

Extubation in the Emergency Department and Resuscitative Unit Setting



Chidinma C. Nwakanma, MD^{a,*}, Brian Joseph Wright, MD, MPH^{b,c}

KEYWORDS

• ED Extubation • Resuscitation • Emergency Department Critical Care

KEY POINTS

- A subset of intubated patients can be extubated in the emergency department (ED).
- Appropriate physician and nurse monitoring is required for ED extubation to detect and manage potential complications and extubation failure.
- The disease process that led to intubation should be reversed before considering extubation in the ED.
- ED physicians should select patients with a low probability of extubation failure for ED extubation.

INTRODUCTION

Patients are placed on invasive mechanical ventilation (IMV) for many different reasons. The common goal is to safely protect the airway while maintaining adequate oxygenation and ventilation until the underlying disease process is reversed. Patients should be on IMV for the shortest amount of time that is medically necessary. Endotracheal Intubation (ETI) and IMV are life-saving interventions, but are associated with complications like ventilator-associated pneumonia, lung injury, venous thromboembolism, delirium, and acquired weakness. IMV also requires expensive and scarce critical care resources, including high-intensity nursing and intensive care unit (ICU) beds. Finally, ETI and IMV can be uncomfortable and painful.

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^a Department of Emergency Medicine, Perelman School of Medicine at the Hospital of University of Pennsylvania, 3400 Spruce Street, Philadelphia, PA 19104, USA; ^b Department of Emergency Medicine, Renaissance School of Medicine, Stony Brook University, 101 Nicolls Road, Health Sciences Center, Level 4, Stony Brook, NY 11794, USA; ^c Department of Neurosurgery, Renaissance School of Medicine, Stony Brook University, 101 Nicolls Road, Health Sciences Center, Level 4, Stony Brook, NY 11794, USA

* Corresponding author.

E-mail address: chidi776@gmail.com

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Resuscitation and critical care specialists should have expertise in both initiation and cessation of IMV.

Extubation is not a common emergency department (ED) practice. With the development of ED-ICUs and resuscitation units, and the increased boarding of critically ill patients managed by emergency medicine providers, ED extubation (EDEX) may become a more common practice. This article provides a framework for determining appropriate patients for EDEX and a practical approach on how to safely perform the procedure.

DIFFERENCES BETWEEN EXTUBATION IN THE EMERGENCY DEPARTMENT VERSUS INTENSIVE CARE UNIT

There is a paucity of published literature on EDEX. Weingart and colleagues¹ examined the safety of extubation in a cohort of 50 ED trauma patients cared for in a highly specialized ED with ICU-level nurse-patient ratios (1:2 or 1:3) and run by trauma and critical care specialists experienced in extubation. Selected patients were intoxicated, had no significant injury after the initial trauma workup was completed, or had injuries that required temporary deep sedation only. In carefully selected patients they found that EDEX was safe with no unplanned reintubations. Sixteen percent of their patients were discharged from the ED. The application of this and similar extubation studies from the ICU or Post Anesthesia Care Unit should be applied with caution to the general ED setting. EDEX is safe and feasible provided that certain unit logistic and patient features are met.^{1,2}

Close monitoring after extubation is the biggest obstacle to EDEX. The clinical environment must provide intensive monitoring by clinicians and nurses who can recognize and manage extubation failure and reintubate if necessary. Continuous pulse oximetry, telemetry, and blood pressure monitoring are a minimum. End-tidal carbon dioxide monitoring is not standard practice but may be helpful in determining the presence of apnea, airway obstruction, hypoventilation, or hypercapnia. Dedicated staff (1:1 or 1:2 nurse:patient) must continuously monitor a newly extubated patient, similar to recovering a patient after procedural sedation.

There is debate in extubation literature regarding acceptable reintubation or extubation failure rates.^{3,4} Extubation failure is associated with significant morbidity and mortality, even after correcting for the underlying disease process that led to extubation failure.⁴ ED patients are early in their disease process. If there is question or concern about extubation readiness and whether a particular disease process is resolved, then the patient should be extubated in a traditional ICU setting.

