Monitoring during mechanical ventilation: 1168–1181

1168

ULTRASOUND SLIDING SIGN SPECIFICITY IN ALVEOLAR-INTERSTITIAL SYNDROMES ON MECHANICAL VENTILATION

B. Rode[1], M. Vučić[1], M. Širanović[1], N. Kovač[1], M. Kelečić[1], A. Gopčević[1]

[1]University Hospital 'Sisters of Mercy', Anesthesiology and Intensive Care, Zagreb, Croatia

INTRODUCTION. Low compliance pulmonary states on mechanical ventilation are exposed to volu-, baro-, bio-trauma. Pleural ultrasound with dynamic sliding sign in 2D mode (seashore sign in M-mode) is sensitive method for detecting anterior pneumothorax (PNX) but with poor visibility in present of elevated extravascular lung water (EVLW)—alveolar-interstitial syndrome (AIS). Sliding gives the security of PNX exclusion although typical artefacts for AIS, ultrasound lung comets (ULC) indicate expanded lung.

OBJECTIVES. We determined specificity of sliding sign in AIS in ventilatory settings.

SUBJECTS AND METHODS. Including criteria for AIS were at least two ULC in one intercostal space. 42 mechanically ventilated semiprone patients fulfilled criteria: 16 indistinct respiratory failures (ALI/ARDS with heart failure), 15 pneumonias (10 unilateral, 5 bilateral), 6 cardiogenic pulmonary edema and 5 obvious ALI/ARDS—altogether 74 hemithoraces. PNX was ruled out on anteroposterior chest X-ray (CXR) and the diagnose of AIS confirmed. Ventilation modes were BIPAP, PS or PPS by mean PEEP of 7 mbar (5–14 mbar). Ultrasound was performed with linear 5–10 MHz transducer. Three scans in 2D and M-mode in second and third anterior intercostal space and fourth or fifth axillary space in semiprone position on every hemithorax were proceeded in two times. First observing (222 scans) was inside an hour after starting mechanical ventilation and repeated between 2 and 72 h later but before delivered support has fallen under 10 mbar over PEEP (weaning time). Present ULC were not more including condition. Timing for second scanning in cardiac edema and ALI/ARDS was guided by clinical improvement, auscultation, better compliance (LIP-UIP shapes) and lower FiO_2, lowering EVLWI or PCWP, or lower CVP + tricuspidal gradient and LVEDP; pneumonias were scanned prior to lowering delivered pressure under 10 mbar over PEEP. PNX was again excluded by CXR.

RESULTS. Out of 222 scans first and second series showed 25.2 and 23.8% scans without sliding sign in 2D and 22.0 and 20.7% with absent or atypical seashore sign in M-mode respectively. 7 scans with invisible sliding but typical seashore sign were found in same intercostal spaces of both series. The highest rate of scans with invisible sliding was in patients with ARDS, the lowest in cardiogenic pulmonary edema. Most of undetected slidings were noticed in fourth or fifth intercostal space. ULC were still visible in second series in 94.6% regardless of expected lower EVLW.

CONCLUSION. Sliding sign gives the additional security for excluding anterior PNX in AIS on mechanical ventilation but is invisible in 25% scans. No significant difference in specificity was found between first and second scan timing when EVLW was expected to be lower. Method shows 75.5% specificity.

REFERENCE. 1. Lichtenstein DA (2005) General ultrasound. In: The critically Ill. Springer, Berlin

1169

PLEUROPULMONARY ULTRASONOGRAPHY IN ICU PATIENTS: IS IT FEASIBLE AND ACCURATE?

