Comparison of C-MAC® Video Laryngoscope and Macintosh Conventional Laryngoscope for Nasotracheal Intubation Convenience in Adult Malay Race Population

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ABSTRACT

Background: Nasotracheal intubation is a widely used airway management, especially in oral surgery. Various devices were found to perform intubation techniques, such as video laryngoscopes. The use of the C-MAC® video laryngoscope enables better glottis visualization compared to the Machintosh laryngoscope. In the case of a difficult airway, C-MAC® increases the success rate of orotracheal intubation. However, this device is not commonly used in nasotracheal intubation.

Methods: A single blinded randomized clinical trial study of 86 subjects has been done to compare the success of intubation and duration of nasotracheal intubation in adult Malay patients between the use of C-MAC® video laryngoscopes and the use of a conventional Macintosh laryngoscope. Exclution criteria are difficult airway, pregnancy, acute ischemic heart disease, heart failure, second- or third-degree block, uncontrolled hypertension, Guillen Barre syndrome, Myasthenia Gravis, and contraindications to nasotracheal intubation.

Results: The use of C-MAC® increased the success rate of the first attempt at intubation (RR 1,265, 95% CI (1,084-1,475)) and required a shorter duration of intubation (p value <0.001) than the use of conventional Macintosh laryngoscopes in the adult Malay race population.

Conclusion: In adult Malay patients, nasotracheal intubation is easier using the C-MAC® video laryngoscope compared to using a conventional Macintosh laryngoscope. The ease of intubation is defined as the high rate of successful first attempt and the shorter time of the intubation procedure.

Keyword: C-MAC®, ease of intubation, Macintosh, nasotracheal intubation

Perbandingan Video Laringoskopi C-MAC® dan Laringoskopi Macintosh Konvensional dalam Intubasi Nasotrakea pada Populasi Dewasa Ras Melayu

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ABSTRAK

Latar Belakang: Intubasi nasotrakeal sudah sering digunakan sebagai tatalaksana jalan napas, terutama pada pembedahan di rongga mulut. Banyak alat yang dapat digunakan dalam teknik intubasi, seperti laringoskopi video. Penggunaan laringoskopi video C-MAC® dapat memberikan visualisasi glottis yang lebih baik daripada laringoskop Macintosh. Pada kasus jalan napas sulit, C-MAC® dapat meningkatkan laju kesuksesan intubasi orotrakeal. Namun, alat ini masih jarang digunakan pada intubasi nasotrakeal.

Metode: Uji klinis acak terkontrol single blinded yang terdiri dari 86 subjek dilakukan untuk membandingkan keberhasilan intubasi dan durasi intubasi nasotrakea pada pasien dewasa ras Melayu antara penggunaan laringoskop video C-MAC® dengan laringoskop Macintosh konvensional. Kriteria eksklusi adalah jalan napas sulit, hamil, penyakit jantung iskemik akut, gagal jantung, blok derajat dua atau tiga, hipertensi tidak terkontol, sindrom Guillen-Barre, myasthenia gravis, dan kontraindikasi terhadap intubasi nasotrakea.

Hasil: Penggunaan C-MAC® meningkatkan laju keberhasilan intubasi pada percobaan pertama (RR 1,265, 95% CI (1,084-1,475)) dan membutuhkan durasi intubasi yang lebih singkat (nilai $p<0.001$) daripada penggunaan laringoskopi konvensional Macintoh pada populasi dewasa ras Melayu.

Kesimpulan: Pada pasien dewasa ras Melayu, intubasi nasotrakea lebih mudah dilakukan dengan menggunakan laringoskopi video C-MAC® daripada laringoskopi Macintosh konvensional. Kemudahan intubasi dinilai dari keberhasilan intubasi pada percobaan pertama dan durasi yang lebih singkat selama prosedur intubasi.

