Poster Corner 2 - Monitoring patient - Ventilator interaction

026 Efficacy of proportional modes versus pressure support ventilation: a systematic review and meta-analysis

J. Kataoka[1], A. Kuriyama[2], Y. Norisue[1], S. Fujitani[3]
[1]Tokyo Bay Urayasu Ichikawa Medical Center, Pulmonary and Critical Care Medicine, Urayasu, Japan, [2]Kurashiki Central Hospital, Okayama, Japan, [3]St. Marianna Medical School, Emergency and Critical Care Medicine Department, Kawasaki, Japan

INTRODUCTION. Proportional modes (proportional assist ventilation, PAV and neurally adjusted ventilator assist, NAVA) are designed to adjust inspiratory pressure proportionally to the patient´s inspiratory demand. Theoretically, these modes could improve patient-ventilator interaction. PAV could monitor work of breathing of the patients, and NAVA could monitor the electrical activity of diaphragm. These may result in preventing diaphragmatic atrophy and shortening duration of mechanical ventilation. Therefore proportional modes may be efficient as a weaning modes.
OBJECTIVES. We conducted a systematic review and meta-analysis to assess the efficacy of these proportional modes as weaning modes. The purpose of this systematic review is to examine whether proportional modes improve patient-ventilator interaction and whether they have impact on the weaning duration and length of mechanical ventilation in mechanically ventilated patients, in comparison with PSV.
METHODS. We included randomized controlled trials that examined efficacy of proportional modes as weaning modes in comparison with PSV in mechanically ventilated adults. Our primary outcomes were (1) weaning failure, (2) asynchrony index (AI) and (3) duration of mechanical ventilation.
RESULTS. We included seven parallel-group and four crossover randomized controlled trials. Four trials evaluated PAV+ (Covidien) (n=367, 60%), six trials evaluated NAVA (Maquet) (n=226, 37%), and one crossover RCT evaluated both modes (n=16, 3%). Compared with PSV, use of NAVA or PAV was not associated with reduction in weaning failure (RR, 0.74; 95% CI, 0.48 to 1.15; p= 0.183; *df*= 3; I^2= 58.3%). Use of NAVA or PAV was associated with reduction in asynchrony index (WMD, -3.96; 95% CI, -7.45 to -0.48; p= 0.026; *df*= 5; I^2= 82.8%) or patients with AI >10% (RR, 0.06; 95% CI, 0.02 to 0.26; p< 0.001; *df*= 3; I^2= 0.0%), compared with PSV. Use of NAVA or PAV was associated with a shorter duration of mechanical ventilation (WMD, -1.78 days; 95% CI, -3.25 to -0.32; p= 0.017; *df*= 4; I^2= 32.5%) in comparison with PSV.
CONCLUSIONS. The use of proportional modes as weaning modes is associated with improvement of patient-ventilator interaction and significant reductions in the duration of mechanical ventilation. These results suggest that it is reasonable to use proportional modes during weaning phase for the mechanical ventilated patients.

027 Effect of decreasing trigger sensitivity on ventilation homogeneity in patients under pressure support ventilation

X.-M. Sun[1], G.-Q. Chen[1], Y.-M. Zhou[1], J.-R. Chen[1], Y.-M. Wang[1], K.-M. Cheng[1], Y.-L. Yang[1], K. Chen[1], M. Xu[1], J.-X. Zhou[1]
[1]Beijing Tiantan Hospital, Capital Medical University, Critical Care Medicine, Beijing, China

INTRODUCTION. Mechanically ventilated patients often existed collapse in dependent lung region and was related to ventilator-induced lung injury [1]. Theoretically, decreasing trigger sensitivity of ventilator could increase the inspiratory effort [2], that might be beneficial for increasing the ventilation in dependent region [3].
OBJECTIVES. To observe the effect of different trigger sensitivity on ventilation homogeneity in mechanically patients, evaluate clinical feasibility and safety.
METHODS. We prospectively enrolled 20 patients who existed the heterogeneous ventilation with pressure support ventilation, that were defined by electrical impedance tomography (EIT) as the distribution of tidal volume in dependent region ($V_T\%_{DEP}$) lower than 45% [1]. The low and high flow trigger sensitivity (the lowest and highest limits of Servo-I, 2L/min and 0.2L/min, respectively) were

randomly applied for 20 minutes. The $V_T\%_{DEP}$ and end expiratory lung volume (EELV) was evaluated by EIT. The esophageal pressure (P_{ES}) was used to measure inspiratory effort, work of breathing and transpulmonary pressure [4].

RESULTS. The low trigger sensitivity increased $V_T\%_{DEP}$ (36±9% vs 33±9%, *p*=0.001) and improved lung homogeneity, comparing to high trigger sensitivity. Meanwhile, low trigger sensitivity also increased the global EELV (115 ± 150ml), mainly acted on the dependent region (101 ± 150ml). With application of low trigger sensitivity, the P_{ES} swings during inspiration, representing patient's inspiratory effort, increased from 0.8(0.4, 1.8) to 1.6 (1.0, 2.1) cmH_2O (*p*=0.021), accompanying with an increase of work of breathing, that ranged from 29 (15, 54) to 48(23, 74) cmH_2O/s/min (*p*=0.044). Whereas, low trigger sensitivity did not significantly increase the transpulmonary pressure (12.6±4.3vs12.8±4.2cmH_2O, *p*=0.376).

CONCLUSIONS. Decreasing trigger sensitivity could induce more air into the dependent lung region and improve homogeneity during pressure support ventilation by increasing inspiratory effort, meanwhile either the work of breathing or the transpulmonary pressure remained within an acceptable range.

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028 Glottic patency during two levels of pressure support and neurally adjusted noninvasive ventilation in patients with acute exacerbation of chronic obstructive pulmonary disease

E. Oppersma[1,2], J. Doorduin[2], P.J. Gooskens[1], L. Roesthuis[2], E.H. van der Heijden[2], J.G. van der Hoeven[2], P.H. Veltink[1], L.M. Heunks[2,3]

[1]University of Twente, MIRA, Enschede, Netherlands, [2]Radboudumc, Nijmegen, Netherlands, [3]VUmc, Amsterdam, Netherlands

INTRODUCTION. Noninvasive ventilation (NIV) can provide ventilatory support for patients with acute respiratory failure. However, in 5-40% of patients with an acute exacerbation of COPD, noninvasive ventilation fails [1] and endotracheal intubation is required. The involvement of the upper airway is generally ignored during NIV. However, because the larynx can act as a closing valve, effectiveness of delivering support under NIV can be limited. Studies on lambs showed that during NIV with pressure support ventilation (PSV) the activity of the constricting muscle of the glottis increases, resulting in decreased upper airway patency [2]. During Neurally Adjusted Ventilator Assist (NAVA) ventilation, the level of support and the cycling of the ventilator is proportional to the electrical activity of the diaphragm [3]. It has been shown in lambs that, in contrast with PSV, NAVA does not induce inspiratory glottal constrictor muscle activity [4].

OBJECTIVES. The objective is to study inspiratory patency of the glottis in patients with acute exacerbation of COPD. We hypothesize that the patency decreases with higher inspiratory pressures under PSV, but that NAVA ventilation limits the effect of positive pressure on glottis narrowing.

METHODS. A state-of-the-art measurement set-up has been developed for synchronous acquisition of electrical activity of the diaphragm (EAdi), flow, pressure and video laryngoscopy. NIV was randomly applied in two modes (PSV and NAVA) and two levels of support (5 and 15 cmH_2O). The angle formed by the vocal cords was calculated as measure for glottis patency, see figure 1.

RESULTS. Eight COPD patients with an acute exacerbation requiring NIV at the ICU were included. The pattern of glottis opening varied within and over all subjects (example of 1 subject in figure 2), but no differences were found between the angle of the glottis during inspiration for PSV and NAVA ventilation at low and high levels of support.

CONCLUSIONS. The present study shows that patency of the glottis during inspiration in patients with an acute exacerbation of COPD is not dependent of mode or level of noninvasive ventilation.

