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Direct laryngoscopy to predict extubation success following a failed cuff leak test in intensive care patients

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1. Introduction

Extubation failure in the intensive care unit (ICU) has a historical mortality rate of 26–50% [1]. Extubation failure can be multifactorial. Laryngeal oedema is a recognised risk factor, with the incidence varying from 0.6 to 36.8% [2,3].

The endotracheal tube cuff leak test (CLT) may help to predict extubation failure, and two techniques are described [3,4]. The qualitative method involves auscultating for airflow around an electively deflated endotracheal tube cuff. The quantitative method involves measuring the cuff leak volume [3]. The optimal method to conduct the CLT remains uncertain [3].

One systematic review estimated that a failed CLT (defined as absence of airflow around the deflated cuff) increases the risk of extubation failure to 17%, if the baseline extubation failure rate is 5%. A successful CLT (defined as the presence of airflow around the deflated cuff) decreases the risk of extubation failure to 2% [5]. Another systematic review reported that the CLT had a specificity of 0.90 and an area under the summary receiver operator characteristic curve of 0.92, in patients who were intubated more than 5 days [3].

The American Thoracic Society (ATS) and American College of Chest Physicians (ACCP) recommend administering a course of systemic corticosteroids before extubation for patients who fail a CLT [6]. A systematic review suggests that this recommendation, in the absence of large randomised controlled studies, is reasonable [7]. However, a failed CLT does not necessarily indicate significant pathology, and deferring extubation may prolong invasive ventilation unnecessarily.

Direct laryngoscopy can be used to assess laryngeal swelling by allowing direct visualisation of airway structures. Our literature search found no studies using this technique in patients who fail a CLT. This study was therefore conducted to determine if direct laryngoscopy could identify patients who could be immediately and successfully extubated following a failed CLT.

2. Methods

We performed a prospective, observational study of consecutive extubations in a 13-bed tertiary hospital ICU, between March 2017 and October 2018. Data was collected on whether a CLT or direct laryngoscopy was performed prior to extubation, and whether the patient's extubation attempt was successful (defined as not being reintubated within 72 h following extubation). The requirement to obtain written informed consent was waived by the institution's human research ethics committee (CH62/6/2016-240).

Patients were excluded if they had a tracheostomy inserted or were extubated in the operating theatre. The ICU did not have a specific protocol to determine suitability for extubation, or when to perform a CLT or direct laryngoscopy. The decision to wean, perform a CLT, perform direct laryngoscopy or to extubate a patient was at the discretion of the treating Intensivist.

The CLT was performed by deflating the endotracheal tube cuff, after adequate preparation, while the patient was spontaneously breathing on a ventilator or manual breathing circuit. The cuff leak

