Appendix A. Morphine equivalent conversion table

Name	Route	Conversion factor
Morphine	Intravenous	1.0
Codeine	Oral	0.05
Fentanyl	Transdermal	0.1
Hydrocodone	Oral	0.4
Hydromorphone	Oral	2
Morphine	Oral	0.4
Oxycodone	Oral	0.63
Tramadol	Oral	0.05

Reference: Instructions for morphine equivalent daily dose (MEDD). Edmonton Zone Palliative Care Program. Accessed on 14 January 2016 at http://palliative.org/NewPC/_pdfs/tools/INSTRUCTIONsMEDD.pdf

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References

[1] Zgierska A, Miller M, Rabago D. Patient satisfaction, prescription drug abuse, and potential unintended consequences. JAMA 2012;307(13):1377–8.
[2] Schwartz TM, et al. Lack of association between Press Ganey emergency department patient satisfaction scores and emergency department administration of analgesic medications. Ann Emerg Med 2014;64(5):469–81.
[3] Stearns CR, et al. Antibiotic prescriptions are associated with increased patient satisfaction with emergency department visits for acute respiratory tract infections. Acad Emerg Med 2009;16(10):934–41.
[4] Centers for Disease, C. and Prevention. Vital signs: overdoses of prescription opioid pain relievers—United States, 1999-2008. MMWR Morb Mortal Wkly Rep 2011; 60(43):1487–92.
[5] Pomerleau AC, et al. The impact of prescription drug monitoring programs and prescribing guidelines on emergency department opioid prescribing: a multicenter survey. Pain Med 2016.
[6] Goloback M, et al. ED operational factors associated with patient satisfaction. Am J Emerg Med 2015;33(1):111–2.
[7] Handel DA, et al. Associations between patient and emergency department operational characteristics and patient satisfaction scores in an adult population. Ann Emerg Med 2014;64(6):604–8.
[8] Sun BC, et al. Determinants of patient satisfaction and willingness to return with emergency care. Ann Emerg Med 2000;35(5):426–34.
[9] Boudreaux ED, et al. Predictors of emergency department patient satisfaction: stability over 17 months. Acad Emerg Med 2004;11(1):51–8.
[10] Hedges JR, Trout A, Magnusson AR. Satisfied patients exiting the emergency department (SPEED) study. Acad Emerg Med 2002;9(1):15–21.

Absence of lung sliding is not a reliable sign of pneumothorax in patients with high positive end-expiratory pressure☆

To the Editor,

Pneumothorax is a complication occurring in 4% to 15% of patients who require mechanical ventilation in the intensive care unit (ICU) and in 1.5% to 3.1% of patients after central venous catheter insertion [1,2]. Lung ultrasound can be used to diagnose pneumothorax at the bedside [3] and has a higher sensitivity for detection of pneumothorax in comparison to chest radiograph, which has traditionally been used to diagnose pneumothorax [4-6]. Sonographic signs of pneumothorax are absence of lung sliding (LS), absence of B lines, absence of lung pulse and presence of lung point [3]. Absence of LS has been used as a sonographic sign of pneumothorax for 30 years since first description in 1986 [7]. Absence of LS alone as a sign of pneumothorax has a higher sensitivity and lower specificity when compared to chest radiograph, and is frequently used due to its simplicity and rapid execution [4].

Absence of LS as a false positive sign of pneumothorax has been reported in patients with acute respiratory distress syndrome, right mainstem bronchus intubation, pulmonary fibrosis and chronic pleural adhesions [8,9]. In an animal study higher levels of positive end-expiratory pressure (PEEP) were associated with dissappearance of LS [10]. Pneumothorax is a significant event in mechanically ventilated patients, and the ability to accurately diagnose it is of paramount importance. The objective of our study was to evaluate the relationship between the pressure level of PEEP and disappearance of LS as a false positive sign on pneumothorax.

We performed a prospective study in adult patients with acute respiratory failure who required mechanical ventilation. Institutional ethics committee approval was obtained (No. 799/13) and patient/surrogate consent was obtained. Inclusion criteria were all of the following: adult patient who required mechanical ventilation, and recruitment maneuver and lung computed tomography (CT) as determined by the treating physician (ie, only those patients were included where the attending physician decided that both recruitment maneuver and lung CT were required as a treatment strategy).

Lung ultrasound was performed using a linear probe (probe L12–3, ultrasound machine HD11 XE, Philips Ultrasound, Andover, MA). LS was evaluated on contralateral sides in the most anterior part of chest wall in supine patients. Lung ultrasound was performed by physicians trained in lung ultrasound.

