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MINI-REVIEW

Pitfalls of difficult extubation in the ICU; when is the right time to extubate a patient?

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Abstract

Extubation in the intensive care unit continues to be a problematic decision, with a fairly large number of extubations requiring reintubation, resulting in higher patient morbidity and mortality. In order to maximise success rates of tracheal extubation, it is vital to have an airway management plan in place prior to attempting extubation. As compared to the rate of reintubation after planned post-operative extubations in the Operating room (OR), reintubation following unsuccessful extubation in the Intensive care unit (ICU) is a fairly common event, occurring in up to 25% of cases. The recent literature, including retrospective studies, meta-analyses and national society guidelines, prove that extubation in the ICU remains a risk for critically ill patients. Established procedures are intended to enhance and refine respiratory mechanics and airway protection, while also preparing for an extubation strategy. Extubation in the ICU remains a non-compulsory act, depending on the clinician's evaluation. When addressing prior difficult intubation, extubation should follow thoughtful steps, guided by an airway expert. If reintubation is needed, an easily reproducible approach should be followed, supervised by the aforementioned airway expert.

Keywords

Difficult extubation; Extubation failure; Reintubation; Non-invasive ventilation

1. Introduction

Difficulties and problems surrounding tracheal extubation are not a novel topic. Yet, unlike the focus placed on safety protocols surrounding intubation procedures in the ICU, patients are often extubated without a proper strategy to avoid potentially devastating consequences. Despite the increasing awareness of difficult or failed extubation and the accompanying life-threatening complications, one in five patients will need reintubation within 72 hours of their extubation, resulting in an increase in morbidity and mortality of 23–50% [1–3]. The 2011 Report of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society (NAP4) notes serious airway complications in operating rooms, emergency rooms, or ICUs in the UK over a 1-year period; it found the main contributors to adverse events and reintubations were poor airway management strategies, inadequate assessment of risk factors, and a lack of a planned exit strategy [4, 5].

The Difficult Airway Society in the United Kingdom published a set of guidelines for the management of tracheal extubation in 2012, predominantly based on expert opinions. The aim was to provide clinicians with a practical, easy-to-implement guideline [6]. Further studies should evaluate the current knowledge, support recent recommendations concerning airway management [7], and evaluate existing guidelines. As defined in the latest 2022 American Society of Anaesthesiologists Practice Guidelines for Management of the Difficult Airway, a difficult airway is "the clinical situation in which anticipated or unanticipated difficulty or failure is experienced by a physician trained in anaesthesia care, including but not limited to one or more of the following: facemask ventilation, laryngoscopy, ventilation using a supraglottic airway, tracheal intubation, extubation or invasive airway" [8].

In order to better understand and avoid confusion and ambivalence, it is necessary to pinpoint a few important frequently used terms. Extubation failure is "the inability to tolerate the removal of the translaryngeal tube" [9] or the "need for reintubation within hours or days after planned extubation" [9]. In terms of ICU settings [2], reasons for extubation failure include various causes of airway obstruction such as; upper airway oedema; bleeding with hematoma compressing the airway or blood clots obstructing the airway; laryngospasm; accumulation of secretion within the airway; and tracheomalacia and soft tissue collapse caused by anaesthetics. These adverse events at extubation are generally treated with tracheal reintubation and referred to as "extubation related airway complications" [4, 10]. In contrast to extubation failure, weaning failure is the "inability to tolerate spontaneous breathing without ventilator support" [9], which results in either tracheal reintubation or (in a select population) ventilation support using non-invasive ventilation [11, 12].

Commonly used weaning trials in the ICU do not safely assess "airway patency" or "airway competence", and weaning variables do not predict extubation failure [13]. In any discussion of difficult airway, two terms that should also be mentioned are "at risk extubation", meaning the patient's ability to maintain airway patency is uncertain [6], and "difficult extubation", referring to a mechanical obstacle such as subepiglottic stenosis, severe mucosal oedema, or even a tight surgical stich preventing extubation [14]. Failed extubation can be further grouped into those requiring immediate intubation (within the first 2 h following extubation) and delayed intubation (requiring reintubation 6–72 h after extubation) [15].

