) and intubation [KingVision videolaryngoscope: 20 s (IQR 18 to 25) vs. Tuoren videolaryngoscope: 30 s (25−59); P < 0.001] by anaesthesiologists was significantly shorter with KingVision videolaryngoscope channelled blade (Fig. 3). Similarly,

the time to visualise glottis [KingVision videolaryngoscope: 6 s (IQR 4.5 to 15.5) vs. Tuoren videolaryngoscope: 14 s (IQR 8.5 to 23); P = 0.006] (Table 1) and intubate (KingVision videolaryngoscope: 28 s (IQR 18.5 to 40) vs. Tuoren videolaryngoscope: 60 s (IQR 36 to 85.50); P < 0.001) by non-anaesthesiologists were also significantly less with KingVision videolaryngoscope channelled blade (Fig. 3).

Both anaesthesiologists (21.1 s; 95% CI 9.64 to 32.60; P = 0.001) and non-anaesthesiologists (35.9 s; 95% CI 24.4 to 47.4; P = 0.001) took less time for intubation with KingVision videolaryngoscope when compared with Tuoren videolaryngoscope. However, the mean difference in intubation times between non-anaesthesiologists and anaesthesiologists was only 10.5s with KingVision videolaryngoscope (95% CI 2.1 to 18.9); P = 0.15 as compared to 25.3s with Tuoren videolaryngoscope (95% CI 6.5 to 44.2); P = 0.009 (Fig. 4).

All participants succeeded in intubation with KingVision videolaryngoscope. The first attempt success rate was higher with KingVision videolaryngoscope in non-anaesthesiologists (84% vs 52%; P = 0.04) and anaesthesiologists (96% vs 76%, P = 0.25) (Fig. 5).

The POGO score was consistently better with KingVision videolaryngoscope when compared with Tuoren videolaryngoscope by both anaesthesiologists [80 (IQR 55 to 100) vs. 60 (IQR 50 to 80; P = 0.018)] and non-anaesthesiologists [70 (IQR 50 to 100) vs 60 (IQR 42.5 to 75; P = 0.038)]. However, the POGO score between anaesthesiologists and non-anaesthesiologists with the same type of videolaryngoscopes were found to be comparable (Table 1). Overall ease of intubation, ease of glottic visualisation, ease of guiding the tracheal tube to the glottis, and passing the tube into the trachea was better with KingVision videolaryngoscope Channelled blade by both anaesthesiologists and non-anaesthesiologists. (Table 1). Anaesthesiologists caused less audible dental clicks when using with KingVision videolaryngoscope (12% vs 36%) compared with non-anaesthesiologists (24% vs 64%). (P = 0.009) (Table 1)

4. Discussion

We have compared two videolaryngoscope blade designs (Channelled KingVision videolaryngoscope with a non-Channelled Tuoren videolaryngoscope), for intubation in a mannequin by HCPs (anaesthesiologists and non-anaesthesiologists) under full barrier precautions. The main findings in our study were that KingVision videolaryngoscope Channelled blade was superior to Tuoren videolaryngoscope for intubation a mannequin by HCPs with respect to intubation time, first attempt success rates, intubation failure, and ease of intubation.

Intubation and ventilation increase the risk of contracting COVID-19 by about 13 times [12]. The use of barrier enclosures, PPE

