movement of air within the lung—from non-dependent to dependent regions, without overall change in lung volume. The regional (non-dependent) lung deflation was occurring simultaneously to the diaphragmatic contraction, in a pattern not previously described. Lung heterogeneities might explain different rates of lung expansion occurring during inspiration—but not a simultaneous deflation.

OBJECTIVES. We hypothesized that, contrary to traditional concepts, negative P_{pl} generated by diaphragmatic contraction might not be transmitted all over the lung surface in the setting of injured lungs, but rather *localized* to dependent lung, and that such locally concentrated P_{pl} would cause Pendelluft.

METHODS. We used EIT and dynamic CT to analyze regional inflation in anesthetized pigs with lung injury vs. normal lungs. P_{pl} in dependent lung was measured using intrapleural catheters, and the additional airway pressure needed to achieve comparable dependent lung inflation during paralysis vs. spontaneous breathing was estimated.

RESULTS. In all lung-injured animals (n = 7), spontaneous breathing caused Pendelluft, which was associated with more negative local P_{pl} in dependent regions vs. esophageal pressure (-14.3 ± 3.3 vs. -7.1 ± 2.1 cmH_2O, $P < 0.01$). In contrast, in normal lungs, we observed simultaneous inflation of different lung regions during spontaneous breathing, consistent with fluid-like behavior of the lung. Dynamic CT confirmed the Pendelluft, which occurred despite limitation of tidal volume to <6 mL/kg. Comparable over-inflation of dependent lung during paralysis required almost 3-fold greater driving pressure (and tidal volume) vs. spontaneous breathing (28.0 ± 0.5 vs. 10.3 ± 0.6 cmH_2O, $P < 0.01$; 14.8 ± 4.6 vs. 5.8 ± 1.6 mL/kg, $P < 0.05$).

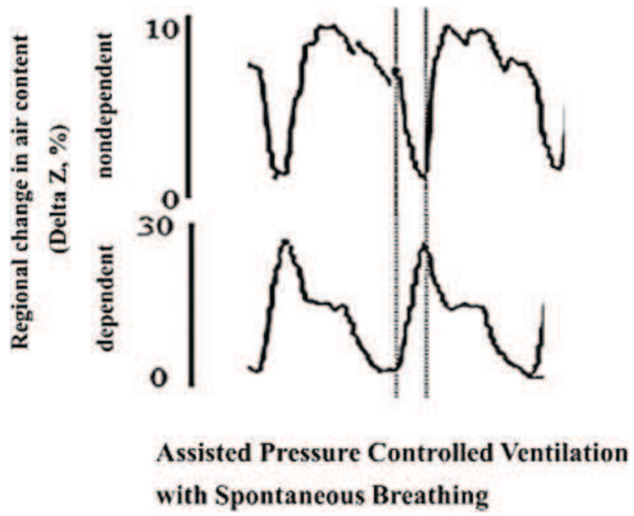

Fig. 1

CONCLUSIONS. 1. Pendelluft may constitute a novel mechanism of ventilator-induced lung injury. The observed overstretch of the dependent lung could cause occult local injury, which cannot be detected (and therefore avoided) using conventional monitoring. 2. Pendelluft occurs because, in contrast to normal lung, the injured lung does not exhibit fluid-like behavior, and in this case the transmission of local changes in pleural pressure is heterogeneous. In this context, a single spatial measurement (e.g. esophageal pressure monitoring) does not represent an overall change in P_{pl}.

REFERENCES. 1. Hoppin FG Jr., et al. J Appl Physiol. 1969;27:863. 2. D'Angelo E, et al. J Appl Physiol. 1974;37:311.