Patients with a low risk of reintubation should be selected (excluding elective reintubations) and the ED unit should have a goal of a near zero rate of reintubation. Patients should be monitored closely for an appropriate amount of time after extubation. Based on existing evidence, 1 hour should be the minimum duration for intensive monitoring and specific patient characteristics should also be considered after EDEX.¹ Patients with cardiac or lung disease may need to be observed for longer than 1 hour in a monitored setting. Further evidence is needed to determine optimal length of monitoring after EDEX.

SELECTION OF PATIENTS FOR EXTUBATION IN THE EMERGENCY DEPARTMENT AND RESUSCITATIVE UNIT

Patient selection for EDEX is highly dependent on the original indication for intubation, and should be more stringent than in the ICU (**Table 1**). For most patients intubated in the ED, a prolonged ventilatory course and ICU admission are necessary. A subset of patients may require only transient IMV.

Table 1 Suggested clinical presentations for emergency department extubation (EDEX) consideration/avoidance		
EDEX Can be Safely Attempted^a	EDEX Can be Considered with Caution^a	EDEX Should Not be Considered
<ul style="list-style-type: none"> • Intoxicated or drug overdose with clinical sobriety • Airway protection for procedural sedation (ie, endoscopy) • Head trauma with improving mental status and negative neuroimaging • Palliative/Terminal extubation^b 	<ul style="list-style-type: none"> • Anaphylaxis/laryngeal edema with improved symptoms and resolution of airway edema^c • Severe asthma/chronic obstructive pulmonary disease with significant improvement • Undifferentiated altered mental status^d • Cardiogenic pulmonary edema with significant improvement and resolved hypoxia/hypercarbia after aggressive management (eg, diuresis, afterload reduction) 	<ul style="list-style-type: none"> • Hemodynamically unstable • Need for high ventilatory support • Expected prolonged clinical course (eg, drowning, pneumonia) • Expected need for repeated invasive procedures, transfer or surgery • Significant neuromuscular disease (eg, myasthenia gravis, multiple sclerosis) • Trauma/Injury to cervical spine, oropharynx, larynx or lung • Cerebrovascular Accident (pons or brainstem lesions can affect airway maintenance)

^a Assuming all extubation criteria are achieved.

^b Extubation in this setting can be performed without meeting criteria.

^c Anaphylaxis may have biphasic distribution, thus despite initial improvement a secondary phase may occur even up to 24 h after primary presentation.

^d Undifferentiated altered mental status is a clinical challenge, as prediction of clinical course is difficult.

Indications for IMV must be resolved in the ideal EDEX candidate. Selected patients should meet ALL of the following criteria before consideration (**Box 1**).²

Resolution of Initial Indication for Intubation

Ventilator liberation will rely on the resolution of the condition that led to necessitation of IMV. This should be the first consideration of EDEX candidacy. The clinician should have

Box 1 Suggested inclusion criteria for emergency department extubation
<ul style="list-style-type: none"> • Resolution of initial indication for intubation • Able to oxygenate and ventilate on minimal ventilator settings • Awake and able to follow commands • Hemodynamically stable • Uncomplicated initial intubation • Expected to maintain airway patency postextubation • Anticipated hospital course does not require mechanical ventilation
<p><i>From Gray SH, Ross JA, Green RS. How to safely extubate a patient in the emergency department: a user's guide to critical care. CJEM 2013;15(5):303–306; with permission.</i></p>

a definitive understanding of the initial indication for IMV. This will indicate the likelihood of extubation failure. For example, the intoxicated patient (with no significant trauma) that is now exhibiting clinical sobriety is an ideal candidate for extubation. A drowning victim who may worsen in the next 24 hours would not be a good candidate (see **Table 1**).

