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Bonfils intubation fiberscope versus C-MAC videolaryngoscope: hemodynamic stability and incidence of sore throat in endotracheal intubated patients

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ABSTRACT

Introduction: Hemodynamic stability at laryngoscopic intubation is influenced by mechanical stimuli on the affected area of the oropharynx. The use of appropriate tools can lower mechanical stimuli and lead to a better outcome. The purpose of this study was to determine whether the use of Bonfils intubation fiberscope provided a better hemodynamic stability, and decreased the incidence of a sore throat compared to Macintosh videolaryngoscope.

Materials and Methods: We conducted a non-blind randomized controlled trial. It was conducted at Sanglah Hospital, Indonesia, in September to October 2016 with a sample of 50 people. The sample was divided into two groups. The patients were induced by propofol TCI target effect 4 μg/ml and analgesia with fentanyl 2 mcg/kg. Hemodynamic conditions assessed since the induction, one minute before intubation, and one minute, three minutes, and five minutes after laryngoscopy intubation. A sore throat was evaluated before and after treatment.

Results: The MAP value and pulse rate in one minute and three minutes after laryngoscopy intubation in CMAC group were significantly higher compared to Bonfils group ($p<0.001$). The proportion of a postoperative sore throat is significantly different between the two groups ($p=0.042$).

Conclusion: Bonfils intubation fiberscope proved better in providing hemodynamic stability and decreased the incidence of a sore throat compared to Macintosh videolaryngoscope in patients underwent general anesthesia.

Keywords: Bonfils intubation fiberscope, C-MAC videolaryngoscope, hemodynamic, sore throat.

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INTRODUCTION

An endotracheal tube is a device for maintaining a patent airway during anesthesia. Insertion of direct laryngoscopy can cause hemodynamic changes.[1] The hemodynamic stress response comes from oropharyngeal stimulation by direct laryngoscopy. The Bonfils intubation fiberscope (BIF) is a thin rigid fibreoptic endoscope used for endotracheal intubation. The BIF provides a visualization of the laryngeal inlet and placement of the endotracheal tube under direct vision.[2] Therefore, it was claimed that in intubation, BIF would produce less mechanical stress and hemodynamic disturbance compared to the Macintosh laryngoscope.[3]

The C-MAC videolaryngoscope is a Macintosh Blade with a light source and an integrated video camera connected via a cable to a video display monitor onto which the image at the blade camera is projected.[4] Laryngoscopy with the C-MAC videolaryngoscope had a better laryngeal view and caused less hemodynamic stress response compared to direct laryngoscopy.[5]

We aimed to evaluate the hemodynamic changes during endotracheal intubation and the presence of a post-surgery sore throat using the Bonfils intubation fiberscope and compare it to the C-MAC videolaryngoscope.

METHODS

This research was a prospective a non-blind randomized controlled trial. The study was conducted in September to October 2016. Fifty patients scheduled for elective surgery under general anesthesia requiring endotracheal intubation. Aged 17 to 60 years old with body mass index (BMI) >19,5 kg/m^2 and <25 kg/m^2, physical status of American Society Anesthesiologists (ASA) class I and II, Mallampati I and Mallampati II, were recruited. A written informed consent was obtained from each patient. The patients were divided into two groups: Bonfils intubation fiberscope (Bonfils) group and C-MAC videolaryngoscope (C-MAC) group. An endotracheal intubation using any of the two devices was performed by an operator, an

Table 1 Patient Characteristics

Characteristics	Groups C-MAC (n=25)	Groups *Bonfils* (n=25)	p-value
Age (years), median (IQR)	28 (24)	22 (22)	0.627
Gender			
Male	18 (72.0)	15 (60.0)	0.370
Female	7 (28.0)	10 (40.0)	
BMI (kg/m²), median (IQR)	22 (4)	22 (5)	0.937
Time to intubation (second), median (IQR)	14 (2)	22 (3)	<0.001
Physical status ASA			
ASA 1	17 (68.0)	19 (76.0)	0.529
ASA 2	8 (32.0)	6 (24.0)	
Mallampati			
Mallampati 1	16 (64)	18 (72)	0.544
Mallampati 2	9 (36)	7 (28)	

Table 2 Post intubation complication (a sore throat)

VAS Sore throat		Groups C-MAC (n=25)	Groups *Bonfils* (n=25)	p-value
VAS	No pain	19 (76)	24 (96)	0.042
Post-operative	Mild	6 (24)	1 (4)	
(In recovery room)	Moderate	0 (0,0)	0 (0)	
VAS	No Pain	25 (100)	25 (100)	
24 hours	Mild	0 (0.0)	0 (0)	
After surgery	Moderate	0 (0.0)	0 (0)	

