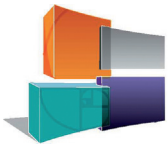
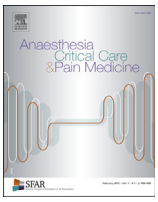
Anaesth Crit Care Pain Med 38 (2019) 221–222



SFAR
Société Française d'Anesthésie et de Réanimation



Editorial

ARDS in patients with chest trauma: Better safe than sorry

ARTICLE INFO

Keywords:
Chest trauma
Acute respiratory distress syndrome
Mechanical ventilation
Prevention
Trauma networks

Acute respiratory distress syndrome (ARDS) is a common cause of respiratory failure in critically ill patients and is defined by the association of bilateral infiltrates and hypoxemia following an initial insult [1]. Since the original description of the ARDS by Ashbaugh and colleagues in 1967, considerable progress has been made in understanding the pathogenesis and pathophysiology of acute lung injury. Common risk factors associated with ARDS can be divided between direct or indirect lung injuries such as pneumonia, sepsis, pancreatitis, burn injury or severe trauma leading to the development of non-cardiogenic pulmonary oedema. Improvement in the definitions of ARDS has led to significant advances in the standardisation of populations in research studies. However, several studies have shown significant heterogeneity among patients meeting criteria for ARDS, and heterogeneity within ARDS has been described on the basis of the predisposing insult (such as sepsis or trauma) or of the mechanism of injury (such as direct or indirect pulmonary injury) [2]. Therefore, subphenotyping ARDS might represent a promising way to enrich future clinical trials and better personalise patient care [3].

The incidence of ARDS in severely-injured trauma patients remains significant [4], with ARDS developing in an estimated 10–30% of critically ill trauma patients, and intubation rates in patients with chest trauma range from 25% to 75%, mainly depending on the severity of trauma, the presence of underlying pulmonary disease, and associated injuries [5]. Although trauma-related ARDS is a rather infrequent ARDS risk factor associated with rather low mortality rates compared to other causes of ARDS such as sepsis [6], the development of ARDS is associated with major increases in morbidity and mortality in patients with severe trauma, independent of underlying illness severity [7]. Among the pathophysiological pathways involved in trauma-related ARDS, the activation of local and systemic inflammatory mechanisms, resulting from the activation of innate immunity, plays a key role [8], and may appear only after a free interval of 24–48 h [9]. Consequently, in trauma patients with pulmonary contusion, the initial assessment may underestimate the severity of lung injury and respiratory status may worsen during the hours or days following admission [10]. Several scoring systems have been developed to predict the outcome with chest trauma such as the Lung Organ Failure Score [11] or the Watkins predictive model [5]; nevertheless, these scores do not allow early identification of ARDS and the radiographic Thoracic Trauma Severity score may probably be the closest to an ideal scoring system for qualifying thoracic trauma [12], allowing early prediction of respiratory impairment and identification of the risk of delayed ARDS in almost half of the trauma patients with lung contusion [13]. In addition, biomarkers might also be used to improve the detection of ARDS after trauma and a two-biomarker panel consisting of plasma levels of angiopoietin-2 and soluble receptor for advanced glycation end products outperformed clinical providers for diagnosing ARDS in patients with severe trauma [14]. However, even in patients who develop ARDS after major trauma, distinct ARDS subphenotypes have been described, with early-onset (days 1–2) ARDS being associated with higher severity of chest trauma, more severe hypotension, and increased red blood cell transfusion requirement, compared to late-onset (days 4–5) ARDS [15].

Once ARDS is established in patients with chest trauma, supportive respiratory therapy should ideally be focused on providing adequate gas exchange while limiting further lung injury to prevent ventilator-associated lung injury. However, only a limited body of specific is available to date on the best strategy to achieve these goals in the specific setting of chest trauma-related ARDS. Therefore, Ramin et al. should be particularly commended for their comprehensive, well detailed, and very nicely-illustrated review on chest trauma-related ARDS published in this issue of *Anaesthesia, Critical Care and Pain Medicine* [16]. In addition to covering the specific epidemiology and pathophysiology of chest trauma-related ARDS and to improving our understanding of the mechanisms involved in ARDS development in trauma patients, a comprehensive review of evidence from the available literature on the best way to deliver mechanical ventilation in the setting of chest trauma is proposed in this article, highlighting the crucial role for lung-protective ventilation in improving clinical outcome and including less-investigated treatment options such as airway pressure release ventilation, high-frequency percussive ventilation or extracorporeal respiratory support.

