C-MAC V/S Bonfil for Endotracheal Intubation – A Prospective, Comparative Study

Monika Sanghavi[1], Swati Daftary[2], Prerna Gomes[3]

ABSTRACT

Introduction: Direct laryngoscopy using a Macintosh blade which is considered as Gold standard can still cause sympathetic stimulation leading to stress response & airway trauma. Addition of optics to laryngoscope design reduces all these problems and improves success of intubation. So in this study, we aimed to compare two indirect laryngoscopes C-mac videolaryngoscope & Bonfil Intubating Fibrescope in non-difficult airway situations.

Material and methods: Sixty six patients with clinically normal airways belonging to ASA status I & II were randomly assigned to be intubated using Bonfil Intubating Fibrescope (Group B; n=33) or C-mac videolaryngoscope (Group C; n=33). The primary outcome measures were time for successful intubation, any optimization manoeuvres required during intubation and number of attempts. Hemodynamic changes and complications were secondary outcomes.

Results: Optimization manoeuvres required for intubation was statistically significant less with Bonfil as compared to C-mac ($P<0.05$). There was no significant difference in time for intubation, number of attempts, hemodynamic changes & complications between the two groups ($P>0.05$).

Conclusion: We conclude that both Bonfil & C-mac are devices whose optical design improves intubating conditions in non-difficult airway patients. Once operator gets used to Bonfil, it was easy to intubate with it as compared to C-mac.

Keywords- Bonfil, C-MAC, Videolaryngoscope

INTRODUCTION

Airway management is the primary responsibility of Anaesthesiologist.[1] It includes to secure, preserve and protect the airway during induction, maintenance and recovery from anesthesia. Failure to do so can result in adverse consequences leading to severe morbidity and even mortality.[1] Orotracheal intubation is the most commonly used method to secure the airway during anaesthesia.

In 1943, Macintosh introduced a curved blade improving the view of glottis during orotracheal intubation and is still considered as a gold standard.[2] However, it can lead to undesired hemodynamic responses related to stimulation of sympathetic system due to lifting forces required for exposure of the glottis.[3] To reduce all these problems, application of physics has led to indirect laryngoscopy. It entails the visualization of the glottis by the way of optical aids such as Fibreoptic bundles, video cameras, mirrors, lenses or prisms.[4] Multiple video laryngoscopes have been introduced and have begun to play an important role in the management of patients with an unanticipated difficult or failed laryngoscopic intubation.[5] Video laryngoscopy can provide a significantly better view of the larynx and may be very helpful for educational purposes also.

Though all these intubating gadgets are being used in difficult airway situation, they cannot be used for the first time during difficult intubation. Therefore this prospective, randomized study was planned to achieve expertise in normal airway first by comparing two indirect laryngoscope i.e. C-MAC video laryngoscope and Bonfil Intubation Fibrescope.

The C-MAC video laryngoscope blade design is similar to the Macintosh laryngoscope with additional advantage of video camera and high power light emitting diode at the distal end of the blade.

The Bonfils Intubation Fibrescope described by Bonfils in 1983, is a 40 cm long, thin rigid fibreoptic endoscope used for endotracheal intubation with distal segment angled at 40 degree including an eyepiece and a DCI (Direct-Coupled-Interface) camera head.

The primary outcome measures were time for successful intubation, any optimization manoeuvres required during intubation and number of attempts. Hemodynamic changes and complications were secondary outcomes.

MATERIAL AND METHODS

This was a prospective, randomized, comparative study, which was conducted at Jaslok Hospital and Research Centre, Mumbai between July 2018 and June 2019, following approval from Institutional Ethics and Scientific Committee. Sixty Six patients aged between 18-60 years, of either sex with body mass index (BMI) <30 kg/m2, physical status of American Society of Anesthesiologists (ASA) class I and II, without anticipated difficult airway, scheduled for elective surgery under general anesthesia requiring endotracheal intubation were recruited. A detailed preanaesthetic and airway evaluation was done, and airway variables such as history of snoring, adequacy of mouth opening, presence of

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buck teeth, Mallampati grade, thyromental distance, neck movement and slux grade were noted to rule out any possible airway difficulties.

