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CASE REPORT

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Intubated or rigid bronchoscopy under high-flow oxygenation and deep sedation without ventilator or anesthesiologist: A report on a new technique

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Abstract

As the demand for advanced bronchoscopic procedures increases, prolonged sedation with adequate oxygenation has become essential. Traditionally, these procedures require an anesthesiologist to provide (positive-pressure or jet) ventilator support. However, recent innovations have enabled advanced bronchoscopy under high-flow endotracheal oxygenation and deep sedation without these requirements. Following oropharyngeal lidocaine anaesthesia, deep sedation was induced using fentanyl and remimazolam. Thereafter lidocaine was instilled into the larynx, trachea, and main bronchi using a flexible bronchoscope with a spray catheter. Finally, either an uncuffed endotracheal tube (Case 1) or a rigid bronchoscope (Case 2) was inserted, and advanced bronchoscopic procedures, such as cryobiopsy and stent insertion, were successfully performed without a ventilator or an anesthesiologist. Our novel technique is expected to facilitate the easier and adequate performance of advanced high-level bronchoscopic procedures by pulmonologists, even in resource-limited settings.

KEYWORDS
advanced bronchoscopic procedures, deep sedation, high-flow oxygenation

INTRODUCTION

As the number of advanced or therapeutic bronchoscopies increase, a longer period of euoxic sedation is required. Traditionally, to perform that, a ventilator is applied under general anaesthesia after endotracheal tube (ETT) or rigid bronchoscope (RB) intubation, and an anesthesiologist is also required to perform positive pressure ventilation or jet ventilation.[1] Recently, we successfully performed bronchoscopy using high flow endotracheal oxygenation under deep sedation. The procedures were performed in a bronchoscopy suite without a ventilator or an anesthesiologist.

CASE REPORT

Case 1: High-flow oxygenation via uncuffed endotracheal tube (ETT)

A 65-year-old man presented to our hospital with airspace consolidations in the upper lobes of both lungs. He had mild exertional dyspnea and cough. Interstitial lung disease such as pleuroparenchymal fibroelastosis or tuberculosis had to be differentiated first. As sputum examination revealed no evidence of tuberculosis, it was decided to perform transbronchial cryobiopsy. Conventionally, transbronchial cryobiopsy is performed in the

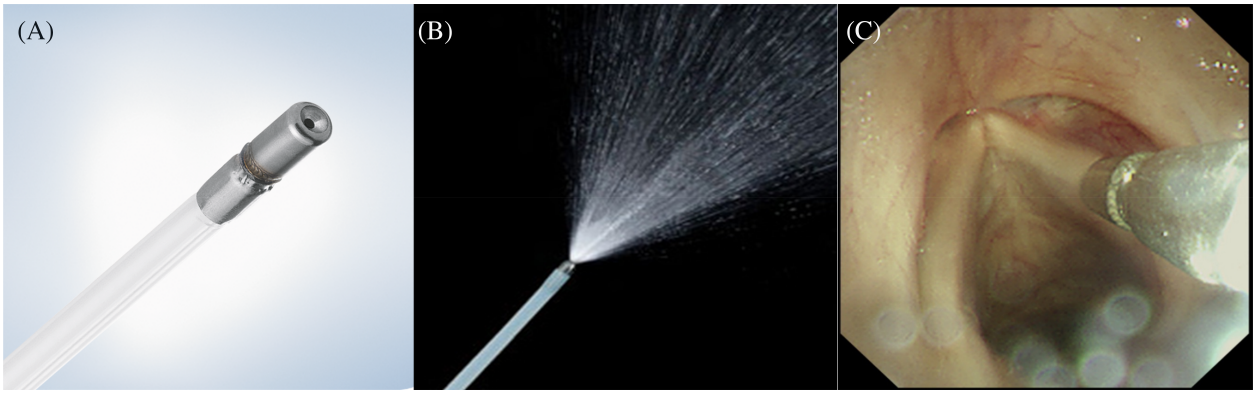

FIGURE 1 Bronchoscopic topical anaesthesia using a spray catheter: For sufficient topical anaesthesia, lidocaine was meticulously applied using a spray catheter (A, B) to the airway (C).