J. Allyn[1], V. Breant[1], O. Pajot[1], R. Hellmann[1], V. Ganthier[2], G. Plantefeve[1], H. Mentec[1], M. Thirion[1]

[1]CH Victor Dupouy, Medico-surgical ICU, Argenteuil, France, [2]CH Victor Dupouy, Radiology, Argenteuil, France

AIMS. Investigation of the pleuropulmonary (PP) pathologies in ICU is based on clinical examination, chest X-ray which is poorly accurate and thoracic CT scan which has become the gold standard. However, its use is limited by the risks of intrahospital transport of patients, X-ray radiation and availability. PP ultrasonography (US) is an alternative. Technique and semiology of this exam is described and mastered by only few authors. The aim of this study was to evaluate diagnostic accuracy of PP US in an adult ICU without experience.

METHODS. We conducted a prospective observational study in an adult ICU of a general hospital during 5 months. All patients requiring a thoracic CT scan according to their physician in charge were included. A PP US was performed by the same operator before the CT scan was done and consisted in examination of 6 areas by lung. Semiological signs for pleural effusion (with quantification), alveolar consolidation and pneumothorax were recorded. The diagnostic performances were evaluated by calculation of sensitivity, specificity, positive and negative predictive values (PPV and NPV), positive and negative likelihood ratios (PLR and NLR) and diagnostic accuracy (DA) in comparison to the CT scan interpreted by a radiologist blinded of the US results. When possible, US was performed by two investigators blinded from each other for evaluation of interobserver agreement (Kappa coefficient).

RESULTS. 37 patients were included with a median (Q1-Q3) age of 61 [51–74], SAPS II 42 [36–62], SOFA 7.5 [4.75–10], 66% were mechanically ventilated. 45 thoracic CT scans and US of 533 pulmonary areas were performed. 65 cases of pleural effusion, 85 cases of alveolar consolidation and 6 cases of pneumothorax were diagnosed by CT scan.

TABLE 1 DIAGNOSTIC PERFORMANCES OF PP US

Syndrome	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	PLR	NLR	DA (%)
Pleural effusion ($n = 65$)	77	84	93	58	4.81	0.27	79
Pneumothorax ($n = 6$)	67	98	67	98	33.5	0.34	96
Alveolar consolidation ($n = 85$)	68	87	83	75	5.23	0.37	78

PP US was realized by 2 investigators in 12 cases corresponding to 133 pulmonary areas with a good interobserver agreement (Kappa coefficient between 0.72 and 0.8).

CONCLUSIONS. Even in an inexperienced ICU, PP US is feasible, reproducible, and may be accurate enough to reduce the need for thoracic CT scan. Diagnostic accuracy of PP US depends of the pathology considered. The best performances concern diagnosis and quantification of the pleural effusions.

GRANT ACKNOWLEDGEMENT. No grant.

1170

CORRELATION BETWEEN VRI MEASUREMENT AND AIRFLOW RATE IN HEALTHY LUNGS

Y. A. Glickman[1], A. Stern[1], M. Yosef[1], R. Langer[1]

[1]Deep Breeze, Ltd., Or-Akiva, Israel

INTRODUCTION. Correlation between sound amplitude and flow in healthy lungs has been reported but the relationship has not been firmly established. In the present study, we correlate sound energy data with airflow rate.

OBJECTIVES. To assess the correlation between airflow rate and lung sound energy as recorded with Vibration Response Imaging (VRI). To assess the effect of this relationship on normalized lung sound distribution maps.

METHODS. Hundred lung sound measurements were performed in 20 healthy adults using 40 piezoelectric sensors positioned on the posterior chest wall. Flow rates, varying between 10 and 50 L/min, were controlled using a pneumotach mouthpiece. Integrated lung sound energy was correlated to integrated airflow rate during inspiration.

RESULTS. A strong relationship ($R^2 = 0.97 \pm 0.04$) was obtained between lung sound energy and airflow rate raised to the third power. Only minimal changes were detected in corresponding normalized acoustic maps.