Patients were briefed on the study and written informed consent was obtained. Each patient was assigned by a computer-generated randomization to either the Bonfils group (Group B) or C-MAC group (Group C). Endotracheal intubation using both devices was performed by a single operator, who was a postgraduate anesthesiology trainee with 2 years of experience in clinical anesthesia.

All patients were fasted for at least 6 hours, and received Tablet Pantoprazole 40mg orally the night and morning before surgery. In the operating theatre, IV access secured and IV fluid was started. Monitors (ECG, Pulse oximeter, Non Invasive Blood Pressure) were attached. A pillow (5cm thickness) was placed under patients head so as to achieve flexion at cervical spine and extension at atlantoaxial joints. Inj. Glycopyrrolate 0.004 mg/kg IV was given. All patients were preoxygenated for 3 minutes with 100% O2 with appropriate size of face mask. Induction of anaesthesia was done till loss of eyelash reflex with Inj. Fentanyl 2µg/kg IV, Inj. Lignocaine (2%) 2cc IV and Inj. Propofol 2mg/kg IV. After checking adequacy of ventilation, muscle relaxation was achieved with IV Atracurium 0.5mg/kg. Patients were ventilated with 100% O2 for 3 minutes. As per randomization and group allocation laryngoscopy was carried out either by Bonfils intubation fiberscope or C-MAC Video Laryngoscope and endotracheal intubation was done by the investigator with Cuffed Portex endotracheal tubes 7.0 or 7.5 mm for female patients and 7.5 or 8.0 mm for the male patients. The endotracheal tube cuff was inflated and correct tube placement confirmed by the presence of end tidal carbon dioxide (ETCO).

The patients were subsequently connected to the ventilator through closed circuit and put on volume control mode with tidal volume of 7ml/ kg with respiratory rate adjusted to keep the EtCO2 of 35 to 40 mm of Hg. Anesthesia was maintained with sevoflurane, titrated to a MAC of 1.0 to 1.2, in a mixture of Oxygen and Nitrous oxide at a ratio of 1:1, with gas flows at 1 L/min.

At the end of surgery when spontaneous breathing pattern was established, the neuromuscular blockade was reversed with IV Glycopyrrolate 0.008mg/kg and IV Neostigmine 0.05 mg/kg. Patients were extubated after doing an oral suction and after return of pharyngeal reflexes. After extubation, 100 % oxygen by a Venti mask was administered till the arrival in the Post Anaesthesia Recovery Room.

The time taken for successful intubation i.e. from introduction of the intubating device into the patient's mouth until the appearance of a capnographic waveform was noted. In the event of unsuccessful intubation, the patient was manually ventilated via facemask in between intubation attempts with 100% oxygen. The operator was allowed to use the same intubation device during next attempt with modification in technique such as readjustment of jaw thrust in the Bonfils group, and application of BURP, repositioning of the patient's head, varying the lifting force on the laryngoscope or use of airway adjuncts such as the gum elastic bougie in the C-MAC group. The number of intubation attempts and techniques of manipulation were recorded by an observer. Optimization manoeuvres required like BURP (Backward, upward, rightward pressure), Bougie or both were also noted. Haemodynamic parameters like heart rate, systolic blood pressure (SBP), diastolic blood pressure(DBP) and mean arterial pressure(MAP) were noted at baseline, after induction, at laryngoscopy at 1, 2, 3, 4, 5 and 10 min post laryngoscopy. Complications or airway morbidity in the form of dental trauma, oropharyngeal trauma or oedema were noted.

Sample size calculation was based on mean time to intubate. The results were presented as number, percentage, mean ± standard deviation or frequencies (%) as appropriate. Continuous data were compared using Unpaired *t*-test if data passed 'Normality test' and by Mann-Whitney Test if data failed 'Normality test', whereas categorical data were compared using Fisher's exact test and Chi-square test. $P < 0.05$ was considered statistically significant.