Kata kunci: C-MAC®, intubasi nasotrakea, kemudahan intubasi, Macintosh

INTRODUCTION

Nasal intubation techniques, hereinafter called nasotracheal intubation (NTI), introduced first by Kuhn in 1902 and popularized by Magill in 1920s.[1] NTI has been commonly used in oral surgery due to better visualization for the operator.[2] Particular devices are needed, for both nasal and oral, to achieve easy and safe procedures. One of the traditional devices which has been widely used is direct laryngoscope with Macintosh blade. Along with the development, many devices have been found including video laryngoscope, which proved to give better glottis visualization and less larynx external manipulation for both normal and difficult airway management.[3,4] Tseng et al showed that first attempt success rate in videolaryngoscope using Glidesope and Pentax is higher than Macintosh conventional laryngoscope.[4] Hoshijima et al also stated that C-MAC® gave better glottis visualization and increased to success rate of intubation.[5] However, it was only included orotracheal intubation.

Okubo et al conducted a research about intubation complication in emergency unit and found several major complications, such as cardiac arrest, hypotension, hypoxemia, regurgitation, latter known esophageal intubation; and several non-major complications, such as bronchial intubation, dental or lips trauma, airway trauma, and allergic reaction. The result showed 97% patient intubated with direct laryngoscope experienced complications, with the most happened was latter known esophageal intubation (5%), followed by dental and lips trauma (4%), regurgitation (2%), and hypotension (2%).[6] Harisson et al also showed that 17% patients experienced complications prior to deaths.[7]

Comparison in easiness between video and conventional laryngoscope in adults hasn't been widely studied. If only the effectivity is proven higher, video laryngoscope C-MAC® is also expected to lower mortality rate and complications. Due to limited study regarding this issue, we conducted a clinical trial study in adult Malay race population; which further expected to be a reference in choosing nasal intubation devices in Indonesia. Malay race population was proven to has narrower airway structure which contributed to more difficult larynx visualization.[8] The purpose of this study is to compare the first attempt success rate and the duration of nasotracheal intubation procedure between C-MAC® video laryngoscope and Macintosh conventional laryngoscope in adult Malay race population. We hypothized that video laryngoscope C-MAC® is easier to be used.

METHODS

Patients

This single blinded randomized-controlled trial study was conduncted in operating theatre of in Cipto Mangunkusumo General Hospital between March until May 2019. The inclusion criteria were adults with age ranging from 18-65 years old, ASA physical status 1-2, planned for elective surgery with general anesthesia, body mass index (BMI) 18,5-30 kg/mg^2, and had agreed to be the research subject by signing the consent. The exclusion criteria were history of difficult airway management, difficult intubation or ventilation (short neck, cervical abnormalities causing limited joint movement, face deformities, submandibular abscess), cervical immobilization, extension <30^o, pregnancy, cancellation of elective surgery, history of myocardial infarction, heart failure, second- or third-degree block, uncontrolled hypertension in ward, Guillain-Barre syndrome, myasthenia gravis, and prescence of absolute and relative contraindication of nasotracheal intubation. Absolute contraindications were suspected epiglottitis, face asymmetry, coagulopathy, history of skull base fracture, apneu, or respiratory failure. Relative contraindications were profound nasal polyp, infection or hematoma in upper cervical, history of recurrent epistaxis, and artificial heart valve (which increased risk of bacteremia during insertion). Drop-outs for the patients who kept moving during intubation procedure, experienced desaturation <90% or any emergency situation, and failed in first attempt of intubation.

Protocols

Sampling method of this research was convenience sampling. The samples were allocated by randomization table from www.

randomizer.org, divided to two groups of C-MAC® video laryngoscope and Macintosh conventional laryngoscope. Intubation was done by anesthesiologist or resident on second term and above of Faculty of Medicine Universitas Indonesia, which had been introduced and trained to perform intubation by using Macintosh or C-MAC®, and also had done direct observe procedural skill (DOPS) of video laryngoscope. The subjects selected based on the criteria through history taking, physical examination, and supportive examination. Patients were educated regarding the research and asked to sign the consent form as a documentation. The data were collected after got a permission from ethics committee and written informed patient consent. Patients refused to participate would undergoing futher procedure in accordance with the hospital. Randomization using numbered sealed envelope, consisted of number 1 which belonged to conventional laryngoscope group and number 2 belonged to video laryngoscope group.