Table 3 Comparison of Mean Arterial Pressure within the Bonfils and C-MAC groups

MAP	Groups C-MAC (n = 25)	Groups *Bonfils* (n = 25)	p-value
Surgery preparation room	92.4 ± 8.4	89.2 ± 7.8	0.164
1 minute before intubation	78.1 ± 9.5	80.2 ± 8.9	0.416
1 minute post intubation	92.5 ± 11.2	78.7 ± 8.9	<0.001
3 minutes post intubation	89.5 ± 8.4	76.8 ± 7.6	<0.001
5 minutes post intubation	84.0 ± 7.9	82.1 ± 6.9	0.360

experienced anesthesiology registrar who had had more than 25 successful intubations before the study.

The random sampling and the decision which intubation technique had to be used to the patient were made by a researcher who also gave the anesthesia. Another researcher, an anesthesiology registrar did the intubation. The third researcher, another anesthesiology registrar stayed in the operating theater to fill in the anesthesia chart and collect the data. The patient was randomly assigned to either group. In the preparation room, before the surgery, each patient was asked whether he or she had a sore throat. A standard monitoring was recorded, which comprised of a non-invasive blood pressure (NIBP), electrocardiography (ECG), and pulse oximetry. The baseline of the mean arterial pressure (MAP), systolic (SBP) and diastolic (DBP) blood pressures, heart rate (HR), and oxygen saturation (SpO_2) were also recorded.

After three minutes of preoxygenation, each patient was given fentanyl 2 mcg/kg as analgesia, and the anesthesia was induced with propofol TCI Schneider with target effect 4 μg/ml, followed by paralysis with atracurium 0.5 mg/kg. The patient was then manually ventilated via facemask with 100% oxygen, Three minutes after the administration of atracurium, endotracheal intubation was performed using either the Bonfils intubation fiberscope or C-MAC videolaryngoscope. The endotracheal tube cuff was inflated and a correct tube placement was confirmed by an auscultation using a stethoscope. Anesthesia was maintained with sevoflurane, titrated to 1-1.5 vol%, with gas flows at 2 L/min. The MAP, SBP, DBP, HR, and SpO_2 were recorded before the induction of anesthesia, one minute prior to intubation, one minute after intubation, three minutes after intubation and five minutes after intubation.

In the Bonfils group, the endotracheal intubation was performed using the Bonfils intubation fiberscope via midline approach. The endotracheal tube was loaded on and taped to the proximal end of the lubricated shaft of the Bonfils intubation fiberscope. After adjusting the fiberscope to optimal view on the display monitor, antifog solution was applied to its distal tip. The operating bed was adjusted to allow the optimal manipulation of the Bonfils intubation fiberscope. The operator did a modified jaw thrust (chin and tongue lift). The fiberscope was held in the operator's dominant hand and introduced midline into the patient's oral cavity until it reached the oropharynx. At the posterior wall, the distal end was rotated towards the anterior to bring the epiglottis into view to get the best visualization of rima glottidis. The endotracheal tube was inserted with a sliding maneuver into the rima glottidis with the helped from Bonfils fiberscope monitor.In the C-MAC group, the endotracheal intubation was done using the C-MAC videolaryngoscope with a size three or four blade. An observer recorded the time to intubation (TTI), commencing from the insertion of the intubating device into the patient's mouth until the confirmation of the endotracheal tube placement. The number of intubation attempts

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Table 4 Comparison of increasing pulse within the Bonfils and C-MAC groups at the time

Pulse increase	Groups		p-value
	C-MAC (n = 25)	*Bonfils* (n = 25)	
1 minute post intubation	-14.36 ± 8.8	1.52 ± 8.9	0.001
3 minutes post intubation	-11.36 ± 6.6	3.4 ± 10.6	0.001
5 minutes post intubation	-5.9 ± 7.14	-1.8 ± 9.27	0.202

was defined as the number of insertions of the intubation device into the patient's oral cavity. Cormack and Lehane grade I to IV was recorded on the first attempt at endotracheal intubation based on the observed laryngeal view on the monitor. For both techniques, in the event of an unsuccessful intubation, the patient was excluded from the study. The data were presented in mean ± SD where applicable. The continuous data were tested for a distribution normality and analyzed using a T-test. The nonparametric data were analyzed using Mann–Whitney *U*-test and Chi-square test. The alpha was 0.05.

RESULTS

Fifty patients were equally divided into two groups. Endotracheal intubation at first attempt was successful in 25 patients (100%) in both groups.

The demographic data were shown in Table 1. There was no significant difference in age, weight, height, BMI, and gender. The mean TTI was significantly longer in the Bonfils group compared to the C-MAC (p<0,001).

