



The Utilization of Awake Flexible Bronchoscopic Intubation in Lieu of Rapid Sequence Induction in the Critically Ill: A Case Series

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Abstract

Background: Critically ill patients in the intensive care unit (ICU) often present with complex comorbidities and hemodynamic instability, making rapid sequence induction (RSI) for airway management potentially hazardous. Awake flexible bronchoscopic intubation (FBI) offers a safe alternative without the need for the utilization of procedural induction or in those with anticipated difficult airways.

Methods: This case series describes nine ICU patients who underwent FBI due to conditional intolerance to RSI, either from hemodynamic instability requiring vasopressor support, anticipated difficult airways, or the need for subsequent bronchoscopic evaluation/management. Patient demographics, comorbidities, vasopressor requirements before and after intubation, and peri-intubation events were described.

Results: All nine patients were successfully intubated on the first attempt using FBI. The cohort included individuals with significant comorbidities such as obesity (BMI up to 76), cardiovascular disease, malignancy, and respiratory failure. FBI was performed without the need for RSI, and most patients maintained stable or improved hemodynamics post-intubation. Some had reduced or no vasopressor requirement following the procedure. In addition to airway management, FBI facilitated concurrent diagnostic and therapeutic bronchoscopic interventions, including bronchoalveolar lavage and removal of airway obstructions.

Conclusions: Awake FBI is a valuable technique for securing the airway in critically ill patients who are poor candidates for RSI due to hemodynamic instability or anticipated difficult airways. FBI not only reduced the risk of peri-intubation hypotension but also allows for immediate airway evaluation and intervention. These findings support the inclusion of FBI for select high-risk ICU patients.

Keywords: Flexible Bronchoscopic Intubation; ICU; Hemodynamic; Rapid sequence induction; Ventilation

Introduction

In the intensive care unit (ICU), patients frequently present with life-threatening conditions that involve multiple, complex issues requiring meticulous management by intensivists. These challenges include respiratory failure, which demands securing a definitive airway and providing mechanical ventilation, as well as persistent hypotension or hemodynamic instability, which often requires the administration of vasopressors and inotropic agents. In this complex patient population, an intervention for one condition can sometimes exacerbate or worsen other ongoing hemodynamic issues.

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Rapid sequence induction (RSI) is a well described procedure in which patients are given a combination of a sedating agent (Induction) and a paralytic to facilitate endotracheal intubation [1]. Compared to controlled settings, such as in the operating room, performance of RSI is associated with induction or worsening of hemodynamic compromise in patients in at-risk patients such as those requiring vasopressor support to maintain hemodynamic stability. The proposed mechanisms for which RSI precipitates hemodynamic instability is that patients are plenty and affect mean arterial pressure by reducing its dependent factors, cardiac output and systemic vascular resistance [2, 3]. Of those mechanisms are reduction in sympathetic nervous system mechanism of compensation [3] which is commonly seen in propofol. Ketamine is often used in hemodynamic instability given its associated increase in heart rate and blood pressure, however, has also been associated with post-intubation hypotension.

In light of concerning hemodynamic instability with RSI in regard to the ICU patient population with minimal reserve for further blood pressure control in the setting of hypotension managed with vasopressor support, other means of intubation are necessary. Awake flexible bronchoscopic intubation (FBI) is an alternative approach in which awake patients are intubated with bronchoscopy guidance. Its benefits include the option to avoid RSI for intubation as well as relatively high success rates in achieving airway placement [4]. Its main use is in anticipated "difficult airway", however, has great potential in the repertoire of the intensivist.

In this case series, we discuss 9 cases of patients requiring intubation while were deemed high risk for RSI given hemodynamic instability or had other indications for FBI. We discuss their comorbidities, vasopressor requirements prior and post FBI, and peri-intubation events.

Case series

2.1 Case 1

A 74-year-old male with body mass index (BMI) of 34, and past medical history of Type 2 diabetes mellitus, peripheral artery disease status-post aorto-bifemoral bypass, three prior myocardial infarctions post stent placement, atrial fibrillation, and moderately differentiated gastric adenocarcinoma was admitted for a gastrointestinal bleed. Soon after the ICU admission, the patient developed hypovolemic and cardiogenic shock and was started on vasopressin at a dosage of 0.03 units per minute and norepinephrine at 0.3 micrograms per kilogram per minute. On the next day the patient was requiring higher infusion rates on both pressors, BP reading was 76/66 mmHg. Due to increased work of breathing, worsening hypoxia with saturation of peripheral O₂ (SpO₂ 66%) on 3L nasal canula. Given the hemodynamic instability and need for intubation, FBI was performed with a 7.5mm endotracheal tube. Post-intubation, the patient was started on

dobutamine 5 mcg/kg/min, BP improved at 127/64 mmHg. The patient was later taken to the cardiac catheterization lab for placement of a percutaneous ventricular assist device and left/right heart catheterization.