During the extubation period, patients are at increased risk of numerous complications, including hypoxemia, airway trauma, circulatory collapse and even death [16–18]. Moreover, a lack of planning or hesitation to reintubate contribute to significant morbidity [19]. To be able to evaluate the patient's ability to breathe sufficiently, one should identify conditions and mechanisms that might compromise the patient, returning him to mechanical support. These conditions and mechanisms could be "airway-related adverse events at extubation" [4, 5, 20] or weaning failure as the "inability to tolerate spontaneous breathing without ventilator support" [21].

2. Problems relating to difficult or failed extubation in ICU

Many patient-specific risk factors increase the likelihood of difficult or failed extubation in the ICU. These include obesity, pregnancy, sleep apnoea, head and neck pathology or surgery, and iatrogenic pathology. According to the Centers for Disease Control and Prevention, individuals with a body mass index >30 kg/m^2 are considered obese [22]. This patient population is difficult to ventilate, and have a higher incidence of pulmonary aspiration, airway obstruction, and oxygen desaturation following anaesthesia induction as compared to the general population [23, 24].

Furthermore, this group has an increased susceptibility to respiratory depression caused by opioids and anaesthetics, as well as a poor tolerance of the supine position owing to increased abdominal pressure on the diaphragm [23, 25, 26], all resulting in greater risk of hypoxia. These postoperative concerns are quite similar in patients with obstructive sleep apnoea. Patients with head and neck pathology or undergoing maxillofacial or major neck surgery are also at an increased risk of difficult or failed extubation and reintubation [27, 28]. Post-radiation airway oedema is a contributory factor for laryngeal obstruction after extubation [29]. Airway obstruction after cervical spine injury or anterior cervical spine surgery is known to be a cause of extubation failure. Since airway complications after cervical spine surgery are sometime subtle, they occur even in patients who have been kept intubated after surgery to avoid complications from slow-growing retropharyngeal haematomas [15]. In rheumatoid arthritis (RA), difficult intubation conditions due to decreased neck mobility can lead to post-extubation airway obstruction. Patients with RA may have deviation of the larynx, arthritis of the cricoarytenoid joints, and laryngeal rheumatoid nodules, all of which can contribute to airway obstruction following extubation [30–33]. Among the obstetric population, those in labour, and those undergoing non-obstetric surgery, obesity and airway oedema are contributory factors to extubation problems [34, 35].

In the ICU, extended mechanical ventilation can result in difficult weaning as a result of prolonged dependence on respiratory support. Patients dependent on mechanical ventilation develop respiratory muscle weakness and atrophy [36, 37]. Inadequate cough resulting from muscle weakness as well as possible residual effects of sedative drugs combined with excessive airway secretion may lead to loss of airway patency and thus to extubation failure [38–40]. It is necessary to improve underlying comorbidities such as chronic pulmonary obstructive disease, pneumonia, cardiac failure, neurological disorders or blunt thoracic injury to optimise the patient for extubation [2, 41–44]. Also, physicians should take care to avoid patient malnutrition and low pre-albumin serum levels, which correlate with shorter extubation time [45].

3. Evaluation and decision to extubate in the ICU

Patients who satisfy all the weaning criteria and pass a weaning readiness test still have an extubation failure rate ranging from 10 to 20% [46, 47]. Of the ICU population only 50–60% undergo planned extubation, a proportion of which require tracheostomy prior to an extubation attempt. Approximately 30% die while still intubated, others undergo terminal extubation [48, 49].

The role of extubation failure in patient mortality is still uncertain and requires further investigation to determine if it is a sign of poor prognosis. Thille *et al.* [49] conducted a prospective observational study, demonstrating that extubation failure and subsequent reintubation can decrease patients' chances of survival [49]. Reintubation is often tied to ventilator-associated pneumonia, which can lead to a significant decline in the health of ICU patients. Epstein *et al.* [50] found that late reintubation can also increase mortality rates in critically ill patients [50, 51]. Esteban and Ciubotaru conducted a study on non-invasive positive-pressure ventilation (NIV) for respiratory failure following extubation.