After entering the operating room, patients were given epinephrine 0,01% compress with cotton swab in their respective nostrils. Patients were instructed to laying down in supine position, with intravenous access and monitors (electrocardiogram, blood pressure, and pulse-oxymeter) attached. Patients' hemodynamic (systolic and diastolic blood pressure, mean arterial pressure, heart rate, and peripheral saturation) were documented. Then, patients were given coinduction using midazolam 0,05 mg/kg and fentanyl 2 mcg/kg, continued with propofol 1,5-2 mg/kg and rocuronium 0,6 mg/kg. Preoxygenation with oxygen 100% for 2 minutes with oxygen mask and positive pressure ventilation for 2 minutes. Time documented since the insertion of Ring-Adair-Elwyn endotracheal tube (RAE ETT), with xylocain gel 2% applied beforehand. Intubation counted as successful if the monitor showed capnography end-tidal carbondioxide (EtCO2). Then, laryngoscope, was inserted and the operator mentioned the Cormack Lehane scale. If the scale 1-2, the ETT inserted through vocal cord using Magill forcep. If the scale 3-4, the operator conducted maneuver to achieve good visualization of the larynx. The intubation must reach the trachea on the first attempt. If the blade of the laryngoscope was taken out from the mouth, even for a second, and then inserted again, it counted as numbers of effort. If it reached three times failure, subject was dismissed. Patients were given ventilation and oxygenation as usual and were intubated again. If emergency situation came up or patients undergoing desaturation for 90% or below, management of the patients based on Advanced Life Support (ALS) and Basic Life Support (BLS), later the subject was dismissed from the research subject. During anesthesia, laryngoscopy and intubation procedures were all under supervision of anesthesiologist in charge.

Statistical analysis

Data were analyzed using Statistical Package for the Social Science or SPSS software. Between-group numerical data were analyzed with an unpaired T-test if data distributed normally, or Mann-Whitney test if not; meanwhile non-parametric data were analyzed with a Chi-square or with Fisher if the expected count value <5 was more than 20%. The confidence interval used was 95%, with p=0,05.

RESULTS

A total of 86 subject which met the criteria and divided into two groups, C-MAC® video laryngoscope group and Macintosh conventional laryngoscope group. All of the subjects were analyzed with no drop-out.

Demographic characteristic of the subjects presented in Table 1, showing similarity for both groups in respective variables. The analysis of first attempt success of intubaion showed p=0,002, which means it is stastically significant that C-MAC® groups had a better success rate than Macintosh (Table 2).

Duration of intubation divided into three period of time. Time A began when ETT entered nostrils and reached oropharynx until the blade was inside oral cavity passing the incisor. Time B began when the blade passed the incisor until the operator was able to visualize glottis. Time C began when the operator was able to visualize glottis until ETT was confirmed to be placed inside trachea. Total duration of intubation was time B + time C.

Time A was analysed using unpaired T-test and showed unsignificant result between two groups

(p=0,697). Time B was analysed using Mann-Whitney and showed significant difference (p<0,001), as well as the time C (p=0,002). Both time A+B+C and time B+C were analysed using Mann-Whitney test, and all is statistically significant (p=0,001 and p<0,001). Those results lead into conclusion that intubation with C-MAC® video laryngoscope needed less time than Macintosh conventional laryngoscope (Table 3).

In this research, complications were found, which presented in Table 4. The incidence of hypertension was most found in C-MAC® group (20,9%), while hypotension was most found in Macintosh group (25,6%).

Tabel 1. Subject' Characteristics

Variables	Groups	
	Macintosh (n=43)	C-MAC® (n=43)
Sex		
Male	19 (44,2%)	17 (39,5%)
Female	24 (55,8%)	26 (60,5%)
Age (year)[b]	37 (18-62)	33 (18-61)
Weight (kg)[c]	59,88 ± 11,48	59,26 ± 13,23
Height (cm)[b]	160 (140-177)	160 (148-187)
BMI (kg/m²)[c]	23,43 ± 3,64	22,78 ± 3,89
ASA[a]		
1	17 (39,5%)	9 (20,9%)
2	26 (60,5%)	34 (79,1%)

[a] categorical data presented in n (%)
[b] non-normal distribution numerical data presented in median (minimum-maximum)
[c] normal distribution numerical data presented in mean value ± standard deviantion
BMI: body mass index