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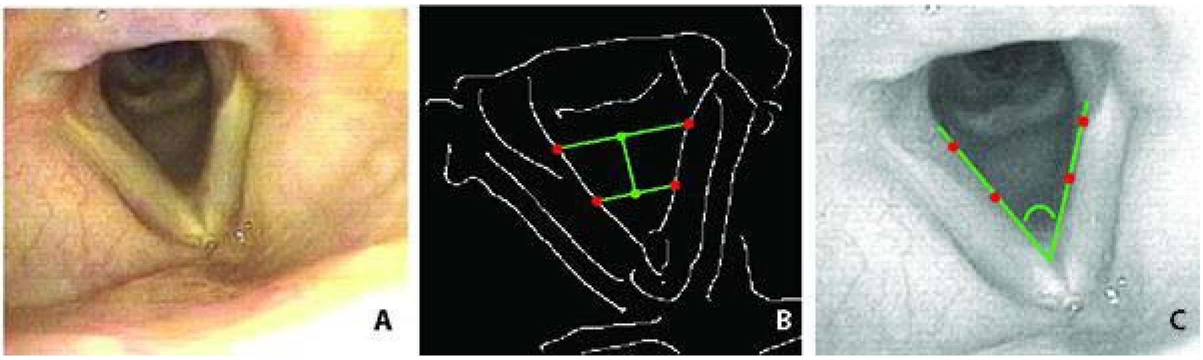
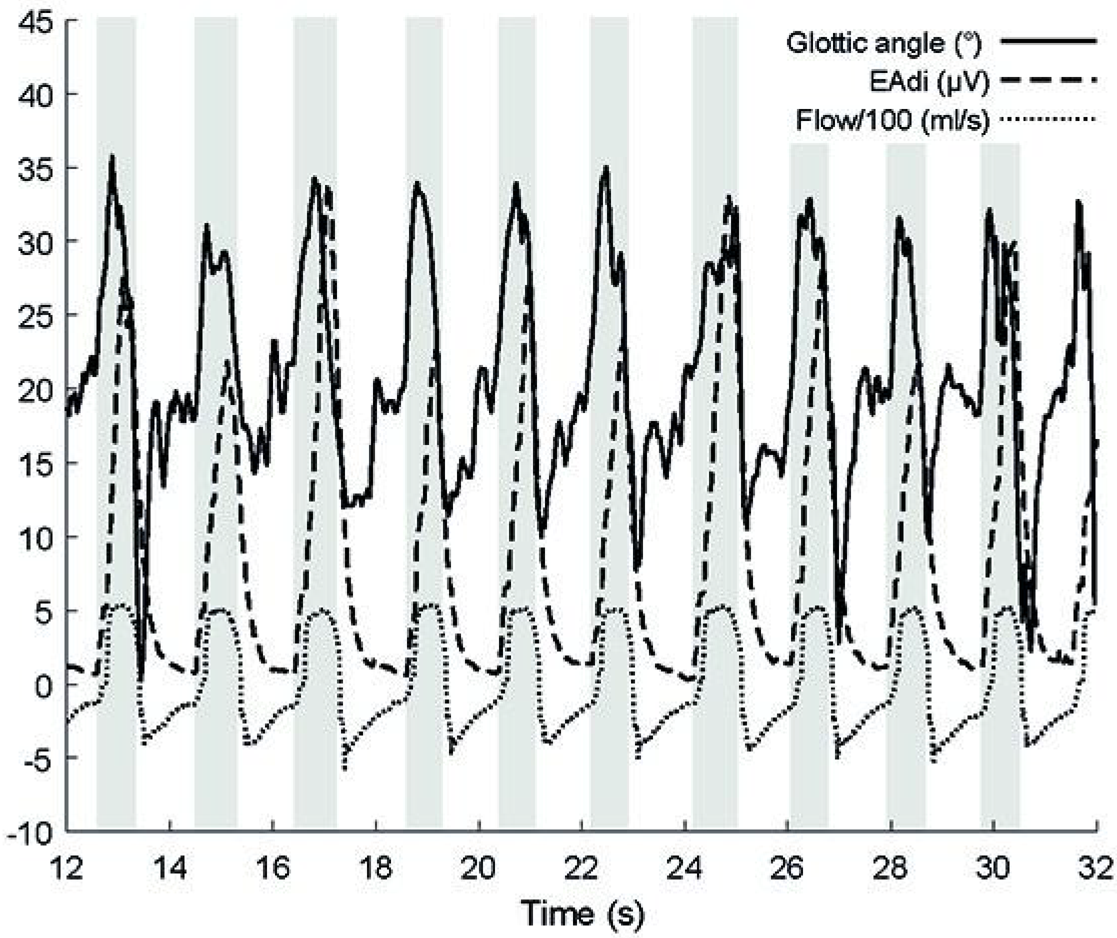


[Schematic representation of angle determination]



[EAdi, flow and glottis angle of 1 subject. Grey areas represent neural inspiration.]

029 Presence of ineffective efforts in clusters (Events) is associated with adverse patient outcome: a validation study of the ineffective effort event algorithm

K. Vaporidi[1], A. Proklou[1], E.M. Antonogiannaki[1], S. Soundoulounaki[1], E. Pediaditis[1], D. Babalis[1], A. Chytas[2], I. Chouvarda[2], R. Magrans[3], J. Montanya[4], C. de Haro[5], J. Lopez Aguilar[5], R. Kacmarek[6], L. Blanch[5], D. Georgopoulos[1]
[1]University Of Crete Faculty Of Medicine, Intensive Care, Heraklio, Greece, [2]Medical School, Aristotle University of Thessaloniki, Lab of Computing and Medical Informatics,, Thessaloniki, Greece, [3]CIBERes and Institut de Investigació i Innovacio Parc Tauli, Sabadell, Spain, [4]Better Care SL, Sabadell, Spain, [5]CIBERes. Institut de Investigació i Innovacio Parc Tauli, Critical Care Center, Sabadell, Spain, [6]Massachusetts General Hospital, Harvard Medical School, Department of Respiratory Care, Boston, United States

I**INTRODUCTION.** Ineffective efforts (IE), defined as the inability of patient's inspiratory effort to trigger a ventilator-delivered breath, is a commonly encountered asynchrony, and has been reported to adversely affect patient outcome[1,2,3]. We have recently reported that IEs often occur in clusters, and developed a mathematical description of clusters, the IE 'events' (IEEV)[3]. This study showed that the presence and characteristics of IEEV are associated with prolonged duration of mechanical ventilation and ICU stay.
OBJECTIVES. Aim of this study was to validate the significance of the presence of IEEV on the outcome of critically ill patients in another patient dataset[1] .
METHODS. Data from the 50 patients included in the study by Blanch et al. [1] and from additional 46 patients from the same center (University Hospital of Sabadell, ICU) were analyzed using the algorithm for recognition of IEEV and calculation of their characteristics. The data were analyzed separately and in combination with our study (University Hospital of Heraklio, ICU) results[3]. In our study patients were studied when placed in assisted ventilation, and IEs were identified using a prototype monitor (PVI-monitor). Patients from Sabadell ICU were enrolled on ICU admission, in all modes of ventilation, and IEs were identified using dedicated software (BetterCare™). Because both methods provide the number of effective and ineffective efforts the algorithm for detection of clusters (IEEV) was applicable to both datasets.
RESULTS. Overall data from 206 patients, 110 from Crete ICU, and 96 patients from Sabadell ICU, corresponding to 17133 hours of ventilation were analyzed. Patients from Sabadell had lower severity score on admission and lower hospital mortality than patients from Crete (APACHE-II score 15 vs. 19, $p< 0.001$, and mortality 27% vs. 44%, $p=0.02$). IEEVs were identified in 46% of patients from Sabadell, and in 38% of patients from Crete. The duration of mechanical ventilation and ICU stay was higher in patients with IEEV than in those without (Table). The characteristics of IEEV, power and duration were also correlated with the duration of mechanical ventilation and ICU stay ($p< 0.01$). The presence of IEEV was not associated with hospital mortality in patient from Sabadell ($p=0.10$), but remained significantly associated in the combined dataset ($p=0.01$).
CONCLUSIONS. The presence of IEEV, as well as their power and duration, is associated with prolonged duration of mechanical ventilation and ICU stay. Identification of IEEV should be considered for monitoring IEs in clinical practice.
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Data Source	Sabadell			Combined (Sabadell and Crete)		
	Events present	No Events	p-value	Events present	No Events	p-value
MV duration	10 (6-17)	5 (5-15)	0.01	14 (8-24)	8 (5-15)	0.003
ICU stay	18 (8-32)	10 (5-18)	0.02	19 (13-31)	14 (8-23)	0.001

[Duration of mechanical ventilation and ICU stay in patients with and without IEEV]

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030 High-flow nasal cannula in acute respiratory failure monitoring

R. Andino[1], G. Vega[1], S.K. Pacheco[1], A.M. Leal[1], N. Arevalillo[1], L. Fernández[1], M.J. Rodriguez[1]
[1]*Hospital Universitario de la Princesa, Unidad de cuidados intensivos, Madrid, Spain*

INTRODUCTION. Classic treatment of the acute respiratory failure (ARF) has been the conventional oxygenotherapy (CO) and the mechanical ventilation in the acute cases. The high-flow nasal cannula (HFNC) device is now a rising alternative.
OBJECTIVES. to compare the clinical and analytical evolution in patients with severe ARF treated with 50lpm HFNC-OptiFlow® device versus CO.
METHODS. Controlled clinical trial in patients with severe ARF, comparing the HFNC_ Optiflow® Fisher & Paykel (Intervention group_IG) with conventional oxygen therapy (control group_CG). Sequence data for basal time (with CO) and after placement OptiFlow® were registered. Mean changes in oxygen saturation, (estimated) PaO2/FiO2, respiratory rate (RR), dyspnea Borg scale, visual analogic comfort scale and endotracheal intubation (EI) in both groups were compared.
RESULTS. 46 patients were included, 24 in the IG and 22 in the CG. The randomization was adequate, no significant differences in the initial variables were found.
Although there were no differences between initial PaO2/FiO2 relation, we found an almost significant difference in the first 24 hours successive determinations (F Snédecor =4,1; p=0,05), being higher in the IG. Also they presented difference in the PaCO2 measurements, being significantly lower in the CG (Snédecor =2,6; p< 0,02), associated with higher RR in this group (F Snédecor =6,1; p=0,02). In the IG, those who needed EI after an initial improvement in PaO_2/FiO_2 (estimated) presented a significant decrease during 8-24 hours of treatment, compared to those of the IG who were not intubated (p = 0.02).
The device tolerance was worse than described. 14 of the 24 IG patients (58%) presented discomfort (IC95%:39-75,5%), so we cannot reach the flow objective (50lpm). It was mainly due to heat in all of this cases and also to noise in 4 patients (17%) (IC95%7-36%). Three patients (12,5%) could not be treated (IC95%:4-31%) . Nevertheless no significant differences were found in the comfort scales between the two groups.
CONCLUSIONS. The treatment with OptiFlow® device is associated with a significant improvement in pO2/FiO2 relationship, RR and dyspnea.
Nevertheless this improvement trend, which does not continue in the 8 hours posterior to its application, should alert us to perform EI.
The tolerance to the device was worse than described. An important percentage of patients with severe and ARF treated with HFNC declared some kind of discomfort.
Nevertheless the tolerance, measured by a comfort scale was similar to conventional oxygenotherapy.
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031 Screening weaning failure in prolonged mechanical ventilation: role of the diaphragm

