Prone Ventilation in Critical Care: Decade Since PROSEVA

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Prone ventilation in critical care is indicated for patients with moderate to severe acute respiratory distress syndrome (ARDS) as a lung recruitment maneuver. A joint statement by the American Thoracic Society, Society of Critical Care Medicine, and European Society of Intensive Care Medicine in 2017 recommended prone positioning ventilation in adult patients with severe ARDS.[1] Keeping up with the postulated hypothesis, during the COVID-19 pandemic, most guidelines recommended prone ventilation in the very early management stages. Despite these consensus recommendations and other supportive evidence, prone ventilation remains underused in patients who may benefit from its use.[2,3] This has been studied in various settings, and the results remain the same. The reasons for this underutilisation include concerns regarding hemodynamic instability, limitations in hospital resources, staff comfort, and lack of education.[4] It is time to appraise the evolvement of the practice of prone ventilation, current research trends, and new evidence.

The first use of prone-position ventilation was reported over 45 years ago by Piehl and Brown, and since then, it has been used in the treatment of severe hypoxaemia.[5] Initial studies have shown no benefit in the use of this method. This can be attributed to the fact that the concept of lung protective ventilation was not established during that era. All these findings lead to the ground-breaking study; PROSEVA. [6] In contrast to previous studies, the PROSEVA study focused on a subgroup of patients with moderate-severe ARDS with ($PaO_2/FiO_2 < 150$ mmHg) after 12–24 hrs of commencing mechanical ventilation and optimization. PROSEVA study showed that out of the 466 patients enrolled in the trial, 28-day mortality was significantly lower in the patients mechanically ventilated in the PP (16% vs 33% for those remaining in the supine position); $p < 0.001$).

Following the PROSEVA study in 2013, most units changed their practice to use PP in patients with moderate to severe ARDS. A meta-analysis of 8 randomized controlled trials (RCTs) (2129 patients) demonstrated a mortality benefit of PP across studies that only enrolled patients with moderate-to-severe ARDS.[7] A recent meta-analysis also suggested an improvement in survival when PP is used in ARDS patients receiving extracorporeal membrane oxygenation (ECMO).[8]

The COVID-19 pandemic has changed the critical care management of hypoxemic patients in the ICU. The use of the prone position increased exponentially to reverse hypoxemia in mechanically ventilated and spontaneously breathing patients.[9] Most guidelines had incorporated PP despite the lack of strong evidence associated with the mortality benefit of using PP in COVID-19-related ARDS. Epidemiological studies have shown that PP improves oxygenation in 60–80% of COVID-19 patients. (C-ARDS). [10]

With solid evidence of PP in moderate to severe ARDS since the PROSEVA study, recent studies have been aimed at determining the optimal duration of PP. In initial studies, PP was conducted only for short durations due to problems with nursing care and haemodynamic

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instability. Current guidelines recommend using PP for more than 16 hours a day. Longer durations have been shown to be beneficial compared to shorter durations of PP. Since there is abundant evidence to support the efficacy of PP in ARDS, future studies should focus on testing its usefulness in various clinical conditions leading to ARDS. PP may not work in all pathologies leading to severe hypoxemia, which should be studied further. Similarly, it should be further explored in the setting of spontaneous ventilation and non-invasive ventilation with hypoxemia.

Identifying the barriers and myths related to the implementation and practice of PP in most ICUs is essential. In addition to time consumption, it also requires an additional workforce, and practicing PP in patients who require PP is crucial. Frequent audits should be conducted to check adherence to PP guidance in severe ARDS patients. If a particular ICU does not reach the expected standards, it is essential that the practices of PP are implemented and reaudited in due course.

In conclusion, ample evidence supports the use of PP in ARDS that has emerged in the decade following the ground-breaking study PROSEVA. But the adaptability to use PP in various ICU setups is limited by multiple factors. These need to be identified and sorted for a better outcome for patients with ARDS.

References

1. Fan E, Del Sorbo L, Goligher EC, et al.; American Thoracic Society, European Society of Intensive Care Medicine, and Society of Critical Care MedicineAn official American thoracic society/European society of intensive care medicine/society of critical care medicine clinical practice guideline: Mechanical ventilation in adult patients with acute respiratory distress syndrome. Am J Respir Crit Care Med. 2017; 195:1253–1263
2. Guérin C, Beuret P, Constantin JM, et al.; investigators of the APRONET Study Group, the REVA Network, the Réseau recherche de la Société Française d'Anesthésie-Réanimation (SFAR-recherche) and the ESICM Trials GroupA prospective international observational prevalence study on prone positioning of ARDS patients: The APRONET (ARDS prone position network) study. Intensive Care Med. 2018; 44:22–37
3. 7. Bellani G, Laffey JG, Pham T, et al.; LUNG SAFE Investigators; ESICM Trials Group 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
4. Mathews, Kusum S. MD, MPH, MSCR[1,2]; Soh, Howard MD, MS[1]; Shaefi, Shahzad MD, MPH[3]; Wang, Wei PhD[4]; Bose, Sonali MD[1]; Coca, Steven MD[5]; Gupta, Shruti MD, MPH[6]; Hayek, Salim S. MD[7]; Srivastava, Anand MD, MPH[8]; Brenner, Samantha K. MD, MPH[9,10]; Radbel, Jared MD[11]; Green, Adam MD, MBA[12]; Sutherland, Anne MD[13]; Leonberg-Yoo, Amanda MD, MS[14]; Shehata, Alexandre MD[15]; Schenck, Edward J. MD[16]; Short, Samuel A.P. BA[17]; Hernán, Miguel A. MD, DrPH[18–20]; Chan, Lili MD, MSCR[5]; Leaf, David E. MD, MMSc[6]; for the STOP-COVID Investigators. Prone Positioning and Survival in Mechanically Ventilated Patients With Coronavirus Disease 2019–Related Respiratory Failure*. Critical Care Medicine 49(7):p 1026-1037, July 2021. | DOI: 10.1097/CCM.0000000000004938
5. Piehl MA, Brown RS (1976) Use of extreme position changes in acute respiratory failure. Crit Care Med 4:13–14. DOI:10.1097/00003246-197601000-00003
6. Guérin C, Reignier J, Richard J-C et al (2013) Prone positioning in severe acute respiratory distress syndrome. N Engl J Med 368:2159–2168. DOI: 10.1056/NEJMoa1214103
7. Munshi L, Del Sorbo L, Adhikari NKJ et al (2017) Prone position for acute respiratory distress syndrome. A systematic review and meta-analysis. Ann Am Thorac Soc 14:S280–S288. DOI:10.1513/AnnalsATS.201704-343OT
8. Papazian L, Schmidt M, Hajage D et al (2022) Effect of prone positioning on survival in adult patients receiving venovenous extracorporeal membrane oxygenation for acute respiratory distress syndrome: a systematic review and meta-analysis. Intensive Care Med 48:270–280. DOI:10.1007/s00134-021-06604-x
9. Gattinoni, Luciano MD, FRCP[1]; Camporota, Luigi MD, PhD[2]; Marini, John J. MD[3]. Prone

Position and COVID-19: Mechanisms and Effects*. Critical Care Medicine 50(5):p 873-875, May 2022. | DOI: 10.1097/CCM.0000000000005486

10. Camporota L, Sanderson B, Chiumello D, et al.: Prone position in coronavirus disease 2019 and noncoronavirus disease 2019 acute respiratory distress syndrome: An international multicenter observational comparative study. Crit Care Med. 2022.