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ANTICIPATING REINTUBATION AFTER SCHEDULED EXTUBATION: COUGH STRENGTH SCORE VS COUGH PEAK FLOW.

Anesthesiology

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ABSTRACT

Introduction: Reintubation is one of the major hazards we encounter. Many reports had advocated parameters to enhance the prediction of the reintubation- candidate. Some of the cardinal parameters are the use of cough peak flow (CPF) and cough strength score (CSS) measurements.
Objective: This study aims to assess the impact of cough peak flow (CPF) and cough strength score (CSS) evaluation and measurements.
Methods: A retrospective analysis was steered. Between February 2018 to December 2019, we observed the cough peak flow (CPF) and cough strength score (CSS) to predict successful extubation outcomes in patients scheduled for extubation. Failed extubation defined as the requirement for reintubation within the first 3-days of planned extubation. The CSS initially charted followed by CPF measurements.
Results: Our study included 204-patients. Before extubation, every candidate patient underwent a cough peak flow measurement and a cough strength score evaluation. The demographical data of patients recruited are displayed in Table I. Of these cases 26-caese were reintubated within 3-days, the reintubation incidence rate was 12.7%. The successfully extubated patients showed CPF values greater than (76.2 ± 32.2) L/min corresponding to the values of the patients of reintubated group, who showed values around (55.4 ± 20.3) L/min, while CSS evaluations revealed CSS values of (3.1 ± 1.4) compared to (1.9 ± 1.3) respectively.
Conclusions: Reintubation considered a major hazard for patients needed prolonged mechanical ventilation. Considering reliable parameters coast-effective and applicable are of paramount importance. CPF showed a reliable measurement, but still sophisticated. In consequence, the CSS can be appropriately obtained by clinicians with high credibility.

KEYWORDS

Cough Peak Flow; Reintubation; Cough Strength Score; Extubation.

Introduction

Acute respiratory failure is a life-threatening condition mandates mechanical ventilation (MV), which replaces the regular spontaneous ventilation through normal respiration. By introducing mechanical ventilation, we aim to promote gases exchange and to decrease breathing burden. However, this is not completely anodyne, as the longer patient stays ventilator- dependent, the increased frequency of complications and harmful effects including infections, pressure sores, and complications of prolonged immobility such as deep veins thrombosis. Subsequently, tremendous efforts had been made to reduce associated morbidity and mortality [1-4]. It is of paramount importance, to identify promptly when patients are ready to breathe solo, and it is time to become gradually off the ventilator, this process called globally weaning. Extubation is the final step of weaning, as clinical practice in many centers weaning is left to the decision of treating physicians. However nowadays, protocols are emerging for weaning have been found to be safer for patients and useful for clinicians. Failure of extubation is one of the major hazards we encounter and leads to reintubation [3]. The incidence of reintubation diverse according to protocol used and the underlying morbidities and reports showed incidence from 10%-30% in patients with scheduled extubation, taking into consideration that extubation in some units depends on the experience rather than clinical protocols which cause a difference in the practical issues and the period of mechanical ventilation [3,5-7]. Unfortunately, this is not the only issue we face, as the mortality incidence of the reintubated patients is greater than patients achieved extubation from the first attempt, incidences are of 50% and 5% respectively [8].

Many reports had advocated parameters to enhance the prediction of the reintubation- candidate patients [9]. Some of the cardinal parameters are the use of cough peak flow (CPF) and cough strength score (CSS) evaluation and measurements for patients-candidate for extubation. This study carried out to assess the impact of both, moreover, to confirm if both are accurate separately or together to anticipate reintubation.

Methods

In this prospectively acquired data, a retrospective analysis was steered of patients treated in the intensive caring unit of King Hussein hospital, King Hussein Medical Center (KHMC), between February 2018 to December 2019, we observed the cough peak flow (CPF) and cough strength score (CSS) to predict successful extubation outcomes in patients scheduled for extubation. Inclusion criteria were all patients >18 years of age, invasive mechanical ventilation for >3-dayss, where exclusion criteria were; patients with neuromuscular dystrophy, multiple sclerosis or myasthenia gravis, patients directly underwent tracheostomy or passed away. Failed extubation defined as the requirement for reintubation within the first 3-days of planned extubation. Patients were followed up to 7-days post-extubation if no death occurred.

Our protocol of extubation include: sedation interruption and caseation before the early morning round, once the patient tolerate we continue to next step, otherwise, the sedation resumed and another trial carried out, so in accordance of our ICU protocol, patients were evaluated for tolerance to be off ventilation. After a positive spontaneous breathing test, the patients placed in bed in semi-sitting position, with head of bed at 30° to 45°, a good and patent airway free of secretions secured by meticulous suctioning, then oxygen

administered for three minutes. Once these steps achieved the CSS initially charted followed by CPF measurements. CSS evaluated in patients by recommending the patients to cough with the maximum effort feasible after detaching the ventilator. Cough strength was registered on a scale from 0 to 5 giving the best achieved by patient response. Recording CPF values carried using a Spirometer that is coupled to the endotracheal tube. The ventilator disengaged, and the spirometer then attached to the endotracheal tube, and the patient was requested to cough with the maximum effort possible. The highest CPF was documented from 3 appraisals.