Pulmonary Assessment: Ability to Oxygenate and Ventilate on Low Ventilator Settings

A patient's ability to oxygenate and ventilate on minimal ventilatory settings (continuous positive airway pressure [CPAP] alone or minimal pressure support [PS]) may be able to risk stratify the patient as low-risk for a failed extubation. Generally, a spontaneously breathing patient should be able to generate a tidal volume ≥ 5 mL/kg on CPAP or minimal PS and adequate oxygenation with a FiO_2 less than 40% on a positive end-expiratory pressure (PEEP) ≤ 8 .⁵ An arterial blood gas on minimal ventilator settings can support the decision to extubate in patients with cardiac or pulmonary pathology but may not be necessary in patients without cardiovascular or pulmonary pathology. Adequate oxygenation can be defined as oxygen saturation greater than 92% and PaO_2 greater than 70 mm Hg. Adequate ventilation can be defined as a PaCO_2 between 38 and 42 mm Hg.^{2,5}

A spontaneous breathing trial (SBT) can be helpful for clinicians to determine extubation readiness, especially if the patient was intubated for pulmonary or cardiovascular pathology. SBTs have been studied heavily and implemented in most ICU ventilator weaning strategies. Patients should be clinically and hemodynamically stable for an SBT. There are 3 potential approaches to an SBT (**Box 2**).^{4,6}

PS provides the most ventilatory assistance during the SBT and the T-piece provides the least.⁴ Current extubation guidelines recommend that a PS SBT is an acceptable screening for extubation readiness and may be more sensitive than the other methods.^{7–9} A CPAP-only or T-piece strategy may be more specific, but can incorrectly classify patients as SBT failures that may otherwise be extubated safely.^{4,10} CHEST and the American Thoracic Society⁷ recommend using a PS strategy in patients who have been on the ventilator for more than 24 hours.

Patients extubated in the ED setting should have an exceedingly low rate of reintubation. As a result, we recommend using a low PS trial or CPAP-only trial as it provides a good estimation of extubation readiness and does not require additional equipment. The SBT should be conducted for at least 30 minutes and no longer than 120 minutes.^{4,6} **Box 3** includes successful SBT criteria.²

The rapid shallow breathing index (RSBI) is a dynamic measurement that can be used during an SBT to determine extubation preparedness.^{9,11} RBSI is defined as follows:

Box 2

Ventilator setting options for spontaneous breathing trial

- Pressure support spontaneous breathing trial: pressure support (PS) of 5 cm H₂O (to overcome the resistance of the endotracheal tube [ETT]) with positive end-expiratory pressure (PEEP) ≤ 5 cm H₂O
- Continuous positive airway pressure only: PEEP ≤ 5 cm H₂O, no PS
- T-piece trial: Supplemental oxygen only through the ETT

Data from Thille AW, Richard JCM, Brochard L. The decision to extubate in the intensive care unit. *Am J Respir Crit Care Med* 2013;187(12):1294–1302. <http://doi.org/10.1164/rccm.201208-1523Cl>; and Zein H, Baratloo A, Negida A, Safari S. Ventilator weaning and spontaneous breathing trials; an educational review. *Emergency* 2016;4(2):65–71. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4893753/pdf/emerg-4-065.pdf>.

Box 3**Predictors of a successful spontaneous breathing trial**

- Respiratory rate <30 breaths per minute and more than 8 breaths per minute
- Heart rate <140 beats per minute and more than 60 beats per minute
- Systolic blood pressure less than 200 mm Hg and more than 90 mm Hg or less than 20% change from baseline
- Oxygen saturation greater than 92%, Pao₂ greater than 70 mm Hg (on FiO₂ <0.4 and PEEP ≤8 cm H₂O)
- Spontaneous tidal volume >5 mL/kg
- No signs of increased work of breathing, severe anxiety, or altered mental status

Data from Weingart SD, Menaker J, Truong H, Bochicchio K, Scalea TM. Trauma patients can be safely extubated in the emergency department. *J Emerg Med* 2011;40(2):235–239. <http://doi.org/10.1016/j.jemermed.2009.05.033>; and Gray SH, Ross JA, Green RS. How to safely extubate a patient in the emergency department: a user's guide to critical care. *CJEM* 2013;15(5):303–306.

