515. Mechanical ventilation and weaning

P5000
Time course of diaphragm function recovery after mechanical ventilation in an animal model
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Rationale: Several studies have previously shown that controlled mechanical ventilation (CMV) results in rapid and severe diaphragmatic dysfunction. On the other hand, the recovery response of the diaphragm to normal function after mechanical ventilation is not known, although these data may have an impact on weaning from the ventilator. Therefore we examined the time-course of diaphragm function recovery in an animal model of CMV.

Methods: Rats were anesthetized and submitted to 24-27h of CMV or to 24h of CMV followed by either 1h, 2h or 3h of spontaneous breathing (CMV + 1h SB, CMV + 2h SB, and CMV + 3h SB, respectively).

Results: There were no differences in blood pressure, body weight or muscle weights between the four groups. The in vitro diaphragm force-frequency curve was similar in the CMV, CMV + 1h SB and CMV + 2h SB groups. Three hours of SB after CMV resulted in a significant improvement of diaphragm force compared to the other groups (eg, maximal tetanic force: +29% vs CMV, p <0.01). Diaphragm cross sectional area (CSA) of the type I and type IIa fibers was similar in all groups, while the CSA of the type IIx/b fibers was significant increased in the CMV + 3h SB group (+27% vs CMV, p<0.05). No differences were observed in the activity of the proteolytic enzymes calpain and caspase-3. Protein oxidation was similar in the diaphragm of all groups.

Conclusions: These data show that, in rats, reloading the diaphragm for 3h after CMV is sufficient to result in a significant improvement of the diaphragm force together with an increase in the CSA of the type IIx/b muscle fibers.

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P5001
Mechanical ventilation induces a time-dependent reduction in diaphragmatic blood flow
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Introduction: Continuous mandatory ventilation (CMV) induces atrophy of the diaphragm, contributing to ventilator induced diaphragmatic dysfunction (VIDD), which is significant after 6 h of CMV. However, the effects of prolonged CMV on diaphragmatic blood flow remain unknown. Therefore, we tested the hypothesis that long term CMV (6 h) will further decrease diaphragm perfusion versus that measured during acute CMV (30 min) and may contribute, in part, to VIDD due to reduced oxygen delivery.

Methods: Blood flow to the diaphragm and other skeletal muscle was assessed (via the radioactive microsphere technique) during spontaneous breathing (SB) and after 30 min and 6 h of CMV in female Sprague-Dawley rats (n= 42). Blood pressure and heart rate were monitored continuously throughout the protocol.

Results: In the midcostal portion of the diaphragm blood flow decreased by ~32% from SB to 30 min CMV, with a further reduction in flow of ~37% after 6 h CMV (i.e., SB 28.3 ± 3.5 vs. CMV, 30 min 19.3 ± 2.9; 6 h 8.8 ± 0.6 ml/100 g/min; P<0.05). The other constituents of the diaphragm demonstrated a similar trend in perfusion over time. Blood flow to other hindlimb skeletal muscle did not decrease significantly at any time point.

Discussion: Our study demonstrates, for the first time, that there is a time-dependent reduction in diaphragmatic perfusion during prolonged CMV. Further, a decrease in blood flow over the same time period was not observed in other skeletal muscles, even with matched oxidative capacities (e.g., red. portion of the gastrocnemius). Our data indicate that prolonged CMV elicits vascular dysfunction in the diaphragm which may contribute, in part, to the ongoing process of VIDD.

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P5002
High dose methylprednisolone counteracts the negative effect of rocuronium on diaphragm function in a rat model of mechanical ventilation
Karen Maes, Dries Testelmans, Debby Thomas, Marc Decramer, Ghislaine Gayan-Ramirez. Laboratory of Pneumology, KU Leuven, Leuven, Belgium

Rationale: We previously showed that rocuronium (ROC) combined with 24h of controlled mechanical ventilation leads to an additional negative effect on diaphragm function in rats. Based on clinical observations we hypothesized that the combination of rocuronium with corticosteroids in our animal model of CMV would result into a further deterioration of diaphragm function.

