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A Comparison of Ease of Intubation with Direct Laryngoscopy and Video Laryngoscopy in Patients with Anticipated Difficult Airway

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Abstract

Introduction: Difficult airway remains a frequent cause of anesthesia related morbidity and mortality due to difficulty with tracheal intubation. Around 30% of deaths attributable to anesthesia is mainly due to inability to manage difficult airways. For intubation in cases of difficult direct laryngoscopy many alternatives have been developed such as video laryngoscopes. *Objectives:* To Compare the ease of intubation by direct laryngoscopy and video laryngoscopy in patients with difficult airway. *Outcome variables:* Time taken for intubation, Number of Attempts of laryngoscopy for intubation and Cormack Lehane view. *Methodology:* 100 patients with difficult airway (Mallampatti class III, Upper lip bite test Score II and III, Neck mobility Score III) are divided into two groups of 50 each:

Group A - Video Laryngoscopy group;

Group B - Direct Laryngoscopy group.

Time taken for intubation, number of attempts of laryngoscopy for intubation and glottic view were assessed in both Groups.

Results: The time taken for tracheal intubation was shorter with Direct Laryngoscopy compared with Video Laryngoscopy. Number of attempts for tracheal intubation and laryngoscopic views were better with Video Laryngoscopy than with Direct Laryngoscopy. *Conclusion:* Video Laryngoscopy eases tracheal intubations in patients with difficult intubating conditions. The glottic view for guiding endotracheal tube is significantly improved, with a decreased number of optimizing manoeuvres resulting in a significantly higher success rate of tracheal intubations.

Keywords: Direct Laryngoscopy; Video Laryngoscopy; Cormack Lehane view; Mallampatti class.

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Introduction

The primary responsibility of Anesthesiologist as a peri-operative physician is to safeguard the airway *i.e.* to protect and preserve it during induction, maintenance and recovery from anesthesia. In the event of loss of the airway, prompt management is mandatory before the individual suffers irreversible injury from inadequate or compromised oxygenation. Of the various methods available to secure an airway like orotracheal, nasotracheal and tracheostomy, orotracheal intubation is most commonly used. On occasions when considerable technical difficulty is encountered, orotracheal intubation is attempted under direct vision for securing airway. Unusual anatomic configurations

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may be encountered when the airway itself is difficult. Unanticipated difficult airway remains a frequent cause of anesthesia related morbidity and mortality due to difficulty with tracheal intubation.

Direct laryngoscopy using a Macintosh blade introduced by Sir Robert Macintosh in 1941 remains the standard technique to facilitate tracheal intubation during routine anesthesia.[1,2] However, this method has some limitations.

Aligning the three axes of airway (oral, pharyngeal and laryngeal axes) which is achieved by 'Sniffing the morning air position is needed for successful direct layngoscopy.[3,4] Although "sniffing the morning air position" is successful for intubation in a large number of cases, laryngoscopy may still be difficult due to other causes like anatomical problems. Another limitation is that this view is available only to the laryngoscopist, making it a difficult to train and teach laryngoscopy effectively to novices. Additional manoeuvres such as increased neck flexion, external laryngeal manipulation or the use of gum elastic bougie or stylet are required in most intubations with poor Cormack and Lehane grades and are also often effectively blind. To facilitate intubation in cases of difficult direct laryngoscopy many alternatives have been developed such as video laryngoscopes.

Video laryngoscopes are essentially indirect laryngoscopes and have several advantages like providing a wider viewing angle, showing magnified images on a display screen where they can then be viewed or recorded. All have exactly the same view on the video monitor which allows operator and assistant to co-ordinate their movements when assistance is required. It is not essential to create a line-of-vision by aligning oral, pharyngeal and laryngeal axis.[3,5]

Video laryngoscopes have a specific role in difficult airway scenarios where Macintosh has failed but it remains unclear if intubation success is improved in routine difficult airway management. This study compared the time taken for intubation, success rates for tracheal intubation and Cormack Lehane view with the video laryngoscope and with conventional direct laryngoscopy in patients with anticipated difficult airway.

Materials and Methods

This study was conducted at a tertiary care institution after obtaining approval from Institutional Ethics Committee and written informed consent from the participants.