RESULTS

Patients in both the groups were comparable with respect to demographic data and airway parameters [Table-1]. Mouth opening was adequate in all the patients of both groups.

Table-2: Number of attempts required and laryngoscopy time between the two groups was statistically not significant. Whereas intubation using C-MAC required significantly more aids than Bonfil.

Table-3 shows significant increase in mean HR from baseline value at all intervals in group B, whereas in group C, except for after induction and at 10 min interval, increase in HR was statistically significant in all other intervals as compared to baseline HR. While comparing both groups, HR in group B was significantly higher than group C at 4, 5 and 10 min post laryngoscopy.

Table-4 shows significant change in mean BP at all intervals

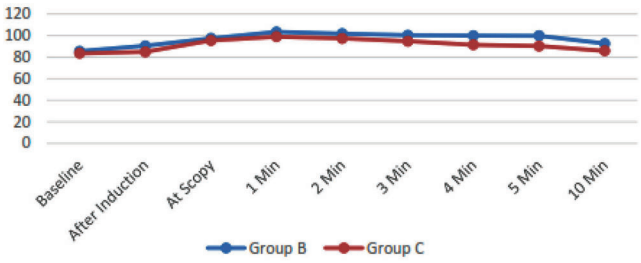

Figure-1: Comparison of Heart rate between the groups

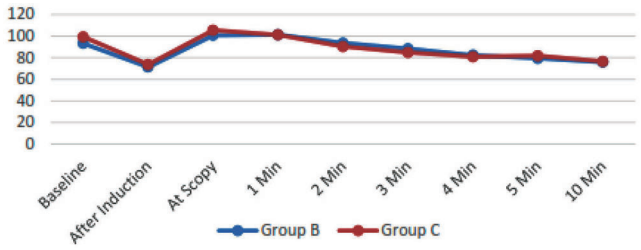

Figure-2: Comparison of Mean BP between the groups

Patient Characteristics	Group B	Group C	P value
Age	40.03±11.24	45.03±11.65	0.08
Weight	62.48±10.39	66.69±9.40	0.08
Height	158.30±7.95	159.58±7.67	0.51
BMI	24.87±3.31	26.16±2.89	0.09
Gender: Male Female	 10 (30.30) 23 (69.70)	 15 (45.45) 18 (54.55)	>0.05
Mallampati Class (I / II)	15/18	14/19	
Thyromental Distance	10.10±0.99	9.75±1.03	0.16
Slux (I /II)	29/ 04	31/02	

Table-1: Demographic Data and Airway Parameters (n= 33)

	Group B (%)	Group C (%)	P value
No. of Attempts 1 2 3	 23 (69.6) 10 (30.3) 00	 27 (81.8) 05 (15.1) 01 (3.03)	0.22
Aids used BURP BOUGIE BURP+BOUGIE NONE	 01 (3.03) 00 00 32 (96.9)	 7 (21.2) 5 (15.1) 12 (36.3) 9 (27.2)	0.001
Laryngoscopic Time Mean±SD	 57.06±27.13	 66.90±32.26	0.18

Table-2: Comparison of Intubation related data between the groups

Duration (min)	BONFILS (n=33)		MAC (n=33)		Intergroup p value
	Mean HR	p value	Mean HR	p value	
Baseline	85.52±13.739	-	83.48±14.784	-	0.56
After induction	90.45±13.730	0.03	84.85±12.535	0.58	0.08
At scopy	97.42±12.430	0.001	95.39±16.545	0.001	0.57
1 min	103.36±10.776	0.001	98.94±13.834	0.001	0.15
2 min	101.73±11.259	0.001	97.39±15.328	0.001	0.19
3 min	100.42±11.306	0.001	94.76±13.998	0.001	0.07
4 min	99.97±10.611	0.001	91.39±14.556	0.001	0.008
5 min	99.79±11.480	0.001	90.30±14.662	0.02	0.005
10 min	92.64±10.325	0.001	85.88±13.105	0.37	0.02