Methods: Mechanically ventilated (24h) rats received intravenously either a con-
timous infusion of saline (CMV) or ROC or ROC combined with an intramuscular injection of 80 mg/kg of methylprednisolone (ROC-MP).

**Results:** ROC treatment resulted in a significant reduction of diaphragm force compared with CMV. Treatment with MP attenuated the ROC-induced contractile dysfunction of the diaphragm. Cross-sectional area of the diaphragm type I/IIb fibres tended to decrease with 13% after ROC compared with the other groups. Diaphragm MURF-1 mRNA expression was significantly increased with 30% after ROC and ROC-MP compared to CMV while MAFbx was significantly increased in all groups. Diaphragm caspase-3 activity (+39%) and calpain activity (+99%) were increased after ROC compared to CMV. Treatment with ROC abolished the increase in caspase-3 and calpain activity. Proteolytic activity in the gastrocnemius was similar in all groups. The ratio of MyHC to actin was similar in the diaphragm and the gastrocnemius in all groups.

**Conclusions:** The negative effect of ROC on the diaphragm during CMV is abolished with administration of a high dose of MP. This effect is most likely due to an inhibition of the calpain and caspase-3 system.

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**PS003**

Severe metabolic acidosis in chronically ventilated Duchenne muscular dystrophy patients

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**Background:** Duchenne muscular dystrophy (DMD) leads to progressive paralytic respiratory failure and premature death. Long-term pressure ventilation pressure (iPPV) improves quality of life and life expectancy while previously unrecognized DMD complications like metabolic acidosis (MA) arise. We analyzed characteristics and causes of MA.

**Methods:** 8 DMD patients (26±4 y) admitted to our institution with severe MA during the last 5 years were studied. History, physical exam, chemistry and arterial blood analysis was performed. MA was defined as arterial pH less than 7.35 or bicarbonate less than 22 mmol/L.

**Results:** All 8 patients were on iPPV, 6 for 24h/day. All were treated for chronic constipation and had reduced food/fluid intake in the last few days; 2 had respiratory infection. Despite iPPV they suffered from dyspnea and abdominal discomfort and were in severely reduced condition with tachycardia (96-156/min) but normal blood pressure. Temperature was 36.5-40.0 °C. The table shows ABG characteristics and causes of MA.

**Conclusions:** In older DMD patients on iPPV we observed that severe, metabolic acidosis related to chronic constipation and its treatment, reduced fluid and food intake and associated respiratory infection resulted in a life-threatening condition. Adequate regulation of bowel movements, hydration and nutrition seem to be crucial in prevention of this life-threatening complication. Grant support: Lunge Zurich.

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**PS004**

Predictors of successful weaning from mechanical ventilation

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**Aim:** To compare physiological effects of NAVA with Pressure Support Ventilation (PSV) and Pressure Controlled Ventilation (PCV) in difficult to wean patients with chronic obstructive pulmonary disease (COPD).

**Methods:** Six tracheostomised awake WPs (2 males, age 68±28, 80±30 y) underwent prolonged (>13 days) mechanical ventilation (MV) underwent physiological evaluation during three 20 minute MV sessions, randomly applied, with NAVA, PSV and PCV. Airway pressure (Paw), airflow, and diaphragm electrical activity (EAdi) were derived from ventilator (Servo i, Maquet). Changes in tidal volume (VT), inspiratory (ITD) and expiratory (ETD) time delay, and EAdi-related work of breathing (WOB) were calculated during three 20 minute MV sessions, randomly applied, with NAVA, PSV and PCV. Airway pressure (Paw), airflow, and diaphragm electrical activity (EAdi) were derived from ventilator (Servo i, Maquet). Changes in tidal volume (VT), inspiratory (ITD) and expiratory (ETD) time delay, and EAdi-related work of breathing (WOB) were calculated.

**Results:** In PSV, an increase in EAdipeak, WOB, and a decrease in VT were observed from s1 to s4, unlike NAVA and PCV. In both steps, higher ETD and WOBETD in PCV compared to NAVA were found.

**Conclusions:** In WPs, NAVA was associated to reduced WOB due to patient-ventilator delay.

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**PS005**

Neurally adjusted ventilatory assist (NAVA) in difficult-to-wean patients

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**Conclusions:** In WPs, NAVA was associated to reduced WOB due to patient-ventilator delay.