Respiratory Rate (breaths per minute)/tidal volume (L)

Optimal breathing is slow and deep with a low RSBI. A patient with an inability to tolerate independent breathing will tend to breath fast and shallow generating a high RSBI. A threshold RSBI of less than 75 breaths per min/L (on PS ventilation) or less than 100 breaths per min/L (with T-piece) predict successful weaning and are more accurate than other accepted RSBI values.¹² RSBI less than 105 is wildly cited as an acceptable criterion for extubation success.^{4,12} We recommend using an RSBI of less than 75 breaths per min/L using the PS or CPAP trial technique in the ED. A lower RSBI cutoff is more specific and will potentially reduce the risk of extubating borderline patients.

Despite the common use of RSBI, it is important to remember that extubation evaluation is a global assessment and RSBI should not be used as a singular benchmark for success. In addition to the RSBI formula, the interpretation of SBT failure/success should also consider work of breathing, ability to clear secretions, and clinical appearance. Blood gas analysis is not always necessary to make this determination, especially if the patient was intubated for nonpulmonary indications. An arterial blood gas may be helpful for borderline cases or patients who were intubated for pulmonary indications, particularly if the clinician is concerned about effective oxygenation and ventilation at the end of the trial. If the SBT is successful, proceeding with extubation is encouraged as long as airway, hemodynamic, and neurologic criteria are met. In the setting of SBT failure, the patient should remain on full ventilatory support and the EDEX attempt should be aborted and deferred to the ICU.

Neurologic Assessment: Awake and Able to Follow Commands

When assessing a patient for extubation, it is important to ensure that the patient is fully awake and able to participate in independent breathing. Sedation should be weaned and time should be given to allow the patient to regain full consciousness. Small doses of analgesia or anxiolytic agents may be necessary to maintain patient comfort while sedation is discontinued. Dexmedetomidine (DMT) is an excellent anxiolytic that does not affect respiratory drive and may facilitate extubation in patients with agitation from pain or discomfort due to the endotracheal tube. DMT should not be given in bolus doses, as this is associated with significant bradycardia. The

onset of therapeutic effect is usually reached in 15 to 40 minutes.¹³ DMT use to facilitate safe extubation should be used only if the clinician is certain that the increased respiratory rate is from agitation due to the endotracheal tube and not from a respiratory or cardiovascular derangement. Clinically, the patient should spontaneously achieve normal or high tidal volumes. A blood gas may help discriminate tachypnea due to agitation versus ventilatory insufficiency. A high respiratory rate secondary to agitation will be associated with a respiratory alkalosis and low P_{CO_2} . A normal or elevated P_{CO_2} with a high respiratory rate should trigger the clinician to consider that the patient's agitation and tachypnea is a compensatory mechanism. Once the patient is awake, he or she should have a consistent neurologic examination, and be able to follow commands. Asking a patient to lift his or her head should always be included in the neurologic assessment, as cervical mobility and strength are vital for clearing secretions and maintaining a patent airway.

Cardiovascular Assessment: Hemodynamic Stability

Ensuring hemodynamic stability before extubation is a critical component of assessing readiness for extubation. An extubation candidate should be liberated from the use of inotropes and vasopressors. One suggested criterion for hemodynamic stability includes the following^{2,5}:

1. Oxygen saturation greater than 92% (on $F_{iO_2} < 0.4$)
2. Heart rate less than 100 beats per minute
3. Respiratory rate less than 30/min
4. Systolic blood pressure greater than 90 mm Hg unassisted by vasopressors
5. No active cardiac ischemia or unstable arrhythmia