2.2 Case 2

An 83-year-old male with BMI of 24.2, and past medical history of prostate cancer status post radiation therapy, and active diagnosis of refractory B-cell acute lymphoid leukemia received 2 cycles of vincristine and 1 cycle of cyclophosphamide who was admitted to the ICU for acute hypoxic respiratory failure. The patient was initially on High-flow nasal cannula (HFNC) and then was escalated to Bilevel positive airway pressure (BiPAP) on high setting and Fraction of inspired O₂ (FiO₂) of 100%. However, the patient continued to have respiratory distress and increased work of breathing. His respiratory rate was 42, SpO₂ 96%, blood pressure 138/71 mmHg and heart rate 109 beats per minute. Invasive ventilation was deemed necessary and given the need for bronchoscopic evaluation of the patient's airways; FBI was performed. The patient was positioned appropriately. Preoxygenation with 100% FiO₂ provided via BiPAP achieved saturation of 99%. Via bronchoscopy, a size 7.5 endotracheal tube (ETT) was placed under direct visualization through the cords and placement was confirmed. ETT was then secured in place. Overall, intubation was found to be not difficult and required 1 attempt. The blood pressure after the procedure was 118/68 without any requirement for vasopressor support. A moderate amount bloody secretions were encountered throughout the airways and aspirated. Respiratory cultures from the bronchoalveolar lavage (BAL) grew *Enterococcus faecium* (VRE) which later helped tailoring the antibiotic use.

2.3 Case 3

A 48-year-old female with a BMI of 76 and past medical history of type 2 diabetes, and asthma was transferred to the ICU with multifocal extended spectrum beta-lactamase producing *Klebsiella pneumoniae* pneumonia who was admitted for acute hypoxic respiratory failure secondary to Corona virus disease (COVID) pneumonia. Multiple attempts to wean off the BiPAP to HFNC were unsuccessful. Arterial blood gas was notable for persistent hypoxemia (pH 7.45, pCO₂ 54, pO₂ 76, HCO₃ 33.8), despite being on 100% FiO₂, and increased BiPAP pressure settings. Chest computed tomography (CT) scan showed worsening ground glass opacities in bilateral upper lobes. Given the aforementioned findings, invasive ventilation was deemed necessary. Given increased incidence of difficult intubation in obese patients; FBI was performed. The patient was positioned appropriately. Preoxygenation with 100% FiO₂ provided. Oxygen saturation of 96% achieved. Flexible bronchoscopy utilized to visualize vocal cords through BiPAP. Patient was intubated via bronchoscopic guidance and a size 7.5 ETT

was placed under direct visualization through the cords and placement confirmed ETCO₂ monitor and bronchoscope and auscultation. ETT was then secured in place. Overall, intubation was found to be not difficult and required 1 attempt. The patient remained hemodynamically stable throughout the procedure.

2.4 Case 4

A 67-year-old male with a BMI of 22.75 and a past medical history of hypertension, cerebrovascular accident, and large B-cell Epstein-Barr virus-positive lymphoma presented to the ICU with acute hypoxic respiratory failure likely secondary to aspiration and *Klebsiella pneumoniae* pneumonia. During the admission, the patient's oxygen saturations were between 87-88% on 10L, 60% FiO₂ aerosol face tent. Due to persistent hypoxia, increased work of breathing and lethargy, intubation was deemed necessary. Given that confirmation of the etiology was also necessary via BAL was also necessary, FBI was performed. Preoxygenation with 100% FiO₂ provided. Oxygen saturations of 92% achieved. Initial Mallampati Classification of not assessed. No IV sedation was given. A video laryngoscope was inserted and the vocal cords identified. Size 7.5 ETT was placed under direct visualization through the cords and placement confirmed by bronchoscopy. ETT was then secured. Overall, intubation was found to be not difficult and was successful on the first attempt.