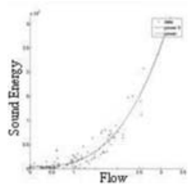

Fig. 1 Sound energy vs flow rate

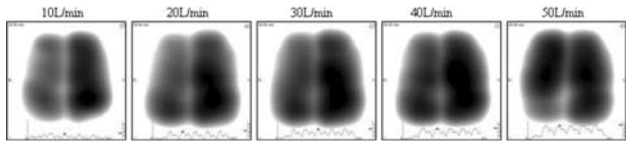

Fig. 2 Normalized sound distribution maps

CONCLUSION. Correlation between absolute sound energy and airflow rate does not affect the normalized VRI lung sound distribution maps.

1171

BEDSIDE INTERPRETATION OF FLOW AND AIRWAY PRESSURE WAVEFORMS TO DETECT PATIENT-VENTILATOR ASYNCHRONY: IS IT REALLY USEFUL IN THE DAILY CLINICAL PRACTICE?

D. Colombo[1], M. Alemani[1], M. De Lucia[1], G. Cammarota[1], R. Vaschetto[1], F. Della Corte[1], P. Navalesi[1]

[1]A.O.U. Maggiore della Carità, Novara, Università del Piemonte Orientale, Anestesia, Terapia Intensiva e Rianimazione Generale, Novara, Italy

INTRODUCTION. Although commonly considered helpful for clinical identification of patient-ventilator asynchrony, the value of the interpretation of the airflow (Fl) and airway pressure (Paw) waveforms displayed on the ventilator screen in recognizing patient ventilator asynchronies has never been systematically evaluated.

AIM AND OBJECTIVES. To assess the ability of ICU physicians with different expertise in identifying asynchronous events (ineffective efforts, auto-triggering, and double triggering) during pressure support ventilation (PSV) through visual inspection of Fl and Paw waveforms.

METHODS. We submitted 43 5-minute reports of Fl-time and Paw-time plots to 20 physicians of our Intensive Care Unit (ICU), 10 in staff for a minimum of 3 years, considered expert (Ex), and 10 resident, considered non expert (n-Ex). All the physicians were requested to detect and mark the asynchronies identified. Their evaluations were compared with those of 3 independent observers who analyzed the same reports including, in addition to Fl and Paw, diaphragm electrical activity (EAdi) waveforms, as obtained through trans-esophageal electromyography (gold standard). Data were analyzed either per breath (BrA) and per report (RepA). Sensitivity (Sens), specificity (Spec), positive (PPV) and negative predictive value (NPV), and positive (PLR) and negative likelihood ratio (NLR) were determined for the overall group and for the Ex and n-Ex separately

RESULTS. Overall, PLR and NLR values indicated a relatively small efficacy of the Fl and Paw waveforms interpretation in detecting asynchronies both with RepA (2.34 PLR, 0.59 NLR) and BrA (2.98 PLR, 0.85 NLR). Compared to BrA, RepA resulted in higher Sens (0.55 vs 0.22 $p < 0.01$) and PPV (0.44 vs. 0.32 $p = 0.01$), but lower Spec (0.76 vs. 0.91 $p < 0.01$) and NPV (0.82 vs. 0.86 $p < 0.05$). With BrA, Sens (0.28 vs. 0.16 $p < 0.05$) was the only difference between Ex and n-Ex, while Spec (0.88 vs 0.93), PPV (0.31 vs. 0.32) and NPV (0.87 vs. 0.86) were not different. With RepA, only PPV (0.51 vs. 0.38 $p < 0.05$) was different between Ex and n-Ex, while Sens (0.63 vs. 0.46), Spec (0.76 vs. 0.75) and NPV (0.85 vs. 0.79) were not.

CONCLUSIONS. The ability to detect asynchronies through Fl and Paw waveforms visual inspection is overall low and of questionable clinical impact. The ability of Ex, as opposed to n-Ex, to detect asynchronies was only slightly increased. Our results suggest other signals reflecting respiratory muscle activity are necessary to properly detect patient-ventilator asynchronies at the bedside.