We used a staircase recruitment maneuver starting from baseline PEEP in increments of 5 cmH_2O to maximal PEEP of 35 cmH_2O and fixed driving pressure of 20 cmH_2O. PEEP was decreased in reversed order. Lung CT scan was used as gold standard to exclude pneumothorax. In absence of clinical changes suggestive of pneumothorax, pneumothorax was deemed to be excluded for 24 h following lung CT. During this time a maximum of 3 evaluations of LS during recruitment maneuver could be performed in one patient (ie, lung ultrasound for study purposes was performed during recruitment menoeuvres in the 24 h period after lung CT).

Statistical analysis was performed using SigmaPlot 11.0 (Systat Software Inc, Chicago, IL, USA). For comparison of nonparametric variables, such as differences between left and right lung and between increases and decreases in PEEP, Wilcoxon signed rank test was used.

A total of 8 patients were included. 5 patients (62.5%) were males. Mean age was 70.1 ± 7.4 years. All patients were mechanically ventilated because of acute respiratory distress syndrome. In all, 26 evaluations of LS were performed during staircase recruitment maneuvers. Mean

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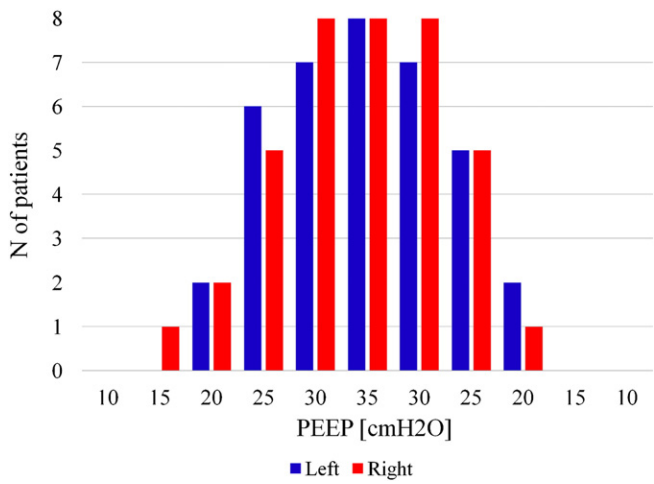

Fig. 1. Absence of lung sliding during increasing and decreasing PEEP. The number of patients showing absence of lung sliding as a function of PEEP while increasing and decreasing PEEP in a step-wise manner.

auto-PEEP was 0.7 ± 0.4 cmH_2O. Mean baseline PEEP was 12.6 ± 2.6 cmH_2O. At baseline PEEP LS was observed in all evaluations.

The number of patients showing absence of LS during increases and decreases in PEEP in the right and the left lung are presented in Fig. 1. The values of PEEP at which LS disappeared or reappeared were compared using nonparametric tests to assess the influences of anatomical side and PEEP increase or decrease. The values of PEEP at disappearance of LS for the right lung did not show statistical significance from the values for the left lung (Wilcoxon signed rank test, $P = .844$ for increases, $P = .938$ for decreases). The values of PEEP at which LS disappeared during the increasing arm of recruitment manouver did not show statistical significance from values obtained in the decreasing arm (Wilcoxon signed rank test, $P = 1.000$ for the left lung, $P = .875$ for the right lung). Thus, from data pooled for both sides and from both increasing and decreasing part of recruitment maneuver, the median value of PEEP at which LS disappeared as a false positive sign of pneumothorax was 25 cmH_2O (interquartile range, 20–30 cmH_2O) (Fig. 2). At PEEP = 10 cmH_2O, no patient showed absence of LS. LS was absent in 4.5% of evaluations at PEEP = 15 cm H_2O, in 26.9% at PEEP = 20 cmH_2O, in 67.3% at PEEP = 25 cm H_2O, in 96.2% at PEEP = 30 cmH_2O, and in 100% of patients at PEEP = 35 cmH_2O.

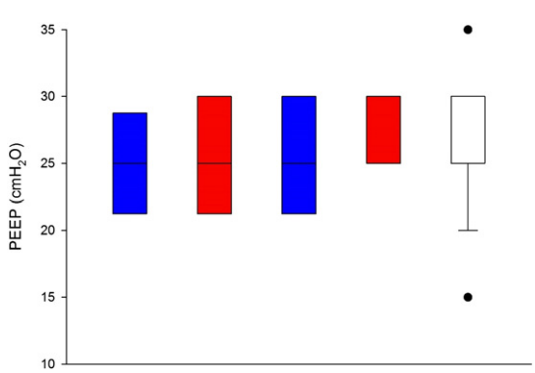

Fig. 2. Values of PEEP above which lung sliding (LS) was not present. Values of PEEP above which lung sliding was absent for the left (blue) and the right (red) lung for increasing values of PEEP (left blue-red pair) and decreasing values of PEEP (right blue-red pair), as well as data pooled across sides and protocols (white). The median, the lower and the upper quartile are shown for each side and each protocol; the median, the lower and the upper quartile, the 10th and 90th percentile, as well as all outliers are shown for pooled data.