2.5 Case 5

A 60-year-old obese male with a BMI of 51.33 and past medical history of alcohol use disorder, gastroesophageal reflux disease, hyperlipidemia, and hypertension who presented with cervical and thoracic spine osteomyelitis, retropharyngeal abscess and acute hypoxic respiratory failure. Given the patients' condition of morbid obesity and laryngeal edema; a difficult airway was expected. FBI was carried out. Intubation was successful on the first attempt administering 2 mg of midazolam for sedation. Following intubation, the patient's vital signs showed a blood pressure of 100/55 mmHg and a heart rate of 66 beats per minute, notably without requiring vasopressor support. A BAL was performed following intubation. The culture results later revealed a polymicrobial infection, with the presence of Methicillin-resistant *Staphylococcus aureus*, *Klebsiella aerogenes*, and *Enterobacter cloacae*.

2.6 Case 6

A 25-year-old male with a BMI of 15.77 and past medical history of Lesch-Nyhan syndrome, gastroesophageal reflux disease, baseline non-ambulatory status, and bilateral staghorn calculi with recurrent urinary tract infections. The patient was admitted for septic shock secondary to a complicated urinary tract infection. Urine cultures grew *Morganella* and *Klebsiella* species. The patient was started

on ertapenem per sensitivities. During hospitalization the patient had increasing oxygen requirements and work of breathing. Supplemental oxygen was escalated to HFNC at 50 L/min. Additionally, chest X-ray revealed near complete opacification of the right hemithorax with significant interval change in association with shift of the mediastinal structures to the right likely representing extensive atelectasis/collapse possibly due to mucous plugging. Considering the prior mentioned findings and increased oxygen requirements as well as suspicions of mucous plugging which may require bronchoscopic management, the patient underwent flexible bronchoscopy. Mucous plugging and food were identified and removed. Subsequently, FBI with a 7.0 endotracheal tube was successful on the first attempt. Fentanyl was administered pre-intubation for analgesia. The patient's pre-intubation vital signs showed a blood pressure of 127/97 mmHg and a heart rate of 105 beats per minute. Post-intubation, his blood pressure decreased to 109/71 mmHg, and his heart rate reduced to 84 beats per minute. Notably, the patient did not require vasopressor support either before or after the intubation procedure.

2.7 Case 7

A 59-year-old male with a BMI of 27.6 with a history of P-ANCA associated vasculitis, end-stage renal disease on hemodialysis, and chronic diastolic heart failure was admitted to the ICU for acute hypoxic respiratory failure due to hemoptysis, with concerns for diffuse alveolar hemorrhage. Initially, he was treated with broad-spectrum antibiotics and antifungals for *Candida* found on prior bronchoscopy and later transferred to the MICU for further management. A BAL revealed high MPO-ANCA IgG levels, leading to treatment with methylprednisolone, cefepime, and metronidazole. Antibiotics were later changed to linezolid and levofloxacin based on BAL culture results showing *Stenotrophomonas* and *Enterococcus faecium*. The patient was successfully extubated after 5 days and moved to the floor.

Subsequently, the patient developed recurrent acute hypoxic respiratory failure and persistent increasing oxygen requirements. Given the need for direct alveolar visualization and repeat BAL as well as the patients low blood pressure; the patient underwent FBI. Intubation was successful on the first attempt. Prior to the procedure, the patient was on Dexmedetomidine drip for sedation. Pre-intubation vital signs showed a blood pressure of 83/58 mmHg and a heart rate of 66 beats per minute. Post-intubation, his blood pressure slightly improved to 87/62 mmHg, and his heart rate increased to 70 beats per minute. Notably, the patient did not require vasopressor support. A subsequent BAL culture grew *Aspergillus* and *Enterococcus faecium*, which further guided antimicrobial therapy

2.8 Case 8

A 35-year-old male with a BMI of 66.4 with a history of renal transplant and chronic allograft rejection, obstructive sleep apnea, new-onset diabetes after transplant, and moderate group 2 pulmonary hypertension on 3 liters nasal cannula at baseline who was admitted with acute on chronic hypoxic respiratory failure and acute renal failure with significant volume overload. Oxygen saturation was 72% on 4 liters nasal cannula. The patient was then placed on BiPAP with some improvement of symptoms. High dose diuresis was started without improvement of symptoms. BiPAP could not be weaned off, and intubation was deemed necessary. Given the patient's condition of morbid obesity and anticipated difficult intubation; flexible bronchoscopic intubation was ensued. Blood pressure prior 126/85 and was 134/68 after the procedure.