Table 2 showed that patients in both groups experienced a postoperative sore throat. However, the incidence of a sore throat was significantly higher in C-MAC group than in Bonfils (p=0,042).

Table 3 showed that MAP in CMAC group at 1 minute and 3 minutes post intubation were significantly higher than the Bonfils group. (p <0,001).

The heart rate in CMAC groups 1 minute and 3 minutes post intubation were significantly higher than the Bonfils group (p=0,001), as were shown in Table 4.

DISCUSSION

Endotracheal intubation with direct laryngoscopy can stimulate a hemodynamic stress response. Epiglottis elevation was needed for laryngeal exposure during a direct vision laryngoscopy technique in order to elevate the epiglottis and put the glottis apparatus on one axis with the anesthetist's eye. The forward and upward movement of the laryngoscope blade applied along the axis of the laryngoscope handle can result in hemodynamic stress response. The Bonfils intubation fiberscope and C-MAC videolaryngoscope, video-assisted indirect laryngoscopic devices, had been shown to improve laryngeal view while inducing minimal stress responses.[6,7,8] A study found that in intubating simulated difficult airways, Bonfils and C-MAC were superior to the Macintosh blade.[9] But, in a direct comparison there was no significant difference in intubating time, success and complication rate.[9] Because it is simple to use, C-MAC has gained widespread popularity in contrast to Bonfils. The latter was not widely used in routine clinical practice. Bonfils must be done by a well-trained anesthesiology with more than 25 successful intubations. However, Bonfils has its advantage over C-MAC in a difficult airway, where restricted mouth opening may limit the use of the latter.

Several studies have reported desirable hemodynamic parameters with the use of Bonfils. Boker *et al.* found that the increase in MAP and HR was greater during a laryngoscopy with the conventional laryngoscope than with the Bonfils.[8] Another study also showed a better hemodynamic profile with Bonfils and comparable intubation conditions even without neuromuscular blockade.[3] Moreover, a study presented increasing HR, MAP, and catecholamine level with intubation in all patient, but with a higher increase in Macintosh intubated patient compared to Bonfils. The hemodynamic responses, manifesting as increased heart rate and blood pressure, are due to sympathoadrenal reflex discharge provoked by epi laryngeal and laryngotracheal stimulation. The study from Lee *et al.* compared hemodynamic changes between Bonfils intubation fiberscope and C-MAC videolaryngoscope.[10] They found a significant increase in heart rate in Bonfils group compared to C-MAC group. The persistently high heart rate in the Bonfils group may have been caused by the jaw thrust or the tongue-jaw lift maneuver. [10] The study compared the hemodynamic stress response between Bonfils intubation fiberscope and C-MAC videolaryngoscope without any jaw thrust manipulation during Bonfils intubation. [10] In our study, we used a modified jaw thrust which was limited to chin and tongue lift.Our study showed a significant difference between the MAP and HR increase in C-MAC group compared to Bonfils group at the first and third minute after intubation. The hemodynamic was back to basal at the fifth minute after intubation at both groups. Bonfils intubation fiberscope is a rigid endoscope designed to enable glottis visualization and to facilitate intubation under an endoscopic vision. Bonfils intubation fiberscope avoided direct stimulation to the base of the tongue and epiglottis while C-MAC still does. Stimulation to the tongue and epiglottis cause noxious stimuli mechanoreceptors and nociceptors to produce a neuroendocrine response. It will activate the sympathetic system. Next, the sympathetic system will release catecholamine from adrenal medulla.[11]The TTI mean in the Bonfils group was 22 seconds. It was longer than in C-MAC which TTI mean was 14 seconds ($p<0.01$). Even though the TTI of the Bonfils was longer, the hemodynamic was significantly more stable compared to the C-MAC group. The proportion of the reported post-intubation sore throat evaluated at the recovery room was significantly lower in the Bonfils group. Laryngotracheal tissue damage due to laryngoscope intubation is the main cause of a post-intubation sore throat. With Bonfils, we may avoid a manipulation of the pharynx and the base of the tongue. Thus, decreasing the incidence of a post-intubation sore throat.[12] There were several limitations in this study. Firstly, it was not possible to blind the investigator of the device being used. Nevertheless, all intubations were performed by an operator with adequate clinical experience using both devices. Therefore, the variability in technique would have been minimized. It was assumed that an intubation using the Bonfils would require a greater skill, so thus the success was dependent on the capability of the operator. We considered a clinician is experienced in using the Bonfils intubation fiberscope after the person had had 25 successful intubations with the Bonfils intubation fiberscope.

CONCLUSION

Bonfils intubation fiberscope showed to be better in providing hemodynamic stability and decreasing the sore throat incident when compared to Macintosh videolaryngoscope in patients who underwent general anesthesia.

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