Good clinical judgment would likely include these recommendations, along with the patient's hemodynamic baseline. Weaning-induced cardiovascular dysfunction is a well-described phenomenon, and a common cause for extubation failure.^{4,14,15} Risk factors include volume overload, depressed left ventricular dysfunction, diastolic dysfunction, structural heart disease, obesity, and chronic obstructive lung disease.¹⁴

Procedural Considerations

It is important to review initial airway assessment and documentation before extubation. Airway trauma may increase the risk of postintubation stridor and respiratory failure from airway compromise. Aspiration can lead to delayed airway compromise and progressive hypoxemia. Knowledge of a difficult airway, multiple ETI attempts, and airway trauma should lead to a more comprehensive assessment of airway patency. A cuff leak (CL) test may be indicated in certain patients.⁹

Maintenance of Airway Patency Postextubation

The ability to cough and adequately clear secretions is paramount in maintaining airway patency. Moderate to copious secretion volume is an independent predictor of extubation failure.¹⁶ The patient should be able to generate enough strength to lift his or her head off of the bed and produce a strong cough before extubation.

It is important to avoid extubation in patients with suspected ongoing laryngeal edema.^{17,18} Patients with brainstem strokes and cervical spine injuries have a high risk for reintubation.¹⁹ Extreme caution should be used in these patients and they are probably better served to be extubated in an ICU.

Anticipated Hospital Course Does Not Require Mechanical Ventilation

It is important to anticipate the patient's hospital course before considering extubation. Additional need for high-risk diagnostic testing where limited monitoring is available (ie, MRI), interhospital transfer, or need for future procedural sedation/general anesthesia should be considered. Patients with diseases that classically get worse during the early hospital stay, drowning, acute respiratory distress syndrome, pneumonia, spinal cord injury, ischemic and hemorrhagic cerebrovascular accidents, should remain intubated.

PHYSIOLOGICAL ASPECTS OF EXTUBATION AND MANAGEMENT OF CLINICAL COMPLICATIONS

Postextubation Hypoxemia

The transition from positive pressure ventilation (PPV) to negative-pressure ventilation can lead to significant physiologic cardiopulmonary challenges. Postextubation cardiac dysfunction is one of these well-described complications. Significant increases in left ventricular transmural pressure and afterload can occur after extubation. This can clinically present as an increased work of breathing, hypertension, pulmonary edema, hypoxemia, and progressive recurrent respiratory failure. Postextubation hypertension and new B-lines on lung ultrasound are both concerning signs of postextubation cardiac dysfunction. Myocardial ischemia, arrhythmias, and sudden cardiac death are rare but potential events that require clinical vigilance.¹⁵

Postextubation hypoxemia can also be the result of compromised pulmonary function and gas exchange. Significant de-recruitment, atelectasis, changes in work of breathing, increased airway resistance and shunt can all contribute to new onset hypoxemia or recurrent respiratory dysfunction after extubation. Soummer and colleagues²⁰ prospectively evaluated 86 ICU patients with lung ultrasound before extubation after a successful SBT. Of the patients who developed postextubation respiratory distress (more than 30%), there was a higher incidence of loss of lung aeration (indicated by development of new B-lines or consolidation on lung ultrasound) during their SBT. Lung ultrasound may be a clinically useful tool in assessing patients during SBT or after extubation with respiratory distress.

Management of postextubation cardiac dysfunction is similar to management of a patient with sympathetic crashing pulmonary edema. Intravenous nitroglycerin is an excellent agent to reduce cardiac preload and afterload. Diuretics also may be helpful, as negative fluid balance is associated with less extravascular lung water, better pulmonary function, and decreased ventilator time.²¹ The reinstatement of PPV with a trial of noninvasive ventilation (NIV) may be a valuable temporary intervention to allow time for aggressive medical management. However, similar to the use of NIV for other causes of acute respiratory failure, reintubation should not be delayed if the patient is not rapidly improving with these interventions.

