Journal of clinical anesthesia (2012.Nov) 24巻7号:561～565.

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A Comparison of the Pentax-AWS Airway Scope® with the Macintosh Laryngoscope for Nasotracheal Intubation. A randomized, prospective study.

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Running title Pentax-AWS Airwayscope for Nasotracheal intubation

Key Words Pentax-AWS Airway Scope, Nasotracheal Intubation, Difficult airway

Presentation: Presented, in part, in an annual meeting of American Society of Anesthesia at Orlando, 2008.

Conflict of interest: None
Supports and Grants: Study was fully covered by the departmental budget

Abstract 247 words

Manuscript 1678 words

3 figures & 1 table

Abstract

【Study objectives】: To evaluate the effectiveness of the Pentax-AWS Airway scope (AWS: HOYA, Tokyo) in comparison with the Macintosh laryngoscope during nasotracheal intubation.

【Design】 Prospective, randomized study

【Setting】 Operating room in university affiliated hospital.

【Patients】 90 ASA physical status I and II adults, aged 18 to 72 years, scheduled for orthodontia surgery and requiring nasotracheal intubation.

【Interventions】 Patients were randomly assigned to undergo tracheal intubation using a Macintosh (group Mac, n=30), or AWS with its tip inserted into the vallecula to indirectly elevate the epiglottis(group AWS-I, n=30), or AWS with its tip positioned posterior to the epiglottis for direct elevation of the epiglottis (group AWS-D, n=30).

【Measurements】 Percentage of glottic opening (POGO) score at the time of laryngeal exposure, time for intubation and intubation difficulty scale (IDS) were measured. The frequency of postoperative sorethroat and hoarseness were noted.

【Main Result】: Patient demographics were not different between the groups. Both the AWS-I and AWS-D significantly reduced the intubation difficulty score, and significantly improved the POGO when compared to the group Mac. Time to place the ETT was significantly shorter in group AWS-I. In one case from each group intubation within 2 attempts failed and a different approach was required.

【Conclusion】: The AWS offers better intubation conditions than the Macintosh laryngoscope during nasotracheal intubation. The AWS can be used to elevate the epiglottis both directly and indirectly for nasotracheal intubation.

Introduction

The Pentax-AWS Airway Scope (AWS, HOYA, Tokyo, Japan) is a new channeled rigid indirect video-laryngoscope[1]. Nasotracheal intubation with the AWS can be performed not only in patients undergoing maxillofacial surgery but also in patient with difficulty with tracheal intubation. There have been only a few anecdotal reports of successful nasotracheal intubation using the AWS in patients after failed orotracheal intubation with the Macintosh laryngoscope, or the AWS [2-4]. As with the oral intubation, the AWS may provide better intubation conditions for nasotracheal intubation compared to the conventional Macintosh laryngoscope. We evaluated whether the AWS provides better laryngeal views and intubation profiles compared to the Macintosh laryngoscope in patients requiring nasotracheal intubation.

The standard AWS technique for orotracheal intubation involves direct elevation of the epiglottis. We have reported that the indirect elevation technique frequently results in failure to advance the tube through the channel during orotracheal intubation [5], and this technique is only effective under certain circumstances [6,7]. The best technique of epiglottic elevation for nasotracheal AWS intubation has not been studied. As the channel is not necessary for nasotracheal AWS intubation, the optimal technique may be different from that of oral intubation. The secondary endpoint of this study is to determine whether direct or indirect elevation of the epiglottis is the better technique for laryngeal exposure for nasotracheal AWS intubation.

Material and Methods

The protocol was approved by the Asahikawa medical university research ethics committee, and written informed consent was obtained from 90 unpremedicated ASA I – II patients aged over 18 years scheduled for elective orthodontia surgery, which required general anesthesia with nasotracheal intubation. Exclusion criteria included a history of cervical spine injury, difficult airway, gastro-esophageal reflux disease, or body mass index >35 kg.m-2. Mallampati classification without phonation and thyromental distance were evaluated before surgery and recorded in all patients.

