Original Article

Comparison of Mc Grath-MAC and C-MAC video laryngoscopes for intubation in a COVID simulated mannequin by novice users wearing face protective gear: A randomized crossover trial

ABSTRACT

Introduction: Intubation in COVID patients is challenging. Various guidelines suggest the use of video-laryngoscope (VL) as the first device to aid intubation in a COVID patient. The best VL to facilitate intubation in such a setting especially by novices is not ascertained. We compared intubation characteristics by two VL's (McGrath-MAC and C-MAC) for intubation in a COVID simulated mannequin by novices.

Methodology: This prospective randomized manikin-based crossover study was done in thirty medical professionals with no previous experience of intubation with VL. All participants were trained on Laerdel airway management trainer and were allowed 5 practice sessions with each scope with an intubation box while wearing face protective personal protective equipment (PPE). Participants were randomized into two groups of 15 each, one group performed the intubation first with McGrath and the other with C-MAC before crossing over.

Results: The mean (S. D.) time to intubation was similar with both McGrath-VL and CMAC VL [31.33 (14.72) s vs 26.47 (8.5) s, *P* = (p-0.063)]. POGO score [mean (S. D.)] was better with CMAC [81.33 (16.24) vs 60.33 (14.73), p-0.00. The majority of the users preferred C-MAC VL for intubation (93.33%). The incidence of failed intubation and multiple attempts at intubating were similar with the two scopes.

Conclusion: The time to intubation was similar with both VL's but the majority of novices preferred CMAC probably due to a bigger screen that helped them to have a better view of glottis in the COVID simulated mannequin.

Key words: COVID-19; intubation; PPE; video laryngoscope

Introduction

The world is currently in the middle of a global battle against the COVID 19 global pandemic.[1] The spectrum of illness in COVID ranges from mild respiratory symptoms like cough to severe acute respiratory illness.

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Patients among the severe end of the disease spectrum need intubation and mechanical ventilation. The novel coronavirus is known to spread via droplets and aerosols.[2,3] Intubation in such a patient is considered a high-risk aerosol-generating procedure (AGP) and is associated with an increased risk of transmission to the health care worker (HCW).[4] Considering the magnitude of the pandemic, non-anesthesiologists may often intubate the COVID patients but they may not be well versed with intubation devices.

Various airway management guidelines have suggested the use of appropriate PPE and VL for intubation for a COVID patient.[5] Literature also suggests the use of protective equipment like "intubation or aerosol box" made from transparent fiberglass material to cover the patient's head end to prevent the spread of aerosols to HCWs during intubation.[6]

However, the use of PPE like eye shields, well fitted N-95 masks and an external transparent visor to protect the face from aerosols may make intubation challenging due to reduced visibility as a result of fogging of eye shields and poorly fitted equipment, etc. Also, using an "intubation box" for additional protection may lead to restricted hand movement and pose additional difficulties to achieve successful intubation.[6] In these challenging conditions, choosing the best VL among the various available options may be tricky especially for novices.

Guidelines for intubation and airway management in COVID patients do not specify the type of VL to be used.[5,7] The choice of VL may depend on the institutional practice, availability, and personal preference of the intubating person. However, in the setting of the COVID pandemic, a device that has disposable parts or is easily cleaned and disinfected may have an advantage.

Keeping the mind the vast scale of this pandemic and limited human resources globally, health care personal novices in airway management may have to work closely with COVID positive patients. The best VL to facilitate intubation in COVID setting especially by novices is not ascertained. We compared intubation characteristics by two commonly available and used VL's (McGrath-MAC - Aircraft Medical, Edinburgh, UK, and C-MAC - Karl Storz GmbH and Co. KG, Tuttlingen, Germany) for intubation in a COVID-simulated mannequin by novices.

Methodology

A prospective randomized manikin-based crossover study was conducted after obtaining institutional ethical clearance (ref no - IEC-535/05.06.2020) and prospective CTRI registration (CTRI/2020/06/025927).

Participating doctors were recruited from a multidisciplinary team working in a tertiary cancer hospital converted into a COVID care hospital.

All of those who had previous experience of intubating in a similar setting (i.e., within an intubation box with video laryngoscope) or refused to give consent to participate were excluded from the study.