Table-3(Original): Comparison of mean Heart Rate within the groups

Duration (min)	BONFILS (n=33)		C-MAC (n=33)		Intergroup p value
	Mean BP	p value	Mean BP	p value	
Baseline	93.36±12.015	-	99.39±12.674	-	0.05
After induction	71.42±13.238	0.001	73.64±13.722	0.001	0.50
At scopy	100.76±20.634	0.01	105.52±20.084	0.06	0.34
1 min	101.36±24.157	0.04	101.21±20.169	0.59	0.97
2 min	93.61±19.097	0.93	90.36±16.466	0.004	0.46
3 min	88.33±15.278	0.05	84.91±14.529	0.001	0.35
4 min	82.33±12.808	0.001	80.94±14.622	0.001	0.68
5 min	79.39±12.908	0.001	81.76±24.732	0.001	0.62
10 min	75.94±9.086	0.001	76.48±11.476	0.001	0.83

Table-4(Original): Comparison of mean BP within the groups.

except at 2min in group B and at scopy & at 1 min in group C as compared to baseline. In intergroup comparison, there was no statistically significant difference in MAP at any interval except for the baseline.

DISCUSSION

The present study was designed to be conducted in our institute to compare the ease and success of intubation using two indirect videolaryngoscopes i.e. Bonfils intubation

fiberscope and C-MAC videolaryngoscope and gain experience in non-difficult airway situations. Both have shown to improve laryngeal view while inducing minimal stress responses. C-MAC, with its simplicity of use, has gained widespread popularity in contrast to the Bonfils which is not widely used in routine clinical practice. However Bonfils intubation fiberscope has its advantage over the C-MAC in difficult airway situations where restricted mouth opening may limit use of the latter.[6]

As Bonfil intubation fiberscope is not in regular use and requires greater skill with more learning curve, we decided to do 15 pilot cases before starting our actual study to get familiar with Bonfil intubation technique. As we were doing more and more cases, time to intubation reduced and ease of intubation improved. We also noticed that patients were requiring more than 1 attempt due to pooling of oropharyngeal secretion which was obstructing the laryngeal view. So we attached suction to the device but it was also sucking the mucosa and soft tissues which was further obstructing the view. So we decided to give antisialagogue in premedication. This was supported by (Ai H. Lee et al (2016), Senapathi et al (2017), Ezhar et al (2018), Hosdurg et al (2015).

The number of patients requiring second attempt was more in group B than group C, which may be due to more learning curve of Bonfil intubation fiberscope. But this difference in between the groups was not statistically significant. As seen by AI H. Lee et.al.[6], in our study also not all patients had optimal laryngeal views when intubated with the C-MAC videolaryngoscope requiring additional airway manipulation and were subjected to more number of attempts.

The difference in mean laryngoscopy time between the two groups was statistically not significant (P>0.05). In studies conducted by AI H.Lee et al[6], Ezhar et al[8] and Senapathi et.al.[7], they found intubation time shorter with C-MAC than with Bonfil, which was not similar to our study. Clinically we required less time with Bonfil, as once visualization of vocal cords was possible, we were able to easily pass the ETT through the cords without much manipulation. This may be due to natural curvature of rigid Bonfil fiberscope i.e. 40degree angulation of distal segment[10], which made passage of ETT into vocal cord so easy. In group C, though the visualization of vocal cord was easy, but the passage of ETT through the cords was not as easy in every case as that of Bonfil. Ng *et al* found that the C-MAC videolaryngoscope produced good laryngeal views which did not always guarantee ease and success in endotracheal tube insertion.[11] Endotracheal tube tends to go posteriorly instead of going into cord, even though the vocal cord visualization is good. So for that additional manipulations like BURP and Bougie are required which increases laryngoscopy time.

The difference in requirement of aids like BURP, BOUGIE or both to facilitate intubation between the two groups was statistically significant (Table-2). Halligan et al found that postural adjustment and additional aids was rarely required with Bonfils intubation fiberscope.[12] This was also true for our study.