Even if invasive mechanical ventilation appears as a key factor in the treatment of ARDS once it is established, prevention of lung injury before the onset of ARDS should be considered a cornerstone in the management of patients with chest trauma, thus emphasising needs for appropriate identification of patients the most at risk of developing ARDS and treatment of the underlying cause for

https://doi.org/10.1016/j.accpm.2019.04.006

ARDS in these patients. In order to improve the prognosis of patients with severe chest trauma, early and continuous application of non-invasive mechanical ventilation can indeed reduce the need for intubation and shorten intensive care unit length-of-stay [17,18]. Among different mechanisms, the early use of positive end-expiratory pressure after chest trauma, when feasible, seems mandatory to optimise oxygenation and improve clinical outcomes. Indeed, interventions aimed at preventing ARDS after chest trauma carry the greatest potential to reduce the substantial morbidity, mortality, and resource utilisation associated with this syndrome [19]. Notably, pain control seems a crucial endpoint in our success to deliver non-invasive ventilation to patients with chest trauma, with regional analgesia techniques such as thoracic epidural analgesia or thoracic paravertebral blockade being proposed, when feasible, as a pivotal component of patient care after chest trauma, along with non-invasive ventilation [20]. However, caring for trauma patients should be focused not only on these preventive interventions nor in the treatment of ARDS once established, but perhaps more importantly, on the crucial organisation of specialised and expertised networks of anaesthesiology, critical care, and emergency medicine health care professionals who should be able to deliver such best evidence-based cares to trauma patients in a timely manner [21].

Disclosure of interest

The authors declare that they have no competing interest.