C O N S O R T

TRANSPARENT REPORTING of TRIALS
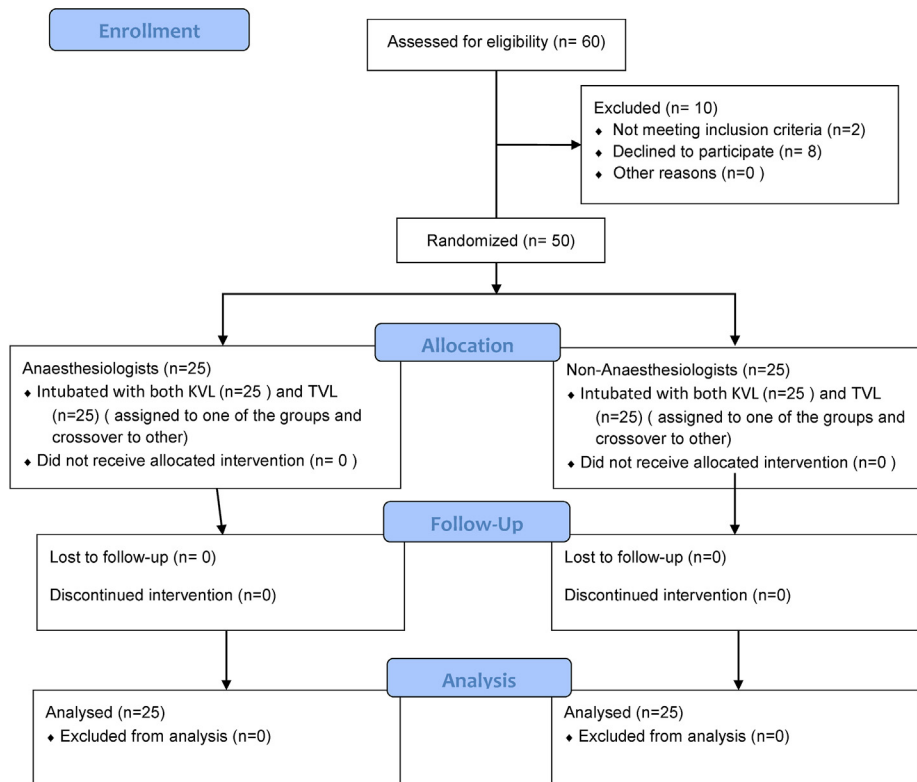
CONSORT 2010 Flow Diagram

Fig. 2. CONSORT 2010 flow diagram.

and fogging of the goggles tends to restrict the vision and fine movements needed during laryngoscopy [13–18]. These factors were reported as a deterrent by all the participants. Begley et al. had reported prolonged intubation times with the use of the aerosol box as compared to the lack of it [13]. All these factors make the intubation conditions challenging in hypoxic COVID-19 patients, even for experienced anaesthesiologists. The present pandemic situation has necessitated the recruitment of non-anaesthesiologists for management of COVID-19 patients [9]. Non-anaesthesiologists are not regular airway managers and may find intubation exceedingly difficult under these sub-optimal conditions.

In line with the clinical practice at our institute, we used a transparent plastic sheet as a barrier to prevent aerosol spread. We did not use intubation boxes because they were not easily available, tend to restrict the manoeuvrability of the device, can lead to a breach in PPE, and increase the dispersal of aerosols in case of their emergency removal in difficult airway scenario [13].

The videolaryngoscope devices used in our study had disposable blades as recommended by the majority of the guidelines on airway management in the COVID-19 patients [4,19,20]. In our study, the POGO scores were significantly better with KingVision video-laryngoscope channelled blade with median POGO scores of more than 50 with both (Table 1). This may be because the blade of

KingVision videolaryngoscope is angled ninety degrees at the tip which probably resulted in better glottic views as compared to Tuoren videolaryngoscope with an angulation of sixty degrees. However, an important limitation of videolaryngoscopes is that it may be challenging to intubate despite a good glottic view, and one may need to use aids like stylets to facilitate intubation [21]. The use of stylets may potentially increase the risk of soft tissue trauma to the upper airway, prolong intubation times and maybe an additional source of aerosol generation during their removal [22]. In the COVID-19 setting, it has been suggested that the tracheal tube should be clamped or heat and moisture exchange (HME) filter should be pre-attached to its proximal end till the patient is intubated and its cuff is inflated to reduce the generation of aerosols [4,19,20]. The use of intubation adjuncts may hamper the application of a clamp and it may also be difficult to remove them due to other deterrents in place (plastic sheet, aerosol boxes, etc). All the above-mentioned limitations of videolaryngoscopes with non-Channelled blade can be circumvented with channelled blades that have a specific slot through which a clamped tracheal tube can be guided towards the glottis [23–25].

