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Respiration and the Airway

Comparison of the paediatric blade of the Pentax-AWS and Ovassapian airway in fibreoptic tracheal intubation in patients with limited mouth opening and cervical spine immobilization by a semi-rigid neck collar: a randomized controlled trial

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Abstract

Background. We compared the performances of the paediatric blade of a Pentax Airway Scope and an Ovassapian airway in fibreoptic tracheal intubation in patients whose necks were stabilized by semi-rigid neck collars.
Methods. Ninety patients were enrolled in this prospective, open-label, randomized controlled trial. Patients were randomly allocated to one of two groups (Group OVA-FOB and Group AWS-FOB). The time to tracheal intubation, success rate of tracheal intubation, number of optimization manoeuvres (jaw thrust), and difficulty of manipulation of the fibreoptic bronchoscope were compared between the groups.
Results. The time to tracheal intubation was significantly shorter (32 *vs* 50 s; median difference 19 s; 95% confidence interval 14–25 s; $P<0.001$) and manipulation of the fibreoptic bronchoscope was significantly easier for Group AWS-FOB. Optimization manoeuvres were rarely required to facilitate fibreoptic tracheal intubation in Group AWS-FOB [jaw thrust, 0 (0%); jaw thrust with anterior neck collar removal, 1 (2%)] compared with that required in Group OVA-FOB [jaw thrust, 39 (87%); jaw thrust with anterior neck collar removal, 2 (4%)]. There was no significant difference in the success rate of tracheal intubation on the first attempt between groups [Group AWS-FOB, 45 (100%); Group OVA-FOB, 44 (98%)].
Conclusions. Combined use of the paediatric blade of a Pentax Airway Scope and a fibreoptic bronchoscope enabled rapid tracheal intubation, minimizing the use of external manoeuvres of the airway, in patients with limited mouth opening and cervical spine immobilization by semi-rigid neck collars, compared with use of the Ovassapian airway and the fibreoptic bronchoscope.
Clinical trial registration. NCT02827110.

Key words: airway management; bronchoscopes; laryngoscopes

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Editor's key points

- Fibreoptic tracheal intubation may frequently be difficult in patients with restricted neck movement, and the use of an insertion aid may facilitate intubation.
- Comparison in the ease of fibreoptic tracheal intubation was made between the use of an Ovassapian oral airway and a Pentax Airway Scope (with a blade of paediatric size) as an insertion aid.
- The Pentax Airway Scope (with a blade of paediatric size) was more useful than the Ovassapian oral airway in facilitating fibreoptic tracheal intubation in patients with restricted neck movement.

The presence of a neck collar has been associated with decreased mouth opening[1 2] and worsening of direct laryngoscopic view, consequently reducing the success rate of tracheal intubation.[3] In such situations, fibreoptic tracheal intubation is a reliable method to obtain a high success rate of tracheal intubation and minimize cervical spine movement.[4] Under general anaesthesia, the loss of pharyngeal muscle tone reduces the oropharyngeal space for passage of the fibrescope and makes it difficult to maintain the fibrescope in the midline while advancing its tip into the pharynx and the laryngeal inlet.[5–7] Moreover, fibreoptic tracheal intubation becomes difficult when the head and neck are stabilized.[8] The Ovassapian airway is one of the specific airways designed for making the oropharyngeal space open and introducing the fibrescope in the midline of the oropharynx.[9] Despite the use of this airway, partial or total obstruction of the fibreoptic view is frequent,[10] and the active application of a jaw thrust manoeuvre is required in patients with neck stabilization.[9]

Recently, there have been several reports on the combined use of a fibrescope and a video laryngoscope.[5 11–17] Among the various types of video laryngoscopes, the channel of the Pentax Airway Scope (Pentax-AWS; Pentax Corporation, Tokyo, Japan) can be used for the passage of a fibrescope into the glottic inlet. However, as the channel was originally designed for a tracheal tube, an adult-sized blade is bulky for insertion; there is poor manoeuvrability (multiple attempts) and a reported failure rate of 17–30% with limited mouth opening.[18–23] As a paediatric-sized blade is thinner, it would be easier to insert into the mouth and have better manoeuvrability in a narrow oropharyngeal space than the adult-sized blade. Moreover, when combined with the use of a fibrescope, the optimal position might be non-essential, thereby reducing the attempts for positioning.

