A CLINICAL ASSESSMENT OF MACINTOSH BLADE, MILLER BLADE AND KING VISION™ VIDEOLARYNGOSCOPE FOR LARYNGEAL EXPOSURE AND DIFFICULTY IN ENDOTRACHEAL INTUBATION

Apoorva Mahendera Garhwal[1], Anjali Rakesh Bhure[2], Sumita Vivek Bhargava[3], Ketki Sushant Marodkar[4], Arihant Ravikumar Jain[5], Himanshu Prabhudayal Nandwani[6], Nikita Narayan Jagtap[7]

[1]3rd Year Junior Resident, Department of Anaesthesiology, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur.
[2]Professor & HOD, Department of Anaesthesiology, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur.
[3]Associate Professor, Department of Anaesthesiology, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur.
[4]Assistant Professor, Department of Anaesthesiology, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur.
[5]2nd Year Junior Resident, Department of Anaesthesiology, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur.
[6]2nd Year Junior Resident, Department of Anaesthesiology, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur.
[7]1st Year Junior Resident, Department of Anaesthesiology, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur.

ABSTRACT

CONTEXT
Previous studies suggest glottic view is better achieved with straight blades while tracheal intubation is easier with curved blades and videolaryngoscope is better than conventional laryngoscope.

AIMS
Comparison of conventional laryngoscope (Macintosh blade and Miller blade) with channelled videolaryngoscope (King Vision™) with respect to laryngeal visualisation and difficulty in endotracheal intubation.

SETTINGS AND DESIGN
This prospective randomised comparative study was conducted at a tertiary care hospital (in ASA I and ASA II patients) after approval from the Institutional Ethics Committee.

METHODS
We compared Macintosh, Miller, and the King Vision-™ videolaryngoscope for glottic visualisation and ease of tracheal intubation. Patients undergoing elective surgeries under general anaesthesia requiring endotracheal intubation were randomly divided into three groups (N=180). After induction of anaesthesia, laryngoscopy was performed and trachea intubated.

We recorded visualisation of glottis (Cormack-Lehane grade-CL), ease of intubation, number of attempts, need to change blade, and need for external laryngeal manipulation.

STATISTICAL ANALYSIS
Demographic data, Mandibular length, Mallampati classification were compared using ANOVA, Chi-square test, Kruskal-Wallis Test, where P value <0.005 is statically significant.

RESULTS
CL grade 1 was most often observed in King Vision-™ VL group (90%) which is followed by Miller (28.33%), and Macintosh group (15%). We found intubation was to be easier (grade 1) with King Vision-™ VL group (73.33%), followed by Macintosh (38.33%), and Miller group (1.67%). External manipulation (BURP) was needed more frequently in patients in Miller group (71.67%), followed by Macintosh (28.33%) and in King Vision-™ VL group (6.67%). All (100%) patients were intubated in the 1st attempt with King Vision-™ VL group, followed by Macintosh group (90%) and Miller group (58.33%).

CONCLUSIONS
In patients with normal airway, glottis direct laryngoscope with Miller blade may provide better glottis view than Macintosh blade, but intubation was easier with Macintosh blade laryngoscope. Our study supports the superior performance of King Vision ™ videolaryngoscope for both glottis visualisation and ease to intubate.

KEYWORDS
Intubation, Laryngoscopy, Glottis, Vocal cords

HOW TO CITE THIS ARTICLE: Garhwal AM, Bhure AR, Bhargava SV, et al. A clinical assessment of Macintosh blade, Miller blade and King Vision™ videolaryngoscope for laryngeal exposure and difficulty in endotracheal intubation. J. Evid. Based Med. Healthc. 2016; 3(31), 1380-1385. DOI: 10.18410/jebmh/2016/317

Financial or Other, Competing Interest: None.
Submission 14-03-2016, Peer Review 28-03-2016, Acceptance 04-04-2016, Published 16-04-2016.
Corresponding Author:
Dr. Apoorva Garhwal,
Behind Sai Baba Temple, Main Road, Adersh Colony, At & po-WANI, Yavatmal-445304, Maharashtra.
E-mail: apoorv.garhwal@gmail.com
DOI: 10.18410/jebmh/2016/317

INTRODUCTION: Airway management is the greatest challenge among anaesthesiologists. The need to secure it urgently and decisively makes all the difference, and may cause significant morbidity & mortality.