Tabel 2. Univariate Analysis Using Fisher Extract for First Attempt Success

First Attempt Success	Groups		p value	RR	95% CI	
	C-MAC® (%)	Macintosh (%)			Min	Max
Yes	43 (100)	34 (79,1)	0,002	1,265	1,084	1,475
No	0 (0)	9 (20,9)				

RR: relative risk
CI: confidence interval
Min: minimum
Max: maximum

Tabel 3. Univariate Analysis for Time Duration of Intubation

Variables	Groups		Difference (95% CI)	p value
	Macintosh	C-MAC®		
Time A[a]		19,62 ± 7,58		0,697[c]
Time B[b]	17,5 (8,5-51,5)	13 (4,2-69,2)		<0,001[d]
Time C[b]	44,8 (16,3-121,8)	35,9 (14,9-62,9)	-0,69 (-4,18-2,81)	0,002[d]
Time A+B+C[b]	79,3 (42,4-194,3)	64,4 (41,4-117,6)		0,001[d]
Total (time B+C) [b]	62,5 (24,8-163,8)	47,5 (21,7-99,7)		<0,001[d]

[a] normal distribution numerical data presented with mean ± standard deviance
[b] unnormal distribution numerical data presented with median value (minimum-maximum)
[c] unpaired T-test (statistically significant if p <0,05)
[d] mann-Whitney test (statistically significant if p <0,05)
Time A: recorded since ETT enters nostrils and reaches oropharynx until the blade is inside oral cavity passing the incisor
Time B: recorded since the blade passed the incisor until the operator was able to visualize glottis
Time C: recorded since the operator was able to visualize glottis until ETT was confirmed to be placed inside trachea

Tabel 4. Analysis of Complication

Variables	Groups	
	Macintosh (%)	C-MAC® (%)
Hypertension		
Yes	9 (20,9)	4 (9,3)
No	34 (79,1)	39 (90,7)
Hypotension		
Yes	8 (18,6)	11 (25,6)
No	35 (81,4)	32 (74,4)
Bradycardia		
Yes	5 (11,6)	1 (2,3)
No	38 (88,4)	42 (97,7)
Tachycardia		
Yes	4 (9,3)	5 (11,6)
No	39 (90,7)	38 (88,4)
Gastric Intubation		
Yes	8 (18,6)	0 (0)
No	35 (81,4)	43 (100)
Epistaxis		
Yes	2 (4,7)	1 (2,3)
No	41 (95,3)	42 (97,7)

[a] categorical data presented in n (%)
[b] non-normal distribution numerical data presented in median (minimum-maximum)
[c] normal distribution numerical data presented in mean value ± standard deviantion
BMI: body mass index

DISCUSSION

According to the demographic characteristics, the patients were dominated by sex female for both groups. The age distribution was relatively younger than subjects in research conducted by Tseng et al, with median of 40,9-44 for both groups, but relatively similar to Sato et al, with median of 33,8-36,3 for both groups.[4,9] A meta-analysis conducted by Wang et al stated that obesity significantly increased the risk of difficult intubation and laryngoscopy,(10) so that, we exclude patients with BMI >30 and the mean of BMI for group C-MAC® and Macintosh were 22,78 and 23,43 respectively. The ASA physical status was limited to ASA 1 and 2 in order to ensure all the management methods, like the dose of induction agent, could be applied to all subjects and to minimize risk of developing complications during induction and intubation.

To assess the easiness of nasotracheal intubation, we defined two variables, higher first attempt success rate and less duration of intubation. In line with this research, Tseng et al also defined the easiness by duration, first attempt success rate, and scoring with modified Intubation Difficulty Scale; also, Hazarika et al defined it by duration, first attempt success rate, and glottis visualization.[4,11]

The result showed significant difference (p=0,0002) for first attempt success rate for both groups, with the rate of 100% for C-MAC® group and 79,1% for Macintosh. The relative risk was 1,265, means that C-MAC® video laryngoscope significantly has higher first attempt success rate compared to Macintosh conventional laryngoscope. Absolute risk reduction (ARR) was 0,21 and the number needed to treat (NNT) was 4,76 (by dividing 1 with ARR). Hence, 5 patients intubated with C-MAC® were needed to increase one successful procedure on the first attempt in nasotracheal intubation in adults Malay race

population.