Decision for mandatory reintubation considered if patients demonstrated sustainable one or more of the following: decrease level of consciousness, tachypnea; hypoxemia, hypercapnia, hemodynamic instability, diaphoresis, or signs of respiratory muscle weakness.

Statistical analysis

The main baseline cardinal characteristics of the patients are plotted as means and standard deviations for definite variables. We compared the baseline characteristics between the successful extubation and reintubation groups using the analysis of variance method. While appropriate evaluation of correlation between CSS and CPF conducted utilizing the Pearson correlation coefficient. A value of $P < 0.05$ defined as statistically significant.

Results

During the analysis period, our study included 204-patients who were scheduled for weaning off invasive mechanical ventilation and extubation after achieving a positive spontaneous breathing trial according to our protocol of management. Before extubation, every candidate patient underwent a cough peak flow measurement and a cough strength score evaluation. After extubation, attending practitioner confirm clinically which patients in need for supplementary non-invasive measures or not. The demographical data of patients recruited are displayed in Table I. Of these cases, 178-cases were successfully extubated, and 26-caese were reintubated within 3-days after scheduled extubation, the reintubation incidence rate was 12.7%. PaCO2 showed no statistically significant differences at extubation between the study populations. Noninvasive ventilation was needed and applied in 28 out of all patients, from whom 9-patients from reintubation groups. The pre-extubation clinical data just after a positive spontaneous breathing test are shown in Table II. The successfully extubated patients showed CPF values greater than (76.2 ± 32.2) L/min corresponding to the values of the patients in reintubated group, who showed values around (55.4 ± 20.3) L/min, while CSS evaluations revealed CSS values of (3.1 ± 1.4) compared to (1.9 ± 1.3) respectively, the acquired outcomes revealed significant difference as the P value was less than 0.05, despite the fact the diagnostic accuracy of CSS showed no difference from that of CPF.

Results indicated that CSS has increased in linear fashion in correlation to CPF increased. Where CSS demonstrated a potent positive association with CPF $P < 0.05$. The reintubation showed increased incidence as the CSS showed lower rank (Table III). Patients with CSS grades of 5 showed 0.9 risk of reintubation, while lower grades from 4- 0 revealed: 2.9, 3.7, 4.1, 5.8, and 6.9 times respectively (Table IV).

Table I: Demographical features of patients recruited

Parameter	Extubation n=178	Reintubation n=26	P
Age(years)	63.2 ± 16	768.5 ± 14	0.500
Male Gender (No): Female	127 51	14 12	 0.05
Causes of initial intubation (No): Road traffic accidents Falls Lung contusions Pneumonia Direct head injury Postop. Respiratory Failure	77 43 16 4 25 13	7 6 3 1 4 5	0.200 0.600 0.001 0.001 0.001 0.001
Mechanical ventilation duration (Days)	6.6 ± 8.2	7.1 ± 4.5	0.001
Co- morbidity (No)	26	8	0.910

Table II: Clinical data monitored, and blood gases analysis acquired after spontaneous breathing trial

Parameter	Extubation N=178	Reintubation N=26
Resp. rate(/min)	19 ±4	18 ± 3
Heart rate(B/min)	89 ± 9	91 ±12
PH	7.39 ± 0.37	7.34 ± 0.15
PaCO2, mmHg	45 ± 9	46 ±11
PaO2, mmHg	87 ± 19	92 ± 25
Fraction of inspired O2(Fio2)	0.39 ± 0.04	0.40 ± 0.03
Cough peak flow, L/min	76.2 ± 32.2	55.4 ± 20.3
Cough strength score	3.1 ± 1.4	1.9 ± 1.3

Table III: Shows correlation between CSS values and CPF measurements

Grade of CSS	0	1	2	3	4	5
Measured CPF	32.1 ±9.2	34.4 ± 8.4	39.2 ± 15.1	52.6 ± 17.6	71.9 ± 27.3	106.8 ± 29.3

Table IV: Shows the incidence of reintubation in correlation with CSS values

CSS	Interpretation	TOTAL NO.	NO, %	RISK
Level 5	Multiple strong coughs	43	2(7.69%)	0.9(0.08-1.1)
Level 4	stronger cough	26	3(11.53%)	2.9(1.2-9.3)
Level 3	clearly audible cough	24	3(17.6)	3.7(1.7-11.3)
Level 2	barely audible cough	32	5(19.23%)	4.1(2.1-16.4)
level 1	no audible cough	43	6(23.07%)	5.8(3.2-21.5)
Level 0	no cough	36	7(26.92%)	6.9(4.3-27.1)