Direct Laryngoscopy for airway management has remained the dominant modality and most economical means since its introduction in the 1940s. Previous study [1] suggested that glottis is viewed better with the straight blades while tracheal intubation is easier with the curved blades.

Video laryngoscopy provides a potential solution when direct laryngoscopy fails to provide glottic visualization. The camera brings the view of the glottis out of the patient's mouth to a video monitor, eliminating the need to align the three axis.[2,3] Better view can be obtained even when mouth opening or neck mobility is limited. Higher success rates are observed in difficult situations, it is useful for awake intubation, have less risk of oesophageal intubation and have less hemodynamic response to intubation.[2,3]

Laryngoscopic view can be classified using Cormack Lehane grading.[4,5] Glottic view can be improved by external manipulation of larynx using either backward-upward-rightward pressure (BURP) or Bimanual Laryngoscopy. The need for external manipulation and the number of attempts are indicators of difficulty faced during laryngoscopy and intubation.[6]

Therefore, we compared Macintosh blade, Miller blades and the video laryngoscope to evaluate the laryngeal view, optimizing laryngeal view with manipulation required, and the degree of difficulty with endotracheal intubation.

METHODS: After the approval from the Ethic Committee, this prospective, randomised, comparative study was conducted in tertiary care hospital. Based on convenience sampling (80% P; 95% CI), included 180 patients, with ASA grade I or II, between 18 to 60 years of age, MPC grade 1 and 2, upper lip bite test grade 1, weight 40-70 kg, body mass index less or equals to 25 kg/m^2, mandibular length ≥ 9 cm, hyomental distance ≥4 cm going for elective surgeries under general anaesthesia requiring endotracheal intubation. Patients were excluded from the study if they refuse consent, pregnancy, with potential difficult mask ventilation, anticipated difficult intubation or had pathology in neck, upper respiratory tract and upper alimentary tract.

A detailed routine pre-anaesthetic checkup was performed; where airway assessment using Mallampati Scale (Samson and Young's modification),[7] upper lip bite test,[8,9,10] mandibular length,[11] mandibulohyoid distance,[9] normalcy of neck movements,[11] and relevant laboratory investigations were obtained.

Computer generated randomised patients were divided in three groups (60 in each); Group A: Macintosh blade, Group B: Miller blade, and Group C: King Vision ™ videolaryngoscope.

Patients were kept nil by mouth over 8-10 hours prior to surgery. On the day of surgery, patient demographic data such as age, sex, weight, BMI was noted. In the preoperative room, written and informed consent was checked and NBM status was confirmed. In the operating room pulse-oximeter, electrocardiograph, capnography and automated non-invasive blood pressure were attached for monitoring and wide-bore intravenous access was secured. Patient was pre-medicated with Inj ranitidine 50 mg IV in drip and injection ondansetron 4 mg IV and intravenous fluid was started.

Classical sniffing position was achieved by placing a standard pillow of 9 cm height under the head of the patient. (Same pillow was used in all cases to reduce bias).

After premedication with Inj midazolam 0.03 mg/kg, Inj glycopyrrolate 0.004 mg/kg, Inj fentanyl 1 µg/kg, pre-oxygenation was done with 100% oxygen for three minutes. This was followed by induction with Inj propofol 2 mg/kg. Feasibility of ventilation with a facemask was checked prior to injecting Inj succinylcholine 2 mg/kg IV as a muscle relaxant. Patients were ventilated with oxygen by facemask. The laryngoscopy and intubation was then carried out in classical sniffing position in either of three groups by a single anaesthesiologist with more than six months of experience and at least 50 successful endotracheal intubations with each of the three blades. No blinding was done.

We studied following aspects during tracheal intubation.

Visualization of laryngeal inlet using Cormack-Lehane (CL) Grades[1]:
Grade 1: Complete glottis visible.
Grade 2: Anterior glottis not seen.
Grade 3: Epiglottis seen but not glottis.
Grade 4: Epiglottis not seen.