Study design

Randomised Controlled Trial.

Study population

Patients with ASA Grade I and II, aged *18–65 years*, of both sex scheduled for surgery under general anesthesia, with difficult airway condition.

Inclusion criteria

Patients with difficult airway (Mallampatti Grade III, Upper lip bite test Score II and III, Neck mobility Score III).

Exclusion criteria

Patients below *18 years* of age, patients with huge thyroid swelling, patients with valvular and ischemic heart disease.

Study variables

- Time taken for intubation;
- Number of attempts;
- Glottic view.

Following routine pre-anesthetic check up by the attending anesthesiologist, Patients was categorised using Modified Mallampatti scoring, neck extension and upper lip bite test.

In turn, ease or difficulty of laryngoscopy was assessed while the patient isfully anesthetized.

After establishing venous access, standard monitoring, pre-medication and pre-oxygenation, general anesthesia was induced using propofol (mean dose *2.0 mg/kg*), fentanyl (mean dose *2.0 µg/kg*), and vecuronium (mean dose *0.1 mg/kg*).

After mask ventilation with the patient in the sniffing the morning air position, laryngoscopy was performed with a Macintosh direct laryngoscopy blade or Video laryngoscopy according to the allocation, by an Anesthesiologist who is blinded to the results of pre-operative airway assessment. Glottic view was assessed and noted with either direct laryngoscopy or video laryngoscopy with the Cormack and Lehane classification.

After evaluation, if needed external laryngeal pressure was permitted forendotracheal tube insertion in difficult cases. Time taken for intubation, number of attempts and glottis view on both groups were assessed and recorded.

Statistical Analysis

The collected data were coded and entered into Microsoft excel. Then data was analyzed using SPSS software. Between groups comparison of quantitative variables were analysed by '*t*' test and that of qualitative variables analyzed by Chi-square test.

A '*p*' value of < 0.05 was considered as the level of significance;

A '*p*' value of > 0.05 was considered as not significant.

Results

Table 1: Comparison of sample based on time taken for intubation

Group	n	Time taken for intubation in seconds		t	*p*
		Mean	SD		
Video Laryngoscopy	50	37.82	5.216	2.783	0.006
Direct Laryngoscopy	50	35.18	4.217		

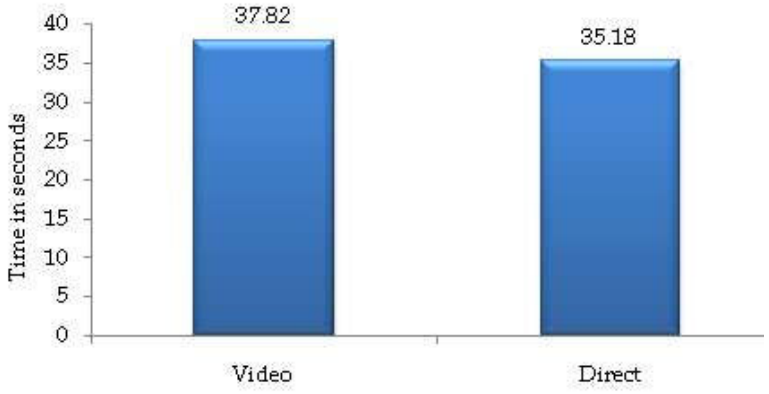
The time taken for tracheal intubation (from opening of the mouth to inflating the cuff) was shorter for Direct Laryngoscopy compared with Video Laryngoscopy, shown as Table 1 and Graph 1.

Number of attempts needed for tracheal intubation with Video Laryngoscopy compared with Direct Laryngoscopy is significantly better. Out of the 50 cases second attempt was need or Video Laryngoscopy only in 5 cases, (Table 2 and Graph 2).

While intubating in difficult airway scenarios Laryngeal manipulations was applied on 10 cases with Video Laryngoscopy, which is significantly better comparing with Direct Laryngoscopy, (Table 3 and Graph 3).

Regarding the Laryngeal view comparing in both Groups, Video Laryngoscopy has significantly better view than Direct Laryngoscopy.

Out of the 50 patients of each Group, Video Laryngoscopy had Grade I Cormack Lehane view on almost more than 95% cases excluding the laryngeal manipulation given for the better view, (Table 4 and Graph 4).