All the participants were explained about the procedure by an experienced anesthetist. The technique of intubation with both devices was explained. This was followed by a video demonstration of the intubation technique using the two devices and intubation for 5 times with each device on the Laerdal Airway Management Trainer (Laerdal Medical Korea, Ltd, Seoul, Korea) to familiarize with the intubation technique. An intubation box (cuboidal box made of transparent fiberglass with the following dimensions: base and top 70*40 cm, front face 70*50 cm, lateral walls 50*40 cm) with back covered with transparent polythene was used. Working channels in the front face—two circular channels 10 cm in diameter cut out in the center of the front face.

After the initial practice sessions, 5 practice sessions with each device in a COVID simulated scenario were done. In the COVID simulation, the participants wore N95 masks, eye shields, and visors to protect the face with the manikin kept inside the intubation box. The screen of the C-MAC VL was outside the intubation box in front of the intubating personal and the Mc GRATH-MAC was inside the intubation box. Size 4 blade was used in both the VL's. A 7.5 cuffed endotracheal tube (ETT) with a malleable plastic stylet (Portex™ intubation stylet, Smiths Medical ASD, Inc., Norwell, MA, USA) was used for intubation by all participants. The tube with stylet was bent in a J-shape for intubation with both the devices. An assistant helped to remove the stylet once the ETT passed the vocal cords and inflated the cuff before the intubating person connected the ETT to the catheter mount and gave initial breaths with an AMBU bag to confirm ETT placement. After these practice sessions, a gap of 24 hours was given before the final timed session.

At the start of the final session, each participant was given a unique serial number from 1 to 30. Thereafter 15 random numbers were selected from the series of 30 by a computer-generated random number sequence. Selected 15 were designated as group 1 and allotted Mc GRATH-MAC as the initial laryngoscope. The remaining 15 were designated as

group 2 and were allotted C-MAC as the initial laryngoscope. Later each participant crossed over to the other group.

An independent anesthetist timed the intubation attempts using a stopwatch and recorded glottic view using POGO score (Percentage of glottic view seen) and modified Cormack-Lehane Grade, time to intubate (time taken from the insertion of the blade between the teeth until the ability to ventilate with AMBU bag), first attempt success rate, failed intubation (oesophageal intubation), or failed attempt—(where intubation of the trachea required >120 s to perform), the number of optimization maneuvers to aid tracheal intubation and dental trauma as assessed by the audible teeth clicks were noted. After intubating with both the VL's, users were asked about the preference of VL based on ease of passing the VL blade in mouth, ease of obtaining glottic view, ease of tube insertion, and overall preference. Experience of usage for each scope was graded on a scale of 0 to 10, 0 being extremely difficult to use and 10 being very easy to use.

Sample size estimation

Based on results of a similar study[8] for the continuous outcome of intubation time for overall attempts between McGrath-MAC (21.8 ± 1.2) versus C-MAC (23.2 ± 1.2) group with equal size ($r = 1$) among both groups assuming alpha (0.05) and power of the study (80%). The total sample size calculated was 24, with the minimum sample size required in each group as 12. We included a total of 30 participants (15 in each group).

Statistical analysis

Statistical analysis was performed using SPSS Version 24 (SPSS Inc, Chicago IL, USA). The normal distribution of data was tested using the Shapiro-Wilk test. Analyses of continuous data were performed using the student's t-test (unpaired) (for parametric data) and independent-samples Mann Whitney U test (for non-parametric data) with Bonferroni correction. A *P* value of <0.05 was considered to be significant.

Results

Thirty medical residents from various specialties agreed to participate in the study. Steps of participant recruitment training and final timed intubation sequence are summarized in Figure 1. The varying subspecialties of the participating health care workers are shown in Figure 2. All the participating doctors had no previous experience of intubating with video laryngoscopes. Regarding the basic experience of intubating using direct laryngoscopy—11 participants had performed >50 intubations, 4 had performed between 10 and 50 intubations and 15 had an experience of <10 intubations.