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**PS006**

Predicting the outcome from noninvasive ventilation for acute exacerbation of chronic obstructive pulmonary disease in the emergency department

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**Introduction:** Emergency physicians (EP) face the challenge of predicting short-term outcomes for patients with acute respiratory failure (ARF) in the emergency department (ED).

**Objectives:** To identify early objective clinical parameters and biomarkers for severity assessment and predicting outcomes in acute exacerbation of chronic obstructive pulmonary disease (AECOPD) requiring noninvasive mechanical ventilation (NIV).

**Methods:** Three-months observational prospective study in the acute setting of the ED of a university teaching hospital, including consecutive nonselected patients emergently admitted for ARF due to AECOPD treated by NIV according to EP’s indication referring to an institutional protocol. Treatment failure was defined as hospital mortality or need for invasive mechanical ventilation at any time.

**Results:** 124 patients (media 1.38/day). Failure (23 cases, 18.5%) and success (101; 81.5%) patients were different in: neurologic status score (Kelly-Mathay scale), urea, creatinin, AST, ALT, CPK, CK-MB, troponin T, LDL, PCR, pH, and arterial blood gas analysis parameters after 1 hour of NIV (PaO2, pH, PaCO2, HCO3-, SaO2, PaO2/FiO2).

**Conclusions:** NIV is a cost effective intervention even outside intensive care units for the treatment of ARF caused by AECOPD. We were able to identify in the ED early predictors of outcome (mainly about more severe clinical conditions and the...
response to treatment). An unresolved question in the ED is about selection criteria and early choices for patients with ARF having preset therapeutic-prognostic limits and acutely reversible processes for which NIV should be considered as ceiling treatment.

P5007 Acute exacerbations of COPD (AECOPD) in intensive care unit (ICU): Are non-invasive ventilation (NIV) use and mortality different in high volume ICU?  
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Introduction: NIV for the management of acute exacerbations of chronic obstructive pulmonary disease (AECOPD) increased last decades. ICU teams caring for a high number of AECOPD could gain more experience and therefore use NIV in a higher proportion of patients. The case-volume could also be associated with ICU mortality.

Material and methods: The French CURB-E REA database includes 32 ICUs. AE-COPD cases were extracted according to ICD-10 coding. To assess the effect of case volume on NIV use, invasive ventilation (IV) use and mortality, multivariable analysis using mixed models was performed to adjust for severity of illness and other confounding factors.

Results: Between 1998 and 2008, 6,434 AECOPD were identified. SAPS II and ICU mortality gradually increased (35 to 41 and 11 to 16%, respectively). The proportion of patients receiving any mechanical ventilation increased (66% to 85%), with a marked increase in the use of NIV (from 19% to 43%) and a decrease in the use of IV (35 to 23%). Case volume tertiles were: low volume (10 admissions per year), intermediate (10-26) and high volume (more than 26). There was a significant association between case volume, NIV use and ICU mortality: OR for the highest versus lowest and intermediate tertiles were: 5.61 [95% CI: 4.87 - 6.46] and 0.83 [95% CI: 0.73 - 0.94], respectively.

Conclusion: During this period, the severity and mortality rate of AECOPD admitted in CURB-E REA ICUs increased. There was a growing use of NIV and a decreased use of IV. NIV use and ICU mortality were related to case volume, suggesting that increasing experience favours the use of NIV without impairing patients’ outcomes.

P5008 Low-t3 state a crucial biomarker in determining NIV failure and outcome in pulmonary patient?  
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Background: Various low T3 states have been described in severe nonthyroidal illnesses; they have been associated with a poor prognosis in cardiovascular and pulmonary disease patients.

Aim: The aim of the study was to test whether a low T3 state is a marker of outcome in patients suffering from respiratory failure (RF), needing invasive or non-invasive mechanical ventilation (NIV), in order to evaluate the prognostic value of nonthyroidal illness syndrome in NIV failure.