J.F. Martínez Carmona[1], M. Ariza González[2], F.A. Hijano Muñoz[1], E. López Luque[1], M. Delgado Amaya[1], M.A. Barbancho[1]
[1]*HRU de Málaga, Intensive Care Unit, Málaga, Spain,* [2]*HRU de Málaga, Emergency Department, Málaga, Spain*

INTRODUCTION. Weaning failure of patients in mechanical ventilation is associated with increased complications, higher mortality, as well as, longer stay. Strategies are needed to detect patients with risk of weaning failure, which allow to implement therapies that act against this problem, thus improving the morbi-mortality associated.
OBJECTIVES. - Patients undergoing mechanical ventilation for at least 48 hours, detect patients with higher risk of weaning failure, identify and treat the main cause.
- Assessment of the role of echocardiography and diaphragmatic ultrasound in the detection of patients at risk of weaning failure.
METHODS. We prospectively studied 23 patients undergoing mechanical ventilation for more than 48

hours. After solving the main cause that required respiratory support, presenting hemodynamic and respiratory stability, we performed a weaning test in support pressure with 10 cms H_2O and PEEP 5 cms H_2O.
Variables: MIP, P0.1, RSBI, diaphragmatic and heart ultrasound, RASS scale, secretion management and effective cough.
RESULTS. The mean age was 57.22 years + 14.16 SD. 65.2% males. Main cause of respiratory support: ACV (26.1%). The median MV was 9 days. The overall mortality was 20%. 16 patients (69.56%) had weaning failure (31.25% diaphragmatic dysfunction, 37.5% diastolic dysfunction and 31.25% low level of consciousness).
We found a relationship between diaphragmatic ultrasound assessment and weaning failure ($p < 0.05$). Diaphragmatic excursion presented AUC 0.839 (IC95% 0.66-1) p 0.011 with cut off 19 mm (S 81.3% and E 71.4%); TDI presented AUC 0.888 (IC95% 0.756 - 1) p 0.004 with cut off 41% (S 68.8% and E 100%).
We found a relationship between weaning failure and prolonged mechanical ventilation with AUC 0.808 (IC95% 0.632 - 0.984) p 0.021), with cut off in 8.5 days of mechanical ventilation (S 68.8% and E 85.7%).
CONCLUSIONS. Weaning test is necessary in patients undergoing mechanical ventilation for more than 48 hours.
It is essential to implement a weaning failure protocol to detect patients at risk of weaning failure and reduce associated morbidity and mortality.
Diaphragm has a main role in weaning failure, especially in patients with mechanical ventilation over 7 days.

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032 Relationship between weaning failure due to diaphragmatic dysfunction and muscle wasting in patients with sepsis and prolonged mechanical ventilation

J.F. Martínez Carmona[1], M. Ariza González[2], E. López Luque[1], F.A. Hijano Muñoz[1], M. Delgado Amaya[1], M.A. Barbancho[1]
[1]HRU de Málaga, Intensive Care Unit, Málaga, Spain, [2]HRU de Málaga, Emergency Department, Málaga, Spain

OBJECTIVES.
- Determine the loss of muscle mass for 7 days in patients with sepsis and mechanical ventilation
- Study the possible relationship between muscle wasting and weaning failure due to diaphragmatic dysfunction in sepsis

MATERIAL AND METHOD.
It is an ongoing prospective study, with 8 patients included, so we only have preliminary results.
Inclusion criteria: Patients admitted to the ICU due to sepsis and need mechanical ventilation. An ultrasound evaluation of the rectus femoris muscle was performed on day 1 and 7 after the start of mechanical ventilation, assessing CSA. The measurement point is located in the lower third of the femur, tracing a line from the anterior superior iliac spine. We use a linear probe of 5 - 10MHz.
In the weaning phase, with the patient stable hemodynamic and respiratory, we performed a weaning test in support pressure 10cmsH_2O and PEEP of 5cmsH_2O, performing a diaphragmatic ultrasound control (diaphragmatic excursion and TDI%).
RESULTS. It is an ongoing study, with 8 patients included. The average age is 60.6 years + 11.9 SD. 75% are males. The most frequent cause of admission was respiratory sepsis (75%). APACHE II on admission: 24 + 9.58 SD. SOFA on admission: 10.5 + 2.97 SD. The median stay in the ICU is 27.5 days.
Patients with a diaphragmatic excursion below 12mm and TDI less than 29% had a higher risk of

weaning failure due to diaphragmatic dysfunction, with a statistical relationship.
Those patients with loss of muscle mass measured in rectus femoris greater than 20.29% in 7 days, had a longer ICU stay as well as longer mechanical ventilation time.
We did not find a statistically significant relationship between the loss of muscle mass measured in rectus femoris with diaphragmatic dysfunction and weaning failure.
These are only preliminary data, we will include more patients in the coming months and we can offer definitive data of our study.

CONCLUSIONS.

- Diaphragm is the main key for weaning, should be evaluated in patients undergoing mechanical ventilation for more than 48 hours

-The rapid and early loss of muscle mass in septic patients undergoing mechanical ventilation plays an important role in the evolution of the patient, we need tools to assess the muscle wasting and initiate therapies to modify the outcome.

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033 Comparison of occlusion pressure at 100 ms measured with Evita XL ventilator and with airway opening and esophageal pressure in patients at the time of weaning from invasive mechanical ventilation

L. Baboi[1], M. Mezidi[1], N. Chebib[1], H. Yonis[1], L. Kreitmann[1], F. Lissonde[1], E. Joffredo[1], J.-C. Richard[1], **C. Guérin**[1,2]
[1]Hopital de la Croix rousse, Médecine Intensive Réanimation, Lyon, France, [2]Institut Mondor Recherches Biomédicales, INSERM 955, Créteil, France

INTRODUCTION. Measurement of airway pressure 100 ms after airway occlusion (P0.1) has been initially described in normal subjects to quantify the intensity of the respiratory drive (1). At this time it was measured at the mouth of the subject (1). Its measurement has been implemented into ICU ventilators to make its monitoring easily available at the bedside for the respiratory drive (2). It has also been shown reflecting the work of breathing (3). However, during mechanical ventilation P0.1 is measured upstream the ventilator circuit and hence may not reflect mouth P0.1 due to the compliance of the circuit.

OBJECTIVES. To compare P0.1 as commonly measured with the Evita XL ICU ventilator (Dräger) with airway (P0.1,aw) and esophageal P0.1 pressure (P0.1,es) in ICU patients, who were attempting a spontaneous breathing trial during weaning from mechanical ventilation.

METHODS. Measurement of P0.1 is part of an ongoing study comparing pressure support (PS) 7 cmH2O + PEEP 4 cmH2O (treatment A) to PS 0 cmH2O + PEEP 4 cmH2O + 100% automatic tube compensation (treatment B), each applied for 30 minutes, at the time of weaning from invasive mechanical ventilation. Before each treatment the baseline PS was resumed for 30 minutes.We used the P0.1 built-in function available in the Evita XL ventilator. Paw and flow were measured at the proximal tip of the endotracheal tube. Pes was obtained from esophageal balloon whose right position and optimal volume were checked properly. Paw, Pes and flow signals were recorded with BIOPAC 150 at 200 Hz. Three to ten P0.1 measurements were performed, each separated by 4-8 breaths, in each condition in each patient. The value of P0.1 displayed at the ventilator screen (P0.1,Evita) was compared to P0.1,aw and P0.1,es. Values are expressed as mean±SD. The data were assessed by using Bland and Altman representation and linear mixed effect model with method of P0.1 measurement and rank of measurement used as the fixed variables and patient as the random variable.

RESULTS. Nine patients have been included to date totalizing 209 measures with each method. P0.1,Evita averaged 2.89±2.26, P0.1,aw 2.58±2.11 and P0.1,es 2.80±2.54 cmH2O.The bias and limits of agreement for the relationship of P0.1,Evita to P0.1,aw and of P0.1,Evita to P0.1,es were 0.3 (-

1.2;1.8) (Figure 1 left panel) and 0.1 (-3.0;3.1) cmH2O (figure 1 right panel), respectively. The linear mixed model found that neither the method used nor the rank of the measurement had a significant effect on P0.1,Evita (Table 1).

CONCLUSIONS. P0.1 automatically implemented in the Evita XL ventilator provided reasonable estimate of P0.1 measured close to the patient.