References

[1] Thompson BT, Chambers RC, Liu KD. Acute respiratory distress syndrome. N Engl J Med 2017;377:562–72.
[2] Jabaudon M, Blondonnet R, Audard J, Fournet M, Godet T, Sapin V, et al. Recent directions in personalised acute respiratory distress syndrome medicine. Anaesth Crit Care Pain Med 2018;37:251–8.
[3] Prescott HC, Calfee CS, Thompson BT, Angus DC, Liu VX. Toward Smarter Lumping and Smarter Splitting: Rethinking Strategies for Sepsis and Acute Respiratory Distress Syndrome Clinical Trial Design. Am J Respir Crit Care Med 2016;194:147–55.
[4] Robinson BRH, Cotton BA, Pritts TA, Branson R, Holcomb JB, Muskat P, et al. Application of the Berlin definition in PROMMTT patients: the impact of resuscitation on the incidence of hypoxemia. J Trauma Acute Care Surg 2013;75:S61–7.
[5] Watkins TR, Nathens AB, Cooke CR, Psaty BM, Maier RV, Cuschieri J, et al. Acute respiratory distress syndrome after trauma: development and validation of a predictive model. Crit Care Med 2012;40:2295–303.
[6] Bellani G, Laffey JG, Pham T, Fan E, Brochard L, Esteban A, et al. Epidemiology, Patterns of Care, and Mortality for Patients With Acute Respiratory Distress Syndrome in Intensive Care Units in 50 Countries. JAMA 2016;315:788–800.
[7] Shah CV, Localio AR, Lanken PN, Kahn JM, Bellamy S, Gallop R, et al. The impact of development of acute lung injury on hospital mortality in critically ill trauma patients. Crit Care Med 2008;36:2309–15.
[8] Hoth JJ, Stitzel JD, Gayzik FS, Brownlee NA, Miller PR, Yoza BK, et al. The pathogenesis of pulmonary contusion: an open chest model in the rat. J Trauma 2006;61:32–44 [discussion 44-5].
[9] Raghavendran K, Notter RH, Davidson BA, Helinski JD, Kunkel SL, Knight PR. Lung contusion: inflammatory mechanisms and interaction with other injuries. Shock 2009;32:122–30.
[10] Moore FA, Sauaia A, Moore EE, Haenel JB, Burch JM, Lezotte DC. Postinjury multiple organ failure: a bimodal phenomenon. J Trauma 1996;40:501–10 [discussion 510-2].
[11] Wutzler S, Wafaisade A, Maegele M, Laurer H, Geiger EV, Walcher F, et al. Lung Organ Failure Score (LOFS): probability of severe pulmonary organ failure after multiple injuries including chest trauma. Injury 2012;43:1507–12.
[12] Pape HC, Remmers D, Rice J, Ebisch M, Krettek C, Tscherne H. Appraisal of early evaluation of blunt chest trauma: development of a standardized scoring system for initial clinical decision making. J Trauma 2000;49:496–504.
[13] Daurat A, Millet I, Roustan J-P, Maury C, Taourel P, Jaber S, et al. Thoracic Trauma Severity score on admission allows to determine the risk of delayed ARDS in trauma patients with pulmonary contusion. Injury 2016;47:147–53.
[14] Ware LB, Zhao Z, Koyama T, Brown RM, Semler MW, Janz DR, et al. Derivation and validation of a two-biomarker panel for diagnosis of ARDS in patients with severe traumatic injuries. Trauma Surg Acute Care Open 2017;2:e000121.
[15] Reilly JP, Bellamy S, Shashaty MGS, Gallop R, Meyer NJ, Lanken PN, et al. Heterogeneous phenotypes of acute respiratory distress syndrome after major trauma. Ann Am Thorac Soc 2014;11:728–36.
[16] Ramin S, Charbit J, Jaber S, et al. Acute respiratory distress syndrome after chest trauma: Epidemiology, specific physiopathology and ventilation strategies. Anaesth Crit Care Pain Med 2018. http://dx.doi.org/10.1016/j.accpm.2018.09.009 [pii: S2352-5568(18)30303-5].
[17] Hernandez G, Fernandez R, Lopez-Reina P, Cuena R, Pedrosa A, Ortiz R, et al. Noninvasive Ventilation Reduces Intubation in Chest Trauma-Related Hypoxemia: A Randomized Clinical Trial. Chest 2010;137:74–80.
[18] Rochwerg B, Brochard L, Elliott MW, Hess D, Hill NS, Nava S, et al. Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure. Eur Respir J 2017;50(2).
[19] Beitler JR, Schoenfeld DA, Thompson BT, Preventing ARDS:. Progress, Promise, and Pitfalls. Chest 2014;146:1102–13.
[20] Bouzat P, Raux M, David JS, Tazarourte K, Galinski M, Desmettre T, et al. Chest trauma: First 48 hours management. Anaesth Crit Care Pain Med 2017;36:135–45.
[21] Gauss T, Balandraud P, Frandon J, Abba J, Ageron FX, Albaladejo P, et al. Strategic proposal for a national trauma system in France. Anaesth Crit Care Pain Med 2019;38:121–30.

Matthieu Jabaudon M.D., Ph.D.[a,b,*], Raiko Blondonnet M.D., M.Sc.[a,b], Jean-Michel Constantin M.D., Ph.D.[a,b]

[a]*Department of Perioperative Medicine, CHU de Clermont-Ferrand, 1, place Lucie-Aubrac, 63003 Clermont-Ferrand cedex 1, France*

[b]*GReD, CNRS UMR 6293, Inserm U1103, université Clermont Auvergne, Clermont-Ferrand, France*

[*]Corresponding author at: Department of Perioperative Medicine, CHU de Clermont-Ferrand, 1, place Lucie-Aubrac, 63003 Clermont-Ferrand cedex 1, France

E-mail address: mjabaudon@chu-clermontferrand.fr (M. Jabaudon).