We hypothesized that, in patients with semi-rigid foam neck collars under general anaesthesia, the combined use of the paediatric blade of the Pentax-AWS and a fibreoptic bronchoscope would allow quicker tracheal intubation and require fewer external manoeuvres of the airway to facilitate intubation compared with the use of an Ovassapian airway and the fibreoptic bronchoscope.

Methods

This study was a single-centre, prospective, open-label, randomized controlled superiority trial with two parallel groups. The study protocol was approved by the Institutional Review Board of Ajou University Hospital (Suwon, South Korea) and was registered with ClinicalTrials.gov (NCT02827110). We recruited patients from Ajou University Hospital in Suwon, South Korea from June 2016 to December 2016. Patients with ASA physical status class I or II, aged 20–65 yr, and undergoing robot-assisted or laparoscopic cholecystectomy were eligible for inclusion. Patients with histories of cardiopulmonary, gastrointestinal, or upper airway disease, increased risk of pulmonary aspiration, BMI>30 kg m^{-2}, or poor dentition were excluded. Written informed consent was obtained on the day before surgery. Before induction of anaesthesia, the patients were randomly assigned in a 1:1 allocation ratio to one of two groups (Group OVA-FOB and Group AWS-FOB) by computer-generated codes that were maintained in sequentially numbered, sealed, opaque envelopes.

All patients received standardized general anaesthesia, including electrocardiography, non-invasive monitoring of blood pressure, pulse oximetry, capnography, and measurement of volatile anaesthetic concentrations. After preoxygenation with a tight-fitting mask for 3 min, anaesthesia was induced with fentanyl (2 μg kg^{-1}) and thiopental sodium (4 mg kg^{-1}). After loss of consciousness, manual ventilation by mask was undertaken with sevoflurane (end-tidal concentration, 2–3%) in oxygen, and rocuronium (0.6 mg kg^{-1}) was injected. Ninety seconds after rocuronium injection, neck circumferences, mouth opening (inter-incisor distance), and modified Cormack–Lehane grade by direct laryngoscope[24] were measured. After the appropriate size of the semi-rigid foam neck collar (Philadelphia cervical collar) was positioned around the neck according to the manufacturer's recommendations, the measurements of the mouth opening and modified Cormack–Lehane grade were repeated. Tracheal intubation was then performed using one of the study devices with a standard bevelled Portex® tracheal tube (Smiths Medical, Hythe, UK; males, 8.0 mm internal diameter, 10.9 mm outer diameter; females, 7.0 mm internal diameter, 9.6 mm outer diameter). A flexible fibreoptic bronchoscope (PortaView® LF-GP; Olympus Optical Company, Tokyo, Japan) with an outer diameter of 4.1 mm was used. The paediatric blade of the Pentax-AWS was used. The acceptable outer diameter of the tracheal tube was 5.5–7.6 mm without a cuff.

In all Group OVA-FOB participants, the Ovassapian airway was inserted before insertion of the flexible fibreoptic bronchoscope. In Group AWS-FOB, an anaesthetist inserted the paediatric blade of the Pentax-AWS into the patient's pharynx to obtain a laryngeal view on the video screen and held it in place. If elevation of the epiglottis was easily obtained in a single advancement attempt, it was maintained while introducing the fibreoptic bronchoscope. If the epiglottis could not be elevated in one attempt because the paediatric blade was too short, we did not attempt to elevate the epiglottis and instead introduced the fibreoptic bronchoscope through a tube channel of the paediatric blade of the Pentax-AWS. In these instances, we maintained the position of the paediatric blade without applying a ventral (lifting) force to prevent impediment of the bronchoscope resulting from contact between the tip of the fibreoptic bronchoscope passing through the tube channel of the paediatric blade of the Pentax-AWS and the posterior portion of the tongue.

In both groups, if the fibreoptic view during advancement was insufficient (i.e. not clear) or the advancement of the fibreoptic bronchoscope into the laryngeal inlet was difficult to perform, jaw thrust was requested. If difficulty in the advancement of the fibreoptic bronchoscope into the laryngeal inlet was encountered even after jaw thrust, we removed the anterior portion of the neck collar and performed jaw thrust at once. When the tip of the fibreoptic bronchoscope was positioned