In general, videolaryngoscopes have a steep learning curve and it can be attained with approximately 10 uses for various video-laryngoscopes (C-MAC, Glidescope Ranger and McGrath Series 5) [26,27]. Both the groups went through didactic and hands-on

Table 1
Comparison of two videolaryngoscopes for intubation in a COVID-19 simulated mannequin by anaesthesiologists and non-anaesthesiologists. The various parameters are expressed as median [IQR]. The age of participants is expressed as mean (SD).

Characteristics	Anaesthesiologist TVL (n = 25)	Anaesthesiologist KVL (n = 25)	Non-Anaesthesiologist TVL (n = 25)	Non-Anaesthesiologist KVL (n = 25)	P-Value [a] (TVL vs KVL in anaesthesiologist)	P-Value [a] (TVL vs KVL) in non-anaesthesiologist	Anaesthesiologist vs non-Anaesthesiologist[b]	
							KVL vs KVL	TVL vs TVL
Age of participant (yrs)	28.3 (0.97)		27.8(1.2)		NS	NS	NS	NS
POGO	60[50.0−80.0]	80.0[55.0−100)	60.0(42.5−75.0)	70.0(50.0−100)	0.018	0.038	0.994	1.00
TIME G (s)	10.0[7.5−15.0]	6.0[5.0−8.0]	14.0[8.5−23.0]	6.0[4.5−15.5]	0.002	0.006	1.00	0.166
TTI (s)	30.0[25.0−59.0]	20.0[18.0−25.0]	60.0[36.0−85.50]	28.0[18.5−40.0]	<0.001	<0.001	0.058	0.010
VAS (overall ease of use)	1.0[1.0−3.0]	1.0[1.0−1.0]	3.0[2.0−3.0]	1.0[1.0−1.5]	0.024	<0.001	0.306	0.002
Ease of blade insertion	1.0[1.0−2.5]	1.0[1.0−1.0]	2.0[1.0−3.0]	1.0[0.5−1.0]	0.098	<0.001	1.00	0.198
Ease of glottic visualisation	1.0[1.0−3.0]	1.0[1.0−1.0]	3.0[1.5−3.0]	1.0[1.0−1.0]	0.006	<0.001	1.00	0.080
Ease of brining TT to glottis	2.0[1.0−3.0]	1.0[0.0−1.0]	3.0[2.0−3.5]	1.0[0.0−1.0]	<0.001	<0.001	0.932	0.082
Ease of inserting TT into trachea	3.0[1.0−3.0]	1.0[1.0−1.0]	3.0[2.5−3.5]	1.0[1.0−1.0]	<0.001	<0.001	0.898	0.076
Number of attempts	1.0[1.0−1.5]	1.0[1.0−1.0]	1.0[1.0−2.0]	1.0[1.0−1.0]	0.218	<0.001	1.00	0.110
Overall Ease of intubation	5.0[3.0−6.0]	2.0[1.0−2.0]	5.0[3.0−6.0]	2.0[1.0−2.0]	<0.001	<0.001	0.018	0.022
1st attempt success (n; %)	19(76)	24(96)	13(52)	21(84)	0.250	0.044	0.154	0.314
Manuvers needed: (n; %)	8(32.0)	0(0.0)	14(56.0)	3(12.0)	0.016	0.006	0.174	0.470

[a] Paired tests was applied: Wilcoxon singed rank test, McNemar test and p-value adjusted as per Bonferroni corrections.

[b] Unpaired tests- Mann-Whitney U test, Chi-square and P-value adjusted as per Bonferroni correction; TVL = Touren videolaryngosocpe; KVL= KingVision videolaryngosocpe; TT = tracheal tube; TTI = total time to tracheal intubation; s = seconds; n = number.