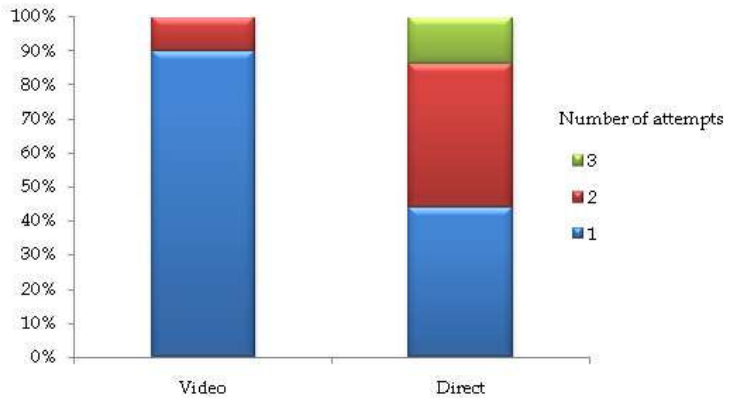
Graph 1: Comparison of Time taken for Intubation

Table 2: Comparison of Number of Attempts needed for intubation

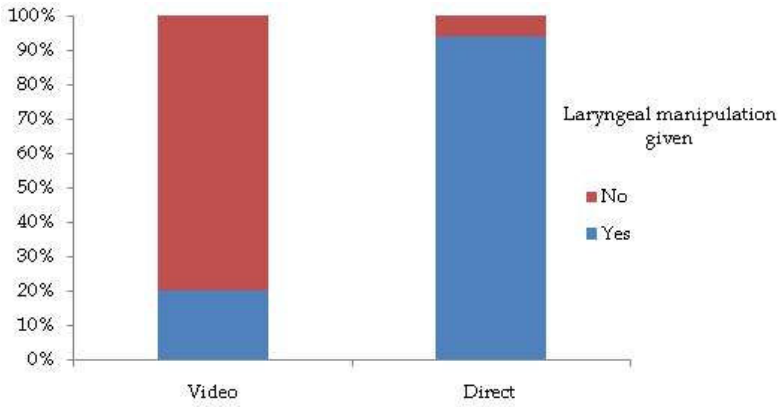
Number of attempts	Device				Total		χ^2	df	*p*
	Video		Direct						
	n	%	n	%	n	%			
1	45	90	22	44	67	67	24.742	2	0
2	5	10	21	42	26	26			
3	0	0	7	14	7	7			
Total	50	100	50	100	100	100			

Table 3: Comparison of Laryngeal manipulation applied on each group

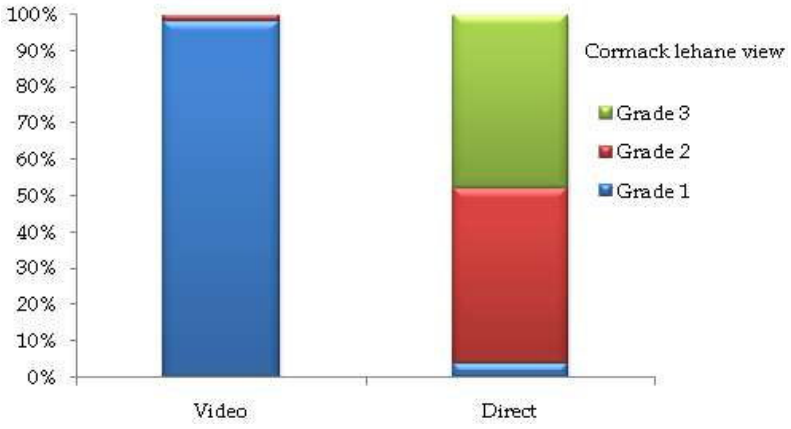
Laryngeal manipulation given	Device				Total		χ^2	df	*p*
	Video		Direct						
	n	%	n	%	n	%			
Yes	10	20	47	94	57	57	55.855	1	0
No	40	80	3	6	43	43			
Total	50	100	50	100	100	100			