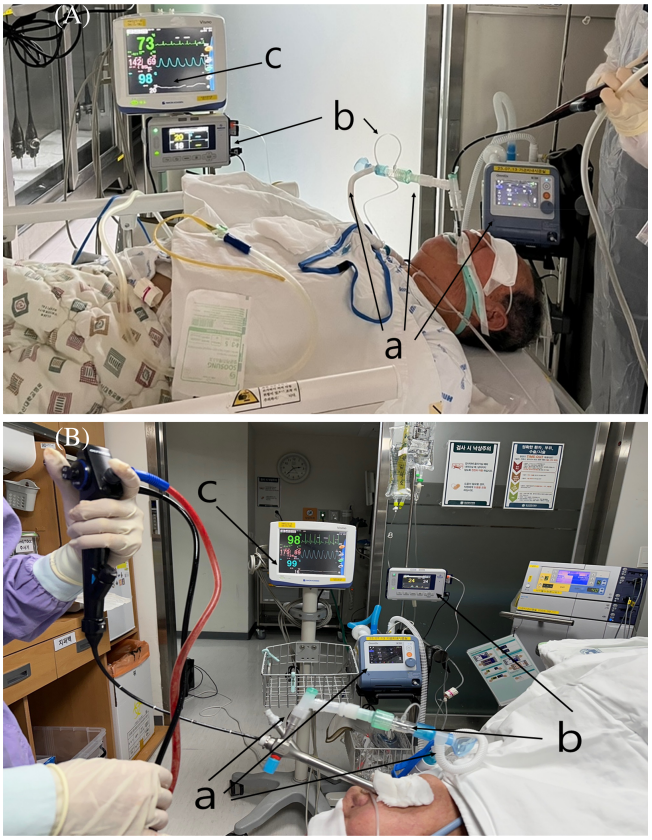

FIGURE 2 (A) High-flow oxygenation using an uncuffed endotracheal tube: High-flow oxygen was administered through the ETT using a side adapter (a). End-tidal CO2 (EtCO2) (b), vital signs (V/S), electrocardiogram (ECG), and peripheral oxygen saturation (SpO2) (c) were monitored. (B) High-flow oxygenation via a rigid bronchoscope: High-flow oxygen was administered through the side ventilation port of the rigid bronchoscope (a). EtCO2 (b), V/S, ECG, and SpO2 (c) were monitored.

operating room after tracheal intubation under general anaesthesia.[2] However, we successfully performed the procedure in the bronchoscopy suite using sufficient topical anaesthesia and deep sedation, without a ventilator or an anesthesiologist.

First, 10 min before flexible bronchoscopy (FB) was initiated, the patient gargled 5 mL of 2% lidocaine and spat it out. Next, three puffs of 10% lidocaine spray (10 mg/puff) were administered to the oropharynx. Following this, 1 min before FB, 50 mcg of fentanyl and 5 mg of remimazolam were intravenously injected to induce sedation. After achieving moderate sedation (patient opened the eyes when called),[3] FB was initiated, and 2 mL of 1% lidocaine was applied using a spray catheter (PW-6C-1; Olympus, Tokyo, Japan) four, four, one, and one times to the larynx (vocal cords), trachea, right main bronchus, and left main bronchus, respectively (Figure 1).

After achieving sufficient topical anaesthesia, additional injections of 50 mcg of fentanyl and 5 mg of remimazolam were administered to induce deep sedation (spontaneous breathing was maintained at a reduced level, but no response to stimuli was elicited),[3] followed by bronchoscope-guided ETT (8.5 mm internal diameter; Smiths Medical, Minneapolis, MN) insertion. High-flow oxygen (OmniOx HFT750; MEKICS, Seoul, Korea) was administered through the ETT using a side adapter with a fraction of inspired oxygen of 0.6 at a flow rate of 50 L/min (cuff inflation was not performed), and end-tidal CO2 (EtCO2) (Capnostream 35; Medtronic, Minneapolis, MN), peripheral oxygen saturation (SpO2), electrocardiogram (ECG) and vital signs (V/S) were monitored (Figure 2A).

After confirming that EtCO2, SpO2, and V/S remained stable, transbronchial forceps biopsy (five times) and cryobiopsy (three times) (1.1 mm outer diameter Cryprobe; ERBE, Germany) were performed at the left upper lobe under fluoroscopy. The time required from the start of the FB to ETT insertion was 6 min, and the subsequent bronchoscopy procedure (forceps biopsy and cryobiopsy) required 25 min. No additional drugs were administered during the procedure. At the end of the procedure, the patient responded when called. After confirming the stability of V/S, including EtCO2, the endotracheal tube (ETT) was promptly removed, and no antidote was required. The patient was monitored in the recovery room for 15 min, transferred to the ward after achieving full consciousness,

and discharged on the same day without complications. Both cryobiopsy and forceps biopsy confirmed granulomatous inflammation with necrosis, compatible with tuberculosis. Therefore, antituberculosis medication was initiated.

Case 2: High flow oxygenation via rigid bronchoscope (RB)

A 67-year-old man undergoing palliative chemotherapy for advanced oesophageal cancer presented with a severe cough after food intake. A bronchoesophageal fistula due to invasion of the left main bronchus by the oesophageal cancer was confirmed using chest computed tomography and flexible bronchoscopy. Therefore, insertion of a covered metal stent across the malignant bronchoesophageal fistula was planned for palliation. Conventionally, central airway stent insertion is performed under general anaesthesia in the operating room via rigid bronchoscopy. We successfully performed stent insertion using an RB in the bronchoscopy suite using sufficient topical anaesthesia and deep sedation, without the need for a ventilator or an anesthesiologist.

