Original contribution

Wire-guided catheter exchange after failed direct laryngoscopy in critically ill adults

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Received 23 June 2008; revised 11 February 2009; accepted 23 February 2009

Keywords: Airway management; Difficult airway; Critical care; Adults; Wire-guided catheter exchange

Abstract

Study Objective: To describe a technique for tracheal intubation after failed direct laryngoscopy using a Laryngeal Mask Airway (LMA) to secure the airway and to establish ventilation, and as a conduit for fiberoptic intubation utilizing a pre-packaged, convenient, and commercially available wire-guided catheter exchange kit.

Design: Retrospective case series.

Setting: University hospital.

Measurements: The cases of 5 critically ill adult patients who required intubation for respiratory failure, and in whom direct laryngoscopy was unsuccessful and unanticipated, were reviewed. Difficult intubation was defined as ≥ two attempts by direct laryngoscopy and use of an airway adjunct/alternate airway device, or ≥ three attempts by direct laryngoscopy. Occurrence of hypotension, hypoxemia, and the time required to accomplish the intubation were recorded.

Main Results: Patients’ tracheas were intubated in the emergency department (n = 2), the intensive care unit (n = 2), and the radiology department (n = 1). An Eschmann endotracheal tube (ETT) introducer was used in 4 of the 5 patients, and a GlideScope was used in the fifth patient. After failed direct laryngoscopy, an LMA Classic was inserted to gain an airway, after which a fiberoptic bronchoscope and wire-guided catheter exchange set was used to change the LMA to a conventional ETT. Ventilation was maintained via the LMA with an attached bronchoscope adapter throughout the procedure.

Conclusions: In all 5 patients, the trachea was successfully intubated within three minutes on the first attempt, using a wire-guided exchange, without hypoxemia or hypotension.

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1. Introduction

Tracheal intubation is a common and essential procedure performed in the critical care setting. However, airway management outside of the operating room (OR) in general, and in the critically ill in particular, is different from routine intubation performed in the OR. Dubbed the “critical airway” [1], these intubations are distinguished from routine intubation by their timing, indication, margin of safety in cases of unanticipated difficult airway, patient’s physiologic reserve, availability of equipment, and expertise of assisting personnel. Insofar as 50% to 70% of critically ill patients require intubation for ongoing, life-threatening hypoxemia or shock [2-4], and traditional preoxygenation may be minimally effective [5], inability to secure the airway in this circumstance may be catastrophic.

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Use of a Laryngeal Mask Airway (LMA) as a conduit for fiberoptic endotracheal tube (ETT) placement by modified Seldinger technique in this setting is not new. However, currently reported techniques are limited by the size of the fiberoptic bronchoscope (FOB) [6] that can be used or the immediate availability of appropriate equipment designed for this use [7-10]. We describe a method of orotracheal intubation after failed direct laryngoscopy using an LMA Classic (LMA North America, Inc., San Diego, CA, USA) as a conduit for FOB to facilitate the use of a pre-packaged, commercially available, wire-guided airway exchange catheter set (Cook Critical Care, Bloomington, IN, USA) in the setting of the adult critical airway.

2. Materials and methods

The University of Wisconsin Minimal-Risk Institutional Review Board approved this retrospective case series with a waiver of informed consent. All intubations and procedures were performed by an anesthesiology trainee with at least 12 months of anesthesia-specific training, with the assistance of the nursing and respiratory staff in immediate attendance. A single attempt at direct laryngoscopy was defined as placement of the laryngoscope in the patient’s oropharynx and does not take into account repositioning or use of airway adjuncts (Eschmann tracheal tube introducer; SIMS Portex, Inc., Keene, NH, USA) during the attempt. Difficult intubation was defined as failure to intubate the patient’s trachea after ≥ two attempts at direct laryngoscopy when used in combination with an airway adjunct. All intubations took place outside the OR in adults between 18 and 30 years of age. Due to the emergent nature of the intervention, no formal airway examinations were documented. Nonetheless, the operators documented in the patient’s record features observed during airway management that may have contributed to difficulty. In all cases, failure to intubate by direct laryngoscopy was attributed to inadequate exposure of the vocal cords. Cormack-Lehane view was recorded for each attempt by direct laryngoscopy as at least a grade IIIb view (ie, epiglottis visible, no airspace between epiglottis and posterior pharynx) in all cases. Trauma and the need for cervical spine stabilization limited mouth opening and neck extension sufficient to obscure direct visualization of the glottis in two patients, even preventing passage of an ETT after the glottis was visualized with a GlideScope (Verathon, Bothell, WA, USA) in one. Another patient had a large tongue hematoma and two others had micrognathia. All first attempts at direct laryngoscopy were made with a #3 Macintosh blade. An Eschmann ETT introducer was used in all patients except for the patient in whom the GlideScope was used. Three patients were administered etomidate and succinylcholine to facilitate intubation; one was given propofol only; and one patient, who suffered full cardiopulmonary arrest, received no induction medications.