Immediately prior to induction patients were randomly assigned into three groups by the sealed envelope technique. Patients in group Mac underwent nasotracheal intubation with the Macintosh laryngoscope. In group AWS-I, AWS was used and its blade tip was inserted into the vallecula to “indirectly” elevate the epiglottis for laryngeal exposure. In group AWS-D, AWS was used and its tip was positioned posterior to the epiglottis for “direct” elevation **[figure1]**. The latter technique is recommended for standard orotracheal intubation by the manufacturer. Endotracheal tubes (ETT) used were cuffed nasotracheal Portex directional tracheal tube (ID 6.5 mm for females women and 7.0 mm for man).

Patients were placed in the supine position with their head on a ring shaped pillow, breathing 100% oxygen for 3 minutes. Induction of anesthesia was performed with propofol (1.5-2.0 mg/kg) and fentanyl (1 μg/kg) intravenously. After loss of consciousness, confirmed by loss of eyelid reflex, positive pressure mask ventilation was initiated. Anesthesia was then maintained with sevoflurane (3-5%) with oxygen. Once adequate mask ventilation was established, vecuronium (0.1mg/kg) was administered. After developing complete paralysis, laryngoscopy was performed in all patients with the Macintosh laryngoscope. The operator was allowed to change the patient’s head and neck position, if necessary in order to achieve the best laryngeal view, as evaluated by percentage of glottic opening (POGO) [8]. External laryngeal manipulation was not applied during the laryngeal evaluation with Macintosh laryngoscope. After initial evaluation of the Macintosh laryngeal view, a lubricated ETT was inserted halfway into right nostril. Laryngoscopy with the randomly allocated device was then performed and POGO was again evaluated. With gentle rotation and advance/withdraw manipulation, the ETT was advanced into the trachea under vision until the depth marker was at the level of the vocal cords. The time for intubation, defined as the time taken from the blade passing the incisors until passage of the ETT was completed, was recorded. To evaluate the ease of intubation, intubation difficulty scale (IDS) score was recorded. The IDS score [9] is a quantitative scale of intubation difficulty that can objectively compares the complexity of tracheal intubations and appears be an excellent global measure of intubation difficulty [10].

When any of the following situations occurred, the AWS was removed and mask ventilation employed: i) If the SpO_2 fell below 95% during the procedure. ii) The view was inadequate due to fogging or secretions.

If the tracheal tube could not be placed at an ideal depth within 2 attempts, the operator was allowed to use the best available technique for them to achieve successful intubation. If ventilation proved impossible, placement of LMA Fastrach® was recommended.

Statistics:

We based our sample size estimation on the IDS score. The IDS score=0 represents ideal intubating conditions. As the score increases, it represents the more difficult intubating conditions. Based on the pilot data, we projected an IDS score of ≥ 1 in 50% of patients with the Macintosh laryngoscope. We considered that a clinically important reduction in the number of patients with an IDS score greater than zero in the patients would be a 50% absolute reduction, i.e. an IDS score of ≥ 1 in 25% of patients. Using an $\alpha = 0.05$ and $\beta = 0.2$, for an experimental design incorporating three equal-sized groups, we estimated that 29 patients would be required per group. We therefore aimed to enroll 30 patients per group.

Data for the IDS score was analyzed using the Kruskal-Wallis with post hoc (Dunns) test. For comparisons of POGO and intubation time between groups, one-way ANOVA, with post hoc (Scheffe) test.

Results

Patient profiles were not different among the groups**[table 1]**. In three cases (one case in each group), intubation was not completed within 2 attempts. Initial laryngeal view（POGO） with the Macintosh laryngoscope was not different between groups. At the time of intubation, POGO scores were significantly higher in both AWS-D (84±16%) and AWS-I(69±24%) compared to the group Mac(50±30%, $p<0.01$). Time to place the ETT was significantly shorter in group AWS-I （15±5 sec） compared to group AWS-D (28±12 sec, $p<0.01$) and Mac （26±11 sec, $p<0.05$） **[figure2]**. IDS was significantly higher in group Mac($p<0.05$) **[figure 3]** .

Discussion

The AWS has been shown to provide better laryngeal view and intubating conditions than the conventional Macintosh laryngoscope for orotracheal intubation [11]. In the current study, the AWS significantly reduced the IDS score, confirming better intubating conditions than those achieved with the Macintosh laryngoscope for nasotracheal intubation. This is the first randomized prospective study to show the effectiveness of the AWS for nasotracheal intubation.