Ease of Intubation[12]:
Grade 1: Intubation easy.
Grade 2: Intubation requiring an increased anterior lifting force and assistance to pull the right corner of the mouth upwards to increase space.
Grade 3: Intubation requiring multiple attempts and a curved stylet.
Grade 4: Failure to intubate with the assigned laryngoscope.

When the views after laryngoscopy were more than Cormack-Lehane Grade 2 external laryngeal manipulation have been applied.

The need for external manipulation is classified as[13]:
Grade 1: No requirement of external laryngeal manipulations.
Grade 2: Requirement of external laryngeal manipulation.

Number of Attempts[14]: An attempt was defined as the insertion of the device into the mouth regardless of whether there was an attempt to pass the tube or not. Numbers of attempts were noted. After failure at second attempt stylet was used. Patients have been ventilated with 100% oxygen between attempts at laryngoscopy and intubation so that no patient desaturates below 94%. After the 3rd intubation attempts with assigned blade, patients would have been intubated using McCoy blade and bougie stylet.

STATISTICAL ANALYSIS: Intergroup comparison was done with ANOVA, Chi-square test, and Kruskal-Wallis Test, where a P value < 0.005 is statistically significant.

RESULTS: The mean age, weight, BMI, mandibular length and Mallampati scores were similar in patients undergoing intubation in all three groups. All patients were easy to ventilate. (Table 1)

Glottic Visualisation: Difference in Cormack-Lehane score was highly significant (P<0.0001) among three groups, CL grade 1 was most often seen in group C (90%), followed by group B (28.33%) and group A (15%). There are 13.33% patients in group A and 11.67% patients in group B seen as CL grade 3, but there were no CL grade 3 or 4 in group C. (Table 2).

We found no statistical difference in Cormack-Lehane scores between group A and group B, while the difference of group C with group A and group B is highly statistically significant (P<0.0001).

Ease of Intubation: Grade 1 ease of intubation most frequently seen in group C (73.33%), with the remaining patients in the same group being intubated as EOI grade 2. While only 38.33% and 1.67% patients were intubated as EOI grade 1 in group A and B respectively, there were 1 and 4 patients in group A and B who have failed to be intubated with assigned blade. Difference among these comparisons was found to be statically significant (P< 0.0001).

On subgroup comparison of ease of intubation scores with Cormack-Lehane scores, it was found that with CL grade 1 score; 74.07% patients were intubated as EOI grade -1, whereas 33.3% and 5.88% in group A and B were intubated as EOI grade 1 respectively.

Where as in patients with CL grade 2 score; 66.66% in group C are EOI grade 1 which is far better than other groups i.e. 38.46 % in group A and 0% in group B which is statistically significant (p-value < 0.0004).

External Manipulation: In our study, external manipulation (BURP) was needed more frequently in group B (71.67%), than in group A(28.33%) and least in group C (6.67%) which is highly significant statistically (P< 0.0001).

Attempts for Intubation: In group C, every patient was intubated in the first attempt. Group A followed with 90% patients intubated in first attempt and 58.33% in group B (P value < 0.0001).

DISCUSSION: In our study, difference in findings in Cormack-Lehane is highly significant (P<0.0001) among three groups, CL grade 1 were seen most frequently in King Vision-TM VL group (90%), followed by Miller (28.33%), and Macintosh group (15%); CL grade 4 were seen only in Macintosh group (1.67%).

Difference in Cormack-Lehane scores between Macintosh group and Miller group are not statistically significant, while the difference of CL score in King Vision TM VL group with Macintosh group and Miller group is highly statistically significant (P<0.0001). This suggests that glottic view obtained by Miller is better than Macintosh laryngoscope but not statically significant, when Miller and Macintosh blades are compared with videolaryngoscope, videolaryngoscope significantly improves the glottic view.

Similar results were seen in previous study of Kulkarni Atul P and Tirmanwar Amar S[13] where videolaryngoscope and Miller blade was better in exposing glottis view than Macintosh blade.