Methods: We studied retrospectively 32 consecutive patients with acute or acute on chronic RF needing mechanical ventilation. Measured variables upon admission included: APACHE II score, the ratio of the partial pressure of oxygen in arterial blood to the fraction of oxygen in inspired gas (PaO2/FiO2), plasma levels of free T3 (fT3), fT4, T45, and Thyroid Stimulating Hormone (TSH) levels.

Results: Plasma levels of fT3 were below normal range in 17 patients (53%). Plasma fT3 correlated with PaO2/FiO2 (p<0.001), and with APACHE II score (p=0.003).

Ten patients with low levels of fT3 needed invasive mechanical ventilation due to NIV failure. These patients, with comparable APACHE II score and gas exchange, showed fT3 value significantly lower than patients improving with NIV.

FT3 levels were significantly lower (p=0.002) in four patients (12.5%) who died, in comparison to the patients who survived. FT3 value was the only factor significantly associated with an increased risk of death, according univariate logistic regression analysis (Odds Ratio 64.23, 95% Confidence Interval 1.78 to 2316.86, p=0.023).

Conclusion: Our data suggest that low T3 state can predict NIV failure and outcome in pulmonary patients with acute RF.

P5009 Evaluation of adrenal function in patients receiving invasive and noninvasive mechanical ventilation  
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Aim: Although adrenal insufficiency (AI) is a rarely seen condition in critically ill cases (2-3%), it is reported that relative AI is encountered more frequently. In this study, our aim was to detect the frequency of AI using standard dose corticotropin (ACTH) test in patients with critical illness and to determine IL-6, aldosterone, BAL cortisol, procalcitonine and 24-hour uriner cortisol values effects of the prognosis. Material and method: A total of 80 patients with acute critical illness were recruited to the study. The patients were divided into two groups according to the applications of IV and NIV. Vital findings and APACHE II scoring were recorded and blood samples were taken for ACTH and cortisol. Furthermore, standard dose (250 μg) ACTH test was done for AI diagnosis.

Results: AI detected in patients according to the basal cortisol < 15 μg/dl and/or delta cortisol < 9 μg/dl. AI were detected in 18 patients (22.5%). AI was detected in 6 (15%) of the 40 patients who were received IV. Thirty two of these 40 patients died. AI was determined at 4 (12.5%) of these 32 patients who were died. There was AI in 12 (30%) of 40 patients to whom NIV was applied. 12 of these 40 patients died. Two (16.7%) of these 12 patients who died bad AI. In patients with and without AI, there was no significant difference with respect to the mortality rates at the IV and NIV group (p>0.05).

Conclusion: The frequency of AI was common in patients with critical illness. AI was determined more frequently at the NIV group. We think that adrenal functions should be routinely followed in the intensive care even though there was no clinical finding.

P5010 A novel way of heliox administration in patients with COPD exacerbation  
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Introduction: Chronic obstructive pulmonary disease (COPD) is a major cause of chronic morbidity and mortality throughout the world. The purpose of heliox (helium and oxygen mixture) administration in patients with severe COPD exacerbation is to avoid invasive ventilation which is recognized as an adverse prognostic factor.

Aims: The aim of the study is to test suitability of a modified semi-closed anesthetic circuit with CO2 absorber for heliox administration. The circuit may offer a safe way of heliox administration to spontaneously breathing patients at significantly reduced costs.

Methods: The semi-closed circuit was evaluated by work of breathing (WOB) measurement in healthy volunteers (N=9) who signed the informed consent. An esophageal balloon catheter was used for carbon dioxide measurement. The resistive component of WOB and pressure-time product (PTP) were calculated; O2 consumption and end-tidal CO2 were evaluated. These parameters were compared with the corresponding parameters obtained during spontaneous ventilation on air. Results: WOB was increased by 15% and PTP was increased by 12% during the spontaneous ventilation with heliox using the semi-closed circuit compared to the ventilation on air.

Conclusion: The study showed that administration of heliox using the semi-closed circuit increases WOB and PTP for a patient due to the intrinsic resistance of the circuit. Nevertheless, as resistance of the airways and WOB are increased significantly in patients with COPD exacerbation, the semi-closed circuit using the semi-closed circuit does not represent a significant workload for patients with COPD exacerbation.