We did not consider Cormac Lehane grading in our study. Although Cormac Lehane grading is the most popular means to describe laryngeal view, but this grading was devised for direct laryngoscopy therefore it can under estimate the difficulty of intubation with indirect laryngoscopes.[13]

Considering the hemodynamic variations the rise in HR was significantly higher in group B and stays for a longer duration than group C (Table-3, Figure 1). Our study results were similar to the study by AI H. Lee et al[6] where they found significant increase in HR although the MAP remained comparable following intubation with the Bonfils compared to the C-MAC. This may be due to the jaw thrust or tongue jaw lift maneuver. Neither of these maneuvers was applied in the C-MAC group. Park *et al* found that the jaw thrust increased MAP and HR irrespective of the magnitude of thrust force applied.[14] Our patients in the C-MAC group had transient increase in HR immediately following laryngoscopy and intubation which was most likely due to oropharyngeal stimulation during laryngoscopy.

Both groups had significant fall in MAP after induction as compared to baseline; it became statistically non-significant in intergroup comparison. So, in intergroup, there was significant difference in MAP between the two groups at baseline only which might have happened due to randomization of patients such that patients with high BP came to group C. (Table-4, Figure 2)

Boker et al found that increase in MAP and HR was greater during laryngoscopy with the conventional laryngoscope than with the Bonfils intubation fiberscope.[15] Najafi et al also found better hemodynamic profile with the latter and comparable intubation conditions even without neuromuscular blockade.[16] Senapathi et al found that even though the intubation time of the Bonfils was longer, the hemodynamics were significantly more stable compared to the C-MAC group.[7]

In our study, there was no trauma during laryngoscopy or any post op complication in both groups which was similar to study by AI H. Lee et al.[6] Hosdurg et al found that postoperative sore throat ($P \leq 0.009$) and hoarseness of voice ($P \leq 0.04$) was much lesser in the Bonfil group compared to the direct laryngoscopy group.[9] Senapathi et al.[7] found that proportion of the reported post-intubation sore throat was significantly lower in the Bonfils group. With Bonfils, we can avoid manipulation of pharynx along with base of tongue and decrease the incidence of post-intubation sore throat.[16]

The study design did not permit blinding to the device leading to potential for operator bias. Both groups were not comparable regarding intubation skills, as Bonfil required greater skills and pilot cases which was not necessary in C-MAC group. While using Bonfil, it was difficult to access the exact depth of ETT into trachea as it was difficult to see vocal cords through the tube. Patients with anticipated difficult intubations were not included in the study. Therefore, the applicability or advantage of these devices in actually difficult scenarios could not be assessed.

Future studies on difficult airways using Bonfil could look at the hemodynamic responses for which it was intended for. Studying the effect of retromolar approach of Bonfil will

be useful, since this technique is perceived to be easier to perform, limits the manipulation of epiglottis and produces less hemodynamic response as per Gupta K et.al.[17] Future studies on C-MAC can find out various manipulations or laryngoscopic techniques, so that passing of ETT into the glottis can be achieved without aids.

CONCLUSION

As compared to conventional laryngoscopes, video laryngoscopes by using the principle of optics/refraction improve intubating condition and minimize hemodynamic variations. Experience with such devices in normal airway will prepare the Anaesthesiologists to tackle difficult airway situation and to perform non-stressful intubation in critical patients. Hence it has become a necessity to have such type of video laryngoscopes as an addition to our armamentarium and get familiar with them. The cost of devices may be variable, but affordable. It should not hinder with the patient's safety.

In our study, considering ease of intubation, Bonfil was found better than C-MAC once the operator gets used to the device. However, future studies on C-MAC can find out various laryngoscopic techniques so that passing the tube into glottis will be possible without using aids and in less time. Bonfil fiberscope requires adequate skill to comfortably intubate a patient in first attempt. It is essential to have done good number of cases primarily to learn the skill.

