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Brief Report

Emergency endotracheal intubation under fluoroscopy guidance for patients with acute dyspnea or asphyxia☆

Dechao Jiao, MD [a], Na Xie, MD [b], Xinwei Han, PhD [a,*], Gang Wu, PhD [a]

[a] Department of Interventional Radiology, The First Affiliated Hospital of Zhengzhou University, Zhengzhou, People's Republic of China
[b] Department of neurology, Anyang District Hospital, Puyang City, Henan province, People's Republic of China

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ABSTRACT

Objective: To evaluate the feasibility and effectiveness of emergency endotracheal intubation (EEI) under fluoroscopy guidance for patients with acute dyspnea or asphyxia.
Methods: From October 2011 to October 2014, of 1521 patients with acute dyspnea or asphyxia who required EEI in 6 departments, 43 patients who experienced intubation difficulty or failure were entered into this study. Data on technical success, procedure time, complications, and clinical outcome were collected. The pulse oxygen saturation and Hugh-Jones classification changes were analyzed.
Results: Fluoroscopy-guided EEI was technically successful in all patients. Acute dyspnea had resolved in all patients with clinical success rate 100% after the procedure. There were no serious complications during or after the procedure. The pulse oxygen saturation and Hugh-Jones classification showed significant increase after EEI ($P < .05$). Further treatments, including tracheal stents (n = 21), surgical resection (n = 16), palliative tracheotomy (n = 4), and bronchoscopic treatment (n = 2), were performed 1 to 72 hours after EEI. During a mean follow-up period of 13.2 months, 13 patients had died and 30 patients remained alive without dyspnea.
Conclusions: Fluoroscopy-guided EEI is a safe and feasible procedure, and may serve as an alternative treatment option for patients when traditional EEI is unsuccessful.

1. Introduction

Successful emergency airway management is an essential component of the modern practice of emergency medicine [1]. Rapid-sequence intubation has become an important procedure, which is a stepwise process developed to assist health care providers in placing emergent artificial airways for patients requiring assisted ventilation [2-4]. Although emergency endotracheal intubation (EEI) is the accepted criterion standard for patients who require a definitive airway and is a critical and often lifesaving procedure, it may be difficult or fail completely in 0.2% to 7% of cases [5] and may require more than 2 attempts in some patients. For patients who present with severe stenosis of the larynx or trachea, the difficulty and failure rates of airway intubation are even higher, which may often result in severe complications that include serious hypoxia, brain damage, and even death after multiple failures of intubation [6]. To overcome these disadvantages, we devised a technique for sheath-assisted tracheal intubation for adult patents, a remedial measure used after routine tracheal intubation failure, which is specifically intended for patients with acute dyspnea that results from severe stenosis of the airway [7]. This report details our single institution experience of fluoroscopy-guided EEI for patients with acute dyspnea related to the larynx or trachea.

2. Materials and methods

2.1. Ethical approval

This study was approved by the ethics committee of our University, and written informed consent was obtained from all patients or from children's guardians.

2.2. Fluoroscopy-guided EEI

All of the procedures were performed with the use of local anesthetic by 2 interventional radiologists (G. Wu and D.C. Jiao), who had 10 and 5 years, respectively, of experience in thoracic interventional radiology. The blood pressure, heart rate, pulse oxygen saturation (Spo_2), and other vital signs were monitored throughout the procedure. The sheath-assisted tracheal intubation system consists of the tracheal cannula, an 80-cm long, 14F sheath (Steer Ease; Lifetech Scientific, Shenzhen, China; Fig. 1a) and the entire sheath-assisted tracheal

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* Corresponding author at: Department of Interventional Radiology, The First Affiliated Hospital of Zhengzhou University, Zhengzhou, Henan, People's Republic of China. Tel.: +86 13803842129.
E-mail address: 13592583911@163.com (X. Han).

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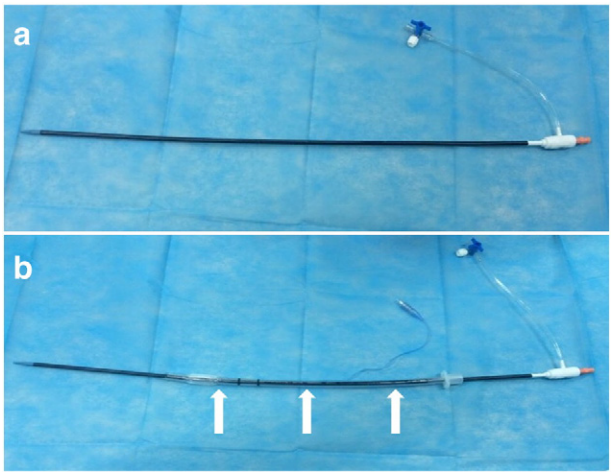

Fig. 1. The sheath-assisted tracheal intubation system consists of a tracheal cannula (white arrow), a 14F introducer sheath with tapered tip (a), and the entire sheath-assisted tracheal intubation system. The tracheal cannula is mounted over the 14F introducer sheath.