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P5011 Sleep monitoring with portable devices in ICU patients  
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Introduction: Sleep disruption and deprivation is a continuing problem in the Intensive Care Unit, but measures to improve sleep cannot utilize traditional polysomnography. Practical, non-intrusive diagnostic monitoring of sleep is required.

Aim: To: 1) test two new portable ambulatory sleep diagnostic devices to monitor sleep in ICU and 2) compare sleep data generated by the different devices.

Methods: The devices were a) WakoHPAT200 (Iruma Medical), wrist watch-style, employing peripheral arterial tonometry and actigraphy to evaluate sleep time and sleep stage by an automatic algorithm (PAT device) and b) ALICE PDs (Respironics Philips), miniature polysomnographic device utilizing EEG and EMG recordings, with technician scoring (Mini-PSG device). Both include oximetry and position sensors. Seven ICU patients provided informed consent (mean age 68 years) and were recorded wearing both devices, from 2100 to 0600.

916s
Results: Both devices successfully monitored sleep in ICU patients. The PAT device was less intrusive with size and attachments. Saturation and heart rate oximetry data were identical from the devices: both devices calculated total sleep time (TST) and deep sleep sleep stages and sleep efficiency although differences were not statistically significant. Yet, REM sleep duration was longer in ICU (10,3±6.8% vs. 8,7±2.0%, p=0.01). Despite pressure support ventilation during night sleep, some breathing abnormalities appeared in ICU patients, with hypoxemia especially during REM (94,4±4,3% 2ICU, 98,3±6,0% apneas or hypoapneas (AHI 3,3±1,16/h). Conclusion: Sleep quality was impaired in PMV patients during hospitalization either in ICU or in RIU, but sleep structure approached normal architecture in ICU. REM sleep breathing abnormalities in RIU patients may require further clinical evaluation in terms of the efficacy of mechanical ventilation mode.

PS013
Swallowing disorders and speech rehabilitation in tracheostomized difficult-to-wean patients
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Background: Intensive Care Unit (ICU) patients recovering from critical illness often present persistent respiratory failure and require prolonged mechanical ventilation (PMV). The aim of this study was to assess sleep quality in PMV patients, during hospitalization in ICU and in a Respiratory Intermediate Unit (RIU).

Patients and methods: A total of 39 PMV patients (13 in ICU and 26 in RIU) were included in the study. All patients were in stable condition, without need for sedation, with GCS >10. All patients had been tracheostomized under mechanical ventilation support at least during the night. A full PSG was performed in all patients during night sleep under PS ventilation.

Results: Sleep efficiency was higher in ICU (82,7±18,3%, RIU 68,4±21,8%, p<0,02) with longer sleep time (SPT ICU 448±62 min, RIU 346±86 min, p<0,001). Duration of stage N2 was 61,4±20,6% in ICU and 48,6±20,5% in RIU, with longer stage N3 in RIU (10,7±15,6%, ICU 5,7±12,6%), but these differences were not statistically significant. Yet, REM sleep duration was longer in RIU (10,3±6,8% vs. ICU 7,3±4,9%, p<0,01). Despite pressure support ventilation during night sleep, some breathing abnormalities appeared in ICU patients, with hypoxemia especially during REM (94,4±4,3% 2ICU, 98,3±6,0% apneas or hypoapneas (AHI 3,3±1,16/h).

Conclusion: Sleep quality was impaired in PMV patients during hospitalization either in ICU or in RIU, but sleep structure approached normal architecture in ICU. REM sleep breathing abnormalities in RIU patients may require further clinical evaluation in terms of the efficacy of mechanical ventilation mode.

PS012
Sleep quality in prolonged mechanical ventilation patients
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Conclusion: Sleep quality was impaired in PMV patients during hospitalization either in ICU or in RIU, but sleep structure approached normal architecture in ICU. REM sleep breathing abnormalities in RIU patients may require further clinical evaluation in terms of the efficacy of mechanical ventilation mode.

PS015
Prognostic factors for long-term survival in ICU tracheostomized patients
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Introduction: Few recent studies have evaluated the long-term prognosis of ICU patients who are tracheostomized for their underlying lung disease.