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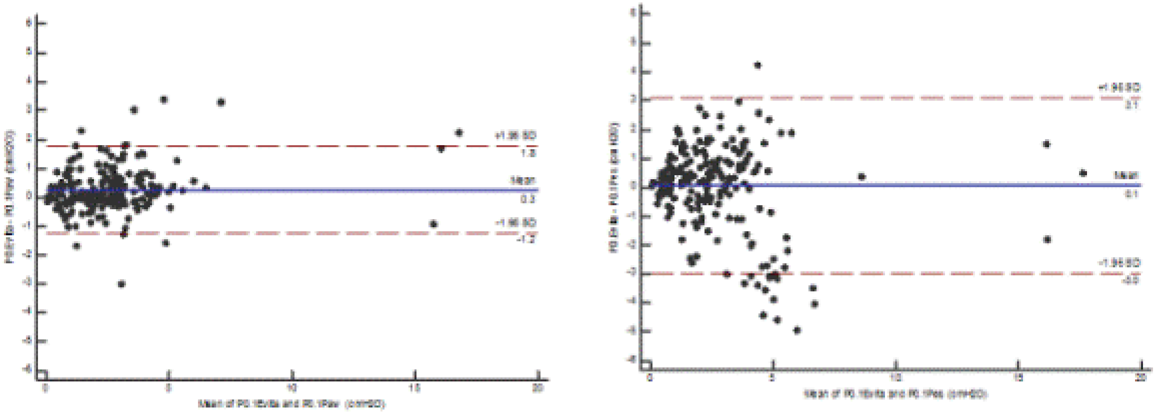
Parameter	Mean value	95% Confidence intervals	P value
P0.1,Evita (reference) cmH2O	3.01	2.07;3.96	0.00001
P0.1,Paw cmH2O (change from reference)	-0.27	-0.65;0.11	0.16
P0.1,Pes cmH2O (change from reference)	0.04	-0.34;0.42	0.83
Rank of measurement cmH2O (change from reference)	-0.07	-0.19;0.04	0.21

[Table 1.Effects of factors with fixed effects on P0.1 measurement]

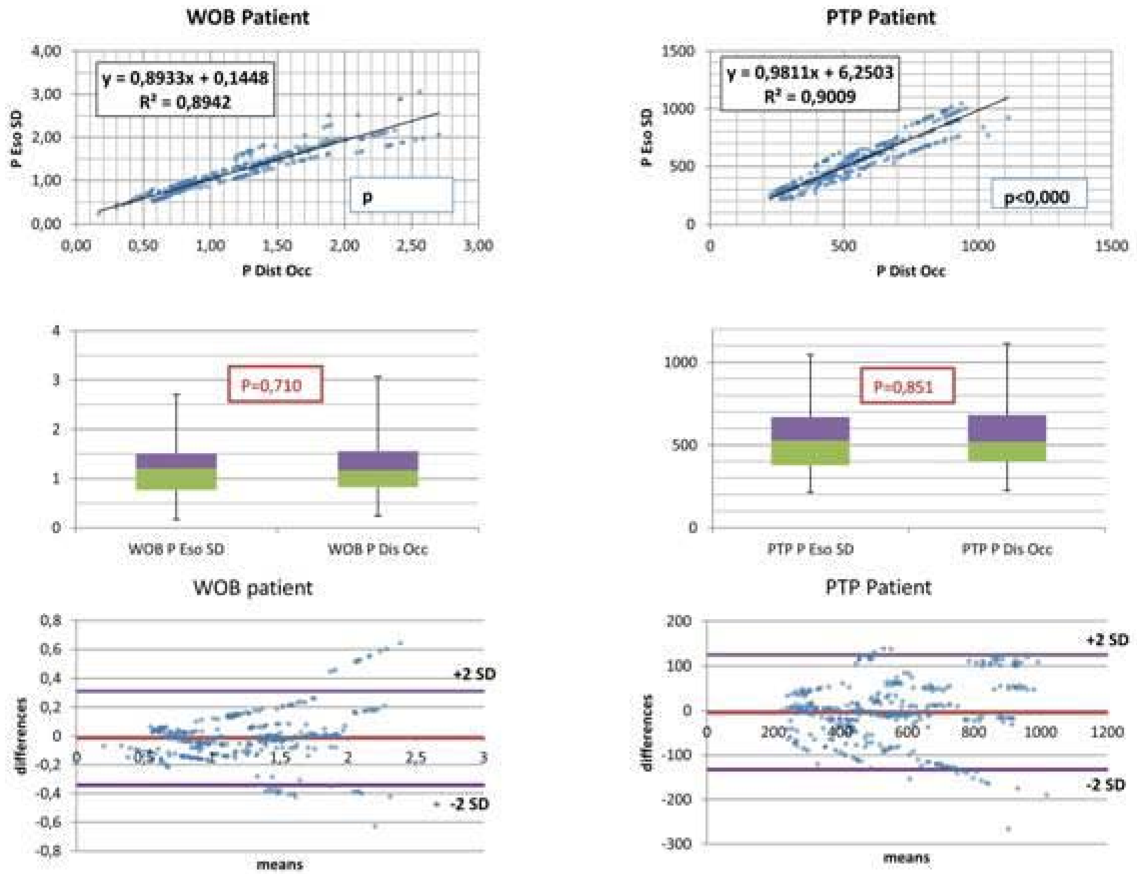


[Figure 1]

034 Usefulness of airway occlusion pressure for to monitor effort and respiratory work during pressures support ventilation

J.A. Benítez Lozano[1], **P. Carmona Sánchez**[2], M. Delgado Amaya[3], J.M. Serrano Simón[2]
[1]Hospital Quirón, Intensive Care Unit, Málaga, Spain, [2]Hospital Universitario Reina Sofía, Intensive Care Unit, Córdoba, Spain, [3]Hospital General Universitario Carlos Haya, Intensive Care Unit, Málaga, Spain

INTRODUCTION. Airway occlusion pressure has been used for assessing output of the respiratory controller. It gives a measurement of a weighted sum of the effect of all respiratory muscles, does not depend on the resistance or compliance of the respiratory system, nor Hering-Breuer inflation reflex.
OBJECTIVES. To compare the effort and work of breathing with a new method using data obtained from occlusion pressure maneuver, versus the values obtained by measurements with standard technique by esophageal pressure.
METHODS. Out of a total of 96 patients who had a record of esophageal during different levels of pressure support ventilation, 33 cases were included for the study, which showed a good esophageal signal-to-noise ratio and no significant active expiration. Esophageal pressure (Pes), gastric (Pgas), airway pressure (Paw), and airway flow (V´) were registered at 560 Hz for posterior analysis. From each of the 33 recordings, 15 cycles were chosen that included a Baydur test. The Pes was corrected after a linear regression with Paw occluded.The calibration factor for the slope between Pes and Paw was 0.8 to 1.2. The Elastance of the thoracic wall (Etw) was determined during relaxed ventilation. Respiratory effort (PTP, cmH2O/sec*min) and work of patient (WOB, j/L) were determined by esophageal-muscle pressure, according to usual technique (P Eso SD).
We calculated a new parameter, total distending pressure (∫PDist_Occ) as the integral during the inspiration of Paw (∫Paw) plus the product of the half of the delta of occlusion by inspiratory time, in 5 cycles prior to occlusion.
The time constant (τ) was obtained from the linear regression between V´ and volume (V) in the half middle expiratory of each cycle.
The Elastance of the respiratory system (Ers) was obtained from the equation:
$\sum_i^e Ers*V+Ers*\tau*V'+PEEPt=\int PDist\_Occ$ by numerical iteration. The resistances of the respiratory system (Rrs) were obtained by multiplying τ * Ers. Ers and Rrs were averaged out of the 5 cycles. A new signal was generated as the occlusion distending pressure (PDist_Occ) in the inspiratory phase of each cycle according to the equation: $PDist\_Occ=Ers*V+Rrs*V'+PEEPt$. With PDist_Occ values of PTP and WOB were obtained and were compared in each of the 394 cycles with the measurements obtained by standard technique.
Data were expressed as mean ± SD, the comparison was made with Student's t-test and agreement with linear regression and the Bland-Altman analysis.
RESULTS. WOB (P Eso SD): 1.21±0.025, WOB (P Dist Occ): 1.19 ±0,026. t = 0.372 p=0.710. PTP (P Eso SD): 545.44± 10.01, PTP (P Dist Occ): 542.74±10.31. t=0.188 p=0.851. Other results are shown in the graphs:



[Figure 1]

CONCLUSIONS. The new method can be used to monitor the patient´s respiratory work without the need of the esophageal catheter.

035 Identification of asynchrony due to reverse triggering by flow-volume loops

J.A. Benítez Lozano[1], **P. Carmona Sánchez**[2], J.M. Serrano Simón[2]
[1]Hospital Quirón, Intensive Care Unit, Málaga, Spain, [2]Hospital Universitario Reina Sofía, Intensive Care Unit, Córdoba, Spain

INTRODUCTION. Reverse triggering (RT) constitutes a particular patient-ventilator asynchrony in which the diaphragmatic muscle contractions appear after the cycle induced by the ventilator, supposedly mediated by a spinal reflex. Their recognition requires monitoring of the effort by esophageal pressure (Pes) or of the electrical activity of the diaphragm.
OBJECTIVES. We have observed different patterns in the flow-volume loops (FVL) morphology during RT, which could be used to identify this asynchrony. Our objective is to evaluate the sensitivity of the FVL versus Pes in the identification of RT during mechanical ventilation.
METHODS. Over a 2 years period, recordings of flows, airway pressures (Paw) and Pes, were obtained of a total of 103 patients.
Of these, 36 cases with RT were studied, 18 during controlled ventilation (CMV) and 18 in pressure support ventilation (PSV).Ten to fifteen cycles in each case containing this asynchrony were subjected to study. A total of 497 cycles were analyzed through two independent observers, identifying RT according to the esophageal pressure tracings and flow-volume loops, respectively. A sensitivity and specificity test was carried out.
RESULTS. The sensitivity and specificity for identification of RT by Flow-volume loops (RT- FV) versus esophageal pressure tracing (RT - Pes) are show in the tables bellow. The figure shows

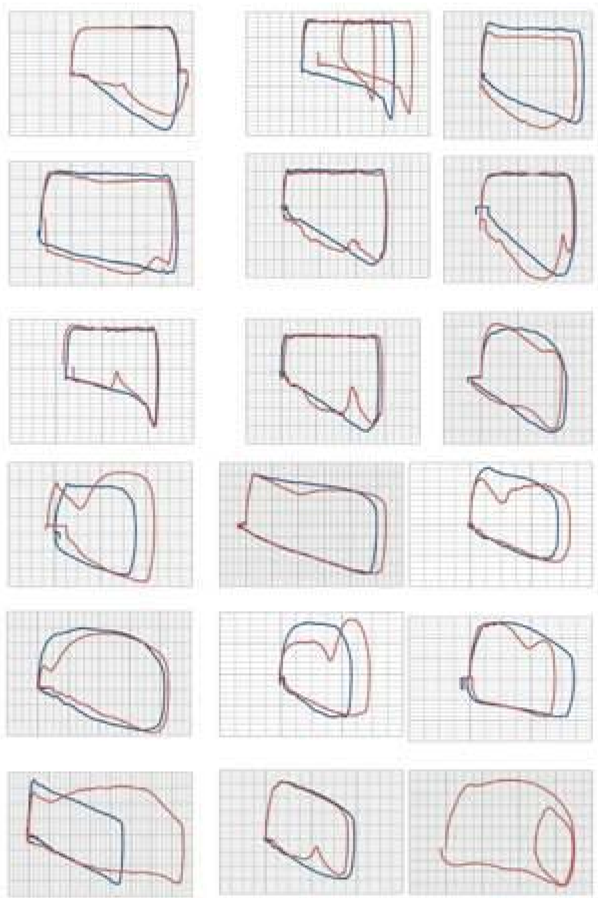
different patterns of RT on the FVL.