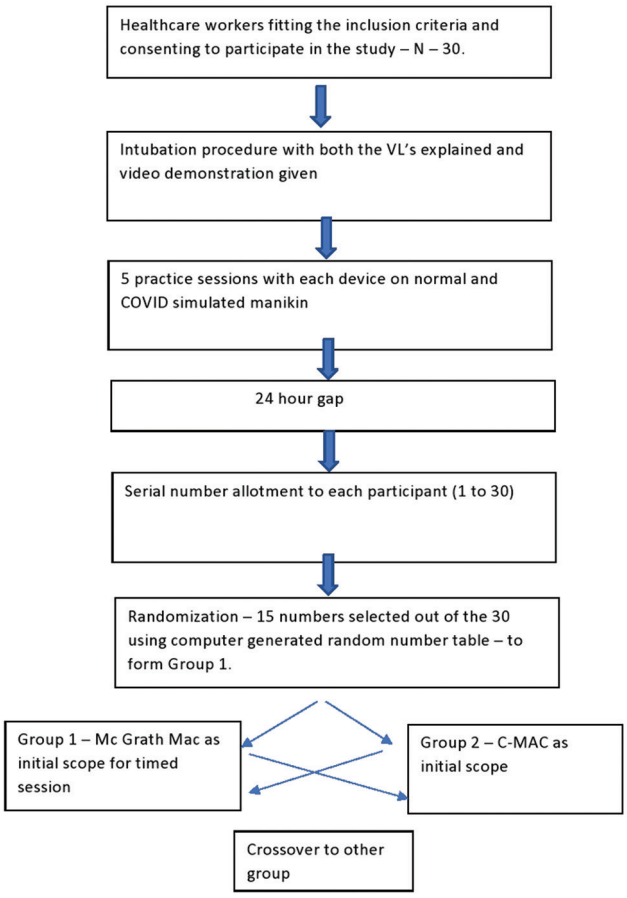

Figure 1: Flow chart summarizing the conduct of the study

As shown in Table 1 the time to intubation was comparable between both the VL's (31.33 vs. 26.27 sec; $P > 0.05$); however, C-MAC gave better visualization (81.33% mean POGO score and 23 out of 30 participants obtaining CL grade 1 or 2a, as compared to 60.33% mean POGO score and only 11 participants obtaining CL grade 1 or 2a.

The incidences of participant requiring optimization maneuvers failed intubation and multiple attempts were seen only in a single participant with McGRATH scope. Thus, the success rate in the first attempt was 100% with the C-MAC and 96.67% with Mc-GRATH MAC. Dental clicks were more when the participants used McGRATH scope (4 participants, 13.33%).

Discussion

The results of this RCT showed that time to intubation was similar with both McGRATH MAC and C-MAC VL for intubation in a COVID simulated manikin by novices. However, the majority of users preferred the C-MAC VL on a subjective user-based scoring.

Choosing the right VL is of utmost importance in the current pandemic as patients requiring intubation and mechanical

Table 1: The comparison between the glottic view obtained and ease of usage with both the video-laryngoscopes

Parameter	Mc-GRATH	C-MAC	*P* value
Time to intubation (seconds) (mean, S.D.)	31.33 (±14.72)	26.27 (±8.5)	0.063
POGO score (mean S. D.)	60.33 (±14.73)	81.33 (±16.24)	0.00
CL GRADE - *n* (%)			
1	3 (10%)	18 (60%)	
2a	8 (26.7%)	5 (16.7%)	
2b	17 (56.7%)	7 (23.3%)	
3	2 (6.7%)	0	
Dental Trauma (*n*)	4 (13.33%)	1 (3.33%)	
Optimization maneuvers (*n*)	1	0	
Failed Intubation (*n*)	1	0	
Multiple attempts (*n*)	1	0	
Difficulty score (Mean (S. D)	6.3 (1.29)	8.13 (0.97)	
Users Preference - *n* (%)			
Ease of blade insertion	1 (3.3%)	27 (90%)*	
Ease of VC view	0 (0)	30 (100%)	
Ease of passing tube	9 (30%)	19 (63.3%)*	
Overall preference	2 (6.7%)	28 (93.3%)	

n - number of participants. difficulty score (0-10) - '0' - Extremely difficult; '10' - extremely easy. *=2 (6.7%) users reported equivocal ease of blade insertion and ease of passing the tube

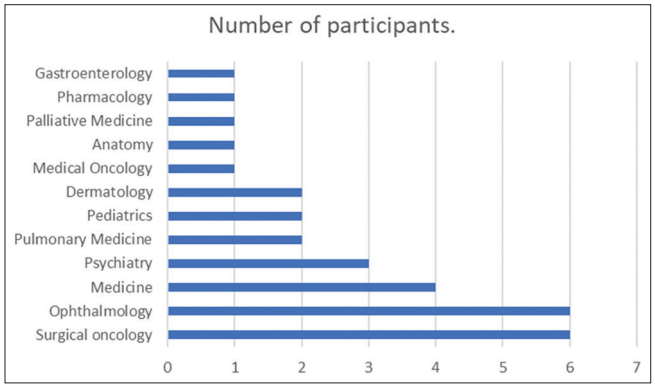

Figure 2: showing the specialty distribution of healthcare workers participating in the study

ventilation are in the severe spectrum and are prone to desaturation and hypoxia during intubation.[7] A device which is easy to use, aids in intubation in minimum time with negligible complications should by ideal. Besides, considering the chances of infection via respiratory secretions, the device should be easy to clean, disinfect, or should have disposable components.