The study revealed that patients in the NIV group who experienced a 12-hour delay in reintubation had a higher mortality rate compared to those who were reintubated within 2 hours of signs of respiratory distress [51]. Conversely, other studies show that reintubation for transient upper airway obstruction is not associated with an increased risk of mortality. This suggests that it is extubation failure, rather than reintubation itself, that is responsible for higher mortality rate observed in some critically patients [50]. Ensuring appropriate respiratory mechanics and optimising clinical conditions by improving contributory comorbidities are essential to successful extubation, although they do not guarantee success [43].

Daily spontaneous breathing trials (SBT) are the gold standard for extubation estimation. For an SBT to be considered successful, patients should meet the following criteria: Oxygen saturation (SpO_2) $\geq$88%; The fraction of inspired oxygen (FiO_2) of $\leq$0.5; positive end expiratory pressure (PEEP) $\leq$8; no cardiopulmonary discomfort [52]. Patients must also be

haemodynamically stable, have good neuromuscular function, and have resolved or at least stable lung disease to be eligible for SBT. However, even a successful SBT does not guarantee that the patient will avoid reintubation, as it cannot account for numerous factors such as: supraglottic oedema; poor cough; excessive secretion; onset of new pathology. Thus, a combination of parameters such as respiratory rate, oxygen saturation, heart rate, blood pressure and patient discomfort should be used to judge the success of an SBT. Another useful weaning parameter is the rapid shallow breathing index (RSBI). As it predicts both failed SBT or difficult/failed extubation, it serves as another easily approachable assessment tool [53]. Patients with an index score above 105 (breaths/min/L) are likely to fail a weaning attempt. The index is calculated by dividing the patient's respiratory rate by tidal volume in litres (f/VT). RSBI remains the most consistent and powerful predictor of failed ventilator disconnection.

Underlying comorbidities, as mentioned before, are often an insufficiently recognised obstacle to successful extubation. Laryngeal oedema, ulceration, granulation and abnormal vocal cord motility are often seen in patients who have been mechanically ventilated in the ICU for extended periods [54]. Physicians take laryngeal pathology of this kind into consideration during head and neck surgery, but these are quite often overlooked in the ICU. The most frequent method by which to evaluate potential laryngeal obstruction after extubation is the presence or absence of a cuff leak [1, 15, 16, 55]. In patients without any cuff leak, but who have additional risk factors for difficult extubation, a short course of systemic steroids more than 12 h prior to extubation results in decreased airway obstruction and less frequent reintubation [55, 56].

Finally, it should be emphasized that planned extubation is an elective plan of action and not an urgent one. If potential problems are expected, it would be wise to further optimise the patient [56–59]. ICU patients are at increased risk of difficult airway management due to reduced physiological reserve and, consequently, a higher rate of morbidity and mortality [4]. Risk factors such as airway oedema following volume resuscitation, an unstable or immobilised spine, and morbid obesity are conditions that make both intubation and extubation difficult. The Difficult Airway Society (DAS) Guidelines Group published a consensus paper on tracheal extubation [6] consisting of three clear algorithms; basic, low-risk and at-risk, each of which has four steps: 1. Plan; 2. Prepare; 3. Perform, and; 4. Post-extubation care (Fig. 1). The algorithms are coherent and uncomplicated, and serve as a well-structured set of rules for handling the difficult airway.

During a planned difficult extubation, one should consider non-invasive ventilation (NIV) and high-flow nasal therapies, which have been recommended as potential plans in "at-risk" patients [60]. High-flow nasal cannula (HFNC) have not been proven inferior to NIV in terms of the rate of reintubation, mortality or improvement in respiratory function in patients at high risk of extubation failure [61].

Finally, elective tracheotomy should also be considered as an exit strategy [8, 16]. Prior to elective tracheotomy as an ultimate exit strategy, it is recommended to place the patient in a head-up position (if not contraindicated); the administration of supplemental oxygen should also be considered.