	RT Pes (+)	RT Pes (-)
RT_FV (+)	258	9
RT_FV (-)	37	192

[Table 1]

Statistic	Value	Lower limit (95%)	Upper limit (95%)
Sensitivity	0.875	0.831	0.908
Specificity	0.955	0.915	0.977
False Positive Rate	0.045	0.016	0.073
False Negative Rate	0.125	0.088	0.163

[Table2]



[Figures: Different patterns of RT observed by FV.]

CONCLUSIONS. Reverse Trigger can be identified by flow-volume loops with approximation similar to monitor pleural with oesophageal balloon.

036 Breathing efforts in ARDS (BEARDS): characteristics of the 27 first patients included

T. Pham[1], I. Telias[1], S. Spadaro[2], O. Roca[3,4], C. Chang-Wen[5], T. Piraino[6,7], T. Mauri[8], J.-X. Zhou[9], M. Dres[10], E. Kondili[11], R. Mellado Artigas[1], L. Heunks[12], H. de Vries[12], T. Becher[13], J. Montanya[4,14], L. Blanch[4,14], J. Mancebo[15], L. Brochard[1,16], PLeUral pressure working Group (PLUG)
[1]University of Toronto, Interdepartmental Division of Critical Care, Toronto, Canada, [2]University of Ferrara, Department of Morphology, Surgery and Experimental Medicine, Ferrara, Italy, [3]Vall d'Hebron University Hospital and Research Institute, Critical Care Department, Barcelona, Spain, [4]Instituto de Salud Carlos III, Ciber Enfermedades Respiratorias (CIBERES), Madrid, Spain, [5]National Cheng Kung University Hospital, Department of Critical Care Medicine, Tainan, Taiwan, Province of China, [6]St. Michael's Hospital, Department of Respiratory Therapy, Toronto, Canada, [7]McMaster University, Department of Anesthesia, Hamilton, Canada, [8]Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, University of Milan, Department of Anesthesia and Critical Care, Monza, Italy, [9]Beijing Tiantan Hospital, Capital Medical University, Department of Critical Care Medicine, Beijing, China, [10]CHU pitié Salpêtrières, université Paris VI, Réanimation médicale et surveillance continue, Paris, France, [11]University Hospital of Heraklion, University of Crete, Intensive Care Medicine, Heraklion, Greece, [12]VU University Medical Center, Department of Intensive Care Medicine, Amsterdam, Netherlands, [13]University Medical Center Schleswig-Holstein, Campus Kiel, Department of Anesthesiology and Intensive Care Medicine, Kiel, Germany, [14]Parc Taulí Hospital Universitari, Institut d'Investigació i Innovació Parc Taulí I3PT, Universitat Autònoma de Barcelona, Critical Care Center, Sabadell, Spain, [15]Hospital Sant Pau, Servei Medicina Intensiva, Barcelona, Spain, [16]Li Ka Shing Knowledge Institute, Keenan Research Centre for Biomedical Science, Toronto, Canada

INTRODUCTION. Dyssynchrony is a mismatch between the patient inspiratory and expiratory time and the mechanical ventilator delivery. In intubated patients with the Acute Respiratory Distress Syndrome (ARDS) this phenomenon seems frequent and is associated with worse outcomes[1, 2]. However, the actual epidemiology of dyssynchrony in the early phase of ARDS is unknown.
OBJECTIVES. The BEARDS study (Breathing Efforts in ARDS) aims at describing the different types of dyssynchrony in the early phase of ARDS, their incidence, risk factors and association with outcomes.
METHODS. Intubated and sedated patients with a PaO2/FiO2 ratio ≤200mmHg were screened. For included patients, an esophageal catheter was inserted to monitor either esophageal pressure or electrical activity of the diaphragm (EaDi); this allowed monitoring patients' own respiratory efforts. Recordings of the airway flow and pressure as well as esophageal pressure or electrical activity were performed three times per day for 3 to 7 days. Each recording lasted at least 20 minutes.
RESULTS. From January 2017 to January 2018, 35 patients were included in 9 centers and 27 patients have complete data collection. Patients have a median [IQR] number of recordings of 11 [7-14] for 5 [3-6] days corresponding to a total number of 283 tracings. The mean age was 65 years and the male/female sex ratio was 1.7. The main comorbidities were hypertension (48%), diabetes (22%) and chronic kidney disease (19%). The main causes for admission were pneumonia (64%) or extra-pulmonary sepsis (19%) and 74% were intubated for hypoxemia (15% for hypercapnia and 15% for coma) and 44% received paralyzing agents. Initial severity and ventilation characteristics are described in Table 1.

	Patients (N=27)
Apache III score	69.4±29.1
SOFA score	9.96±9.50
PaO2/FiO2 ratio, mmHg	160±44.7
PCO2, mmHg	44.5±9.63
Plateau pressure, cm H2O	24.6±4.99
Plateau pressure, cm H2O	24.6±4.99
Driving pressure, cm H2O	13.1±4.12
PEEP, cm H2O	10.8±3.79
Minute Ventilation, L/min	9.91±2.13

[Severity and ventilation parameters at inclusion (mean +/-SD)]

The survival rate was 72%. Tracings analysis is in progress and many patients present dyssynchrony such as reverse triggering, breath stacking or flow starvation (Fig 1).

CONCLUSIONS. Intubated patients in the early phase of respiratory failure present several different types of dyssynchronies. Analysis of the tracings from the BEARDS study should give more insights on the incidence of each type of dyssinchrony, their risk factors and association with duration of mechanical ventilation and mortality.

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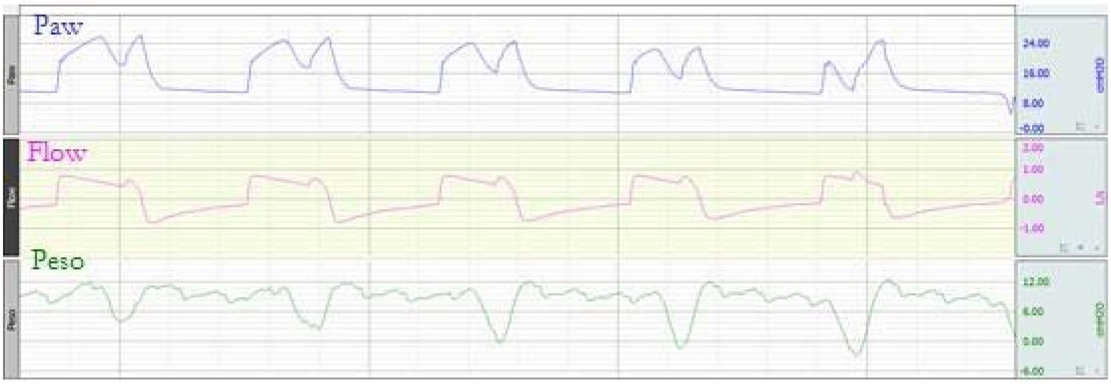
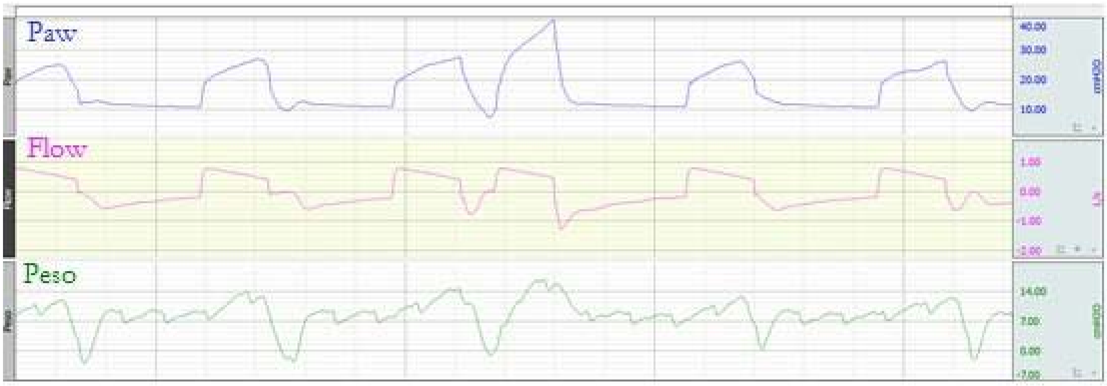
Tracing 1: Reverse triggering



Tracing 2: Reverse triggering and breath stacking



[Figure showing dyssynchronies]

