**Original article**

# Evaluation between Cough Peak Flow and Cough Strength Score for Anticipating Reintubation after Scheduled Extubation

Zaid E.Alawneh, Kafa M.Aldalala'h*, Rayya K.Almashaqbah, Hafiz S.Alshorofat, Mohammad Alhaek

*Correspondence: Kafa M.Aldalala'h, Email: dkafa85@yahoo.com

**Abstract:**

**Introduction:** Cough peak flow and cough strength score were used to anticipate extubation results in patients where extubation was scheduled.

**Methods:** Our prospective, randomized and double-blind investigation included 204 patients who were candidates for extubation after a successful spontaneous breathing test in the intensive care unit of King Hussein medical center, Amman, Jordan, during the period Feb 2014-Apr2016. Cough strength score (CSS, graded 0-5) and cough peak flow (CPF) were evaluated before extubation. Reintubation was recorded 3 days after extubation.

**Findings:** Reintubation incidence was 12.7 %( 26) during 3 days after scheduled extubation. Patients with successful extubation had more cough strength scores than did reintubated patients (mean +/-SD, 2.8 +/-1.4, 1.7 +/-1.3, respectively, $P < 0.05$) and cough peak flow (69.2 +/-31.4, 45.4 +/-19.9 L/min, respectively, $P < 0.05$). The cough strength score demonstrated a positive association with cough peak flow (P <0.05). Mean cough peak flows were 33.1 L/min, 34.4 L/min, 39.2 L/min, 52.6 L/min, 71.9 L/min, and 106.8 L/min in patients with cough strength scores of 0, 1, 2, 3, 4, and 5, respectively. While cough strength score increased from 0 to 1 to 2 to 3 to 4 to 5, the reintubation incidence reduced from 26.96%(55) to 22.5%(46) to 16.7%(34) to 13.7%(28) to 10.8%(22) to 1.96%(4).

**Conclusion:** Cough strength score was suitable to record at the bedside in our intensive care unit. Cough strength score was positively associated with cough peak flow and had the same result for anticipating reintubation after scheduled extubation.

**Keywords:** Cough peak flow, cough strength, reintubation, extubation

## Introduction:

The frequency of complications after intensive care unit stay is increased. Few of these are unavoidable and may cause medical emergemcies. Of these complications is the extubation failure which is due to either scheduled extubation or unscheduled extubation. Unscheduled extubation is considered a real hazard in all intensive care units around the world and in the same time is a major hazard in mechanically ventilated patients. Extubation is the final destination of weaning from intermittent positive pressure ventilation after a spontaneous breathing test. The incidence of reintubation is 15% in patients with scheduled extubation (1).The opinion to extubate or not is one of the important ones of physicians. Extubation in some units depends on experience than on clinic grounds causing difference in practical issues and period of mechanical ventilation. Prolonged intubation has serious implications including ventilator correlated pneumonia and high intensive care unit admission, while premature extubation may cause reintubation. In critical patients, the reintubation incidence is more than 30% (2). Death incidence is more in reintubated patients (50%) than in extubated patients (5%) (3).It is mandatory to enhance the protocol of weaning and extubation by recognizing patients with increased risk of reintubation.

Cough peak flow (CPF), recorded before extubation, is an anticipant of reintubation (4). It has moderate to high sensitivity and specificity if or not the extubation will be optimum. Recording CPF in intubated patients' needs a spirometer, which may not be found in many intensive care units. Researchers had suggested the use of a cough strength score (CSS), graded from 0 (weak) to 5 (potent), to anticipate reintubation after scheduled extubation (5). The patients with a reduced CSS had a more risk of reintubation. The CSS, if it is as accurate as CPF for anticipating reintubation remains to be answered. The aim of our investigation was to evaluate between CSS and CPF in anticipating reintubation.

## Methods:

Our prospective, randomized and double-blind investigation included 204 patients who were candidates for weaning off intermittent ventilation and extubation after a successful spontaneous breathing test in the intensive care unit of King Hussein medical center, Amman, Jordan, during the period Feb 2014-Apr 2016, after obtaining approval of the Royal medical services ethical and research board review committee and written informed consent from all participants relatives.

A Ramsay score of 3 - 4 was sustained if agitation or patient-ventilator asynchrony occurred. Sedation was stopped every morning if the patient was quiet, and if not, the sedation was resumed. Every morning, patients were assessed for readiness to be weaned off mechanical ventilation. After an optimum spontaneous breathing test, the endotracheal tube was removed. Before extubation, the patients were positioned at 30° - 45°, the CSS was recorded first, and then recorded the CPF: To record CSS, patients coughed with as much effort as possible after disconnecting the ventilator. The cough strength was scored from 0 to 5 as: 0 = no cough on command, 1 = audible movement of air via the endotracheal tube but no audible cough, 2 = weakly (barely) audible cough, 3 = clearly audible cough, 4 = stronger cough and 5 = multiple sequential strong coughs (5).