Fig. 4. Estimated marginal means times for intubation for different videolaryngoscope blades by novice and anaesthesiologist.
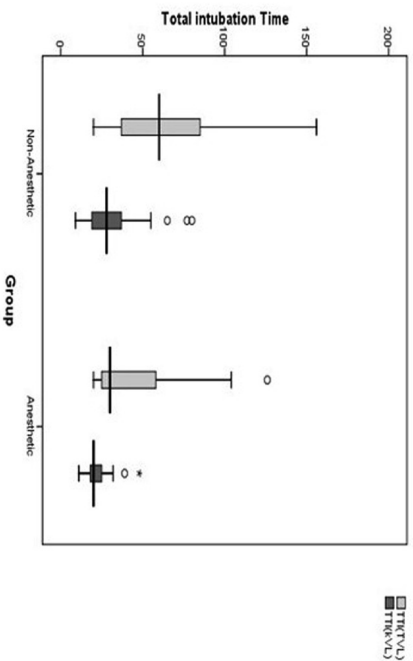

Fig. 3. Box-and-whisker plots illustrating time to tracheal intubation (in seconds) with Tuoren Videolaryngoscope and KingVision Videolaryngoscope Channelled blade in anaesthesiologist and non-anaesthesiologists. The inner horizontal line within the box represents the median time for tracheal intubation, and the outer horizontal lines of the box represent the 25th and 75th quartiles. The horizontal lines of the whiskers represent the 95% confidence intervals.
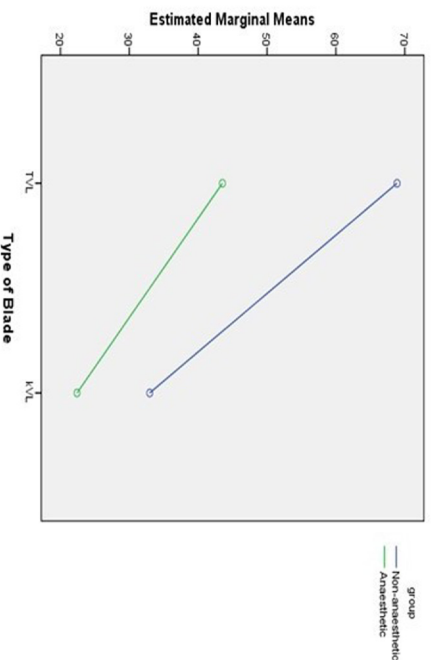
scenario.

In our study, the mean intubation times in mannequin were significantly better with a Channelled KingVision video-laryngoscope than Tuoren videolaryngoscope in hands of anaes-thesiologists (22.4 ± 8.3 vs 43.5 ± 27.7 s) as well as non-anaesthesiologists (32.9 ± 19.3 vs 68.9 ± 37.8 s). A previous study by Chew et al. compared KingVision videolaryngoscope Channelled with non-Channelled blades for intubation by non-anaesthesiologists in a field setting and reported similar times to glottic view and a significantly shorter time of intubation as compared to the Channelled KingVision videolaryngoscope (38.5 ± 18.7 vs 53.8 ± 23 s) [28]. Nabecker et al. reported similar times to intubation and glottic views with KingVision channelled blade and KingVision non-channelled blades. The reason of dif-ferences in their observation and our results may be that King-Vison videolaryngoscopes were used in both groups, with the same hyperangulated blade configuration whereas in present study, Tuoren videolaryngoscope had Macintosh blade like shape
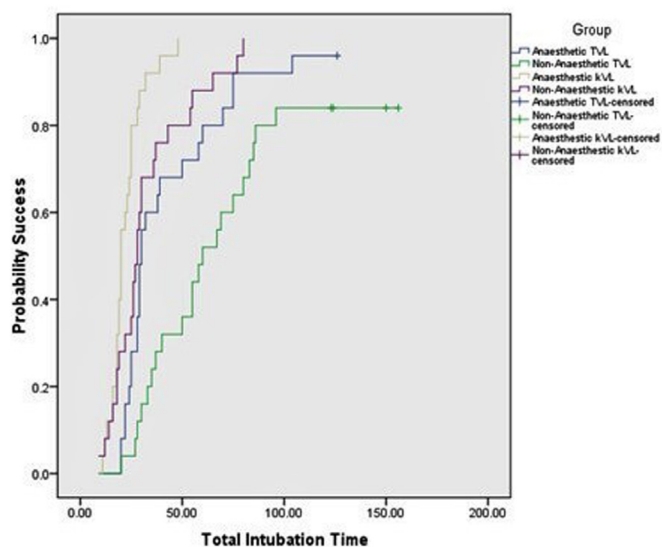
training sessions while being donned in PPE, before the recording of the final study parameters. Fogging and exhaustion factors had come into play by this time, as they would in an actual clinical