037 A Smart Data Display as a tool for patient-ventilator asynchronies detection and management

C. De Haro[1,2], J. Montanya[3], R. Magrans[2,4], J. López-Aguilar[2,4], G. Gomà[1,4], M. Turon[2,4], S. Fernández-Gonzalo[4,5], R.M. Kacmarek[6], L. Blanch[2,4], ASYNCICU group
[1]Corporacio Sanitaria i Universitaria Parc Tauli, Critical Care, Sabadell, Spain, [2]CIBERES, Instituto de Salud Carlos III, Madrid, Spain, [3]Better Care SL, Sabadell, Spain, [4]Institut d'Investigació i Innovació Parc Taulí I3PT, Universitat Autònoma de Barcelona, Sabadell, Spain, [5]CIBERSAM, Instituto de Salud Carlos III, Madrid, Spain, [6]Department of Respiratory Care, Department of Anesthesiology, Massachusetts General Hospital, Harvard Medical School, Boston, United States

INTRODUCTION. Patient-ventilator asynchronies are common throughout mechanical ventilation (MV)(1) and can increase mortality (1,2), but are underdiagnosed. It is necessary the use of continuous monitoring systems to identify asynchronies and to modify ventilatory settings to improve patient-ventilator interaction (1,3). The platform Better Care™ (Barcelona, Spain) quantifies in real time different types of asynchronies and computes the asynchrony index(4).
OBJECTIVES. 1) To develop an interface to facilitate the visualization of asynchronies as well as its trends in real time and 2) to assess the impact of this new tool on reducing the incidence of asynchronies.
METHODS. Design of a graphical interface (Smart Data Display) to visualize at real-time and in an easy and intuitive way, the incidence and trends of asynchronies along the previous 24 hours. We will assess the impact of this graphical interface by comparing the incidence of asynchronies before and after of its implementation in the ICU.
RESULTS. We have designed the graphical interface which has been implemented in two Smart Data Displays installed in areas of wide visibility for the healthcare team (figure 1). The display show in real-time the asynchrony index (AI), ineffective efforts (IEE), double cycling (DC), short cycling (SC) and prolonged cycling (PC), among other data of MV. Data are updated every 15 minutes showing a graphic trend of the last 24 hours by using a code of colors that indicates decrease or increase of the incidence of asynchronies. A clinical decision guide for the management of asynchronies has been also provided to the clinician team. The first phase of data monitoring, before the implementation of the Smart Data Display, has been concluded by including 83 patients undergoing MV. The second phase post-implementation has been started in 2018.
CONCLUSIONS. The implementation of a Smart Data Display system in the ICU has facilitated the visualization of asynchronies and its trends. This graphical interface has been well received by healthcare professionals and it is expected to be a helpful tool for the management of patient-ventilator asynchronies. After completing the second phase, we will evaluate the positive impact of this intervention in the reduction of asynchronies.
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GRANT ACKNOWLEDGMENT. This work is partially financed by Taulí CIR57/2015 and PI16/01606.

[Figure 1. Smart Data Display]

038 Effect of tracheostomy on respiratory mechanics and patient-ventilator asynchronies: an observational study

E. Lena[1], N. López[2], R. Magrans[2,3], J. López Aguilar[2,3], U. Lucangelo[1], R. Kacmarek[4], J. Montanyà[5], L. Blanch[2,3]
[1]*Cattinara Hospital, University of Trieste, Department of Perioperative Medicine, Intensive Care and Emergency, Trieste, Italy,* [2]*Hospital Universitari Parc Taulí, Institut d'Investigació i Innovació Parc Taulí I3PT, Universitat Autònoma de Barcelona, Critical Care Center, Sabadell, Spain,* [3]*CIBERES, Instituto de Salud Carlos III, Madrid, Spain,* [4]*Massachusetts General Hospital, Harvard Medical School., Department of Respiratory Care, Department of Anesthesiology, Boston, United States,* [5]*Better Care, Barcelona, Spain*

INTRODUCTION. Tracheotomy is a technique that is usually applied during long-term ventilatory support in critically ill patients. Previous studies have shown that tracheotomy is associated with a significant decrease in airway resistance and work of breathing (1,2). However, there are no studies that investigate the effect of tracheostomy on patient-ventilator asynchronies.
OBJECTIVES. The aim of this study is to evaluate the changing in respiratory mechanics and patient-ventilator asynchronies comparing the period before and immediately after a tracheotomy in patients undergoing mechanical ventilation (MV).
METHODS. We performed an observational study in twenty tracheostomized adult patients with an expectation of MV for more than 24 hours admitted to the ICU at the Parc Taulí Hospital, Sabadell (Spain). The platform Better Care™ (Barcelona, Spain) (3,4) was used to capture digital output from the ventilators and determine several respiratory variables each averaged per hour in the 24 hours before and after the tracheotomy procedure. The software detected the presence of asynchronies (ineffective inspiratory efforts, double cycling, short and prolonged cycling) breath by breath and expressed it as a rate. The global asynchrony index was also calculated (5). We also recorded hourly the level of consciousness with the sedation assessment scale (SAS) and the amount of sedatives (mg/kg, as equipotents of midazolam). Linear mixed-effects models analyses were used for a proper description of the repeated measures along time (i.e. hours) by period of observations.

RESULTS. Table 1 and Figure 1 summarizes all comparative results pre and post tracheotomy. Data showed a significant reduction on dynamic resistance (Rdyn) followed by an increase on dynamic compliance (Cdyn) and a slight decrease of the peak expiratory flow and of the end expiratory flow after tracheostomy. The asynchrony index and the incidence of infective efforts and double cycling were similar before and after the tracheostomy. There was a general trend towards a decrease of amounts of sedatives and a higher SAS after tracheotomy. Closer to the tracheotomy procedure, there was a rise in the amount of administered sedatives corresponding to an increase in the incidence of double cycling (Table 2).

CONCLUSIONS. In our study population the tracheostomy procedure improved respiratory mechanics but did not influence the rate of incidence of patient-ventilator asynchronies. Only the level of sedation was related to the incidence of double cycling.

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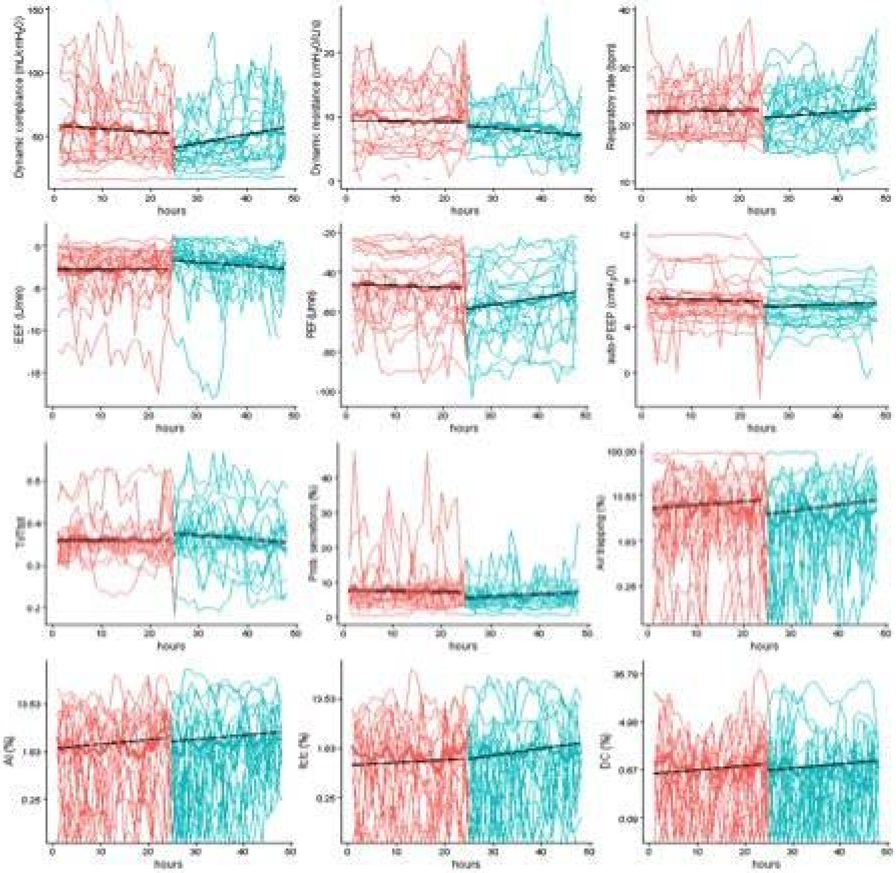

[Figure 1. Spaghetti plots and mean trends for each variable by period of observation.]

	pre	post	pre vs. post
Sedation			
Equipotents midazolam (mg/h)	0.15(0.11, 0.19)***	-0.01(-0.06, 0.03)	***
SAS	-0.04(-0.05, -0.03)***	0.06(0.05, 0.07)***	***
Respiratory mechanics variables			
Cdyn (mL/cmH_2O)	-0.28(-0.47, -0.09)**	0.68(0.49, 0.88)***	***
Rdyn (cmH_2O/L/s)	-0.01(-0.05, 0.02)	-0.07(-0.10, -0.04)***	*
RR (bpm)	0.02(-0.02, 0.05)	0.07(0.03, 0.11)***	
EEF (L/min)	0.01(-0.02, 0.03)	-0.04(-0.07, -0.02)***	**
PEF (L/min)	-0.08(-0.18, 0.01)	0.39(0.29, 0.49)***	***
auto-PEEP (cmH_2O)	-0.01(-0.02, -0.00)*	0.01(0.00, 0.03)*	***
Ti/Ttot	0.00(-0.00, 0.00)	-0.00(-0.00, -0.00)***	*
Vt (mL/kg)	-0.01(-0.02, -0.01)***	0.01(0.01, 0.02)***	***
Prob. secretion (%)	-0.01(-0.06, 0.03)	0.08(0.03, 0.12)**	*
Asynchronies			
Airtrapping (%)	0.02(0.00, 0.03)*	0.03(0.01, 0.04)***	
AI (%)	0.02(0.01, 0.03)**	0.02(0.00, 0.04)*	
IEE (%)	0.01(-0.00, 0.03)	0.03(0.01, 0.04)***	
DC (%)	0.02(-0.00, 0.04)	0.02(-0.00, 0.04)	