To record CPF, we used a spirometer to be connected to the endotracheal tube. Before recording, secretions were cleared by suctioning and patients were oxygenated with pure oxygen for 3 minutes. Then the ventilator was disconnected, and the spirometer was connected to the endotracheal tube, and the patient coughed with as much effort as possible. The highest CPF was recorded from 3 recordings.

Reintubation was required if the patients demonstrated tachypnea, hypoxemia, hypercapnia, hemodynamic instability, reduced consciousness, diaphoresis, or clinical signs of respiratory muscle fatigue.

Reintubation was recorded during 3 days after extubation.

CPF between various CSS groups was statistically analyzed by using ANOVA. The Pearson correlation coefficient was used to evaluate the association between CSS and CPF. A *P* value less than 0 .05 was considered significant.

## Findings:

The demographic data of patients are demonstrated in table 1. The reintubation incidence was 12.7 % (26) during 3 days after scheduled extubation. The pre-extubation data after a spontaneous breathing test was shown in table 2. The successfully extubated patients experienced more CPF (69.2+/-31.4) compared to (45.4 +/-19.9) L/min, *P* <0.05, and more CSS (2.8 +/-1.4) compared to (1.7 +/-1.3), *P* <0.05. The diagnostic precision of CSS was not different from that of CPF.

The CSS increased continuously as CPF increased (Table 3). The CSS demonstrated a potent positive association with CPF (P <0 .05).The reintubation incidence increased as the CSS reduced. Patients with CSSs of 4, 3, 2, 1, and 0, respectively, were 2.9, 3.7, 4.1, 5.8, and 6.9 times as likely to be reintubated as were patients with a CSS of 5 during 3 days after scheduled extubation (Table 4).

## Discussion:

Extubation failure is the inability to maintain a spontaneous breathing after removal of the artificial airway, while the reintubation is during a specified time within 24-72h or up to 7 days. Reintubation was correlated with a 5-fold increase in the relative odds of death and a 2-fold increase in admission in the intensive care unit, hospital admission, and costs (6). Recognizing the anticipators of reintubation is important for health providers. CPF is an independent anticipator of reintubation (7). Patients with unsuccessful extubation experienced remarkably less CPFs than patients with successful extubation. An optimal threshold measurement of 60 L/min was obtained in anticipating extubation failure at 3 days after primary extubation. In our investigation, an optimal cutoff point was comparable to the cutoff found by previous authors. It had comparable precision in anticipating reintubation at 3 days after primary extubation.

CSS was initially introduced in 2001(5). The previous investigation enrolled 91 patients with 100 extubations.Patients with weak (grade 0–2) coughs were 4 times more to have unsuccessful extubation, compared with patients with moderate to strong (grade 3–5) coughs (risk ratio, 4.0; 95% CI, 1.8–8.9) at 3 days after extubation(5). Reintubation was increasingly correlated with cough strength. In patients with CSS of 5, patients with CSSs from 4 to 0 were 2.9 to 6.9 times more at risk for reintubation. The reintubation incidence was as high as 26% in patients with a CSS of 0. Caution must be experienced in patients with weak cough strength. If extubation is performed, these patients must have ameliorated airway management such as optimum humidification, chest physio- therapy, administration of expectorant drugs.

The CPF is a measurement of cough strength. It is increasingly correlated with reintubation after scheduled extubation (8). The sensitivity and specificity of CSS for anticipating reintubation were comparable to those for CPF (9).It was shown that the CSS had a strong positive association with CPF .Recording of CPF in intubated patients' needs a spirometer, a bacterial filter to avoid cross-contamination, and a special connector to connect the spirometer to the endotracheal tube. The CSS, on the other hand, is a scale (graded 0–5) and does not need any instrument. CSS is easy and suitable for health providers to evaluate cough strength. Among mechanically ventilated patients, those with chronic obstructive lung disease are major and difficult to wean with extubation failure incidence of 35-67 % (7).Extubation failure increases mechanical ventilation period, intensive care unit admission and hospital costs. Sedatives and analgesics administered before extubation were correlated with more common reintubation.

The CSS is a semi quantitative recording. Its precision requires the clinicians' expertise and needs frequent training. Our study group was relatively small.

## Conclusion:

CSS is suitably recorded by clinicians, has an increased association with CPF and has good sensitivity and specificity for anticipating reintubation after scheduled extubation. As noninvasive recording, CSS is as precise as CPF for anticipating reintubation after scheduled extubation.