Tseng et al showed similar results, with higher first attempt success rate using Glidescope® (83,3%) and Pentax® scope (69,7%) compared to Macintosh (66,7%),[4] as well as Hazarika et al, with first attempt success rate for C-MAC® D blade (98%) rather than Macintosh we(84%) (p=0,031).(11) Dachlan et al conducted a research to compare the successful of orotracheal intubation with rapid sequence induction (RSI) technique for C-MAC® and Macintosh group. The first attempt success rate for C-MAC® was quite higher (81,7% to 76,3%), but not statistically significant (p=0,470).[12] This difference might be caused by a better glottis visualization was more necessary in nasotracheal intubation to insert the ETT using Magill forcep.

The duration of intubation was also assessed. The results showed no significant difference in time A (p=0,697). Practically, time A alone did not carry weight, but it contributed to total duration of patients in apneu state. For time B, C, and B+C, it showed significant difference. The median difference in total time of intubation was 15 seconds (Table 3). Dachlan et al did not show similar result with unsignificant difference between two groups with only 2 seconds difference (p=0,7) in orotracheal intubation.(12) For time A+B+C, the result was also statistically significant with 15,1 seconds faster in C-MAC® group. The longest duration in Macintosh was 3 minutes 14,3 seconds and in C-MAC® 1 minute 16,7 seconds. Tanoubi et al stated that duration of apnea without desaturation in adult patients with normal preoxygenation was the longest with 8 minutes duration, and the shortest was 0,6 minutes without preoxygenation.[13]

Complications for both groups were also analyzed. The most seen was hypertension (20,9%) for Macintosh group and hypotension (25,6%) for C-MAC® group. This results might be due to various cardiovascular performance in both groups. Hemodynamic response in airway management usually generated by stimulation of the oropharynx by the scope or ETT movement through glottis opening.[14] AJ Shribman et al compared cardiovascular response and cathecolamine toward laryngoscopy, with or without tracheal intubation, and the results were a significant increase in mean heart rate and diastolic blood pressure for both groups.[15] Smith et al also found that mean arterial pressure and heart rate significantly increased in laryngoscopy with intubation group.[16]

Research by Marsaban et al gave results that cardiovascular response and the need of Backwards Upwards Rightwards Pressure (BURP) manuever during laryngoscopy was lower in C-MAC® than conventional laryngoscope (19,3% to 40,3%, p=0,014).[17] Ng et al also stated the similar thing compared to McGrath® laryngoscope,[18] and even lower compared to Macintosh device.[14,19,20]

The study limitation is the sampling used was convenience sampling due to limited device of C-MAC®, which was only one for all subjects and the use was prioritized for patients with risk of difficult intubation. So, if there were two operations held, one with difficult intubation and one for the subject candidate, we had to gave up on the candidate. Another limitation is unavailability of local spray to maintain hemodynamic. In this research, nasal topical drug used was only adrenaline to minimize the risk of epistaxis and lidocaine jelly as a lubricant. Other researches used topical nasal anesthesia to prevent hemodynamic instability due to pain feeling when ETT was inserted to nasal cavity. Tseng et al used cocain spray 6% and Hazarika et al used Xylometazoline 0,05% nasal drops.[4,11] We also did not used Train of Four (TOF) measurement method to assess muscle relaxation after giving muscle relaxant. The operators were all the resident, while it all was operated by experienced anesthesiologist in Tseng et al. This was proved by the time duration (time A+B+C) using conventional laryngoscope in Tseng et al was 42,7 second, nearly half than in our research.[4]

This research can be a reference in choosing devices to simplify nasotracheal intubation procedure in adult patients. For further research about airway management, subjects' characteristics similarity is very important, including the risk of difficult airway. The use of topical nasal anesthetic is also recommended to lower the possibility of cardiovascular side effect; also, the use of TOF measurement to assess muscle relaxation.

CONCLUSION

In conclusion, in adults Malay race population, nasotracheal intubation was easier by using C-MAC® video laryngoscope rather than Macintosh conventional laryngoscope.

CONFLICT OF INTEREST

There is no conflict of interest.

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