[Table 1. COMPARATIVE DATA OF RESPIRATORY MECHANICS AND ASYNCHRONIES PRE AND POST TRACHEOTOMY. Mean c]

	pre	post
Equipotent of midazolam *vs* asynchronies		
AI	0.02(-0.01, 0.04)	0.03(-0.01, 0.08)
IEE	-0.01(-0.03, 0.02)	0.04(-0.01, 0.09)
DC	0.03(0.01, 0.06)*	0.01(-0.04, 0.08)
SAS *vs* asynchronies		
AI	0.02(-0.01, 0.04)	0.03(-0.01, 0.08)
IEE	-0.01(-0.03, 0.02)	0.04(-0.01, 0.09)
DC	0.03(0.01, 0.06)*	0.01(-0.04, 0.08)

[Table 2. EFFECT OF EQUIPOTENTS OF MIDAZOLAM AND SAS ON ASYNCHRONIES. Mean effect (95% CI) estimates]

039 Neural and mechanical inspiration and expiration time during a weaning trial

A.H. Jonkman[1], H.J. de Vries[1], J. Doorduin[2], J.G. van der Hoeven[2], L.M.A. Heunks[1]
[1]VU University Medical Center, Intensive Care Medicine, Amsterdam, Netherlands, [2]Radboudumc, Intensive Care Medicine, Nijmegen, Netherlands

INTRODUCTION. A precise definition of breathing phases has important consequences when defining respiratory mechanics and considering topics such as expiratory activity of the diaphragm(1,2). Start of inspiration and expiration can be defined mechanically, based on zero-crossings in flow waveforms. Currently, there is no scientific method that identifies the onset of expiration based on the electrical activity of the diaphragm (EAdi).
OBJECTIVES. To define neural expiratory onset time using EAdi-derived parameters.
METHODS. Flow, esophageal pressure, gastric pressure and EAdi of 17 ICU patients conducting a weaning trial on T-tube were acquired. Flow was measured with a pneumotachograph placed at the

endotracheal tube or cannula. EAdi was acquired at a sampling frequency of 2KHz using a dedicated nasogastric tube (Neurovent®). Offline signal processing was performed as described previously (3,4). Only breaths from the start of the weaning trial (2-5 minutes) were analyzed.
Flow-based inspiration and expiration onsets were defined as the flow zero-crossings (Fig.1A). The onset of neural inspiration was defined as the start of EAdi increase (Fig.1B). As flow is a mechanical result of EAdi, there is a time-delay between flow onset and EAdi onset. We therefore defined a 'corrected offset EAdi' as the delay-adjusted flow offset time (Fig.1B/C). Peak EAdi was determined in a filtered EAdi signal to limit influence of cardiac artifacts (Fig.1C). Median delay between EAdi onset and flow onset was calculated and used to construct a time-shifted EAdi signal (Fig.1D).
Average median delay between EAdi onset and flow onset was calculated, as well as mean time-difference between corrected EAdi offset and EAdi peak.
RESULTS. In total, 1248 breaths were analyzed as independent samples. The average median delay between EAdi onset and flow onset was 0.28±0.15 seconds. The mean time-difference between corrected EAdi offset and EAdi peak was 0.07±0.18 seconds.
CONCLUSIONS. We showed that EAdi peak coincides closely to mechanical expiration, after correction for the delay between neural activity and mechanical output, during a SBT in a heterogenous cohort of ICU patients. We suggest that this time-delay should be taken into account when analyzing respiratory mechanics.
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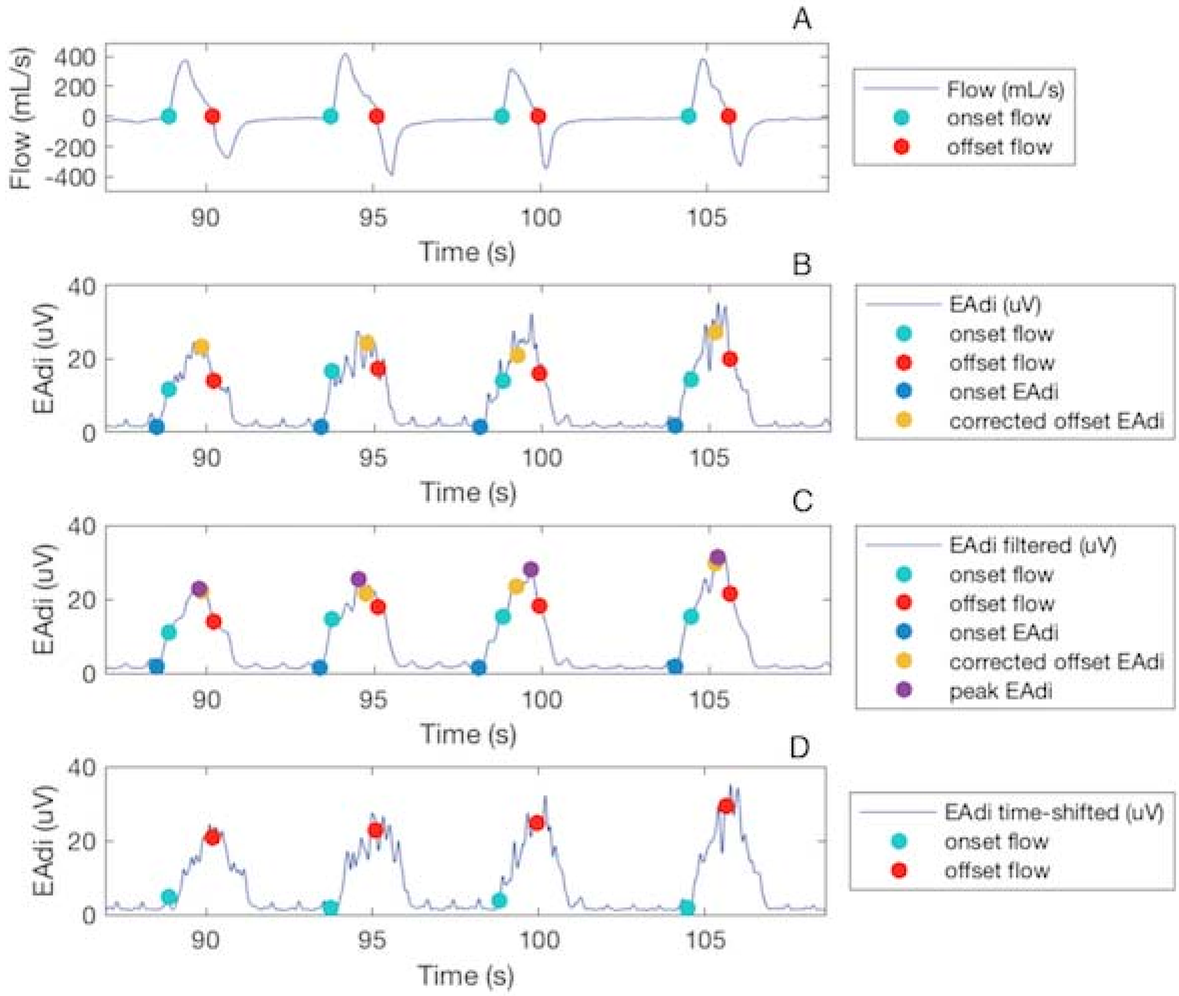

[Flow (A) and EAdi (B-D) tracings of consecutive breaths, as explained in the Methods section]

040 Description and preliminary validation of an automated algorithm to detect reverse-triggering using esophageal pressure

M. Madorno[1,2], I. Telias[3,4], T. Pham[3], S. Spadaro[5], O. Roca[6,7], C. Chang-Wen[8], T. Piraino[9,10], T. Mauri[11], J.-X. Zhou[12], M. Dres[13], E. Kondili[14], R. Mellado Artigas[3], H. de Vries[15], T. Becher[16], L. Blanch[17], J. Mancebo[18], P.O. Rodriguez[19], L. Brochard[3,20], PLeUral pressure working Group
[1]MBMed S.A., Martinez, Argentina, [2]Instituto Tecnológico de Buenos Aires, Bioengineering, Buenos Aires, Argentina, [3]University of Toronto, Interdepartmental Division of Critical Care, Toronto, Canada, [4]Sanatorio Mater Dei, Buenos Aires, Argentina, [5]University of Ferrara, Department of Morphology, Surgery and Experimental Medicine, Ferrara, Italy, [6]6Vall d'Hebron University Hospital and Research Institute, Critical Care Department, Barcelona, Spain, [7]Instituto de Salud Carlos III, Ciber Enfermedades Respiratorias (CIBERES), Madrid, Spain, [8]National Cheng Kung University Hospital, Department of Critical Care Medicine, Tainan, Taiwan, Province of China, [9]St. Michael's Hospital, Department of Respiratory Therapy, Toronto, Canada, [10]McMaster University, McMaster University, Hamilton, Canada, [11]Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Department of Anesthesia and Critical Care, Monza, Italy, [12]Beijing Tiantan Hospital, Capital Medical University, Department of Critical Care Medicine, Beijing, China, [13]CHU pitié Salpêtrières, université Paris VI, Réanimation médicale et surveillance continue, Paris, France, [14]University Hospital of Heraklion, University of Crete, Intensive Care Medicine, Heraklion, Greece, [15]VU University Medical Center, Department of Intensive Care Medicine, Amsterdam, Netherlands, [16]University Medical Center Schleswig-Holstein, Campus Kiel, Department of Anesthesiology and Intensive Care Medicine, Kiel, Germany, [17]Hospital de Sabadell, Corporacio´ Sanitaria Universitaria Parc Taulı´, Universitat Autónoma de Barcelona, Institut de Investigacio´ i Innovacio´ Parc Taulı´, Critical Care Center, Sabadell, Spain, [18]Hospital Sant Pau, Servei Medicina Intensiva, Barcelona, Spain, [19]Instituto Universitation CEMIC, Buenos Aires, Argentina, [20]Li Ka Shing Knowledge Institute, Keenan Research Centre for Biomedical Science, Toronto, Canada