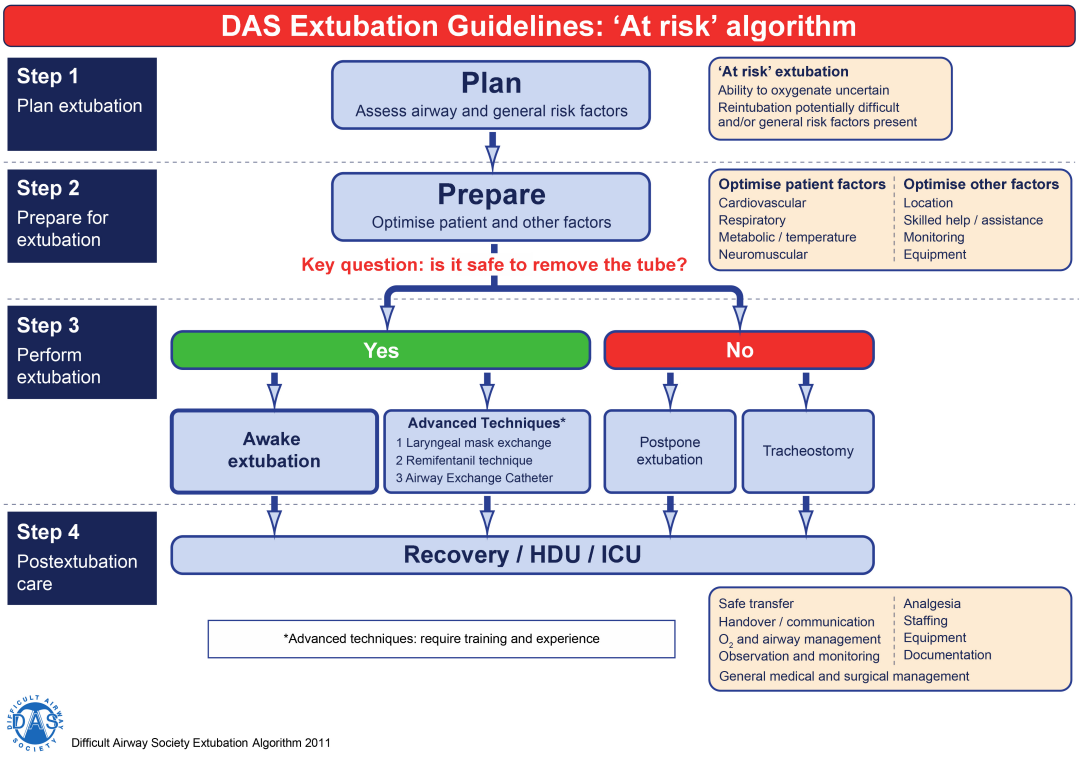

FIGURE 1. DAS extubation Guidelines: "at risk" algorithm. DAS: Difficult Airway Society; HDU: High dependency unit; ICU: Intensive care unit.

4. Conclusion

After decades of searching for a better solution, and despite technological and scientific advancement, we still struggle with the problem of difficult or failed extubation in the ICU. Although new methods and improvements exist, extubation failure rates reach 20% of all extubated patients in the ICU. Patients identified as potentially risky to extubate should be carefully assessed with a view to guiding extubation and reintubation if needed. For patients at risk, NIV or high flow nasal cannula (HFNC) with close monitoring for respiratory failure could be a bridge to safety. It should be noted that each extubation is indeed a "trial" that can easily turn into reintubation.

AVAILABILITY OF DATA AND MATERIALS

The data are contained within this article.

AUTHOR CONTRIBUTIONS

TM—wrote the manuscript, SB and AM—searched the literature and analysed the data in literature. All authors read and approved final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Sturgess DJ, Greenland KB, Senthuran S, Ajvadi FA, van Zundert A, Irwin MG. Tracheal extubation of the adult intensive care patient with a predicted difficult airway—a narrative review. Anaesthesia. 2017; 72: 248–261.

[2] Thille AW, Richard JM, Brochard L. The Decision to extubate in the intensive care unit. American Journal of Respiratory and Critical Care Medicine. 2013; 187: 1294–1302.

[3] Krinsley JS, Reddy PK, Iqbal A. What is the optimal rate of failed extubation? Critical Care. 2012; 16: 111.

[4] Cook TM, Woodall N, Frerk C. Major complications of airway management in the UK: results of the fourth national audit project of the royal college of anaesthetists and the difficult airway society. Part 1: anaesthesia. British Journal of Anaesthesia. 2011; 106: 617–631.