intubation system (Fig. 1b). The tracheal cannula is mounted over the 14F introducer sheath (Fig. 1b). The patient was placed in a right anterior oblique or supine position with the neck extended, and the stenosis was identified by preoperative computed tomography (CT). The mean duration from latest CT to EEI was 11.0 days (range, 1-25 days). After topical anesthesia (lidocaine 2%, 5 mL) was administered, a 0.035-in. Radiofocus guidewire (Terumo, Tokyo, Japan) with a 5F vertebral artery catheter (Cook, Bloomington, IN) was advanced into the trachea or bronchus orally under fluoroscopic guidance (Fig. 2). The initial guidewire was exchanged for a 0.035-in. super-stiff guidewire (Boston Scientific, Watertown, MA). For 38 adults (age range, 27-87 years) in our study, the 14F sheath was used to assist EEI, and the sheath-assisted EEI system was advanced over the guidewire and slowly passed through the stenosis until the tip reached the left or right main bronchus (Fig. 2). After the tracheal cannula (ID 7.0 mm) had been passed across the stenosis, the introducer sheath and the dilator were pulled back and withdrawn, with the tracheal cannula retained in the trachea (Fig. 2). For patients with severe stenosis, if it was difficult to insert the endotracheal tube through the stenosis, the stenosis was first expanded by a balloon with a diameter of 14 mm (Boston Scientific), then the tracheal cannula passed across the stenosis easily (Fig. 3). For 5 children (age range, 1-5 years), the endotracheal tube (ID 4.0 mm) was inserted along the super-stiff guidewire into the trachea without sheath assistance (Fig. 4). After the patient had been allowed to recover within 72 hours, further treatments, such as tracheal stenting, radical surgical resection, palliative tracheotomy, or bronchoscopic treatment, were performed to maintain the long-term patency of the airway.

2.3. Efficacy evaluation and follow-up

Technical success was defined as successful EEI. *Clinical success* was defined as a significant increase in Spo_2 after fluoroscopy-guided EEI. Data on procedure time, use of sheath-assistance or not, performance of balloon dilatation or not, complications, successive treatments, technical success, and clinical success were evaluated at the end of fluoroscopy-guided EEI. Hugh-Jones classification was analyzed before and after EEI in patients able to undergo Hugh-Jones classification. Survival status and time were recorded using follow-up outpatient visits or telephone interviews.

2.4. Statistical analysis

The data in this study are presented as the mean ± SD or median for continuous variables. All statistical analyses were performed using SPSS for Windows version 18.0 (SPSS Inc, Chicago, IL). The Spo_2 and Hugh-Jones classification changes before and after EEI were analyzed using the paired-samples *t* test and Wilcoxon signed rank test, respectively. A *P* value less than .05 was considered statistically significant.

3. Results

3.1. Patients

From October 2011 to October 2014, of 1521 patients with acute dyspnea or asphyxia who required emergency tracheal intubation in 6 departments (intensive care unit, thoracic surgery department, thyroid surgery department, head and neck surgery department, respiration department, and oncology department) at our hospital, routine tracheal intubation failed in 43 patients (27 males, 16 females; mean age, 50.23 ± 22.31 years; age range, 1-87 years). These patients, who experienced intubation difficulty or failure, were entered into this study. Of all the patients, 25 (58.1%) patients had received treatment of primary diseases, including surgery (n = 17) and radiotherapy (n = 8). All patients presented with severe symptoms of dyspnea, and preoperative Spo_2 ranged from 55% to 91%, even with the administration of high-flow oxygen. Demographic data from these patients are summarized in Table 1.

3.2. Technical results

Emergency endotracheal intubation was technically successful and well tolerated in all patients, with mean total procedure time of 14.4 ± 4.1 minutes. The severe dyspnea was relieved in all patients, and postoperative Spo_2 levels rose to 95% to 99% within 5 minutes after EEI, which was a significant increase ($P < .05$). There were 38 adult patients in the study with mean age of 56.4 ± 12.0 years, and the 14F sheath was used to assist EEI in all 38 adult patients. There

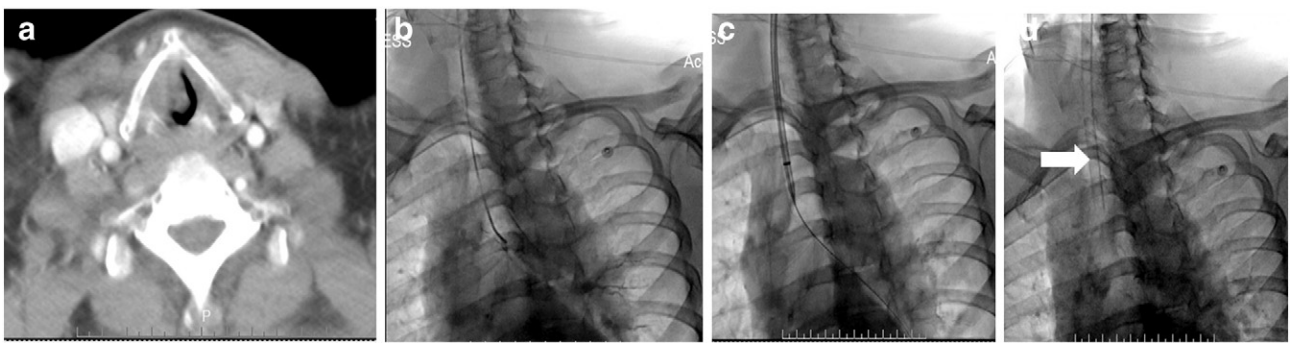

Fig. 2. a, In a 58-year-old patient with carcinoma of the larynx, the preoperative CT showed a severely narrow laryngeal cavity (white arrow). b, A 5F vertebral artery catheter was advanced into the trachea orally with guidewire assistance. c, The sheath-assisted tracheal intubation system was advanced over the guidewire and slowly passed through the stenosis. d, The tracheal cannula (white arrow) was retained in the trachea after the introducer sheath and the super-stiff guidewire were withdrawn.