This difference can be explained by the mechanics of laryngoscopy with different blades; Macintosh blades are curved blades, and the curvature of the blade interrupts the line of sight, called the "Crest of the Hill" effect.[14] On the other hand with straight blades (Miller), the volume of tissue required to be displaced to obtain the view is lower than curved blades. But in videolaryngoscope, an optical view is offered from the glottis without the need to align three axes. Thus, it significantly improves the glottic view.

Arino et al,[12] 2003 also found a better glottic view (96% grade I) in using Miller blades than in Macintosh group (72%). Several studies have corroborated the notion that videolaryngoscope provides better glottic view than direct laryngoscope.[15,16,17]

Regarding difficulty faced during intubation in our study patients intubated as grade 1, ease of intubation scores are 73.33% in King VisionTM VL group, rest all patients in the same group were intubated as EOI grade 2, while only 38.33% and 1.67% patients were intubated as EOI grade 1 in Macintosh group and Miller group, which is statistically significant (P< 0.0001). There are 1 and 4 patients in Macintosh group and Miller Group respectively, which failed to be intubated with assigned blade.

Moreover when ease of intubation scores were compared across all three groups in patients with different Cormack-Lehane scores, it was found that intubation under EOI grade -1 score was most frequently seen in King VisionTM VL group i.e. 74.07% in CL grade 1 and 66.66% in CL grade 2 which is much higher than other groups and is statistically significant (p-value <0.0004) suggesting that intubation was easiest with King VisionTM VL group amongst three followed by Macintosh group and then with Miller group.

This result could be explained by the design of Miller blades; these blades provide a narrow C-shaped channel to view the larynx.[13] Introduction of a tube into or alongside this channel can easily obstruct the view, making intubation itself more difficult. This problem was noted by Miller in his original description of adult laryngoscopy.[18] Most of the time, assistance is needed to pull the right corner of the mouth upwards to increase space.

In 2002, Jose J. Arino et al[12] found intubation to be easier with Macintosh than with Miller blade. This is similar to our study. Macintosh blades have been suggested to significantly increased success rate when compared to Miller blade.[19] In 2015, C. D. Wallace[20] suggested that ease of intubation is better with indirect videolaryngoscope than direct laryngoscope.

Kulkarni Atul P and Tirmanwar Amar S[13] noticed that intubation was easier with TrueView® (VL) (93% EOI Grade 1 intubation) and almost as easy as with Macintosh blade. The difference between TrueView® VL and Miller was statistically significant (P=0.01). Similar results were found in our study where King Vision™ VL provides a better ease of intubation score amongst the three. But intubation was seen easier with Macintosh blade in comparison with Miller blade which has reached the statistical significance (P< 0.0001).

In our study, external manipulation (BURP) was needed more frequently in the Miller group (71.67%) than in the Macintosh group (28.33%) and least in King Vision™ VL group (6.67%), which is highly significant statistically among all three groups (P< 0.0001; Table 4). This suggests that the degree of difficulty[21] for intubation was higher with Miller blade than with other blades. This may be because when we use Miller blade, the view gets obstructed due to passage of endotracheal tube, which may increase the need of assistance for a successful intubation.[16]

Kulkarni Atul P and Tirmanwar Amar S[13] noticed that 23.3% of the patients in Macintosh group and 10% in the Miller group needed external manipulation while in our study the Miller group needed external manipulation more frequently than Macintosh group.

This could be due in part to our effort to avoid excessive force to lift the tongue and epiglottis in view of avoiding injury by the tip of blade, which may have resulted in a decrease in space to pass the endotracheal tube and view glottic together; thus, increasing the need of assistance. Their findings are similar to our study in relation to videolaryngoscope group where no external manipulation was needed. Similar results were found by Sheetal Dalal[22] were BURP Manoeuvre was required more frequently with conventional laryngoscopy than with videolaryngoscope.

In our study, 100% patients were intubated in 1st attempt in King Vision™ VL group, which was followed by Macintosh group which was 90% and in Miller group it was least that is 58.33%. In Miller group 35.0% and in Macintosh group 8.33% were intubated in 2nd attempt (P< 0.0001). (Table 5).

Similar results were found in the study by Sheetal Dalal[22] where 94.2% patients in videolaryngoscope were intubated in 1st attempt, (which suggests videolaryngoscope decreases number of attempts).

