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Original Contribution

# Pentax Airway Scope AWS-S200 video laryngoscope for child tracheal intubation in a manikin study with 3 airway scenarios☆,☆☆,★

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ABSTRACT

*Background:* Endotracheal intubation is considered a criterion standard for securing the airway during cardiopulmonary resuscitation, yet it requires a very skillful operator. The aim of the study was to investigate whether paramedic staff can successfully use the Pentax Airway Scope AWS-S200 video laryngoscope (AWS) for intubating with 3 simulated airway scenarios.

*Methods:* It was a randomized nonblinded crossover simulation trial. Fifty-four paramedics performed intubation using an AWS in a manikin, with 3 airway scenarios: scenario A, normal airway; scenario B, normal airway with chest compression (CC); and scenario C, difficult airway with CC.

*Results:* Median intubation times for the AWS during scenarios A, B, and C were 20 seconds (interquartile range [IQR], 19-23 seconds), 22 seconds (IQR, 20-25 seconds), and 26 seconds (IQR, 23-29 seconds), respectively, and the respective overall success rates of intubation were 100%, 100%, and 94.4%.

*Conclusion:* In this manikin study, paramedics could successfully intubate using the AWS, regardless of CCs being interrupted or not, even when a patient's airway was difficult.



## 1. Introduction

Airway management is crucial for medical support of the patient with a compromised respiratory status both inhospital and out-of-hospital settings. In the prehospital setting, Stringer et al [1] reported that inadequate airway management was the primary cause of preventable mortality. Making sure an appropriate ventilation is secured is particularly important in children, where respiratory failure is the main cause of cardiac arrest. Ensuring adequate airway management and adequate oxygenation of the patient is a key element of cardiopulmonary resuscitation (CPR). The 2010 guidelines of the European Resuscitation Council and the American Heart Association recommend that CPR should be performed with the shortest possible intervals between chest compressions (CCs), yet the criterion standard procedure to secure adequate airway management is endotracheal intubation [2,3]. Thus, the patient should be intubated the soonest and fastest possible, without stopping CCs whenever the operator's skill permits (with a short interruption when the intubation tube is inserted through the vocal cords).

Securing the airway patency with an endotracheal tube is associated with numerous advantages. The most important of them is the possibility to perform the so-called asynchronous resuscitation, owing to which there is no need to stop CCs during resuscitation [4]. This is particularly important in view of the fact that survival of cardiac arrest victims is directly associated with the quality of CPR. Among factors that determine this quality, minimizing interruptions of CC seems to be of great significance. The use of an intubation tube allows positive end-expiratory pressure and carbon dioxide to be monitored.

In practice, child intubation using direct laryngoscopy during CPR can cause many problems for medical rescue teams, when the help of an experienced anesthetist is not available. Gerritse et al [5,6] reported that the effectiveness of child endotracheal intubation in prehospital conditions performed by paramedics using a standard laryngoscope was insufficient and ranged from 63.4% to 77%. Consequently, the question arises how to improve the effectiveness of child intubation performed by paramedics in prehospital conditions. A helpful option may be novel techniques of intubation, including video laryngoscopes, for example, Pentax Airway Scope AWS-S200 video laryngoscope (AWS) (Pentax Europe GmbH, Hamburg, Germany; Fig. 1)—the successor of

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**Fig. 1.** Pentax Airway Scope AWS-S200 video laryngoscope with PBLADE.

Pentax Airway Scope S100. The new thing in the AWS-S200 is a marker on the screen, which makes intubation easier for an inexperienced person. S200 also has a 30-megapixel high-definition color LCD (2.4 in. providing vivid images of the larynx and glottis. In addition, it is possible to connect the Airway Scope to medical monitors or video recording devices.

Paramedics as emergency medical service team members are often involved in the initial management of out-of-hospital cardiac arrest. Therefore, their role in CPR is of great importance. The ability to provide adequate ventilation is among the essential skills of paramedics, and the use of laryngoscope devices for emergency airway management by paramedics is common in some countries. The aim of our study was to investigate whether paramedic staff would be able to intubate successfully using the AWS during CPR in normal and difficult airways.