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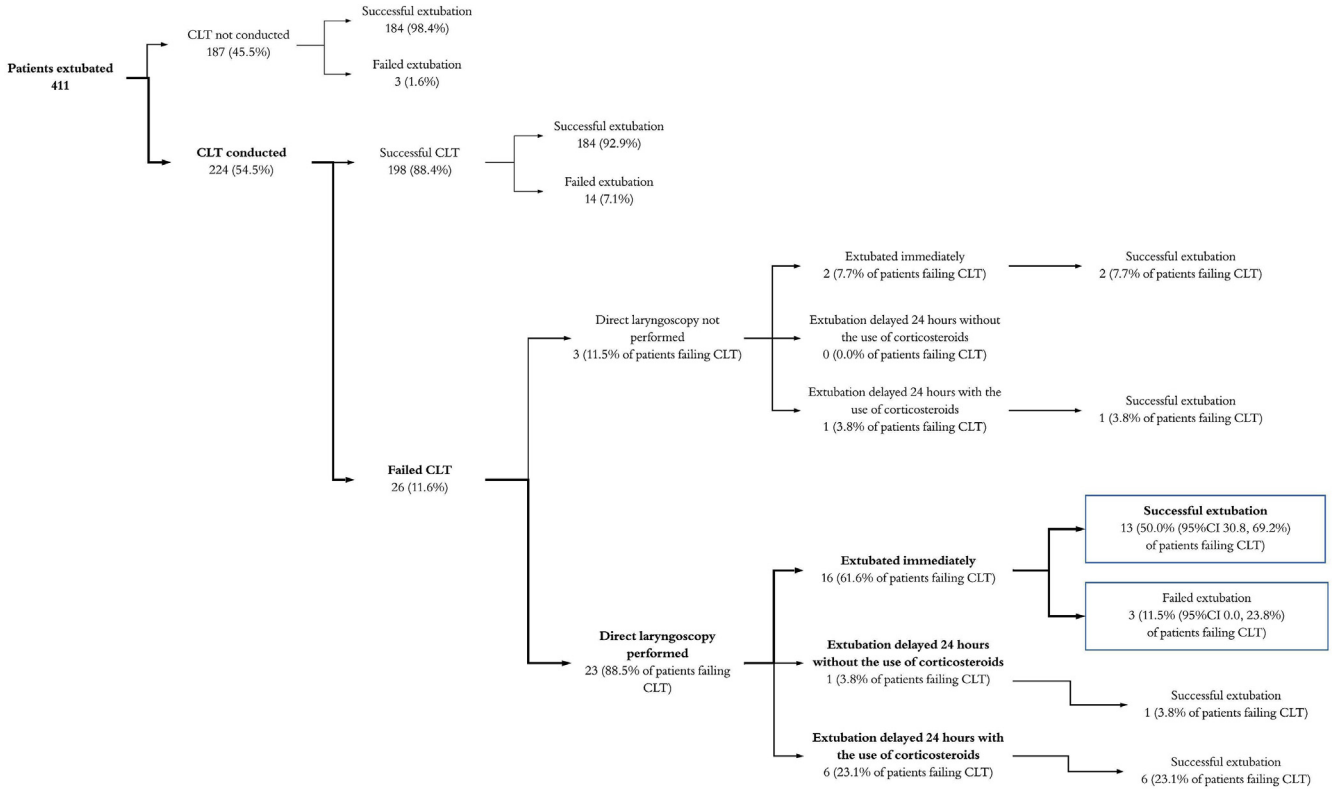

Fig. 1. Results of direct laryngoscopy following a failed cuff leak test. Legend: A successful cuff leak test (CLT) was defined as the auscultation of airflow around an electively deflated endotracheal tube cuff. A failed CLT was defined as no auscultation of airflow around an electively deflated endotracheal tube cuff. A successful extubation was defined as the patient not being reintubated within 72 h.

was determined qualitatively by auscultation only and the magnitude of the leak was not quantified. Inter-rater agreement was not assessed. Ventilators were in pressure support mode, if used during the CLT, and pressure settings were at the discretion of the treating intensivist. Direct laryngoscopy was performed using intravenous sedation and standard Macintosh laryngoscope blade or C-MAC video laryngoscope (Karl Storz, Germany). A quantitative measure of airway swelling was obtained using the Patterson Oedema Score, a rating scale where 11 airway structures and 2 airway spaces are rated from 0 (normal) to 3 (severe oedema or severe narrowing), and the results totalled, to give a score from 0 to 39 [8].

3. Results

Over the study period, 411 patients were extubated in the ICU. The mean patient age was 61 years, mean APACHE 2 score was 18 and the mean duration of ventilation was 87 h.

Of the 26 patients who failed a CLT, direct laryngoscopy resulted in 16 patients being immediately extubated, of which 13 (50.0% of patients who failed a CLT (95% confidence interval (CI) 30.8, 69.2%)) were successful and 3 (11.5% of patients who failed a CLT (95%CI 0.0, 23.8%)) failed extubation. The median Patterson Oedema Score and range was 3 and 2–12 in patients who were successfully extubated, and the two patients who failed extubation had scores of 7 and 8.

4. Discussion

This study generates a plausible hypothesis that performing direct laryngoscopy in ICU for patients who failed a CLT may allow some of these patients to be extubated immediately and successfully. This may mitigate many hours of unnecessary invasive ventilation and suggests that the current ATS and ACCP recommendation of corticosteroid administration for patients with a failed CLT may be inordinate. Our findings are not conclusive, and need to be confirmed with further studies.

A limitation of direct laryngoscopy is that not all airway swelling can be visualised. The limitations of the study include its observational design, small sample size, a low extubation failure rate, limited numbers of patients in a potential control group where direct laryngoscopy was not performed following a failed CLT, and the absence of a protocol in the ICU to guide the CLT and direct laryngoscopy.

Future studies should evaluate direct laryngoscopy in other ICU settings however, a definitive answer can only be obtained with a large, randomised, controlled study.

5. Conclusion

In conclusion, direct laryngoscopy may be useful in predicting extubation success in ICU patients with a failed CLT, but requires further research. Fig. 1.

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