Altered Mental Status and Agitation

The standard approach to extubation assessment includes pausing sedation to assess mental status and perform a neurologic examination. Agitation and delirium are common conditions in critical illness and may be either secondary to the primary underlying pathology or the clinical interventions (ie, intubation, sedative agents).

Delirium is characterized as fluctuating alteration in consciousness with impaired cognition. It can present as hyperactive, hypoactive, or mixed. Delirium in ICU patients is associated with prolonged mechanical ventilation, extended hospitalization, and increased risk of mortality.²² Delirium in the ED is usually a result of the underlying

presenting condition given the relatively short in-hospital time and ventilator duration compared with an inpatient ICU. Given the fluctuating course of delirium, if present, these patients should not be extubated in the ED.

Airway Assessment and Management of Postextubation Stridor

Careful airway assessment and management is paramount for anticipated extubation success. Often the clinician considering extubation was not present during the patient's initial presentation. Before proceeding with any extubation, all initial intubation documentation and airway evaluations should be reviewed to prepare for potential postextubation complications. For example, documentation of the presence of edema before intubation informs the clinician that this condition was not a result of the presence of the endotracheal tube (ET) tube. Resolution of preexisting edema should occur before extubation. Of note, ET-induced laryngeal edema usually occurs after the first 36 hours^{8,17,18} and this is usually greater than the average length of stay in an ED.

The CL test is used to predict postextubation stridor and is a surrogate marker of laryngeal edema.⁸ To perform a CL test, first document the patient's inspiratory and expiratory tidal volumes (TV) before ET tube cuff deflation on Volume Control IMV. While on Volume Control IMV, TV should *temporarily* be up titrated to 8 to 10 mL/kg ideal body weight, as lower TV may fail to show a CL when one is present.^{23,24} After the ET tube cuff is deflated, the difference between the inhaled and exhaled tidal volume represents the CL, or volume lost around the tube. The volume of air lost should be >110 mL.^{18,23,24} The CL can also be measured by an audible leak or volume loss approximately more than 24% tidal volume.²⁴ A small or absent CL (volume <110 mL) suggests laryngeal edema and is associated with an increased risk of postextubation stridor and respiratory distress.

Risk factors for postintubation laryngeal edema include traumatic intubation, intubation more than 6 days, large ET, female sex, and reintubation after unplanned extubation.^{8,24} Without these factors, a patient can be deemed low risk and extubated without a CL assessment.^{8,24} Higher-risk patients may benefit from a CL test, and if present likely safe to extubate. If CL is absent, initiation of intravenous (IV) glucocorticoid therapy may reduce edema and reduce risk for postextubation stridor. It is important to note that absence of a CL does not necessarily diagnose laryngeal edema. An oversized ET relative to the cross-sectional area of the patient's trachea or secretions around the deflated cuff can also cause a negative CL.

Ultimately, EDEX should be avoided in patients with suspected laryngeal edema or airway trauma. Peri-intubation laryngeal injuries should be viewed with great caution and avoided when selecting for EDEX. If a difficult airway was noted on the initial intubation, the patient may not be appropriate for EDEX. If the decision is made to proceed with extubation, appropriate difficult airway equipment should be readily available at the bedside along with a detailed reintubation plan that is discussed with the ED team before extubation.

Postextubation Stridor Management

Unfortunately, even low-risk patients may experience postextubation stridor.^{8,24} Prompt assessment and management is necessary to avoid additional morbidity. First, all equipment (including difficult airway equipment) and medications for potential reintubation should be readily available for all extubations. Stridor management generally involves administration of nebulized epinephrine and IV steroids (**Box 4**).¹⁷ The combination of steroids and epinephrine can reduce laryngeal edema by anti-inflammatory and vasoconstriction mechanisms, respectively. Consider emergent