Discussion

Cough peak flow (CPF) is a parameter measured frequently to evaluate the strength of cough, these measurements reveals the capacity of patient to wash-out airway secretions, also it can predict the possibility of extubation and the need for reintubation and measured with various devices, such as flow meters, spirometers [10]. According to many reports, values of CPF below 160 L/min have been associated with effective airway clearance and successful extubation [11-16].Though some recent studies advocate that when CPF was of ranges >70 L/minute, reintubation was rare and non-invasive ventilation was not needed, perquisite is normal respiratory muscles [17]. Registration of Cough peak flow measurements in patients on invasive mechanical ventilation considered complex since it needs a spirometer, a bacterial filter to prevent contagion, and a special attachment to fix the spirometer to the endotracheal tube [10].

In contrast, the previously introduced cough strength score (CSS) is semi quantitative, which measured after patients fully recover from respiratory failure and had effectively completed a spontaneous breathing test. Patients asked to cough with maximum effort possible after disengaging the ventilator. Cough strength recorded on scale chart ranging from 0 to 5 conferring the achieved by patient result, according to this scale, the score of *zero* is given when no response or no cough on demand, while the level of 1 is marking an audible air movement via the endotracheal tube but still no audible cough attempts, level 2 signifies the weakly audible cough, level 3 represent the audible cough, and level 4 confirm the stronger cough and level 5 specified to the multiple consecutive strong coughs [18].

Extubation failure considered as the lack of ability to maintain a sufficient, spontaneous breathing work after removal of mechanical ventilation hardware, which in this case leads to reintubation of patients during a time period specified within 24-72h [3,7]. Reintubation is correlated with many factors that increase the relative hazards of death and prolong the length of stay at intensive care unit, adding to the whole health burden and costs [7,19,20]. This study showed that the intubation duration in the group needed reintubation was significantly longer compared to the group of successful extubation.

This had directed research towards recognizing the parameters and helping to avoid reintubation and anticipating the need for it, in order to maximize the successful rates of extubation [3, 4, 7, 19, 17, 18, 20].

Cough peak flow (CPF) considered an independent predictor of reintubation. As patients with low CPFs showed greater unsuccessful extubation rate, as mentioned previously different thresholds were advocated [11-17]. According to our analysis, an optimal cut off threshold measurement of level 76 L/min was confirmed in predicting reintubation at 3-days after primary extubation, and this was comparable to the cut-off found previously [21,22].

Patients with weak coughs graded from 0 to 2 had a 4-fold increased incidence of ineffective extubation, in correlation with patients showed moderate to strong coughs ranged from 3 to 5 (risk ratio, 4.0; 95% CI, 1.8–8.9) at 3-days after extubation. Reintubation was significantly related to cough strength score. Patients with CSS of level 5 revealed lower risk compared with those of CSS values of < 4 which have 2.9 to 6.9 times increased hazard for reintubation. The reintubation incidence was as high as 30% in patients with a CSS of 0.

Once extubation performed, extra care must be practiced in patients showed weak cough strength, these patients must have aggressive airway management by applying optimal humidification, frequent chest physio- therapy, and administration of expectorant drugs also is useful.

Correspondingly, evaluating the CSS on a scale ranging from 0 to 5, is basically applicable with no hardware, make it simple, feasible and appropriate for physicians and even all health care providers.

Finally, this was a small-size retrospective analysis; although large studies may reveal different results, our results indicate that identifying concomitant factors causing extubation failure and leading to reintubation, such as underlying chronic obstructive lung disease, sedatives and analgesics medications administered before extubation, prolonged period of intubation are some of factors correlated with more increased incidence of reintubation, which prolong hospital stay and jeopardize the hospital resources. By conducting studies with larger sample size and evaluating further the concomitant causes of intubation and risks of reintubation. Leading factors of reintubation can be anticipated with a higher precision. Furthermore, this might aid emerging treatment strategies corresponding to each pathophysiology.

Conclusion

Reintubation considered a major hazard for patients needed prolonged mechanical ventilation. Considering reliable parameters coast-effective and applicable are of paramount importance. When we investigated the predictable factors of reintubation, CPF showed a reliable measurement, but still sophisticated since it requires a spirometer, a bacterial filter, and a special attachment to the endotracheal tube. In consequence, the CSS can be appropriately obtained by clinicians with high credibility, and showed an amplified correlation with cough peak flow, also statistically showed good sensitivity and specificity in terms of predicting extubation/ reintubation candidate patients. In contrast, CSS recording as a noninvasive evaluation although subjective, could be considered as an adjunct or an alternative to CPF in predicting reintubation.

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