Fig. 5. Kaplan-Meier probability success with respect to total intubation times for different videolaryngoscope blades by novice and anaesthesiologist, depicting superior success rates with KingVision Videolaryngoscope.

[9]. However, their intubation times were more than our study probably due to the widely different setting (field intubation in simulated tongue oedema and cervical spine immobilization scenario). Akihisa et al. have also reported that the use of a Channelled KingVision videolaryngoscope improved the intubation characteristics as compared to a non-Channelled blade by non-anaesthesiologists [8]. A mean difference (95% CI) of 21.2 s (9.6—32.6; p = 0.001) in the experienced anaesthetist group and 35.9 s (24.4—47.4; p < 0.001) in the non-anaesthesiologist's group in our study between the two study devices is clinically relevant particularly in COVID-19 patients with diminished oxygen reserves. The mean (95% CI) difference in intubation times between non-anaesthesiologists and anaesthesiologists was much less in King-Vision videolaryngoscope [10.5(2.1—18.9) s vs 25.4 (6.5—44.2) s; P = 0.009]. This may be due to easier navigation of both the tube and the blade tip together in the direction of the glottis with a channelled blade which would be especially beneficial for intubation by inexperienced providers.

In our study, the overall success rate of intubation was superior with the channelled KingVision videolaryngoscope blade (Table 1). Our results are in concordance with a previous study which also reported a better overall success rate with the channelled (87%) videolaryngoscope as compared to the non-channelled one (47%) [8].

Non-anaesthesiologists produced more audible clicks than experienced anaesthesiologists during intubation. Also, the dental clicks were consistently more when using Tuoren videolaryngoscope when compared to KingVision videolaryngoscope. The non-anaesthesiologists did not have prior experience in the skill of laryngoscopy, and it is possible that they engendered more pressure on maxillary incisors to cause dental clicks. Moreover, poorer glottic views with Tuoren videolaryngoscope could have resulted in increased lifting force during laryngoscopy. Previous studies have also shown an increased incidence of dental clicks by an inexperienced operator [29].

5. Limitations

Our study had some limitations. Firstly, it was a mannequin study, and the results may not be fully replicated in a clinical setting. We tried to simulate the COVID-19 setting by using full PPE and covered the mannequin with a plastic sheet. This provided a standardized environment to train providers in intubation during the present pandemic using manikins as a safe surrogate to the clinical situation. In actual practice, intubation in COVID-19 patients may be trickier because of poor respiratory reserve in the patients and the urgency of the situation. However, considering that the ease of intubation was significantly better with KingVision videolaryngoscope, presumably the results would apply to a clinical setting as well particularly for non-anaesthesiologists. Secondly, our investigators and participants could not be blinded to the study devices and this may have resulted in potential bias. Also, the participants in the study were being monitored for their skill of intubation. This may have resulted in improved performance. However, investigators were not part of the recording process and an independent assessor recorded all the intubation data objectively. Further, any such impact would have affected the results with both the study devices equally.

6. Conclusion

KingVision videolaryngoscope was found superior for intubation a mannequin in a simulated COVID-19 scenario as compared to Tuoren videolaryngoscope in terms of faster intubation times, improved glottic views, ease of intubation, and overall success rates as compared to Tuoren videolaryngoscope in manikins. KingVision videolaryngoscope might be preferred as an intubation device to reduce intubation times and improve first attempt success rates in the COVID-19 scenario especially for intubation by non-anaesthesiologists or inexperienced operators.

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NA.