Box 4**Recommended pharmacologic treatment for postextubation stridor**

- Steroids:
 - Methylprednisolone: 40 to 125 mg intravenous (IV) every 6 to 8 hours
 - Dexamethasone 5 mg IV every 6 hours
- Nebulized epinephrine:
 - 5 to 10 mL of undiluted "code epinephrine" (0.1 mg/mL, 1:10,000)
 - 0.5 mL of a 2.25% racemic epinephrine diluted in a volume of 2 to 4 mL

Data from Lee CH, Peng MJ, Wu CL. Dexamethasone to prevent postextubation airway obstruction in adults: a prospective, randomized, double-blind, placebo-controlled study. *Crit Care* 2007;11(4):R72. <https://doi.org/10.1186/cc5957>; and Pluijms WA, van Mook WN, Wittekamp BH, Bergmans DC. Postextubation laryngeal edema and stridor resulting in respiratory failure in critically ill adult patients: updated review. *Crit Care* 2015;19(1):295. <https://doi.org/10.1186/s13054-015-1018-2>.

reintubation if the patient is in severe respiratory distress, or if the stridor does not improve after 1 to 2 hours after treatment.

Before reintubation, direct airway assessment via nasopharyngolaryngoscopy may identify cause for airway obstruction; however, this may be difficult in a patient with significant respiratory distress. Potential etiologies that are refractory to steroids and epinephrine (eg, vocal cord paralysis, laryngeal lesions) can be identified and reintubation can be reconsidered based on the findings.

Palliative Extubation

Palliative extubation refers to the intentional cessation of ventilatory support to limit patient and family suffering. Usually palliative extubation is performed on the patient who is unknowingly intubated against his or her prior expressed desires, or diagnosed with a nonsurvivable medical condition after intubation that would not be consistent with his or her goals of care or desired quality of life (ie, devastating neurologic injury). These patients are ideal candidates for EDEx; however, extubation must be performed in an organized and well-communicated manner.

Initially, the patient's end-of-life wishes should be confirmed with the patient's health care proxy. This discussion should include a family meeting that details the patient's current clinical status, prognosis, expected outcome, postextubation protocol, and an offer of clergy or social work support if needed. The act of withdrawal of life support and extubation can be emotionally and ethically taxing for a patient's loved ones in many instances. It is important that communication is compassionate, yet informed and direct. If extubation is ultimately decided by the family and clinical team, it must be accomplished in a controlled manner to avoid patient and caregiver discomfort.

Providing comfort, alleviating patient or family distress, and effective team communication should be the cornerstone of any palliative extubation. First, the treatment plan should be thoroughly discussed with the patient's nurse and respiratory therapist. Nursing staff must perform frequent patient reassessments to guide medication titration after extubation. Turning off patient alarms can reduce unnecessary patient stimulation and family distress. Allow time for any paralytic to wear off (by identifying spontaneous breaths on the ventilator) so that the clinicians and nurses can assess for nonverbal cues of discomfort (eg, grimacing, tearing, sweating). Medications aimed at managing dyspnea and pain should be initiated before extubation. An opioid infusion, with additional as-needed boluses available for nursing, should be titrated for

signs of pain or respiratory distress. Anxiety can be managed with IV boluses of lorazepam or midazolam. Glycopyrrolate can be used to control copious oral secretions. These medications should be part of a standard comfort care order set available for use in the ED.

Once optimal comfort is achieved, the respiratory therapist may deflate the ET tube cuff and remove the tube. As the patient coughs or exhales, oral secretions should be suctioned. Room air is generally preferred, to avoid any unnecessary patient tubing that may cause discomfort. Supplemental oxygen may unnecessarily prolong the dying process, but more importantly seeing their loved ones unencumbered with medical devices may be more comforting to family members. Patients may expire minutes after extubation; however, admission to a general medical floor or other private area where palliative care can continue may be warranted in instances in which the patient does not immediately die.