The number of attempts across three groups keeping ease of intubation in mind (Table 6) was also observed with 27.27% in the Miller group needing 2nd attempt whereas only 6.06% in Macintosh group, and not one patient in King Vision™ VL group needed 2nd attempt (all 16 EOI grade-2 were intubated in 1st attempt). This suggests that the degree of difficulty[23] for intubation was higher with Miller blade than with other blades. This is mainly due to inadequate space to introduce endotracheal tube and impaired vision because of lack of space for both endotracheal tube and vision in Miller group.[24]

A total of five cases, four in Miller group (6.67%) and one in Macintosh group (1.67%) which were not being intubated with assigned blades and were intubated with McCoy blade and bougie stylet.

Incidences of bleeding and soft tissue trauma are similar in all three groups with no statistical significance)

CONCLUSION: Conventional direct laryngoscope with straight (Miller) blade may provide better glottis view most of the times than direct laryngoscope with curved (Macintosh) blade, but Macintosh laryngoscope is proved far better when we see it with ease to intubation point of view. King Vision™ videolaryngoscope is superior to both in all aspects to view the glottis and ease to intubate, thus, can be a fair substitute for conventional laryngoscopy in patients without difficult airway.

LIMITATIONS:

1. Further studies are required to see the utility in difficult airway patients.
2. Unanticipated difficult airway patients were not ruled out.

Group	Age Mean (SD) in years	Weight Mean (SD) in kg	BMI Mean (SD) in (kg/m^2)	Mandibular length Mean (SD) in cm	Mallampati score (Median)
A(n=60)	35.48(11.91)	60.18(7.84)	22.44(2.37)	9.18(0.25)	2
B(n=60)	40.25(13.56)	60.52(7.13)	22.93(2.121)	9.24(0.30)	2
C(n=60)	35.72(13.15)	61.65(6.09)	22.37(2.363)	9.13(0.21)	2
P - value*	0.0765(NS)*	0.492(NS) *	0.3500(NS)*	0.067(NS) *	0.4783(NS) **

Table 1: Patient demography and mallampati score

*Obtained using one way ANOVA, **Obtained using Chi-square test; NS: Non-Significant.

Cormack-Lehane	No. (%)		
	A(n=60)	B(n=60)	C(n=60)
1	9(15.00)	17(28.33)	54(90.00)
2	42(70.00)	36(60.00)	6(10.00)
3	8(13.33)	7(11.67)	0
4	1(1.67)	0	0
Median	2	2	1
P - value*	< 0.0001 (HS)		

Table 2: Distribution of patients as per Cormack-Lehane grade in three groups

*Obtained using Kruskal-Wallis Test; HS: Highly-Significant.

Ease of intubation	No. (%)		
	A(n=60)	B(n=60)	C(n=60)
1	23(38.33)	1(1.67)	44(73.33)
2	33(55.00)	44(73.33)	16(26.67)
3	3(5.00)	11(18.33)	0
4	1(1.67)	4(6.67)	0
Median	2	2	1
P - value*	< 0.0001 (HS)		

Table 3: Distribution of patients as per ease of intubation and groups

*Obtained using Kruskal-Wallis Test; HS: Highly-Significant.

External Manipulation (BURP)	No. (%)		
	A(n=60)	B(n=60)	C(n=60)
1	43 (71.67)	17 (28.33)	56 (93.33)
2	17 (28.33)	43 (71.67)	4 (6.67)
Median	1	2	1
P - value*	0.0004 (S)		

Table 4: Distribution of patients as per external manipulation (BURP) and groups

*Obtained using Chi-Square Test; HS: Non-Significant.

Number of attempts	No (%)		
	A(n=60)	B(n=60)	C(n=60)
1	54(90.00)	35(58.33)	60(100.00)
2	5(8.33)	21(35.00)	0
3	0	0	0
4	1(1.67)	4(6.67)	0
Median	1	1	1
P - value*	< 0.0001 (HS)		

Table 5: Distribution of patients as per number of attempts in three groups

*Obtained using Kruskal-Wallis Test; HS: Highly-Significant.