The AWS is a channeled rigid indirect video laryngoscope. The tube channel provides reliable intubation for orotracheal intubation, but it is not used for nasotracheal intubation. In nasotracheal intubation, the ETT is inserted towards the glottis through the nostril in all groups. Therefore, the AWS facilitates nasotracheal intubation as a consequence of the camera system and anatomically shaped blade. The airway visualization technology used with the AWS is similar to other rigid indirect optical devices, such as Glidescope [12,13] or Airtraq [14], and all improve intubating condition compared to the conventional technique which require direct visualization of the glottis.

We also evaluated the direct or indirect elevation of the epiglottis for nasotracheal AWS intubation. Although the manufacturer's manual recommends direct elevation of the epiglottis as the standard AWS technique for oral intubation [14], our results show that the AWS can be used in both ways for nasotracheal intubation. When direct elevation (group AWS-D) was used the view was significantly improved and intubation time was similar to the Macintosh blade. When indirect elevation (group AWS-I) was used, intubation was performed under improved view and intubation time was reduced. The indirect elevation technique may be beneficial in emergency situations, but is required infrequently in routine anesthesia, since there were no cases in which the SpO2 fell to below 95% in both groups Mac and AWS-D.

There were three cases of failure to complete intubation within two attempts. One case in the Mac group required assistance with Magill forceps to place the ETT at the third attempt. In one case in the AWS-D group, ETT could not be advanced towards the center of the glottis, but impinged onto the right arytenoid. The reason of this misdirection was probably that the back plate of the tube channel obstructed ETT advancement towards the trachea. A rigid indirect laryngoscope without a guide (as the Airtraq® guideless, Prodol, Vizcaya, Spain) seems to be ideal for nasotracheal intubation, but such a blade is not commercially available for the AWS. In this case, the ETT was smoothly inserted into the trachea with indirect elevation technique of the epiglottis at the third attempt. In one case in the AWS-I tube was impinged onto the epiglottis under 30 % POGO score view. At the third attempt, the epiglottis was directly elevated, and ETT was safely inserted under condition of 90% POGO score.

When a channel is used for orotracheal intubation, the tube is delivered only a few mm posterior to the laryngoscope tip and an epiglottis which cannot be completely elevated by the indirect technique may impede advancement of the ETT. In the case of nasotracheal intubation, the tube is delivered more posteriorly in the pharynx and positioning of the laryngoscope close to the anterior commissure of the vocal cords with direct elevation of the epiglottis may allow insufficient room for manipulation of the ETT towards the glottis.

There are limitations of this study. Only patients having normal airway anatomy were studied. We only evaluated nasotracheal intubation through the right nostril. The AWS blade is designed for insertion of the ETT from the right side. Therefore, results may be different if the left nostril is used. Further study to evaluate the effectiveness of the AWS for nasotracheal intubation should be conducted.

In conclusion, the AWS offers better laryngeal views compared to the Macintosh laryngoscope during nasotracheal intubation. During nasotracheal intubation, the AWS blade tip is inserted either into the vallecula or posterior to the epiglottis for laryngeal exposure. Indirect elevation offers faster, reliable intubation with better laryngeal exposure compared to the Macintosh laryngoscope. Although direct elevation of the epiglottis provides the best laryngeal exposure, there may be a risk that the tube channel impedes the ETT advancement. Therefore, both techniques may be complementary.