Grant. CAPES, FINEP, LIM09

0137

AUTOMATIC DYNAMIC HYPERINFLATION AND ASYNCHRONY DETECTION DURING MECHANICAL VENTILATION USING THE RANDOM-DISTORSION TEST AND THE CURVEX PLATFORM

E. L'Her[1,2], F. Lellouche[3], Q.-T. Nguyen[4], D. Pastor[4]

[1]Université de Bretagne Occidentale, CHRU de Brest, LATIM INSERM UMR 1101, Brest, France, [2]CHU de Brest, Université de Bretagne Occidentale, Réanimation Médicale et Urgences Adultes, Brest, France, [3]Université Laval, Centre de Recherche IUCPQ, Québec, Canada, [4]Telecom Bretagne, Lab-STICC CNRS UMR 6285, Brest, France

INTRODUCTION. Patient-ventilator asynchrony has been associated with adverse outcomes, and patients with high rates of asynchronies (as defined by an asynchrony index (AI) of greater than 10 %) are characterized by longer durations of mechanical ventilation and ICU stay.

OBJECTIVES. The purpose of this study was to assess the performance of an automatic flow and pressure curve analysis to detect dynamic hyperinflation and specific patterns of asynchrony.

METHODS. We performed a retrospective analysis on a noninvasive ventilation pressure and flow curves database; from these files, 20 cycles/sequences were blindly selected, after at least 5 min of signal stabilization for each patient. Oesophageal pressure was measured in all cases, in order to validate the occurrence of ineffective efforts. Flow curves were independently analyzed by two different experts, who classified them as having or not the different abnormalities that were monitored and assigned an AI for each. Curvex automatically evaluated the same sequences. Curvex is a signal treatment platform, based on the random-distortion test [1] and multiple mathematical algorithms that automatically detect dynamic hyperinflation (i.e. intrinsic PEEP) [2], and various types of asynchronies: ineffective efforts, short and prolonged inspiration, double and multiple triggering. It allows providing the clinician an overall AI value and the qualification of the different types of asynchrony.

RESULTS. Twenty-five sequences (604 cycles) were evaluated in 18 patients. Mean AI was 16 ± 3 % [0–52]. AI evaluated by Curvex was well correlated to the gold standard (rho = 0.985; $p < 0.0001$), with a low estimation bias (d = 0; see Fig. 1). Automatic AI evaluation depicted a 93 % Se, 99 % Sp, 94 % positive predictive value and a 98 % negative predictive value. When an asynchrony and/or intrinsic PEEP was detected, automatic qualification was always in agreement with the experts.

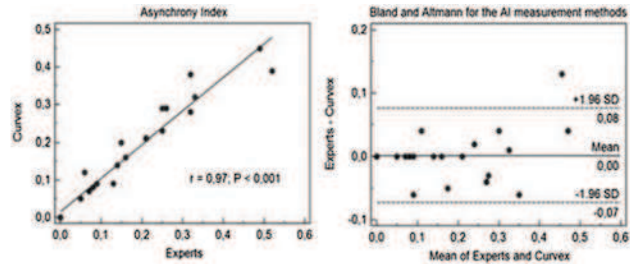

Fig. 1

CONCLUSIONS. In this study, the random-distortion test and the Curvex platform classified breaths as intrinsic PEEP and asynchronies in close agreement with experts.

REFERENCE(S). 1. Pastor D, Nguyen Q-T (2012) Testing the Mahalanobis distance between a random signal with unknown distribution and a known deterministic model in additive and independent standard Gaussian noise: the random distortion testing problem. Rapports Telecom Bretagne; RR-2012-04-SC. 2. Nguyen QT, Pastor D, L'her E. Automatic detection of AutoPEEP during controlled mechanical ventilation. Biomed Eng Online. 2012;11:32.

GRANT ACKNOWLEDGMENT. This study was supported by the "Fonds de Maturation Région Bretagne" 2012.