[5] Cook TM, Woodall N, Harper J, Benger J. Major complications of airway management in the UK: results of the fourth national audit project of the royal college of anaesthetists and the difficult airway society. Part 2: intensive care and emergency departments. British Journal of Anaesthesia. 2011; 106: 632–642.

[6] Mitchell V, Dravid R, Patel A, Swampillai C, Higgs A. Difficult airway society guidelines for the management of tracheal extubation. Anaesthesia. 2012; 67: 318–340.

[7] Crosby ET. An evidence-based approach to airway management: is there a role for clinical practice guidelines? Anaesthesia. 2011; 66: 112–118.

[8] Apfelbaum JL, Hagberg CA, Connis RT, Abdelmalak BB, Agarkar M, Dutton RP, *et al*. 2022 American society of anesthesiologists practice guidelines for management of the difficult airway. Anesthesiology. 2022; 136: 31–81.

[9] Epstein S. Decision to extubate. Intensive Care Medicine. 2002; 28: 535–546.

[10] Hartley M, Vaughan RS. Problems associated with tracheal extubation. British Journal of Anaesthesia. 1993; 71: 561–568.

[11] Blackwood B, Alderdice F, Burns K, Cardwell C, Lavery G, O'Halloran P. Use of weaning protocols for reducing duration of mechanical ventilation in critically ill adult patients: cochrane systematic review and meta-analysis. The BMJ. 2011; 342: c7237.

[12] Perkins GD, Mistry D, Gates S, Gao F, Snelson C, Hart N, *et al*. Effect of protocolized weaning with early extubation to noninvasive ventilation *vs.* invasive weaning on time to liberation from mechanical ventilation among patients with respiratory failure. JAMA. 2018; 320: 1881.

[13] Ko R, Ramos L, Chalela JA. Conventional weaning parameters do not predict extubation failure in neurocritical care patients. Neurocritical Care. 2009; 10: 269–273.

[14] Yazbek-Karam VG, Haswani RW, Karam HS, Haddad WM, Youssef PS, Hachem BF, *et al*. Unusual case of difficult double-lumen endotracheal tube removal. Journal of Clinical Anesthesia. 2009; 21: 514–516.

[15] Cavallone LF, Vannucci A. Extubation of the difficult airway and extubation failure. Anesthesia & Analgesia. 2013; 116: 368–383.

[16] Parotto M, Cooper RM, Behringer EC. Extubation of the challenging or difficult airway. Current Anesthesiology Reports. 2020; 10: 334–340.

[17] Artime CA, Hagberg CA. Tracheal extubation. Respiratory Care. 2014; 59: 991–1002; discussion 1002–1005.

[18] Joffe AM, Aziz MF, Posner KL, Duggan LV, Mincer SL, Domino KB. Management of difficult tracheal intubation. Anesthesiology. 2019; 131: 818–829.

[19] Heidegger T. Extubation of the difficult airway—an important but neglected topic. Anaesthesia. 2012; 67: 213–215.

[20] Metzner J, Posner KL, Lam MS, Domino KB. Closed claims' analysis. Best Practice & Research Clinical Anaesthesiology. 2011; 25: 263–276.

[21] Epstein S. Decision to extubate. Intensive Care Medicine. 2002; 28: 535–546.

[22] Ramachandran SK, Nafiu OO, Ghaferi A, Tremper KK, Shanks A, Kheterpal S. Independent predictors and outcomes of unanticipated early postoperative tracheal intubation after nonemergent, noncardiac surgery. Anesthesiology. 2011; 115: 44–53.

[23] Kristensen MS. Airway management and morbid obesity. European Journal of Anaesthesiology. 2010; 27: 923–927.

[24] Singh P, Liew W, Negar A. Airway management in patients suffering from morbid obesity. Saudi Journal of Anaesthesia. 2022; 16: 314.

[25] Benumof JL. Obesity, sleep apnea, the airway and anesthesia. Current Opinion in Anaesthesiology. 2004; 17: 21–30.

[26] Seet E, Chung F. Management of sleep apnea in adults—functional algorithms for the perioperative period: continuing professional development. Canadian Journal of Anesthesia. 2010; 57: 849–864.