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Author credit statement

Anju Gupta: Study conception and design; Data acquisition, Data analysis, Interpretation of data; and Writing original draft, Critical reviewing and editing, Approval of the final draft.

Anjan Trikha: Study conception and design, statistical analysis and interpretation of results, Critical reviewing and editing, Quality assessment, Approval of the final draft.

Arshad Ayub: Data extraction, Critical reviewing and editing, Outcome measures, Final approval.

Sulagna Bhattacharjee: Critical reviewing and editing, Outcome measures, Final approval.

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Nishkarsh Gupta: Study conception and design, Data acquisition, Data analysis, Critical reviewing and editing, Approval of the final draft.

Kelika Prakash: Critical reviewing and editing, Outcome measures, Final approval.

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Venkata Ganesh: Critical reviewing and editing, Outcome measures, Final approval.

Kapil Dev Soni: Critical reviewing and editing, Outcome measures, Final approval.

Rajeev Kumar Malhotra: Study Design, Data analysis and interpretation, approval of final version.

Everyone in the author list fulfilled the conventional criteria for authorship.

Declaration of competing interest

None.

References

[1] W.J. Guan, Z.Y. Ni, Y. Hu, et al., Clinical characteristics of coronavirus disease 2019 in China, N. Engl. J. Med. 382 (2020) 1708–1720.

[2] X. Yang, Y. Yu, J. Xu, et al., Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centred, retrospective, observational study, Lancet Respir. Med. 8 (2020) 475–481.

[3] J.C. Cheung, L.T. Ho, J.V. Cheng, E.Y.K. Cham, K.N. Lam, Staff safety during emergency airway management for COVID-19 in Hong Kong, Lancet Respir. Med. 8 (2020), https://doi.org/10.1016/S2213-2600(20)30084-9.

[4] M.Z. Zuo, Y.G. Huang, W.H. Ma, et al., Expert recommendations for tracheal intubation in critically ill patients with novel coronavirus disease 2019, Chin. Med. Sci. J. 35 (2020) 105–109.

[5] C.Y. Matava, J. Yu, S. Denning, Clear plastic drapes may be effective at limiting aerosolization and droplet spray during extubation: implications for COVID-19, Can. J. Anaesth. 67 (2020) 902–904.

[6] A. Van Zundert, B. Pieters, V. Doerges, S. Gatt, Videolaryngoscopy allows a better view of the pharynx and larynx than classic laryngoscopy, Br. J. Anaesth. 109 (2012) 1014–1015.

[7] P.K. Wang, C.C. Huang, Y. Lee, T.S. Chen, H.Y. Lai, Comparison of 3 video laryngoscopes with the Macintosh in a manikin with easy and difficult simulated airways, Am. J. Emerg. Med. 31 (2013) 330–338.

[8] Y. Akihisa, K. Maruyama, Y. Koyama, R. Yamada, A. Ogura, T. Andoh, Comparison of intubation performance between the King Vision and Macintosh laryngoscopes in novice personnel: a randomised, crossover manikin study, J. Anesth. 28 (2014) 51–57.

[9] S. Nabecker, X. Koennecke, L. Theiler, C. Riggenbach, R. Greif, M. Kleine-Brueggeney, Effect of the tube-guiding channel on intubation success with videolaryngoscopes, Trends Anaesth. Crit. Care 18 (2018) 16–22.

[10] R.S. Cormack, J. Lehane, Difficult tracheal intubation in obstetrics, Anaesthesia 39 (1984) 1105–1108.

[11] R.M. Levitan, J.E. Hollander, E.A. Ochroch, A grading system for direct laryngoscopy, Anaesthesia 54 (1999) 1009–1110.

[12] K. Tran, K. Cimon, M. Severn, C.L. Pessoa-Silva, J. Conly, Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: a systematic review, PLoS One 7 (2012), e35797, https://doi.org/10.1371/journal.pone.0035797.

[13] J.L. Begley, K.E. Lavery, C.P. Nickson, D.J. Brewste, The aerosol box for intubation in coronavirus disease 2019 patients: an in-situ simulation crossover study, Anaesthesia 75 (2020) 1014–1021.