The correlation between lung over-distension associated with high PEEP or auto-PEEP levels has been described before, however, the level of PEEP at which LS disappears and becomes a false positive sign of pneumothorax is not know [11-14].

Lichtenstein et al reported a sensitivity of 95.3% and specificity of 91.1% for LS alone as a sonographic sign of pneumothorax, however, in that study only 34% patients were mechanically ventilated and PEEP levels were not reported [4]. Similarly a sensitivity of 98.1% and specificity of 99.2% for LS as a sonographic sign of pneumothorax was reported in a prospective study in blunt trauma patients by Blaivais et al. The study did not include mechanically ventilated patients [5]. Lung CT was used as gold standard in both studies.

There are case reports of patients who displayed sonographic signs suggestive of pneumothorax without actual pneumothorax being present. Lichtenstein et al described absence of LS as a false-positive sign of pneumothorax in patients with COPD [4,12]. Similarly, Gelabert et al reported a case where LS was absent as a false positive sign of pneumothorax in a patient with acute exacerbation of chronic obstructive lung disease with severe bullouos emphysema [14]. Both authors attributed the absence of LS to alveolar hyperinflation due to auto-PEEP associated with chronic obstructive lung disease. This was confirmed by Japiassu et al. in an animal model with mechanically ventilated rats. They observed loss of LS at high PEEP levels, which they were able to quantify using a computerized algorithm. They concluded that loss of LS correlates with lung over-distension due to higher PEEP values [10].

Current guidelines propose use of high PEEP levels in order to prevent alveolar collapse and enable ventilation with lower fraction of inspired oxygen [15]. The median PEEP level at which LS disappeared in our study was 25 cmH_2O, which is at the upper limit of PEEP as proposed by the guidelines, however, LS was absent as a false positive sign of pneumothorax in 26.9% of evaluations at PEEP = 20 cmH_2O and in 4.5% of evaluations when PEEP = 15 cmH_2O. PEEP levels between 15 and 20 cmH_2O are commonly used in mechanical ventilation [15,16]. Mechanical ventilation, central venous catheterization and chest tube insertion are frequent procedures in ICU with pneumothorax as a possible complication [1,2]. Implications of our study are relevant to everyday bedside work, as treatment of false positive pneumothorax based solely on absence of LS could result in catastrophic worsening.

The limitations of our study are firstly in the design of the study, which was a small, single-centre study. Secondly, other sonographic signs of pneumothorax were not evaluated. Thirdly, only one sonographic window per hemithorax was used. Fourth, the selection of patients could present a compounding factor, as only those patients were included where the attending physician thought that both lung CT and recruitment maneuver were required. However, a prolonged exposure to high PEEP levels during a recruitment maneuver could be deleterious to the patient, and therefore, due to time constraint, only LS as the most commonly used sonographic sign was chosen [3,8,12]. The decision to use only one sonographic window (the most anterior part of chest wall in supine patients) was also due to time constraint in keeping with the recruitment maneuver. Also, lung CT is a diagnostic procedure where patients are exposed to significant radiation dose, making a lung CT performed solely for study purposes ethically questionable.

To conclude, according to our study the median value of PEEP at which LS disappears as a false positive sign of pneumothorax is 25 cmH_2O, LS was absent at PEEP 15 cmH_2O in 4.5% and at PEEP 20 cmH_2O in 26.9% of cases. Our study outlines the importance of other sonographic signs of pneumothorax, such as lung point. Absence of LS in patients with high PEEP should be interpreted with caution and other signs of pneumothorax should be sought before therapeutic interventions are attempted.