Patients and methods: We conducted a retrospective study from 1997 to 2010 in 82 patients who were tracheostomized during their stay in a medical intensive care unit (ICU). The main objective was the evaluation of long-term survival.

Results: Among the 82 patients, 40 (48.8%) have a chronic respiratory failure (16 obstructive, 9 mixed and 15 restrictive with 11 neuromuscular disease). Fifty-nine patients (72%) died, including 32 (39%) before hospital discharge. The median survival time is 188 days. In multivariate analysis using the Cox model, three prognostic factors have been highlighted: 1) the presence of a neurological disease was significantly associated with a better prognosis (OR 0.48 [0.26-0.9], p = 0.022), 2) an age above 65 years (OR = 2.2 [1.17-4.16], p = 0.015) and 3) a Charlson score greater than 2 (OR = 2.05 [1.09-3.86] p = 0.026) were significantly associated with a poor prognosis. GOLL stage IV COPD was not associated with a poor prognosis (OR = 1.93 [0.98-3.81], p = 0.058). Bleeding or respiratory complications were found respectively in 16 (20%) and 7 (9%) patients. Among patients dischared from hospital, the weaning of mechanical ventilation was obtained in 19 of 46 cases (41.3%).

Conclusion: We found two predictive prognostic factors (age > 65 years and a Charlson score > 2) and one protective factor (presence of a neurological disease) significantly related to the long-term survival in ICU tracheostomized patients.

PS014
Review of decannulation experience and duration of tracheostomy within the Newcastle upon Tyne Hospitals NHS Foundation Trust
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Background: Tracheostomy is increasingly used to manage airway difficulties in paediatric respiratory management. It is important that parents are informed of the likely duration of tracheostomy in different conditions and the prognosis for decannulation.

Aims: The aim of this project was to review the experience of paediatric tracheostomy decannulation in the Newcastle upon Tyne Hospital NHS Foundation Trust (NUTH) Trust over the last 6 years.

Methods: This retrospective review looked at all decannulation episodes in children within the NUTH Trust from January 2005 to December 2010. The notes of the patients identified were reviewed to collect data.

Results: 56 patient episodes were identified, of those, 48 patients were included.

The median duration of tracheostomy was 14 months and the median age at decannulation was 26 months. The indications for tracheostomy were: subglottic stenosis (31%), airway malacia (21%), airway mass (13%), airway obstruction (10%) and other (25%). The median duration for these indications were 35, 17.5, 8, 12 and 11.5 months respectively. 81.25% (39) of planned decannulations were successful. Surprisingly 61.54% (24) of successful decannulations had trachy-cutaneous fistulas requiring surgical closure. It appeared that fistulas were associated with patients who were of a younger age at tracheostomy (4.5 vs. 8.5 months) or who had a longer duration of tracheostomy (20 vs. 12 months).

Conclusions: This review has highlighted likely duration of tracheostomy for the common conditions and prognosis for decannulation. It has also revealed a surprisingly high rate of trachy-cutaneous fistula.
Assessment of rapid shallow breathing index as a predictor for weaning in respiratory care unit

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Introduction: Weaning is gradual removal of mechanical ventilator support. Different predictors are used for weaning initiation. This study is designed to investigate the rapid shallow breathing index (RBSI) as a predictor for successful weaning.

Materials and methods: We did this cross-sectional study on 70 patients who had mechanical ventilation for more than 48 hours in respiratory care unit (RCU) in Tehran Labbafi Nejad hospital. We measured RBSI and then evaluate the value of RBSI for successful extubation.

Results: 63 (90%) Patients had RBSI ≤ 105 (Breath/min/L), among them 49 (77%) patients had successful weaning and did not need re-intubation but the rest had unsuccessful weaning (P=0.001). Weaning index mean for patients with successful extubation was 66±57.2 and for patients with unsuccessful extubation was 76.9±28.1. We could not find a significant difference between means (P=0.433).

Conclusion: Our findings exhibited that RBSI has high sensitivity with low specificity. RBSI ≤ 80 is more reliable than RBSI ≤ 105 as a predictor for weaning.