[14] R.S. Wax, M.D. Christian, Practical recommendations for critical care and anesthesiology teams caring for novel coronavirus (2019-nCoV) patients, Can. J. Anaesth. 67 (2020) 568–576.

[15] A. Jain, G. Singariya, M. Kamal, M. Kumar, A. Jain, R.K. Solanki, COVID-19 pandemic: psychological impact on anaesthesiologists, Indian J. Anaesth. 64 (2020) 774–783.

[16] P. Wu, Y. Fang, Z. Guan, et al., The psychological impact of the SARS epidemic on hospital employees in China: exposure, risk perception, and altruistic acceptance of risk, Can. J. Psychiatr. 54 (2009) 302–311.

[17] Using Personal Protective Equipment (PPE). Center of Disease Prevention and Control. Available from:: https://www.cdc.gov/coronavirus/2019-ncov/hcp/using-ppe.html. [Last accessed on 2020 Sep 25].

[18] K. Pandey, S. Vig, B. Ratre, N. Gupta, Use of sterilium on protective goggles for anti-fogging during donning for care of COVID-19 patients: a novel technique, Turk. J. Anaesthesiol. Reanim. 48 (2020) 344–345, https://doi.org/10.5152/TJAR.2020.682.

[19] T.M. Cook, K. El-Boghdadly, B. McGuire, A.F. McNarry, A. Patel, A. Higgs, Consensus guidelines for managing the airway in patients with COVID-19, Anaesthesia 75 (2020) 785-–799.

[20] Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected. Interim Guidance 25 January 2020. WHO/2019-nCoV/IPC/v2020.2 Last accessed 15.9.20.

[21] P.M. Jones, T.P. Turkstra, K.P. Armstrong, et al., Effect of stylet angulation and endotracheal tube camber on time to intubation with the GlideScope, Can. J. Anaesth. 54 (2007) 21–27.

[22] A. Van Zundert, B. Pieters, T. Van Zundert, S. Gatt, Avoiding palatopharyngeal trauma during videolaryngoscopy: do not forget the 'blind spots, Acta Anaesthesiol. Scand. 56 (2012) 532–534.

[23] N. Arulkumaran, J. Lowe, R. Ions, M. Mendoza, V. Bennett, M.W. Dunser, Videolaryngoscopy versus direct laryngoscopy for emergency orotracheal intubation outside the operating room: a systematic review and meta-analysis, Br. J. Anaesth. 120 (2018) 712–724.

[24] P. Biro, M. Schlaepfer, Tracheal intubation with Channelled vs. non-Channelled videolaryngoscope blades, Rom. J. Anaesth. Intens. Care 25 (2018) 97–101.

[25] King Vision™ a Blade Video Laryngoscope – Ambu. https://www.ambu.com/airway-management-and-anaesthesia/video-laryngoscopes/product/king-vision-ablade. Last accessed: 12.9.20.

[26] M.B. Kaplan, C.A. Hagberg, D.S. Ward, et al., Comparison of direct and video-assisted views of the larynx during routine intubation, J. Anesth. 18 (2006) 357–362.

[27] T. Piepho, K. Weinert, F.M. Heid, C. Werner, R.R. Noppens, Comparison of the McGrath® Series 5 and GlideScope® ranger with the Macintosh laryngoscope by paramedics, Scand. J. Trauma Resuscitation Emerg. Med. 19 (2011) 4, https://doi.org/10.1186/1757-7241-19-4.

[28] S.H. Chew, J.Z.M. Lim, B.Z.B. Chin, J.X. Chan, R.C.H. Siew, Intubation with Channelled versus non-Channelled video laryngoscopes in simulated difficult airway by junior doctors in an out-of-hospital setting: a crossover manikin study, PLoS One 14 (2019), e0224017, https://doi.org/10.1371/journal.pone.0224017.

[29] R.A. Lee, A.A. Van Zundert, Maassen, et al., Forces applied to the maxillary incisors during video-assisted intubation, Anesth. Analg. 108 (2009) 187–191.