Prior to insertion, a bronchoscope adapter with a diaphragm that allows insertion with minimal air leak from the circuit was attached to the LMA. An LMA Classic with the bronchoscope adapter was then inserted using the preferred technique of the operator. Correct placement was verified by observation of chest rise and presence of end-tidal carbon dioxide (ETCO2; EasyCap single-use disposable color change indicator; Tyco Healthcare, Pembroke Parish, Bermuda) after connecting the LMA to a self-inflating, manual resuscitation circuit providing 15 L of 100% oxygen. The patient’s lungs were continuously ventilated via the circuit port of the bronchoscope adapter throughout the procedure. A FOB [Pentax fiberscope FB-15V, with a 4.9 mm outer diameter (OD); Pentax Medical Co., Montvale, NJ, USA] was then inserted and passed via the LMA through the vocal cords and into the trachea. A 160 cm, unmarked, polytetrafluoroethylene (PTFE)-coated, 0.38 mm diameter Amplatz guidewire (Fig. 1, upper view) was then passed through the injection port of the FOB and advanced through...
the working channel until it could be visualized within the trachea beyond the tip of the scope. The scope was gradually removed with the guidewire under direct visualization with the FOB while an assistant assured that the wire remained in position. After the FOB was removed, a 70 cm, 14-French (Fr; 4.7 mm OD) airway exchange catheter with guide markings at every centimeter, was passed over the guidewire, through the adapter, and into the trachea approximately to the 30 cm mark. At this point, the LMA was deflated and removed while the guidewire and airway exchange catheter were maintained in place. An ETT was then passed over the wire and exchange catheter and rotated 90° counterclockwise to ease passage into the trachea; the airway exchange catheter and the guidewire were then removed, leaving the ETT in place. Direct laryngoscopy was not required to pass the ETT over the catheter exchanger. The pilot balloon was then inflated and the presence of the ETT within the airway was confirmed by observing chest rise with manual inflation, auscultation, and ETCO₂. Correct positioning of the ETT tip within the trachea was confirmed by FOB. The LMA, ETT, airway exchange catheter, and FOB were all treated with medical grade silicone spray lubricant.

3. Results

No difficulty related to LMA insertion was noted. The lungs of all patients were adequately ventilated through the LMA without evidence of gastric insufflation, as assessed by auscultation over the epigastrium during the initial 5 breaths immediately after insertion. No difficulty with insertion or withdrawal of the FOB or any components of the wire-guided catheter exchange set were noted. In all 5 patients, intubation was accomplished in a single attempt within three minutes, without hypoxemia or hypotension.

4. Discussion

Management of an unanticipated difficult airway by wire-guided catheter exchange intubation using a LMA as a conduit is attractive because it allows unhurried fiberoptic instrumentation of the airway while permitting oxygenation and ventilation to continue around the bronchoscope through a dedicated airway.

The wire-guided airway exchange catheter set contains a 70 cm, 14-Fr (4.7 mm OD), radiopaque exchange catheter with centimeter markings, a 160 cm, 0.38 mm diameter, PTFE-coated Amplatz guidewire with a flexible distal tip (Fig. 1, lower view) without distance markings, and a bronchoscopic airway adapter. The wire is thin enough to pass through the working channel of all but neonatal bronchoscopes. The wire is twice the length of both the working channel of the bronchoscope and the catheter exchanger. The Amplatz flexible tip minimizes trauma to the tracheal mucosa.

Another popular method for intubation, originally described by Atherton et al., employed a 57 cm ventilation-exchange bougie mounted onto a FOB. Following insertion through the LMA and into the trachea, the FOB was removed, leaving the bougie in place, after which the LMA was removed and the ETT inserted over the bougie [6]. This method allowed virtually uninterrupted ventilation of the patient, as ventilation was maintained first through the LMA and subsequently through the bougie via a standard 15 mm adapter, which enabled connection to a breathing circuit after the LMA was removed. The commercially available catheter (Aintree Intubating Catheter; Cook Critical Care, Bloomington, IN, USA) is 56 cm long. The internal diameter (ID) of 4.7 mm limits the size of bronchoscope that can be used. Regular adult scopes are too large and pediatric scopes are too “loose” inside the catheter to allow adequate control of the scope. Furthermore, the 19-Fr size (6.3 mm OD) accommodates only a ≥7 mm ID ETT. Thus, in cases of a narrowed glottis, tracheal stenosis, or in children or adolescents, this technique will be inadequate. Fiberoptic transoral wire-guided ETT exchange through an LMA has been documented previously. Arndt et al. reported several cases in which the wire and exchange catheter from a retrograde intubation kit were utilized in a manner similar to the technique that we describe [7]. Rajan described the use of a 5-Fr 60 cm ETT introducer modified by perforating the distal tip with a 16-gauge needle and cutting away the proximal one cm and a 140 cm 0.35 mm diameter guidewire, again used in a manner similar to what we described [8]. Neither technique utilized equipment specifically designed for the task. Most distinguishable from our procedure, the technique of Rajan requires not only a separately packaged guidewire, transtracheal tube introducer (TTI), and bronchoscope adapter—none of which may be readily available in an emergency situation—but modification of the TTI with a needle and cutting tool prior to use. Warrillow described a technique using a Corpak nasointestinal feeding tube and guidewire (CORPAK MedSystems, Wheeling, IL, USA) in place of an airway exchange catheter and guidewire [9]. As with the technique reported by Rajan, modification of the equipment by cutting off the terminating connector and side port to accommodate the ETT was necessary. In addition, the tube was actually placed with direct laryngoscopy and Magill forceps to guide the feeding tube/ETT apparatus over the wire.

Our technique overcomes the limitations of these other methods. The wire-guided catheter exchange set described in our series is prepackaged, it contains all necessary components, and it can be stored with all other difficult airway supplies to optimize availability. Regular adult, small adult, double-lumen, and pediatric bronchoscopes are all compatible with the included Amplatz bronchoscopes. There is no limitation in the depth to which the FOB can be advanced into the tracheobronchial tree other than that imposed by the LMA itself; the 14-Fr exchange catheter accommodates ETTs as small as 5 mm ID. In addition, omitting the
exchange catheter and railroading the ETT directly over the guidewire, as originally described by Hasan and Black, allows placement of ETTs smaller than 5 mm ID [10]. Finally, by using the included standard 15 mm connector, the exchange catheter may be attached to a breathing circuit, maintaining ventilation throughout the procedure.

References