## 2. Methods

### 2.1. Study and participants

This randomized controlled crossover trial was approved by the institutional review board of the International Institute of Rescue Research and Education (approval 17.2015.02.26, March 1, 2015; Warsaw, Poland). Written informed consent was obtained from the study participants. Study enrollment occurred from March 3, 2015, to April 1, 2015.

We conducted a randomized crossover trial comparing the effects of the AWS with PBLADE (M-ITL-PL PEDIATRIC) on intubation parameters including time to intubation (TTI) and number of intubation attempts in a manikin study with 3 airway scenarios. Once each had given written informed consent, 54 volunteer paramedics were recruited who met the following inclusion criteria: (1) they had performed less than 100 clinical (human) intubations by direct laryngoscopy and (2) they had received no training in endotracheal intubation using video laryngoscopy including AWS laryngoscope before the study.

### 2.2. Scenario simulation

Each participant performed endotracheal intubation using a PediaSIM CPR manikin (FCAE HealthCare, Sarasota, FL), which represents a 6-year-old child. The intubation was performed in 3 scenarios:

1. Scenario A: normal respiratory tract. In each scenario, the manikin was placed on a floor in a neutral position in a bright room. Elevation of the head or the upper body was not allowed.
2. Scenario B: normal respiratory tract with CCs. Chest compressions were carried out with the Lucas-2 chest compression system (Physio-Control, Redmond, WA). Chest compressions were performed according to the European Resuscitation Council guidelines: frequency, 100 per minute; depth, 40 to 50 mm.
3. Scenario C: difficult respiratory tract, with simultaneous CCs carried out by the Lucas-2 system. The difficult airway was created by tongue edema to generate a Mallampati grade 3. Tongue edema was simulated by inflating the tongue with a pressure of 110 mm Hg.

All intubations were performed with an intubation tube on a manikin (size 5.5 ID; Portex, Smiths Medical, Ashford, UK). Lubricant was already applied to the tracheal tube, and a 10-mL syringe to block the tube's cuff and an Ambu resuscitator bag (Ambu, Copenhagen, Denmark) were readily available and within the participant's reach.

### 2.3. Pretest training

All participants completed a 45-minute training session led by an anesthesiologist with extensive experience in airway management, including an introduction to the anatomy and physiology of the pediatric airway and the endotracheal intubation (ETI) techniques using the AWS. After the session, the participants were given 10 minutes to practice ETI with laryngoscope on the manikin at rest.

### 2.4. Study protocol

The study was designed as a randomized nonblinded crossover simulation trial. The Research Randomizer program was used (www.randomizer.com) to split the volunteers into 3 groups and to determine the order of intubation scenarios and the order of participants (Fig. 2). Group 1 performed intubation according to scenario A; group 2, according to scenario B; and group 3, according to scenario C. After carrying out intubation, the participants had a 10-minute break before going on to perform intubation according to another scenario. A participant had no more than 3 attempts to intubate in each scenario. The participants were not allowed to watch each other during any of the intubation attempts to avoid any learning effects throughout the procedure.

### 2.5. Measurements

Before they attempted to carry out intubation, the participants were informed that the patient needed to undergo emergency endotracheal intubation, to give them a certain feeling of time pressure that would have been present in a real scenario.

The primary outcome of the study was the TTI, and the secondary outcome was the success rate of intubation. The time started to run when a participant took a laryngoscope into his/her hand and stopped when the appropriate position of the tube was confirmed by the fact that it was possible to ventilate with a bag valve mask and by the movements of the chest and the abdomen. To know the subjective opinion about the difficulty of each intubation method, the participants were asked to rate it on a visual analog scale (VAS) with a score from 1 (extremely easy) to 5 (extremely difficult).

### 2.6. Statistical analysis

Statistical package Statistica version 12 for Windows (StatSoft, Inc, Tulsa, OK) was used. $P < .05$ was considered as statistically significant. Times needed to successful intubation were compared using the Wilcoxon signed rank test. To detect possible differences in success rates for ETI, the McNemar test was used. For comparisons of VAS, 1-way analysis of variance, with post hoc (Scheffé) test, was used. Results are shown as median and interquartile range (IQR), mean ± SD, or absolute numbers and percentages (%).