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Table and Figure legends

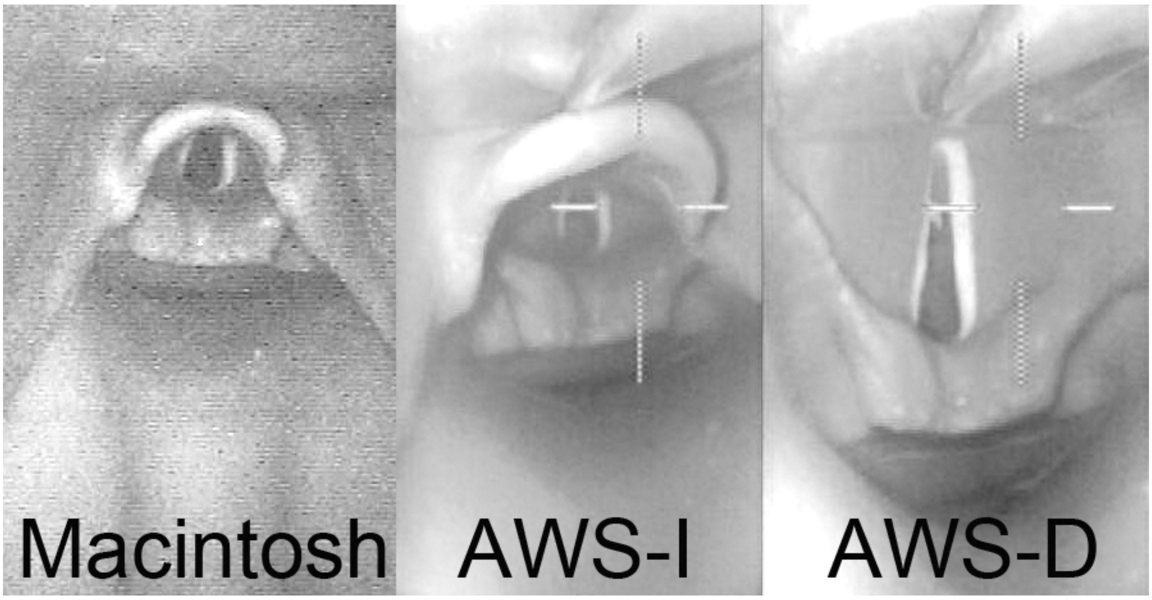
Table 1. Demographic characteristics of patients.

	Macintosh (N=30)	AWS-Indirect (N=30)	AWS-Direct (N=30)	Statistics
Age (yrs)	37±17	35±15	36±15	NS
Height (cm)	162±9	161±8	161±7	NS
Weight (kg)	59±12	56±10	57±11	NS
Mallampati class (I / II / III / IV)	23/7/0/0	23/6/1/0	24/5/1/0	NS
TMD (cm)	7.0±0.8	6.9±1.2	6.8±1.1	NS
Initial POGO (%) with Macintosh	51±31	48±34	49±32	NS

Data are shown as mean ± SD.

TMD: Thyro-mental distance. POGO: Percentage of glottic opening.

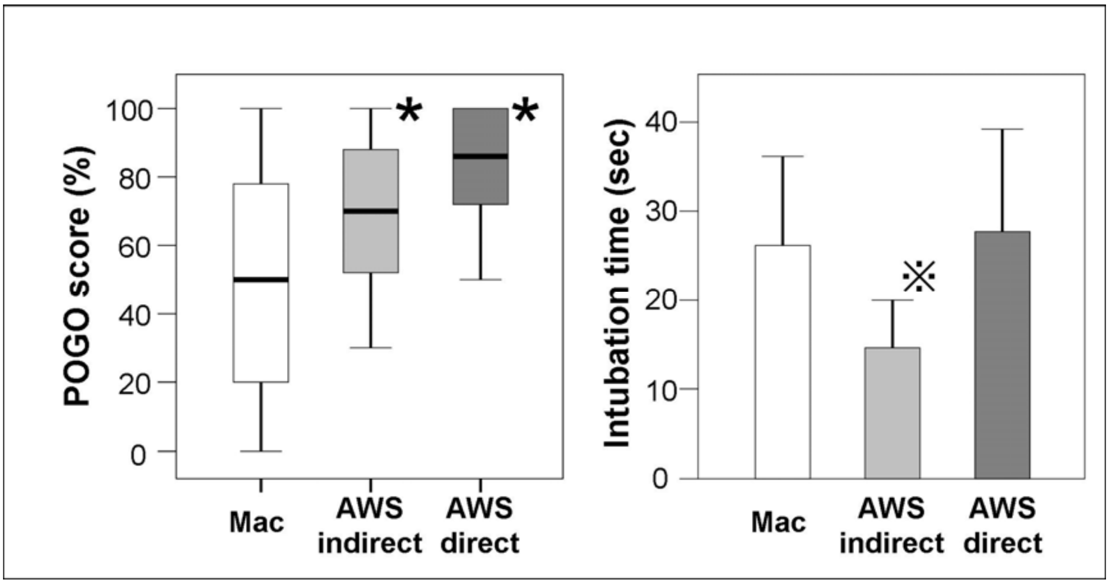
[Figure 1]



Laryngoscopic techniques used in this study are depicted.