Ours is one of the initial RCT'S attempting to assess the VL of choice in the COVID scenario. In a manikin based simulation study by Saito and coworkers,[9] the authors simulated a COVID scenario similar to our study by using a transparent intubation box on a manikin with an intubating person wearing PPE in form of an N-95 mask, face shield, disposable gown, and gloves. The authors compared four VL with the standard Macintosh direct laryngoscope in users experienced in intubating with all the scopes. Of the four VLs compared by the authors, three were devices with a conduit to pass the tube (Kingvision, Airtraq-AVANT, and Airwayscope s-100) and one VL was without tube conduit (Mc-GRATH MAC). Except for the Airtraq-AVANT, the other three VL's significantly reduced the time to intubation when compared with direct laryngoscopy and intubation with Macintosh blade. The minimum median time to intubation was with airway scope (19 sec) and Mc-GRATH scope (20 sec). Subjective assessment for user comfort with each scope or overall user preference was not assessed in this study.

Keeping in mind the current challenging scenario to intubate a potentially infective patient, subjective user comfort with the equipment of their choice is of utmost importance. Thus, in addition to comparing objective criteria (time to intubation, POGO score, CL grading) we included subjective assessment of user comfort and overall preference between the two laryngoscopes. The main results of our study i.e., comparable time to intubation with both the scopes match with a previous manikin-based crossover study by Shin and colleague's[8] in this study a total of 39 novices with an experience of fewer than three intubations were recruited. No significant difference in intubation times was found between C-MAC or Mc-GRATH scope (both with blade size 3). However, the majority of participants chose the McGRATH scope as the VL of choice. Contrary to this result majority of participants in our study selected the C-MAC VL (93.3%). This difference in choice of CL among participants could be attributed to the contrasting setups of our study done in a COVID simulated manikin with PPE equipment in our study compared to intubations done in a non-COVID setup by Shin and co-workers. The current pandemic scenario which necessitates the use of PPE like N 95 masks, eye goggles, and face shields, this extra equipment may hamper vision and may have led to maximum participants preferring the

C-MAC scope which offers a larger screen with a clearer view as compared to McGrath. Thus, changing the choice of the preferred device among novices in our study. Although, both studies used an intubation box as a barrier device; its role has been challenged and questioned[10,11] both studies aimed to find the best VL to use with face protective PPE, fogging or poor vision in which is a major challenge. Thus, the basic premise of both studies holds.

We choose MAC design VL (C-MAC and McGrath) to compare intubation time and comfort of use as these both are readily available in our setup and their proposed ease of use as compared to anatomically designed channeled or non channeled VLs.[12,13]

In the current pandemic situation, training and familiarity with the use of VLs is the need of the hour. A paradigm shift in practice with universal VL for intubation in both COVID and non-COVID scenarios is being suggested.[14] Thus an ideal VL which is easy to use, cost-effective, maximizes success with minimal complications, and can be easily disinfected should be the focus of research in this high priority area.

This is one of the initial studies which offers both objective and subjective comparison of two commonly used VLs. We compared these scopes in novices and found minimal complications, thus any of the two devices may be used in all types of medical facilities where novices or experienced anesthetists may handle the airway. One of the lacunae of our study is that we have not included any channeled VL like Kingvision or Airtraq in our comparison. We compared the two commonly used VL in our setup to develop best practice guidelines within our existing resources. As we found time to intubate comparable, we suggest the CMAC may be used by novices and McGrath may be used by experienced operators or while intubating in peripheries as it is portable and easy to carry. The McGrath also offers a specific advantage in this pandemic era as it has a disposable single-use blade thus no hassles of blade disinfection and the handle can easily be disinfected by dipping in hypochlorite solution after removing the battery. The C-MAC when used should be disinfected as per protocols and it cannot be transported easily.

Conclusion

C-MAC is comparable to McGrath Mac for intubation in a COVID simulated manikin. The choice of scope among these two devices may be guided by institutional resources, user experience, and the place of the intended use of the device with relevant disinfection facilities.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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