Ease of Intubation 1	No. of attempt 1	No. of attempt 2	No. of attempt 3	No. of attempt 4	P value
Group A	23	0	0	00	-
Group B	1	0	0	0	
Group C	44	0	0	0	
Ease of Intubation 2					
Group A	31	2	0	0	0.0074 (S)
Group B	32	12	0	0	
Group C	16	0	0	0	
Ease of Intubation 3					
Group A	0	3	0	0	-
Group B	2	9	0	0	
Group C	0	0	0	0	
Ease of Intubation 4					
Group A	0	0	0	1	-
Group B	0	0	0	4	
Group C	0	0	0	0	

Table 6: Comparison of number of attempts across three groups according to ease of intubation

*Obtained using Chi-Square Test; S: Significant.

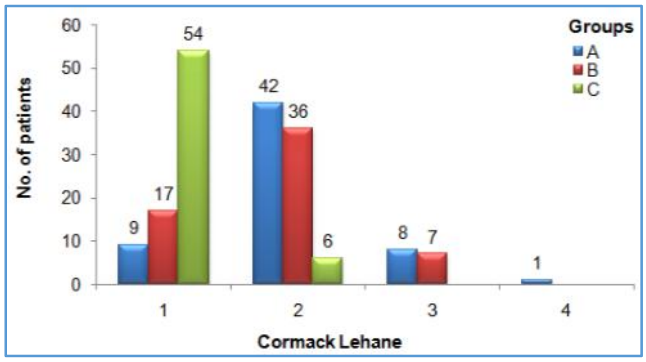

Fig. 1: Bar chart showing the distribution of patients according to Cormack-Lehane scores in groups

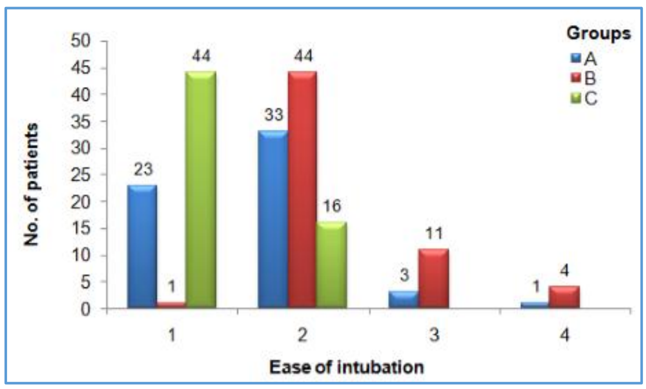

Fig. 2: Bar chart showing distribution of patients according to ease of intubation and groups

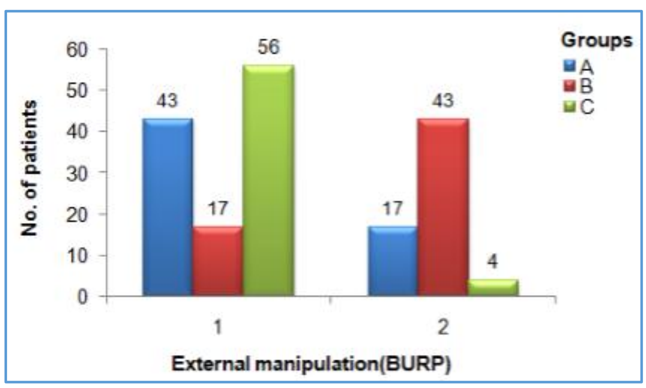

Fig. 3: Bar chart showing distribution of patients according to external manipulation (BURP) in groups

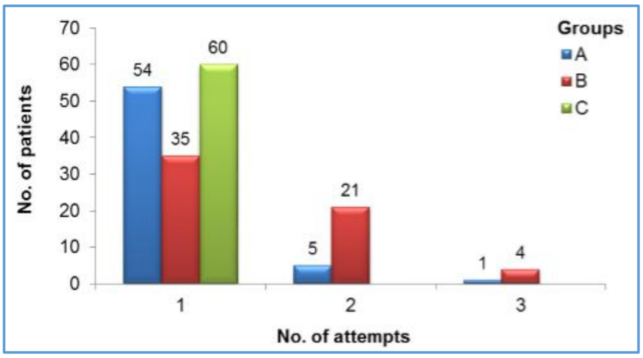

Fig. 4: Bar chart showing distribution of patients according to number of attempts and groups

