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Original Article

Airway support using a pediatric intubation tube in adult patients with atrial fibrillation: A simple and unique method to prevent heart movement during catheter ablation under continuous deep sedation

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ABSTRACT

Background: The present study aimed to elucidate the safety and effectiveness of a noble and unique airway management technique in which a pediatric intubation tube is used in adult patients with atrial fibrillation (AF) undergoing catheter ablation (CA) under continuous deep sedation.
Methods: In total, 246 consecutive patients with AF (mean age, 65 ± 10 years; 60 women) underwent CA under dexmedetomidine-based continuous deep sedation. A 4-mm pediatric intubation tube guided by a 10-French intratracheal suction tube was inserted smoothly, and the tip of the tube was located at the base of the epiglottis. The maximum shifting distance of the heart (MSDH) was measured with the 3D mapping system (Ensite NavX system) before and after inserting the pediatric intubation tube.
Results: At baseline, the MSDH of patients under continuous deep sedation was 23 ± 14 mm. The pediatric intubation tube reduced the MSDH to 13 ± 6 mm (mean reduction from baseline, 38.4 ± 21.7%; $P < 0.0001$). In contrast, oxygen saturation was significantly increased from 89 ± 8% to 95 ± 3% ($P < 0.0001$). The mean distance between the nostril and base of the epiglottis was 16.6 ± 0.5 mm. Major periprocedural complications occurred in 9 (3.6%) patients including 3 (1.2%) cardiac tamponade and 6 (2.4%) phrenic nerve injury cases. Larger MSDH (odds ratio, 1.13; 95% confidence interval, 1.04–1.25; $P = 0.007$) was a significant predictor of major periprocedural complications. No major airway complications occurred, except in 3 patients (1.2%) who had minor nasal bleeding.
Conclusion: This unique airway management technique using a pediatric intubation tube for CA procedures performed in adult patients with AF under continuous deep sedation was easy, safe, and effective.

1. Introduction

Catheter ablation (CA) is a standard therapy for treating patients with atrial fibrillation (AF) [1–3]. In contrast to CA for other less complex arrhythmias, CA of AF requires a relatively long procedural time, resulting in patient restlessness, which interferes with the procedure. Furthermore, the application of radiofrequency (RF) energy during the procedure causes considerable pain to patients. During the procedure, patients are expected to lie still on the operation table for an extended period. Hence, it is necessary to provide patients with adequate sedation and analgesia to avoid restlessness, movement, and pain, and to stabilize their respiration. Several sedation methods are used during CA including conscious sedation with an intravenous anesthetic and an analgesic, deep sedation with or without airway support, and general anesthesia [4]. While each method has advantages and disadvantages, no direct comparison has been reported. Conscious sedation with an intravenous anesthetic and an analgesic is widely used during CA for other arrhythmias and requires a relatively short procedural time. Although conscious sedation has the advantage of avoiding respiratory and hemodynamic instability, it may be insufficient to prevent restless body

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movements, relieve pain, and stabilize respiration during relatively long procedures such as CA of AF. In addition, this type of sedation may be not applied in institutions where repetitive intracardiac defibrillation is required during AF ablation procedures. General anesthesia could meet all these requirements, but it requires the support of an anesthesiologist and intubation of the patient. Recently, deep sedation with intravenous anesthetics and analgesics was reported to be effective during pulmonary vein isolation (PVI) [5]. In other studies, sedation with a propofol infusion administered by cardiologists with or without assisted ventilation was proven to be safe, effective, and feasible for use in AF ablation [4,6]. Deep sedation, however, suppresses respiration and/or sometimes results in airway obstruction by a retracted tongue root, causing a decrease in arterial oxygen saturation. Further, it leads to unstable respiration with considerable respiratory variations that interfere with the CA procedure of AF, including catheter positioning. In the present study, we assessed the safety and efficacy of a unique method of airway support using a 4-mm pediatric intubation tube guided by a 10-French (Fr) intratracheal suction tube.

2. Methods

2.1. Study population

In total, 246 consecutive patients (mean age, 65 years; women, $n=60$) were enrolled in this study. The patients were referred to our institution for an initial CA to treat AF refractory to antiarrhythmic drugs. AF was defined as paroxysmal when it terminated spontaneously within 7 days, and as long-standing persistent when it continued for >12 months according to the guideline [7]. All patients provided written informed consent, and our institutional review board approved the study protocol (IRB approval on 2014/03/18; IRB no. 14-28).