INTRODUCTION. Reverse triggering (RT) is defined as inspiratory efforts triggered by passive insufflation of the thorax[1]. They are probably frequent and underrecognized, resulting in ineffective efforts (IE) or double-cycling (DC). These, have potential adverse consequences for the lung and the diaphragm.
In clinical practice, visual inspection of airway pressure(Paw) and flow tracings,is most often used to determine patient-ventilation interacaction, including RT. However, frequency and distribution of dyssynchrony may have prognostic implications[2]. Automated algorithms based on Paw and flow to detect other types of dyssynchronies have been published[3, 4]. This, allows for analysis of prolonged recordings, which may be important for research and clinical purposes.
OBJECTIVES. The primary aim is to validate an automated algorithm based on flow and esophageal pressure signal (Pes) to detect RT. The secondary objective is to validate the classification of RT into IE or DC.
METHODS. The algorithm is based on the detection of mechanical breaths (MechB) using flow, and inspiratory efforts using the muscular pressure (Pmus) derived from Pes. An inspiratory effort is recognized based on the first derivative of Pmus and is associated with a MechB. The beginning of the effort is the maximum decay of Pmus preceding the recognition of the effort. A MechB is time-triggered if it starts before the inspiratory effort, using fuzzy frontiers to define the thresholds.
RT was defined as a time-triggered mechanical breath followed by either DC or IE. DC occurs when the inspiratory effort starts before the end of the previous mechanical inspiration and up to 50msec after, triggering a second MechB. IE in the context of RT is defined when the inspiratory effort is associated with a time-triggered MechB, and there is no DT.
Tracings from a study that aims to quantify dyssynchronies during early course of mechanical ventilation in ARDS (BEARDS) were selected for validation. Four tracings of 20 min each with flow, Paw and Pes with frequent RT were selected, and 4 tracings were randomly selected. An expert classified the breaths as RT or not, and each RT as IE or DC. Then, the automated algorithm was applied. Sensitivity (Se), specificity (Sp), positive and negative predictive values (PPV and NPV) for the diagnosis of RT, IE, and DC were calculated.
RESULTS. 8 tracings from 4 different patients were analyzed including a total of 6689 breaths. A total of 1131 breaths with RT and 5558 breaths without were classified visually. Se to detect RT was 94.0% and Sp was 99.4%, PPV and NPV were 97.4% and 98.8%, respectively. 1040/1109 IE and 17/22 DC were correctly classified.
CONCLUSION. Automatic detection of RT with IE or DC is feasible. In this preliminary validation, the automated algorithm showed a good diagnostic performance.
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041 High flow nasal cannula oxygen therapy (HFNC). Are all respiratory failure the same?

J. Higuera Lucas[1], D. Cabestrero Alonso[1], R. De Pablo Sánchez[1]
[1]*Hospital Universitario Ramón y Cajal, Medicina Intensiva, Madrid, Spain*

INTRODUCTION. HFNC is an oxygenation therapy for patients with acute respiratory failure. There are, some questions about this technique which answer is required.
OBJECTIVES. Our objective is to describe which pathology has the best results with this treatment.
METHODS. We enrolled all consecutive patients admitted to a polyvalent intensive care unit. We analysed all patients that require HFNC as initial support for their acute respiratory failure. We analysed the mortality and connection to mechanical ventilation (V.M.) rates. We performed a global analysis and then a sub analysis for underlying pathology: Acute respiratory failure: Extra pulmonary or intra pulmonary (Pneumonia in immunosuppressed and Pneumonia in immuno competent). Patients who require HFNC as a support for scheduled extubation, heart failure, thoracic trauma and neurocritical patients were excluded.
Qualitative variables with normal distribution are expressed as number and percentages and were analyse using chi-square tests. Quantitative variables were expressed as mean ± standard deviation (Rank) and were analyse using t-student tests and anova. Statistical significance was set with p values < 0.05.
RESULTS. We analysed a total of 128 patients. 76 Men, Mean age 57.4 years, APACHE II 19; SOFA 8.2; SAPS II 55.2; Mean income 13.3 days; Patients required the therapy an average of 2.8 days. 65 patients required connection to M.V. after HFNC therapy. Those patients who were intubated in the first 48 hours had a mortality rate of 45% while those in which the therapy was delayed more than 48 hours had a mortality rate of 56% (P = 0.3).
Patients were divided according to their underline pathology. Acute respiratory failure: Extra pulmonary or intra pulmonary (Pneumonia in immunosuppressed and Pneumonia in immuno competent).
In the first group, connection to MV was required in 54% of the cases, with a mortality rate of 54% in those intubated in the first 48 hours vs 40% later. P=0.5
In the group of pneumonia in immunosuppressed patients, M.V. was required in the 60.5% of the cases with a mortality rate of 75% in those intubated in the first 48 hours vs 71% posteriorly. P=0.6
In the group Pneumonia in immuno competent, M.V. was required in 42% of the cases with a mortality rate of 10% in the ones intubated the first 48 hours vs 50% later.P=0.18 Statistically significant differences were observed regarding the need of M.V connection according to base pathology. P< 0.05. Statistically significant differences were observed in the mortality between groups in those intubated in the first 48 hours. P< 0.05.
CONCLUSIONS. Results of HFNC oxygen therapy do not appear to be different in pulmonary or extrapulmonary respiratory failure. The severity of the patient ilness is related to the need of M.V and mortality rate. The patient who benefits the most from the early identification of the failure of this therapy, is the one who presents acute respiratory failure due to pneumonia in immunocompetent patient.

042 Validation of an automated neural index to detect reverse triggering asynchrony in patients under mechanical ventilation

R. Mellado Artigas[1,2], F. Damiani[1,3], T. Piraino[1], M. Rauseo[1], I. Soliman[1], D. Junhasavasdikul[1], L. Melo[1], L. Chen[1], C. Sinderby[4], N. Comtois[4], L. Heunks[1], L. Brochard[1,4]
[1]*University of Toronto, Critical Care, Toronto, Canada,* [2]*Hospital Clinic de Barcelona, UCI Quirúrgica, Barcelona, Spain,* [3]*Pontificia Universidad Católica de Chile, Medicina Intensiva, Santiago de Chile, Chile,* [4]*University of Toronto, Keenan Research Centre for Biomedical Science, Toronto, Canada*

INTRODUCTION. Reverse triggering (RT) is a recently described type of patient-ventilator interaction where respiratory muscle contractions seem to be triggered by the ventilator. The aim of this study was to test whether an automatic method, using both ventilator waveforms and electrical activity of the diaphragm (Eadi) could accurately detect RT.

OBJECTIVES. Our main goal was to determine the ability of clinicians and Neurosync (Toronto, Canada) in detecting RT.

METHODS. This is a substudy of an observational trial (NCT02434016) to detect when patients resume their diaphragm activity after intubation that included continuous Eadi recording. Definitions of parameters used to assess RT are shown below. 2010 breaths in assist/control mode were obtained and analyzed for this study. These breaths came from 10 patients (mean age 62 years old, SD 18), recorded around 24 hours after intubation and with a primary respiratory failure (n= 4), sepsis (n=4) or neurologic reasons (n=2). For each patient, assessments were done blind to the Eadi in first place and secondarily with Eadi.

Clinical definition is shown in Table 1.

Neurosync was used to collect data from the ventilator, using both waveforms and Eadi. When Neurosync identified an Eadi waveform during the inspiratory phase of a breath, the software determined whether Eadi started before or during the inspiration. To detect RT automatically, we chose the best thresholds for timing and lack of airway pressure drop to detect non-triggered breaths. Intra-rater agreement for detecting RT with and without Eadi and inter-rater agreement was measured by means of Cohen's and Fleiss kappa index respectively. A RT breath was reported when concordance among the three reviewers was found and was then considered the gold standard to assess Neurosync performance.

RESULTS. Intra-rater agreement ranged from 0.5 to 0.68. Inter-rater agreement was 0.84, but only 0.5 when only pressure and flow were used.For Neurosync, the results were: sensitivity 0.8 (0.76-0.84), specificity 0.93 (0.91-0.94), positive predictive value 0.74 (0.71-0.79) and negative predictive value 0.95 (0.93-0.96).

The prevalence of RT measured with Eadi was 21% of all breaths studied.

CONCLUSIONS. Inter three-examiners agreement was good only when Eadi was used: when tracings were analyzed without Eadi, rate of detection and agreement were low. Using an automatic method was shown to be reliable.

REFERENCE(S). Akoumianaki, E., Lyazidi, A., Rey, N. et al. (2013). Mechanical ventilation-induced reverse-triggered breaths: A frequently unrecognized form of neuromechanical coupling. Chest, 143(4), 927-938.Sinderby, C., Liu, S., Colombo, D. et al. (2013). An automated and standardized neural index to quantify patient-ventilator interaction. *Critical Care (London, England)*, *17*(5), R239.

Criterion	No deflection in Paw curve at the trigger moment
Peak expiratory flow	Reduced expiratory Peak flow compared with other breaths
Plateau pressure	Variation in plateau pressure compared with other breaths (volume control) in absence of airflow leak.
Flow and pressure	Drops in pressure and flow during ventilator inspiratory time (Pressure control)
Eadi	Peak Eadi >1 μV

[Table 1]