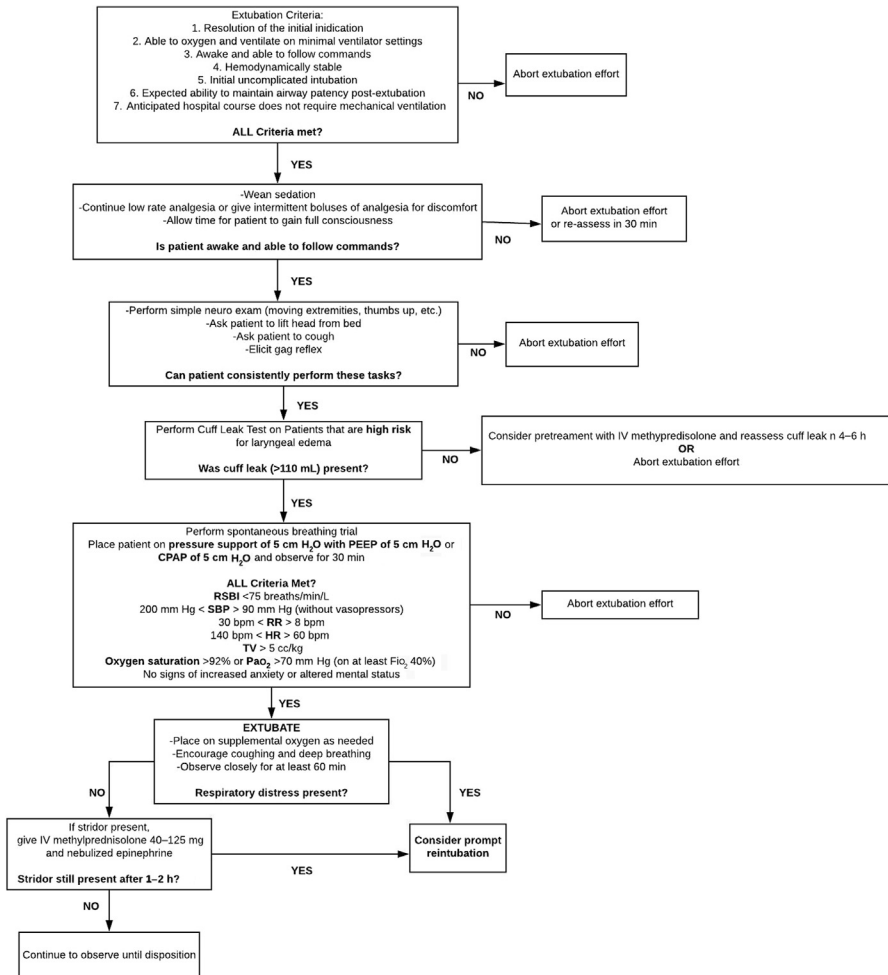


Fig. 1. Suggested EDEX pathway. bpm, beats per minute; HR, heart rate; RR, respiratory rate; SBP, systolic blood pressure.

One of the most discomforting experiences for families is to watch their loved one experience agonal respirations, gasping, or “death rattles.” It is often helpful to assess the patient for these issues after extubation and before bringing the family back to the bedside. Additional analgesia and anxiolytics are often helpful. Repositioning the airway with pillows under the shoulders and/or head may improve respiratory mechanics.

SUMMARY

A subset of patients can safely be extubated in the ED. There is a paucity of data on EDEX, but early extubation of carefully selected ED patients has the potential to minimize the risk of preventable ventilator complications and can also save scarce inpatient ICU resources. More objective data and published research in the ED setting would be helpful to prove or disprove these assertions.

EDEX should be done with diligence and attention to detail. The ED provider should be prepared for both common and life-threatening complications. Patients selected for EDEX should be low-risk for complications with a unit goal of a near zero reintubation rate. Intensive nursing care, monitoring, and reintubation equipment must be readily available. **Fig. 1** provides a suggested EDEX pathway. Unfortunately, there is no perfect predictor of extubation success, but objective risk stratification tools such as the RSBI during an SBT trial and CL test can improve the patient selection process.

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