Graph 2: Comparison of number of attempts for intubation



Graph 3: Comparison of Laryngeal manipulation given for intubation



Graph 4: Comparison of Cormack Lehane View in both groups

Table 4: Comparison of both groups in terms of Cormack Lehane View

Cormack lehane view	Device				Total		χ^2	df	*p*
	Video		Direct						
	n	%	n	%	n	%			
1	49	98	2	4	51	51	88.474	2	< 0.001
2	1	2	24	48	25	25			
3	0	0	24	48	24	24			
Total	50	100	50	100	100	100			

Discussion

Depending on the management, tracheal intubation in patients with difficult airways can lead to airway trauma or even a life threatening disaster.[2] Therefore, on the one hand, difficult airway management guidelines have been developed, while on the other hand video assisted devices which facilitates easy tracheal intubation have been developed. The rationale behind the development of these devices is to abandon the need for the alignment of the optical axis to receive a direct view of the glottis.[2]

Difficult Airway

Difficult airway is defined as the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with facemask ventilation of the upper airway, difficulty in tracheal intubation or both.[6]

Difficult Laryngoscopy is defined as not being able to visualize any portion of the vocal cords after multiple attempts at conventional laryngoscopy.[7] Difficult laryngoscopy is most commonly defined as presence of a Grade 3 or 4 view on laryngoscopy.

Difficult intubation[7] *is* defined as tracheal intubation requiring multiple attempts in the presence or absence of tracheal pathology.

Failed intubation[7] is failure of placement of the tracheal tube after multiple intubation attempts.

Attempt[7] of intubation is defined as physical placement and removal of the laryngoscope blade.

Anesthesia in a patient with a Difficult Airway (DA) can lead to direct airway trauma and morbidity from hypoxia and hypercarbia which can lead to increased incidence of brain damage, cardiac arrest and death.

The inability to manage a difficult airway is responsible for a large proportion of deaths and morbidity directly attributable to anesthesia.

Table 5: Predictors of difficult Intubation

Criteria	Suggestion of difficult intubation
History of difficult intubation	Positive history
Length of upper incisors	Long
Inter incisor distance	Less than two finger breadths (< 3 cm)
Overbite	Maxillary incisors override mandibular incisors
Temporomandibular joint translation	Inability to extend mandibular incisors anterior to maxillary incisors
Mandibular space	Small, indurated, encroached upon by mass
Cervical vertebral range of motion	Inability to touch chin to chest or extend neck
Thyromental distance	Less than three finger breadth (< 6 cm)
Mallampati-Samsoon classification	Mallampati III/Samsoon IV – relatively large tongue: uvula not visible
Neck	Short, thick

Special situations of difficult intubation include morbid obesity, pregnancy, lingual tonsil hypertrophy, burns, epiglottitis, ludwig's angina and rheumatoid arthritis, (Table 5).

Airway Examination

The airway examination and prediction of intubation difficulty can be assisted by mouth opening, Upper lip bite test, Mallampati classification, Atlanto-occipital joint extension, mandibular space (includes thyromental distance and the horizontal length of the mandible), mento-sternal distance and hyomental distance.

Upper lip bite test — (Fig. 1)

Class 1: Lower incisor can bite upper lip above the vermilion line;

Class 2: Lower incisor can bite upper lip below the vermilion line;

Class 3: Lower incisor cannot bite the upper lip.

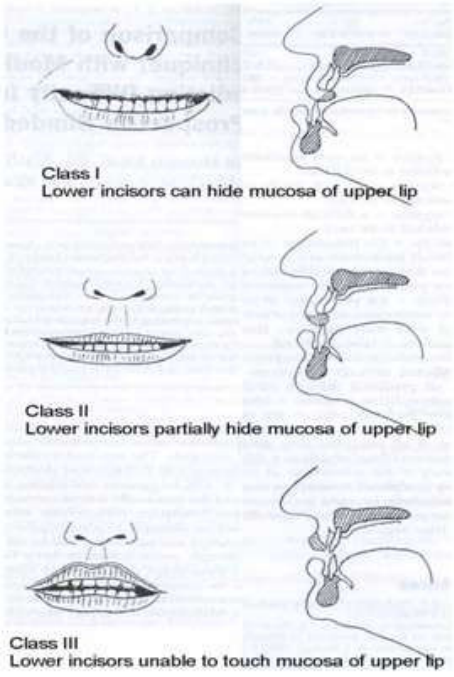


Fig. 1: Upper lip bite (ULB) Test

Modified Mallampatti test

Shown as in (Fig. 2), Mallampatti classification denotes tongue size relative to pharyngeal size. This test is performed with the patient in the sitting position, head in neutral position, the mouth wide open and the tongue protruding to its maximum. Patient should be instructed not to phonate as it can result in contraction and elevation of the soft palate leading to a spurious picture. Classification is assigned according to the extent the base of tongue is able to mask the visibility of pharyngeal structures. There are four classes:

Class I: Visualization of the soft palate, fauces, uvula, anterior and the posterior pillars;

Class II: Visualization of the soft palate, fauces and uvula;

Class III: Visualization of soft palate and base of uvula;

Class IV: Only hard palate is visible. Soft palate is not visible.

To avoid false positive or false negative results, this test should be repeated twice. It is very difficult to measure the size of the posterior part of the tongue relative to the capacity of the oropharynx, this method of assessment gives an indirect means of evaluating their relative proportionality. The exposure of the glottic inlet will be relatively easy, if base of the tongue is proportional to the oropharynx, and there is no other confounding factors. A disproportionately large base of the tongue overshadows the larynx and makes the angle between the two more acute, preventing easy exposure of the larynx.

Fig. 2: Mallampati classification (Class I–IV)

Videolaryngoscopy[8–14]

In recent years, indirect videolaryngoscopy plays an increasingly more important role in the management of patients with an unanticipated difficult airway. Video Laryngoscope intubation blades incorporate optics in their tip used for video imaging on a monitor. The view angle is increased from *15 degrees* during direct laryngoscopy into *60 degrees* during videolaryngoscopy. This distal point of viewing has been proven advantageous in improving glottic view and upgrading of Cormack and Lehane (C and L) grades compared to Direct Laryngoscopy (DL), (Fig. 3).

Fig. 3: Video Laryngoscope

Video laryngoscopes resemble traditional laryngoscopes and have a micro chip embedded in the tip of laryngoscope blade. This transmits magnified images to a display screen where they can then be viewed or recorded. The alignment of the oral, pharyngeal and laryngeal axes for a line-of-sight is not essential for video laryngoscope as the camera is positioned a few millimeter from the vocal cords. This enables the operator to "look around the corners" which previously was not possible with conventional direct laryngoscopy. The laryngoscope tipis inserted into the mouth in the midline, superior to the tongue, and later rotated towards the larynx in a sagittal plane to make the epiglottis visible. The blade is inserted into the mouth under direct vision till the uvula to avoid trauma. After this the operator looks into the screen or the view piece to see the further course of the blade tip and the tube. As in direct laryngoscopy the tip of the video laryngoscope blade is inserted up to the vallecula. For getting glottic view further rotation, and a minimal force may be given along the long axis of the handle, to lift the epiglottis. After getting a good view the endotracheal tube is inserted from the right side of the mouth looking at its tip as far as it is visible directly to avoid trauma. Once out of sight the operator looks in the screen to see the tube tip as it is passed under vision between the cords. The black line can be ascertained to be at the cords. There is a blind spot at which the tube tip cannot be seen. Chances of trauma is there while the endotracheal tube traverses the "blind spot"

after passing through the oral cavity, before being visible on the screen.[15] Confirmation of the correct placement of the tracheal tube should be both visual, and by the use of capnography, (Fig. 4).

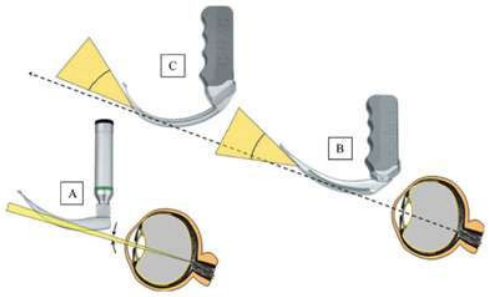


Fig. 4: Angles of different laryngoscopes

A. Direct laryngoscopy **B.** Video Laryngoscopy (60°) with Macintosh blade **C.** C Mac with D blade

Our results show that video laryngoscopy provided an enhanced view of the cords, increased intubation success and slightly increased time for tracheal intubation {from opening of the mouth to inflating cuff} in difficult airway scenarios. Failed intubations in our scenarios we found is most commonly because of maneuvering the endotracheal tube through the vocal cords. It is a technology quickly learned, but requires some practice. We chose the three techniques together to predict the difficult intubations. According to the conclusions of Leopald HJ Eberhart *et al*.[16] single predictors like Modified Mallampatti Score or Upper lip bite Test won't be sufficient enough to correctly predict the difficult airway in all the patients. So, we chose Modified Mallampati Test, Upper Lip Bite Test and Neck Extension Grade all together to predict the difficult airway.