[27] Mathew JP, Rosenbaum SH, O'Connor T, Barash PG. Emergency tracheal intubation in the postanesthesia care unit physician error or patient disease? Anesthesia & Analgesia. 1990; 71: 691–697.

[28] Dosemeci L, Yilmaz M, Yegin A, Cengiz M, Ramazanoglu A. The routine use of pediatric airway exchange catheter after extubation of adult patients who have undergone maxillofacial or major neck surgery: a clinical observational study. Critical Care. 2004; 8: R385–R390.

[29] Burkle CM, Walsh MT, Pryor SG, Kasperbauer JL. Severe postextubation laryngeal obstruction: the role of prior neck dissection and radiation. Anesthesia & Analgesia. 2006; 102: 322–325.

[30] Voulgari PV, Papazisi D, Bai M, Zagorianakou P, Assimakopoulos D, Drosos AA. Laryngeal involvement in rheumatoid arthritis. Rheumatology International. 2005; 25: 321–325.

[31] Jurik AG, Pedersen U, Nøorgård A. Rheumatoid arthritis of the cricoarytenoid joints: a case of laryngeal obstruction due to acute and chronic joint changes. The Laryngoscope. 1985; 95: 846–848.

[32] Leicht MJ, Harrington TM, Davis DE. Cricoarytenoid arthritis: a cause of laryngeal obstruction. Annals of Emergency Medicine. 1987; 16: 885–888.

[33] Bamshad M, Rosa U, Padda G, Luce M. Acute upper airway obstruction in rheumatoid arthritis of the cricoarytenoid joints. Southern Medical Journal. 1989; 82: 507–510.

[34] Kuczkowski KM, Reisner LS, Benumof JL. Airway problems and new solutions for the obstetric patient. Journal of Clinical Anesthesia. 2003; 15: 552–563.

[35] Mhyre J, Riesner M, Polley L, Naughton N. A series of anesthesia-related maternal deaths in Michigan, 1985–2003. Anesthesiology. 2007; 106: 1096–1104.

[36] Goligher EC, Dres M, Fan E, Rubenfeld GD, Scales DC, Herridge MS, *et al*. Mechanical ventilation-induced diaphragm atrophy strongly impacts clinical outcomes. American Journal of Respiratory and Critical Care Medicine. 2018; 197: 204–213.

[37] Hermans G, Van den Berghe G. Clinical review: intensive care unit acquired weakness. Critical Care. 2015; 19: 274.

[38] Su W, Chen Y, Chen C, Yang S, Su C, Perng W, *et al*. Involuntary cough strength and extubation outcomes for patients in an ICU. Chest. 2010; 137: 777–782.

[39] Khamiees M, Raju P, DeGirolamo A, Amoateng-Adjepong Y, Manthous CA. Predictors of extubation outcome in patients who have successfully completed a spontaneous breathing trial. Chest. 2001; 120: 1262–1270.

[40] Smina M, Salam A, Khamiees M, Gada P, Amoateng-Adjepong Y, Manthous CA. Cough peak flows and extubation outcomes. Chest. 2003; 124: 262–268.

[41] Salam A, Tilluckdharry L, Amoateng-Adjepong Y, Manthous CA. Neurologic status, cough, secretions and extubation outcomes. Intensive Care Medicine. 2004; 30: 1334–1339.

[42] Rishi MA, Kashyap R, Wilson G, Schenck L, Hocker S. Association of extubation failure and functional outcomes in patients with acute neurologic illness. Neurocritical Care. 2016; 24: 217–225.

[43] Joffe A, Barnes CR. Extubation of the potentially difficult airway in the intensive care unit. Current Opinion in Anaesthesiology. 2022; 35: 122–129.

[44] Thille AW, Cortés-Puch I, Esteban A. Weaning from the ventilator and extubation in ICU. Current Opinion in Critical Care. 2013; 19: 57–64.

[45] Scarcella M, Scarpellini E, Ascani A, Commissari R, Scorcella C, Zanetti M, *et al*. Effect of whey proteins on malnutrition and extubating time of critically ill COVID-19 patients. Nutrients. 2022; 14: 437.