REFERENCES

1. Kulkarni AP, Tirmanwar AS. Comparison of glottic visualisation and ease of intubation with different laryngoscope blades. Indian journal of anaesthesia. 2013 Mar; 57(2):170.
2. Macintosh RR. A new laryngoscope. The Lancet. 1943 Feb 13; 241(6233):205.
3. Pournajafian AR, Ghodraty MR, Faiz SH, Rahimzadeh P, Goodarzynejad H, Dogmehchi E. Comparing Glide Scope video laryngoscope and Macintosh laryngoscope regarding hemodynamic responses during orotracheal intubation: A randomized controlled trial. Iranian Red Crescent Medical Journal. 2014 Apr;16(4)
4. Miller RD, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Cohen NH, Young WL. Miller's Anesthesia E-Book. Elsevier Health Sciences; 2014 Oct 20.
5. Aziz M, Brambrink A. The Storz C-MAC video laryngoscope: description of a new device, case report, and brief case series. Journal of clinical anesthesia. 2011 Mar 1; 23(2):149-52.
6. Lee AH, Nor NM, Izaham A, Yahya N, Tang SS, Manap NA. Comparison of the Bonfils Intubation Fibrescope versus C-MAC Videolaryngoscope. Middle East journal of Anaesthesiology. 2016 Jun; 23(5):517-25.
7. Senapathi TG, Wiryana M, Aribawa IG, Van Zundert A, Labobar OA. Bonfils intubation fiberscope versus C-MAC videolaryngoscope: hemodynamic stability and incidence of sore throat in endotracheal intubated patients. Bali Medical Journal, 2017 Jan 1; 6(2):251-4.
8. Ezhar Y, D'Aragon F, Echave P. Hemodynamic responses to tracheal intubation with Bonfils compared to C-MAC videolaryngoscope: a randomized trial. BMC Anaesthesiology. 2018 Dec; 18(1):124.
9. Hosdurg B, Prabhakar GS, Gundappa P, Simha J,Ramegowda JK, Pramod A, *et al*. Hemodynamic responses to endotracheal intubation: A comparison between Bonfils intubation fiberscope and direct laryngoscopy", Karnataka Anaesth J 2015;1:17-20.
10. Tim Piepho and Rüdiger Noppens. The Bonfils Intubation Endoscope in Clinical and Emergency Medicine, 2015.
11. Ng I, Hill AL, Williams DL, Lee K, Segal R. Randomized controlled trial comparing the McGrath videolaryngoscope with the C-MAC videolaryngoscope in intubating adult patients with potential difficult airways. British journal of anaesthesia. 2012 Jun 7;109(3):439-43.
12. Halligan M, Charters P. Learning curve for the Bonfils intubation fiberscope. Br J Anaesth. 2003 Jun 1;90:826P.
13. Ochroch EA, Hollander JE, Kush S, Shofer FS, Levitan RM. Assessment of laryngeal view: percentage of glottic opening score vs Cormack and Lehane grading. Canadian Journal of Anaesthesia. 1999 Oct 1;46(10):987-90.
14. Park SJ, Kim BS, Jee DL. Jaw-thrust induces sympathetic responses during induction of general anesthesia. Korean journal of Anaesthesiology. 2013 Aug;65(2):127.
15. Boker A, Almarakbi WA, Arab AA, Almazrooa AA. Reduced hemodynamic responses to tracheal intubation by the Bonfils retromolar fiberscope: a randomized controlled study. Middle East journal of Anaesthesiology. 2011 Oct;21(3):385-90.
16. Najafi A, Rahimi E, Moharari RS, Khan ZH. Bonfils fiberscope: Intubating conditions and hemodynamic changes without neuromuscular blockade. Acta MedicaIranica. 2011:201-7.
17. Gupta K, Girdhar KK, Anand R, Majgi SM, Gupta SP, Gupta PB. Comparison of hemodynamic responses to intubation: Flexible fibreoptic bronchoscope versus bonfils rigid intubation endoscope. Indian journal of anaesthesia. 2012 Jul;56(4):353.

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