Optimising manoeuvres were the external manipulation of the larynx (BURP manoeuvre), use of gum elastic bougie and changes in head positioning. According to A Jungbauer, M Schumann *et al*., optimizing manouevre needed with Video Laryngoscopy was significantly lower than Direct Laryngoscopy.[2] This lack of experience using video Laryngoscopy may account for the increase in time to intubation.

Though an equal or improved view of the cords are screen, intubation time is increased in neck immobility scenarios in ours as well as other studies.[17–20] One study noted that maneuvering the tube was the barrier to successful intubation, as 14 of 26 the failures in a large series occurred with CL Grade I view.[17] The manufacturer suggests curving the endotracheal tube over a stylet at a *60 degree* angle to match that of the blade.[17] Other suggested methods to ease the procedure include using a more rigid stylet, using a "hockey stick" configuration with *90 degree* distal curvature or rigid stylet with flexible tip.[17,21–23]

During our study, we also find difficulty in guiding the endotracheal tube to the vocal cords, with Cormack Lehane Grade I view. The structures like arytenoid cartilages, the inter-arytenoid soft tissues, anterior commissure of the glottis or the anterior wall of the cricoid cartilage sometimes interfere with guiding the ETT into the trachea.

By regular practice we found the method of insertion through bending the stylet along with the curvature of blade. Later on there was significant reduction in time compared to the earlier cases. Even though our study got Decreased time for Direct Laryngoscopy than Video Laryngoscopy, we found on regular practice with Video Laryngoscope, it not only improved laryngeal exposure and first attempt success rate but also shorten tracheal tube insertion time. In a study by Stroumpoulis[24] the rate of failed intubation using Video Laryngoscopy in 112 patients with predictors of a difficult airway was only 2%. A 99% intubation success rate was reported by Jungbauer and colleagues,[2] in their study in which Macintosh video laryngoscope was used in patients with a Mallampati score of 3 or 4. Kaplan *et al*., found an improvement in laryngoscopic view by video laryngoscopy with a Macintosh blade in 865 unselected patients. They also reported a rate of failed intubation of only 0.3%.[25]

It is more distinct in difficult airway scenarios where the video Laryngoscopes are most beneficient regarding successful intubation. One group of students studied had greater ease of intubation and successful intubation using the Video Laryngoscope in simulated Cormack Lehane Grade III airways.[20] Another study showed that anesthetists using the Video Laryngoscope took less time to intubate, had a slightly higher success rate and found intubation easier in the simulated difficult scenarios (Grade III view) when compared with the Macintosh Laryngoscope in patients with simulated difficult airways by using in-line manual stabilization of the head and neck.[26]

Conclusion

In our opinion Video Laryngoscope will become the "gold standard" for all intubations, not limited to those predicted to be "difficult airway". It is an ideal tool in institutions, Operation Theatres, Emergency Departments and Intensive Care Units for learning and teaching endotracheal intubation.

Video Laryngoscope is far superior to the exclusive 'look over my shoulder' training available with Direct Laryngoscope alone. Additionally, Video Laryngoscope can be used as a research tool in airway management. Hemodynamic responses post Laryngoscopy also significantly decreased with Video Laryngoscopy, because of the first attempt success. Airway trauma related to repeated laryngoscopy is avoided by Video Laryngoscopy. Even though our study shows increases time for Video Laryngoscopy, it may be due lack of experience with the gadget. Regular practice in difficult airway scenarios with Video Laryngoscopy will decreases the time for intubation than that of Direct Laryngoscopy and ultimately this can significantly decrease the anesthesia related morbidity and mortality.

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