## References:

1. Krinsley JS, Reddy PK, Iqbal A. What is the optimal rate of failed extubation?. Critical Care. 2012 Feb;16(1):111.
2. Thille AW, Richard JC, Brochard L. The decision to extubate in the intensive care unit. American journal of respiratory and critical care medicine. 2013 Jun 15;187(12):1294-302.
3. 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 Dec 1;39(12):2612-8.
4. Ismaeil MF, El-Shahat HM, El-Gammal MS, Abbas AM. Unplanned versus planned extubation in respiratory intensive care unit, predictors of outcome. Egyptian Journal of Chest Diseases and Tuberculosis. 2014 Jan 1;63(1):219-31.
5. Whitmore D, Mahambray T. Reintubation following planned extubation: incidence, mortality and risk factors. Intensive care medicine experimental. 2015 Dec 1;3(S1):A684.
6. Menon N, Joffe AM, Deem S, Yanez ND, Grabinsky A, Dagal AH, Daniel S, Treggiari MM. Occurrence and complications of tracheal reintubation in critically ill adults. Respiratory care. 2012 Oct 1;57(10):1555-63.
7. Saltürk C, Esquinas AM. Factors Associated With Reintubation in Patients With Chronic Obstructive Pulmonary Disease. Quality Management in Healthcare. 2016 Jul 1;25(3):187.
8. Su WL, Chen YH, Chen CW, Yang SH, Su CL, Perng WC, Wu CP, Chen JH.

Involuntary cough strength and extubation outcomes for patients in an ICU. Chest. 2010 Apr 1;137(4):777-82.
9. Jun Duan,Lintong Zhou,Melling Xiao,et al.Semiquantitative cough strength score for Predicting reintubation after planned extubation. American journal of critical care 2015; 24(6):e86-e90.

## Tables:

**Table 1.** Demographic data of patients.

| parameter | Extubation n=167 | Reintubation n=37 | P |
|---|---|---|---|
| **Age(years),mean(SD)** | 73.4(+/-16) | 78.5(+/-14) | >0.05 |
| **Gender (no) M** | 113 | 21 | >0.05 |
| **F** | 54 | 16 | |
| **Causes of intubation (no)** | | | |
| **COPD** | 85 | 16 | >0.05 |
| **Pneumonia** | 49 | 13 | >0.05 |
| **ARDS** | 22 | 5 | >0.05 |
| **Postop.respiratory failure** | 11 | 3 | >0.05 |
| **Duration of intermittent ventilation pre-extubation,days,mean(SD)** | 6.6(+/-8.2) | 7.1(+/-4.5) | >0.05 |

**Table 2:** Clinical data of patients after spontaneous breathing test.

| parameter | Extubation N=158 | Reintubation N=28 | P |
|---|---|---|---|
| **Resp. rate(/min)** | 19(+/-4) | 18(+/-3) | >0.05 |
| **Heart rate (B/min)** | 89(+/-9) | 91(+/-12) | >0.05 |

| | | | |
|---|---|---|---|
| **PH** | 7.39(+/-0.37) | 7.34(+/-0.15) | >0.05 |
| **PaCO2,mmHg** | 44(+/-9) | 46(+/-11) | >0.05 |
| **PaO2,mmHg** | 87(+/-19) | 92(+/-25) | >0.05 |
| **Fraction of inspired O2(Fio2)** | 0.39(+/-0.04) | 0.40(+/-0.03) | <0.05 |
| **Cough peak flow,L/min** | 69.2(+/-31.4) | 45.4(+/-19.9) | <0.05 |
| **Cough strength score** | 2.8(+/-1.4) | 1.7(+/-1.3) | <0.05 |

**Table 3:** Correlation between CSS and CPF.

| CSS | CPF |
|---|---|
| **0** | 33.1(+/-9.2) |
| **1** | 34.4(+/-8.4) |
| **2** | 39.2(+/-15.1) |
| **3** | 52.6(+/-17.6) |
| **4** | 71.9(+/-27.3) |
| **5** | 106.8(+/-29.3) |

**Table 4:** Reintubation incidence in CSSs.

| CSS | TOTAL NO. | NO, % | RISK |
|---|---|---|---|
| **5** | 52 | 3(5.8) | 0.9(0.08-1.1) |
| **4** | 41 | 6(14.6) | 2.9(1.2-9.3) |

| | | | |
|---|---|---|---|
| **3** | 34 | 6(17.6) | 3.7(1.7-11.3) |
| **2** | 34 | 7(20.6) | 4.1(2.1-16.4) |
| **1** | 23 | 6(26.1) | 5.8(3.2-21.5) |
| **0** | 20 | 6(30) | 6.9(4.3-27.1) |