0138

SAFETY AND EFFICACY OF VENTILATION DELIVERED BY A FULL AUTOMATED MODE (INTELLIVENT-ASV): A RANDOMIZED CONTROLLED STUDY

E. Bialais[1], L. Vignaux[2], X. Wittebole[1], D. Novotni[2], J. Meyer[2], M. Wysocki[2], T. Sottiaux[3], G. Reychler[4], J. Roeseler[1], P.-F. Laterre[1], P. Hantson[1]

[1]Saint Luc University Hospital, Intensive Care, Brussel, Belgium, [2]Hamilton Medical AG, Bonaduz, Switzerland, [3]Clinique Notre-Dame de Grâce, Intensive Care, Gosselies, Belgium, [4]Saint Luc University Hospital, Pneumology, Brussel, Belgium

INTRODUCTION. Intellivent-ASV is a full closed-loop mechanical ventilation mode which keeps $EtCO_2$ and SpO_2 within expert-based target ranges, based on the patient's characteristics and clinical condition (normal lung, ARDS, chronic hypercapnia or brain injury). Safety and efficacy have been demonstrated over short period of time in post-operative and ICU patients [1, 2].

OBJECTIVES. This prospective randomized controlled study compared safety (time spent in sub-optimal ventilation ranges), efficacy (time spent in optimal ventilation ranges), and number of manual adjustments between Intellivent-ASV and conventional ventilation over a 48 h period.

METHODS. Patients mechanically ventilated for at least 48 h were randomized to be ventilated on Intellivent-ASV or conventional ventilation using a S1-ventilator (Hamilton medical AG, Bonaduz, Switzerland). For conventional ventilation, settings were determined by the clinician in charge of the patient. Ventilation and oxygenation parameters were recorded breath by breath and blood gases were performed every 6 h. The ventilation ranges were defined by a panel of expert [3]. Time spent in ventilation ranges was calculated for SpO_2, $EtCO_2$, tidal volume (Vt) and respiratory rate (RR). Clinicians in charge of the patient could adjust manually ventilator settings at any time.

RESULTS. Eighty patients aged 59 [46–70] years, with an APACHE II 24 [18–29], were included. 42 were ventilated with Intellivent-ASV and 38 with conventional ventilation. Characteristics at inclusion were not statistically different between the groups. In the Intellivent-ASV group, the study had to be stopped for 2 patients: one pneumothorax not in relation to the ventilation and one respiratory drive increased caused by severe metabolic acidosis.

Safety and efficacy over the 48 h

	Safety: time spent in sub optimal range (%)			Efficacy: time spent in optimal range (%)		
	Intellivent-ASV	Conventional	p	Intellivent-ASV	Conventional	p
SpO_2	1 [0–2]	1 [0–4]	0.097	91 [78–98]	69 [49–96]	0.014
$EtCO_2$	0 [0–0]	0 [0–2]	0.854	93 [60–99]	90 [36–99]	0.338
Vt	1 [0–2]	1 [0–2]	0.328	91 [82–97]	82 [40–93]	0.016
RR	1 [0–4]	2 [0–6]	0.158	87 [60–96]	83 [62–95]	0.732

Intellivent-ASV required less manual adjustments than conventional ventilation (3 [1–5] vs. 13 [8–19] manual adjustments over the 48 h, $p < 0.001$). Total number of adjustments was significantly higher with Intellivent-ASV (275 [145–437] vs. 13 [8–19], $p < 0.001$).

CONCLUSIONS. Over a 48 h period, Intellivent-ASV was able to provide ventilation as safe and efficient as conventional ventilation, without generating additional risk for the patient. In addition, the number of manual adjustments was dramatically reduced.

REFERENCE(S). 1. Arnal et al. Intensive Care Med. 2012;38:781–7. 2. Lellouche et al. Intensive Care Med. 2013;39(3):463–71. 3. Wysocki et al. Intensive Care Med. 2010;35:S106.

GRANT ACKNOWLEDGMENT. This study was supported by Hamilton Medical.

0139

PREDICTIVE VALUE AND INTER-PROFESSIONAL UTILISATION OF INDICES OF OXYGENATION IN THE FIRST 24 H OF 3130 VENTILATED ICU ADMISSIONS TO A CENTRAL LONDON ICU

F. Wade-Smith[1], C. Bell[1], A. Feehan[1], K. Peters[1], G. Parsons[1], P.A. Hopkins[1]

[1]King's College Hospital NHS Foundation Trust, London, UK