2.9 Case 9

A 70-year-old male with a BMI of 28.6 and past medical history of hypertension, type-II diabetes, and hypothyroidism presented to the hospital with lower extremity weakness and large liver mass. During the admission, the patient developed acute hypoxic respiratory failure thought to be secondary to an aspiration event. On HFNC (setting FiO₂ 100% and 60L/min) the patient's saturation was 83%, he was later switched to with high pressure settings and FiO₂ 100%. However, he remained increasingly lethargic. CT scan of the chest performed the same day revealed right middle and lower lobe complete atelectasis with occlusion of the bronchus intermedius. Due to the need for intubation as well as concurrent bronchoscopic evaluation was necessary, FBI with subsequent bronchoscopic evaluation were performed. Blood pressure prior to the bronchoscopic intubation was 127/56 while on norepinephrine 0.3 mcg/kg/min and vasopressin 0.03 Units/min. FBI was performed with successful intubation on the first attempt. Pressures following intubation was 111/56 while on phenylephrine 1.5 mcg/kg/min and vasopressin 0.03 units/min. BAL was later attained.

Discussion

3.1. Study Discussion

As was demonstrated in the discussed cases, FBI has beneficial utility in securing definite airway in critically ill patients who are at risk for decompensation with administration of induction or paralytic agents used in RSI. Blood pressure levels were noted to be stable or even improved in these cases with some of them having reduced vasopressor support requirement following FBI. Other than airway securance, FBI benefits from the diagnostic and therapeutic aspects of bronchoscopies, as was discussed in cases 2 and 6, in which airway inspection, biopsies, and lavages may be collected directly after the airway is secured.

3.2. FBI vs RSI

RSI is still the preferred technique in the emergency setting. RSI is fast with patients paralyzed within 1 minute from administration of paralytics [1]. It serves beneficial for quicker airway placement without the need for specialized equipment as is the case in FBI. Thus, is beneficial in more resource limited areas. RSI is described as creating a suitable situation for endotracheal tube placement with mechanisms including abducted vocal cords, lack of vocal cord movements, and lack of cough reflex [5].

Regarding the success of intubation, a study was performed with first year anesthesiology residents who have never performed FBI were instructed on using it then were provided with simulated patients to assess success rates and attempts necessary for successful intubation. The study demonstrated that first-attempt intubation occurred in 87.1% and second attempt in 6.3%. After an average of 15 trials, there was demonstrated improvement in successful attempts. There was improvement of timing as well with minimal further improvements following 9 trials [6]. In another study, awake tracheal intubations with flexible bronchoscopic intubation in anticipated difficult airways were 88-100% successful [4]. A prospective observational multi-center data registry study assessed multiple items regarding emergency department related intubation and noted that approximately 82% of first attempt oral RSI were successful and all attempts were 96% [7].

3.3. Supportive equipment in FBI

Though FBI's can be used alone as a bougie and guidance tool, additional tools may be utilized for improvement in successful attempts, in speed, and evaluation of the airway. Of these tools, supraglottic airway devices (SAD) are used as a conduit for FBI. SAD's, when connected to an anesthetic circuit, allows for spontaneous or controlled ventilation and oxygenation [8]. Another example of tools that may be utilized in FBI is the utilization of video laryngoscopy which in a meta-analysis demonstrated improved first attempt intubation rates and time-to-successful intubation [9].

Conclusion

FBI is a useful tool in the intensivist's armament. Its benefit is notable when awake intubations are necessary in the hemodynamically unstable or if a patient has an anticipated complicated/difficult airway which allows for evaluation of the airway down to the trachea. Resuscitation of the crashing obese ED patient presents numerous challenges for the EP. Even prior to the development of critical illness, obese patients have alterations in respiratory physiology, circulatory physiology, and pharmacokinetics that significantly affect their ED evaluation and resuscitation. These alterations greatly affect the EP's approach to rapid sequence intubation;

initiation and management of mechanical ventilation; circulatory assessment; vascular access; CPR; and the dosing of critical, high-risk medications. It is our hope that, through the application of the pearls and pitfalls discussed in this article, the EP can minimize morbidity and mortality in this very sick patient population.

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