Left: Macintosh laryngoscope was used in a standard manner. Blade tip was inserted into the vallecula to obtain the view. Intubation was performed under direct visual control.
Center: In AWS-indirect group, blade tip was also inserted into the vallecula. Intubation was performed using the camera and the display.
Right: In AWS-Direct group, blade tip was inserted behind the epiglottis. This technique recommended for oral tracheal intubation.

[Figure 2]



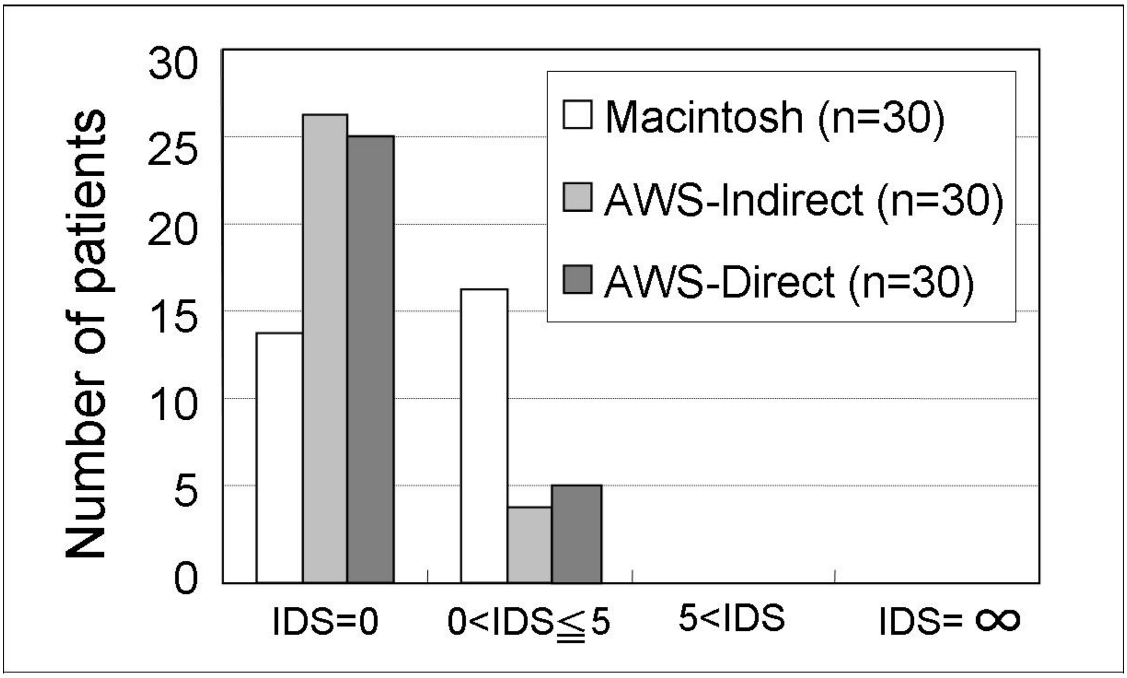
Left panel: Comparison of POGO score between groups Mac, AWS-I, and AWS-D.

POGO scores were significantly improved in both the AWS-I and AWS-D groups compared to the Mac group.Box indicates interquartile range, and the whisker indicates the range.

Right panel: Comparison of intubation time between groups Mac, AWS-I, and AWS-D.

Intubation time in the AWS-I group was significantly shorter than those in the Mac and AWS-D groups. Box top indicates mean, and the whisker indicates the standard deviation..※$p<0.05$ compare to the other group.

[Figure 3]



Comparison of the intubation difficulty scale (IDS) between 3 groups.

IDS was significantly higher in group Mac compared to AWS groups ($p<0.05$).