[46] Frutos-Vivar F, Ferguson ND, Esteban A, Epstein SK, Arabi Y, Apezteguía C, *et al*. Risk factors for extubation failure in patients following a successful spontaneous breathing trial. Chest. 2006; 130: 1664–1671.

[47] Frutos-Vivar F, Esteban A, Apezteguia C, González M, Arabi Y, Restrepo MI, *et al*. Outcome of reintubated patients after scheduled extubation. Journal of Critical Care. 2011; 26: 502–509.

[48] Epstein SK, Ciubotaru RL, Wong JB. Effect of failed extubation on the outcome of mechanical ventilation. Chest. 1997; 112: 186–192.

[49] Thille AW, Harrois A, Schortgen F, Brun-Buisson C, Brochard L. Outcomes of extubation failure in medical intensive care unit patients. Critical Care Medicine. 2011; 39: 2612–2618.

[50] Epstein S, Ciubotaru R. Independent effects of etiology of failure and time to reintubation on outcome for patients failing extubation. American Journal of Respiratory and Critical Care Medicine. 1998; 158: 489–493.

[51] Esteban A, Frutos-Vivar F, Ferguson ND, Arabi Y, Apezteguía C, González M, *et al*. Noninvasive positive-pressure ventilation for respiratory failure after extubation. New England Journal of Medicine. 2004; 350: 2452–2460.

[52] Girard TD, Kress JP, Fuchs BD, Thomason JW, Schweickert WD, Pun BT, *et al*. Efficacy and safety of a paired sedation and ventilator weaning protocol for mechanically ventilated patients in intensive care (Awakening and Breathing Controlled trial): a randomised controlled trial. The Lancet. 2008; 371: 126–134.

[53] Yang KL, Tobin MJ. A prospective study of indexes predicting the outcome of trials of weaning from mechanical ventilation. New England Journal of Medicine. 1991; 324: 1445–1450.

[54] Tadié J, Behm E, Lecuyer L, Benhmamed R, Hans S, Brasnu D, *et al*. Post-intubation laryngeal injuries and extubation failure: a fiberoptic endoscopic study. Intensive Care Medicine. 2010; 36: 991–998.

[55] François B, Bellissant E, Gissot V, Desachy A, Normand S, Boulain T, *et al*. 12-h pretreatment with methylprednisolone versus placebo for prevention of postextubation laryngeal oedema: a randomised double-blind trial. The Lancet. 2007; 369: 1083–1089.

[56] Quintard H, l'Her E, Pottecher J, Adnet F, Constantin JM, De Jong A, *et al*. Experts' guidelines of intubation and extubation of the ICU patient of French Society of Anaesthesia and Intensive Care Medicine (SFAR) and French-speaking Intensive Care Society (SRLF) : In collaboration with the pediatric Association of French-speaking Anaesthetists and Intensivists (ADARPEF), French-speaking Group of Intensive Care and Paediatric emergencies (GFRUP) and Intensive Care physiotherapy society (SKR). Ann Intensive Care. 2019; 9: 13.

[57] Mitchell V, Dravid R, Patel A, Swampillai C, Higgs A. Difficult airway society guidelines for the management of tracheal extubation. Anaesthesia. 2012; 67: 318–340.

[58] Bösel J. Who is safe to extubate in the neuroscience intensive care unit? Seminars in Respiratory and Critical Care Medicine. 2017; 38: 830–839.

[59] Langeron O, Bourgain JL, Francon D, Amour J, Baillard C, Bouroche G, *et al*. Difficult intubation and extubation in adult anaesthesia. Anaesthesia Critical Care & Pain Medicine. 2018; 37: 639–651.

[60] Parotto M, Cooper RM, Behringer EC. Extubation of the challenging or difficult airway. Current Anesthesiology Reports. 2020; 10: 334–340.

[61] Wang Q, Peng Y, Xu S, Lin L, Chen L, Lin Y. The efficacy of high-flow nasal cannula (HFNC) versus non-invasive ventilation (NIV) in patients at high risk of extubation failure: a systematic review and meta-analysis. European Journal of Medical Research. 2023; 28: 120.

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