2.2. Sedation

All procedures were performed with patients under deep sedation. Sedation levels were determined using the Ramsay sedation scale [8] and targeted to level 6 on the scale. The goal of sedation was to keep the patient in deep sedation throughout the procedure while maintaining spontaneous ventilation and cardiovascular hemodynamic stability. After patients were positioned supine on the catheter laboratory table, a pentazocine bolus of 15–30 mg was intravenously administered for analgesia. An introduction dose (3 μg/kg/h) of dexmedetomidine was administered for 20–30 min, followed by a maintenance dose (0.5 μg/kg/h). Low-dose propofol (0.08–0.2 mg/kg/h) was also administered from the beginning of the procedure if required to achieve stable sedation. The dose was carefully titrated to achieve the desired sedation level and to prevent side effects such as bradycardia or hypotension. Additional 2-mL boluses of 2% propofol were given as required to maintain the state of deep sedation. Oxygen was administered via a face mask starting at 5 L/min. Vital signs were continuously monitored throughout the procedure. Heart rate was monitored with a 12-lead electrocardiogram, and arterial pressure was measured invasively through a 4-Fr sheath in the femoral artery. Ventilator function was monitored by regular observation, and by auscultation of the patient, if necessary; oxygenation was continuously monitored by pulse oximetry. The patient's level of consciousness was examined continuously throughout the procedure.

2.3. Insertion of the pediatric intubation tube

After lidocaine hydrochloride jelly was injected through the nasal cavity, a 4-mm pediatric intubation tube was smoothly inserted by a physician or a nurse using a 10-Fr (3.3 mm) tracheal suction tube. The location of the tip of the tube was determined at the point below the epiglottis and beyond the vocal cord. As the vocal cord was not visible under fluoroscopy, we positioned the tip of the tube at the base of the epiglottis as shown in Fig. 1, so we could achieve sufficient airway support and avoid vocal cord damage. If required, the proximal side of the tube was cut to adjust the tube length.

2.4. Maximum shifting distance of the heart (MSDH) using the EnSite NavX System

As shown in Fig. 2, the MSDH was defined as the shifting distance of the catheter in the coronary sinus compared to the initial catheter location displayed in the 3-dimensional mapping system (Ensite NavX, St. Jude Medical, St. Paul, MN, USA). The MSDH was defined as the maximum shifting distance between the location where patients breathe in and that where they breathe out in a stable respiratory state. The distance was measured twice, and the mean value was applied for the study. The MSDH was measured after automatic geometry acquisition without the respiratory compensation function. The MSDH under deep sedation was measured before and after inserting the pediatric intubation tube during the stable state of respiration.

2.5. Electrophysiological study

Antiarrhythmic drugs were discontinued for >7 days (amiodarone was discontinued for >1 month) before the ablation. All patients were also effectively anticoagulated for >1 month. A 7-Fr, 20- or 14-pole, two-site mapping catheter (Irvine Biomedical, Irvine, CA, USA) was inserted through the right jugular vein and positioned in the coronary sinus for pacing, recording, and internal cardioversion.

2.6. CA technique

The strategy of extensive pulmonary vein isolation was previously described [9]. An activated clotting time of >300 s was maintained with a continuous infusion of heparin during the procedure. After a transseptal puncture, two long sheaths (SL0, AF Division, St Jude Medical, Minneapolis, MN, USA) were introduced into both superior pulmonary veins (PVs) via the same transseptal hole, and pulmonary venography and contrast esophagography were performed to determine the anatomical relationships of the PV ostia, left atrium, and esophagus. Two circular mapping catheters were placed in the superior and inferior PVs, and the left and right ipsilateral PVs were circumferentially and extensively ablated under fluoroscopic and electrophysiological guidance. RF energy was delivered with a non-irrigated 8-mm-tip ablation catheter (Japan Lifeline., Tokyo, Japan) using an RF power of 35–40 W under a temperature limit of 55 °C, or an irrigated 4-mm-tip ablation catheter (Cool Path Duo, St. Jude Medical, St. Paul, MN, USA or EZ Steer Thermocool NAV, Biosense Webster, Diamond Bar, CA, USA) with an RF power of 25–30 W and a cut-off temperature of 45 °C. The endpoint of this procedure was complete PVI, which was defined as the disappearance of all PV potentials recorded by multipolar circular catheters (Inquiry TM A-focus TM II, St. Jude Medical, St. Paul, MN, USA or Lasso, Biosense Webster, Diamond Bar, CA, USA) (entrance block) and a loss of capture of the left atrium by circumferential pacing from circular catheters placed at the PV ostium (exit block). Adenosine triphosphate (20–40 mg) was injected to unmask any dormant conduction ≥ 30 min after completing PVI, and the reconnected conduction was disconnected [10]. A cavotricuspid isthmus line was created with an endpoint of a bidirectional conduction block [11]. If AFs were reproducibly

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