REFERENCES:

1. Samson GLT, Young JRB. Difficult tracheal intubation: a retrospective study. Anaesthesia 1987;42(5):487-490.
2. Rai MR, Dering A, Verghese C. The glidescope system: a clinical assessment of performance. Anaesthesia 2005;60(1):60-64.
3. Cooper RM, Pacey JA, Bishop MJ, et al. Early clinical experience with a new videolaryngoscope (Glide Scope) in 728 patients. Can J Anaesth 2005;52(2):191-198.
4. Macintosh RR. A new laryngoscope. Lancet 1943;1:205.
5. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. Anaesthesia 1984;39(11):1105-1111.
6. Levitan RM, Kinkle WC, Levin WJ, et al. Laryngeal view during laryngoscopy: a randomized trial comparing cricoid pressure, backward-upward-rightward pressure, and bimanual laryngoscopy. Ann Emerg Med 2006;47(6):548-555.
7. Mallampati SR. Clinical assessment of airway. Anesthesiol Cl N America 1995;13(2):301-306.
8. Savva D. Prediction of difficult tracheal intubation. Br J Anaesth 1994;73(2):149-153.
9. Chou HC, Wu TL. Mandibulohyoid distance in difficult laryngoscopy. Br J Anaesth 1993;71(3):335-339.
10. Khan ZH, Kashfi A, Ebrahimkhani E. A comparison of the ULBT (a simple new technique) with modified Mallampati classification in predicting difficult endotracheal intubation. A prospective blinded study. Anesth Analg 2003;96(2):595-599.
11. Patil VU, Stehling LC, Zauder HL. Predicting the difficulty of intubation utilizing an intubation guide. Anaesthesiology 1983;10:32.
12. Arino JJ, Velasco JM, Gasco C, et al. Straight blades improve visualization of the larynx while curved blades increase ease of intubation: a comparison of the Macintosh, Miller, McCoy, Belscope and Lee-Fiberview blades. Can J Anaesth 2003;50(5):501-506.
13. Kulkarni AP, Tirmanwar AS. Comparison of glottic visualisation and ease of intubation with different laryngoscope blades. Indian J Anaesth 2013;57(2):170-174.
14. Sakles JC, Mosier J, Chiu S, et al. A comparison of the C-MAC video laryngoscope to the Macintosh direct laryngoscope for intubation in the emergency department. Ann Emerg Med 2012;60(6):739-748.
15. WHO Expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004;363(9403):157-163.
16. Barak M, Philipchuck P, Abecassis P, et al. A comparison of the TrueView® blade with the Macintosh blade in adult patients. Anaesthesia 2007;62(8):827-831.
17. Su YC, Chen CC, Lee YK, et al. Comparison of video laryngoscopes with direct laryngoscopy for tracheal intubation: a meta-analysis of randomised trials. Eur J Anaesthesiol 2011;28(11):788-795.
18. Miller RA. A new laryngoscope. Anesthesiology 1941;2:317–320.
19. Somchai A, Ungkab P, Phongthara V, et al. Comparison of the clinical use of Macintosh and Miller laryngoscopes for orotracheal intubation by second-month nurse students in anesthesiology. Anesthesiol Res Pract Article ID 432846, 2010;P-5.
20. Wallace CD, Foulds LT, McLeod GA, et al. A comparison of the ease of tracheal intubation using a McGrath MAC® laryngoscope and a standard Macintosh laryngoscope. Anaesthesia 2015;70(11):1281-1285.
21. Wu TL, Chou HC. A new laryngoscope: the combination intubating device. Anesthesiology 1994;81(4):1085–1087.
22. Dalal S, Manohar M. Anticipated difficult tracheal intubation: comparison between conventional laryngoscope (Macintosh) and video laryngoscope true view EVO_2. J Health Res Rev 2015;2(2):66-72.
23. Levitan RM. A new tool for teaching and supervising direct laryngoscopy. Acad Emerg Med 1996;3(1):79-81.
24. Macintosh RR. An aid to oral intubation. Br Med J 1949;1:28.