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References

[1] Yarmus L, Feller-Kopman D. Pneumothorax in the critically ill patient. Chest 2012;141:1098–105. http://dx.doi.org/10.1378/chest.11-1691.
[2] Tsotsolis N, Tsirgogianni K, Kioumis I, Pitsiou G, Baka S, Papaiwannou A, et al. Pneumothorax as a complication of central venous catheter insertion. Ann Transl Med 2015;3. http://dx.doi.org/10.3978/j.issn.2305-5839.2015.02.11.
[3] Volpicelli G, Elbarbary M, Blaivas M, Lichtenstein DA, Mathis G, Kirkpatrick AW, et al. International evidence-based recommendations for point-of-care lung ultrasound. Intensive Care Med 2012;38:577–91. http://dx.doi.org/10.1007/s00134-012-2513-4.
[4] Lichtenstein DA, Menu Y. A bedside ultrasound sign ruling out pneumothorax in the critically ill. Lung sliding. Chest 1995;108:1345–8.
[5] Blaivas M, Lyon M, Duggal S. A prospective comparison of supine chest radiography and bedside ultrasound for the diagnosis of traumatic pneumothorax. Acad Emerg Med 2005;12:844–9. http://dx.doi.org/10.1197/j.aem.2005.05.005.
[6] Zhang M, Liu Z-H, Yang J-X, Gan J-X, Xu S-W, You X-D, et al. Rapid detection of pneumothorax by ultrasonography in patients with multiple trauma. Crit Care 2006;10:R112. http://dx.doi.org/10.1186/cc5004.
[7] Rantanen NW. Diseases of the thorax. Vet Clin North Am Equine Pract 1986;2:49–66.
[8] Lichtenstein DA. Lung ultrasound in the critically ill. Ann Intensive Care 2014;4:1. http://dx.doi.org/10.1186/2110-5820-4-1.
[9] Kirkpatrick AW, Sirois M, Laupland KB, Liu D, Rowan K, Ball CG, et al. Hand-held thoracic sonography for detecting post-traumatic pneumothoraces: the extended focused assessment with sonography for trauma (EFAST). J Trauma 2004;57:288–95.
[10] Japiassu AM, Bergamini B, Carvalho N, Carvalho AR. Pleural distension observed by lung ultrasound may identify lung overdistension induced by positive end-expiratory pressure in rats. Intensive Care Med 2013;39(Suppl. 2):212. http://dx.doi.org/10.1007/s00134–013–3095-5.
[11] Via G, Storti E, Gulati G, Neri L, Mojoli F, Braschi A. Lung ultrasound in the ICU: from diagnostic instrument to respiratory monitoring tool. Minerva Anestesiol 2012;78:1282–96.
[12] Lichtenstein DA, Mezière GA. Relevance of lung ultrasound in the diagnosis of acute respiratory failure: the BLUE protocol. Chest 2008;134:117–25. http://dx.doi.org/10.1378/chest.07-2800.
[13] Volpicelli G. Sonographic diagnosis of pneumothorax. Intensive Care Med 2011;37:224–32. http://dx.doi.org/10.1007/s00134-010-2079-y.
[14] Gelabert C, Nelson M. Bleb point: mimicker of pneumothorax in bullous lung disease. West J Emerg Med 2015;16:447–9. http://dx.doi.org/10.5811/westjem.2015.3.24809.
[15] Dellinger RP, Levy MM, Rhodes A, Annane D, Gerlach H, Opal SM, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. Crit Care Med 2013;41:580–637. http://dx.doi.org/10.1097/CCM.0b013e31827e83af.
[16] Vargas M, Sutherasan Y, Gregoretti C, Pelosi P, Vargas M, Sutherasan Y, et al. PEEP role in ICU and operating room: from pathophysiology to clinical practice, PEEP role in ICU and operating room: from pathophysiology to clinical practice. Sci World J Sci World J 2014;2014(2014):e852356. http://dx.doi.org/10.1155/2014/852356.

Routine biological tests in self-poisoning patients: results from an observational prospective multicenter study

To the Editor,

We read with great interest the article by Reydel et al [1] regarding the use of routine biological tests in self-poisoned patients. We commend the authors' attempts to study the necessity of laboratory studies in this particular population. In addition, we appreciate the information they provide regarding the occurrence of abnormal laboratory values in this group. There are several points which we feel would be useful to the reader.

Arguably, the most significant limitation unaddressed by the authors was the fact that only 65% of participants had biological tests done and only 56% had an electrocardiogram performed. The lack of a protocol and guidelines for patient inclusion in the study muddles the results when there are incomplete data for many of the patients studied. It was also surprising to us that less than one-third of patients had an acetaminophen concentration obtained. Acetaminophen is a common co-ingestant in self-poisoning with an effective antidote. It may result in significant morbidity and mortality if untreated and has been notoriously unrecognized following attempted self-poisoning [2].

By informing clinicians which biological studies were going to be assessed in the study, we are concerned on the unintended consequence of affecting clinicians' practice patterns. Although the authors did not explicitly instruct physicians which tests to order, the awareness of the parameters being studied could have influenced physician's decisions. We do applaud the inclusion of the “life threatening lab abnormalities” in the supplemental material. This was extremely useful to the reader but would have been more valuable if the self-poisoned patients were compared with non–self-poisoned patients. In addition, we would have liked to know the magnitude of the effect of laboratory derangements on patient care and disposition.

It may also have been useful to include a cost-benefit analysis with this article. Because every emergency department around the world functions on the constraints of time, finances, or staff, it would have been interesting to know the cost of these biological tests compared with the cost of missing a significant abnormality.

In addition, the patient population in this study was generally well and ingested medications that are relatively well tolerated in overdose (ie, benzodiazepines). This calls into question the generalizability and external validity of this study to clinical practice in a different population of self-poisoning patients.

We commend the authors' efforts to characterize the necessity for biological tests in self -poisoned patients but cannot support any significant conclusions based on the study methodology.

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