After sufficient topical anaesthesia using a flexible bronchoscope and spray catheter similar to that in Case 1, additional injections of 100 mcg of fentanyl and 5 mg of remimazolam were administered to induce deep sedation. An RB (size 8.5, 10318 BP; Karl Storz, Germany) was inserted, high-flow oxygen (OmniOx HFT750; MEKICS, Seoul, Korea) was administered through the side ventilation port of the RB with a fraction of inspired oxygen of 0.6 and a flow rate of 50 L/min, and EtCO2, SpO2, ECG and V/S were monitored (Figure 2B).

After confirming stable condition, a covered metal stent (outer diameter, 12 mm; length, 40 mm) was inserted. The time required from the start of the flexible bronchoscopy to RB insertion was 10 min, and stent insertion required 30 min. During the procedure, an additional 50 mcg of fentanyl and 10 mg of remimazolam were administered. At the end of the procedure, a reduced level of spontaneous breathing was observed, and EtCO2 was 48 mmHg. Because the patient did not respond to stimuli, we administered 1 mg naloxone, and the patient regained alertness after 1 min. After confirming stability of V/S, including EtCO2, the RB was removed. The patient was monitored in the recovery room for 30 min, transferred to the ward after achieving full consciousness, and discharged on the following day without complications.

DISCUSSION

Advanced high-level bronchoscopic procedures (cryobiopsy or stent insertion) were successfully performed in a bronchoscopy suite under high-flow oxygenation using either an ETT or an RB without a ventilator or an anesthesiologist.

For sedation, in Case 1, fentanyl 100 mcg and remimazolam 10 mg were used, whereas in Case 2, fentanyl 200 mcg and remimazolam 20 mg were used. This corresponds to deep sedation rather than light sedation used in ordinary endoscopy, but is significantly lower than the dose required for general anaesthesia.[4,5] The meticulous local application of lidocaine reduced airway irritation due to intubation, thereby reducing the demand for sedatives. We prepared an Ambu bag and a portable ventilator as precautionary measures. However, spontaneous breathing was maintained (although reduced); therefore, they were not required.

Our bronchoscopy suite is not connected to operating theatres or anaesthetic teams, but is located adjacent to the medical intensive care unit (MICU). Patients in poor condition after the procedure are prepared to be transferred to the MICU. The anaesthetic team helped us set up our new technique. We have been concerned about the occurrence of apnea, but it could be managed with precautionary measures such as Ambu bag, portable ventilator, and MICU transport system if necessary.

Our new techniques (high-flow ETT [HF-ETT] and high-flow rigid bronchoscopy [HF-Rigid]) do not require traditional positive-pressure or jet ventilators. High-flow oxygenation equipment is readily available in hospitals. Therefore, our method is expected to facilitate the easier and adequate performance of advanced high-level bronchoscopic procedures by pulmonologists, even in resource-limited settings.[6]

To implement the new technique effectively, both retrospective and prospective experience are needed. Currently, we have been successfully performing many similar cases without any complications. In the near future, we will be present research results evaluating the feasibility and safety of HF-ETT and HF-Rigid.

AUTHOR CONTRIBUTIONS

Conceptualization: Hee Yun Seol and Taehoon Lee. *Funding acquisition*: Hee Yun Seol and Taehoon Lee. *Methodology*: All authors. *Project administration*: Hee Yun Seol. *Resources*: Taehoon Lee. *Software*: Ganghee Chae, Jin Hyoung Kim, Yun Seong Kim, and Seong Hoon Yoon. *Supervision*: Yun Seong Kim. *Writing—original draft*: Hee Yun Seol and Taehoon Lee. *Writing—review & editing*: All authors.

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CONFLICT OF INTEREST STATEMENT

None declared.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The authors declare that appropriate written informed consent was obtained for the publication of this manuscript and accompanying images. The authors declare that this study did not require ethics approval from their institution.

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REFERENCES

1. de Lima A, Kheir F, Majid A, Pawlowski J. Anesthesia for interventional pulmonology procedures: a review of advanced diagnostic and therapeutic bronchoscopy. Can J Anaesth. 2018;65:822–36.
2. Hetzel J, Maldonado F, Ravaglia C, Wells AU, Colby TV, Tomassetti S, et al. Transbronchial Cryobiopsies for the diagnosis of diffuse parenchymal lung diseases: expert statement from the cryobiopsy working group on safety and utility and a call for standardization of the procedure. Respiration. 2018;95:188–200.
3. Practice guidelines for sedation and analgesia by non-anesthesiologists. Anesthesiology. 2002;96:1004–17.
4. Coskun D, Celebi H, Karaca G, Karabiyik L. Remifentanil versus fentanyl compared in a target-controlled infusion of propofol anesthesia: quality of anesthesia and recovery profile. J Anesth. 2010;24:373–9.
5. Kim KM. Remimazolam: pharmacological characteristics and clinical applications in anesthesiology. Anesth Pain Med (Seoul). 2022;17:1–11.
6. Calligaro GL, Lalla U, Audley G, Gina P, Miller MG, Mendelson M, et al. The utility of high-flow nasal oxygen for severe COVID-19 pneumonia in a resource-constrained setting: a multi-centre prospective observational study. EClinicalMedicine. 2020;28:100570.

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