The Down Side of Prone Positioning

The Case of a Coronavirus 2019 Survivor

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Abstract: The coronavirus 2019 pandemic has resulted in a surge of patients with acute respiratory distress syndrome. Prone positioning may be used in such patients to optimize oxygenation. Severe infections may leave survivors with significant functional impairment necessitating rehabilitation. Those who have experienced prolonged prone positioning are at increased risk for complications not typically associated with critical illness. This case report describes the course and clinical findings of a survivor of acute respiratory distress syndrome due to coronavirus 2019 who was prone positioned while in intensive care and subsequently admitted to an inpatient rehabilitation facility. Her related complications, as well as those described in the literature, are reviewed. Critical elements of a comprehensive rehabilitation treatment plan for those who have been prone positioned, including implementation of preventive strategies, as well as early recognition and treatment of related injuries, will be described.

Key Words: Rehabilitation, Corona Virus, Pressure Ulcer, Brachial Plexus Neuropathies

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A 41-yr-old woman presented to the emergency department in late March of 2020 with a 2-day history of fevers, chills, and shortness of breath. She was morbidly obese with a medical history notable for cardiomyopathy, type 2 diabetes mellitus, and hypertension. Her arterial blood gas revealed hypoxemia and hypercarbia, and chest x-ray revealed bibasilar opacities and a prominent interstitial pattern. She was intubated and admitted to an intensive care unit, where she received care for ARDS and multisystem organ failure in the setting of septic shock. Polymerase chain reaction analysis of her nasopharyngeal swab sample subsequently returned positive for COVID-19.

Because of persistent hypoxemia despite full ventilatory support, she was prone positioned 6 days after her admission. Supination was attempted 2 days later, but she was repositioned secondary to worsening oxygen saturation levels. Four days after being placed in prone position for the second time, she was noted to have a dilated, nonreactive left pupil. Prone positioning was aborted because of its potential to result in increased intracranial pressure. Computed tomography of her brain was without acute intracranial pathology at that time.

Her condition improved, and she was successfully extubated after 6 wks in the intensive care unit. Two weeks later, she was admitted for intensive inpatient rehabilitation. She was able to maintain adequate oxygen saturations on room air. She had persistent tachycardia, for which she required a β blocker. She was alert, fully oriented, and able to follow complex commands. Both pupils were equal and reactive to light and accommodation.

In addition to an unstageable sacral pressure injury, she had a large eschar over the sternum extending to the right ribs, as seen in Figure 1. In addition, she had a number of facial wounds, including tissue loss of the lower lip, left nare, and left maxillary region. Her physical examination was also remarkable for prominent left deltoid atrophy, weakness of left shoulder abduction and external rotation and left elbow flexion, and reduced sensation over the distal radial forearm. Her upper limb reflexes were preserved and symmetric in the biceps, brachioradialis, and triceps. She had no current or history of cervical spine disorders, and on physical examination, she had preserved and pain-free range of motion. She had limited and painful active range of motion of her left shoulder; however, passive range of motion was full, and x-ray was without evidence of subluxation. Patient was referred for outpatient electrodiagnostic evaluation for suspected brachial plexopathy, a known potential complication of prone positioning.

DISCUSSION

Since the first reported case of COVID-19 in December 2019, more than 5 million people worldwide have been infected. Preliminary data reveal that up to 17% of patients develop ARDS.
Airway Complications

Intubated patients placed in prone position are at risk for endotracheal obstruction and impaired mucus clearance. A systematic and meta-analysis review by Munshi et al. evaluating three studies with 1594 participants found that patients in prone position have an increased risk of endotracheal tube obstruction. Moreover, intubation can cause derangement in mucociliary function leading to impaired mucus clearance. This is exacerbated by critically ill patients having decreased muscle strength to assist with mucus clearance resulting in retained secretions. Early bedside interventions with therapies in the intensive care setting to preserve muscle function have been found to be safe and feasible. Breathing techniques can assist in diaphragmatic training to strengthen expiratory muscles, prevent atelectasis, and complications such as pneumonia. Rehabilitation consultants evaluating COVID-19 patients prone positioned in such settings should consider implementing such techniques when the affected patients are capable of performing them.

Pressure Injuries

Patients placed in prone position in intensive care settings are at increased risk for pressure injuries in comparison with those kept in supine position, and their injuries may occur in uncommon, ventral locations. Anatomical locations exposed to prolonged pressure such as cheekbones and the anterior thorax are often involved, as they were in the patient described here. Other sites reported include the iliac crests, breasts, and knees. Dudek et al. described a case of bilateral anterior superior iliac spine pressure injuries in a 27-yr-old patient who spent 65 days in intensive care and underwent prone positioning. The patient’s pressure injuries eventually healed after 9 mos of wound care.

Risk factors for the development of prone-related pressure injuries include high body mass index (>28.4 kg/m²), male sex, and older than 60 yrs. Clinicians must remain astute and perform detailed skin examinations. Optimization of nutritional intake and proper wound care can prevent infections and decrease the hospital length of stay and risk of future complications. Early enteral nutritional support has been found to be safe; however, patients should be monitored for signs of aspiration, vomiting, or intolerance due to impaired gut motility. Importantly, patient and family education on wound care and offloading techniques should be implemented early in the rehabilitation course.

Facial Injuries

Facial edema and ocular complications have also been reported in patients who have been put in prone position for surgical procedures and/or respiratory failure. Vision loss can occur as a result of increased orbital pressure or direct trauma to underlying structures. In addition, oropharyngeal edema can arise from prolonged pronation. As a result, patients may have difficulty with communication or swallowing because of localized edema. Trejo-Gabriel-Galan et al. described a case of dysphagia in a 48-yr-old man after prone positioning for 18 hrs a day for 2 days. The authors hypothesized that cranial nerves IX–XII could have been damaged as a result of compression from the U-shape padding used on the face or hyperextension of the neck causing traction on the cranial nerves.

Preventive techniques such as the use of silicone face foams and other head and neck supports are vital to avoid facial injuries, including pressure injuries. Early ophthalmologic intervention may be warranted with new deficits such as blurry vision or impaired extraocular movements. Therapy sessions...
to educate patients on compensatory swallowing techniques and safely advancing a patient’s diet are crucial for the timely restoration of function and prevention of aspiration pneumonia.

Peripheral Nerve Injuries

Nerve injuries are uncommon after prone positioning, but brachial plexus injuries have been reported. Less than 1% of patients sustain neurological injuries when prone positioning is used during surgery.17,18 Goettler et al.18 described two cases of brachial plexopathy from prone position ventilation with gradual improvement after therapy. Their report highlights two individuals, a 34-yr-old woman prone for 12 hrs daily for 6 days because of severe ARDS and a 52-yr-old man prone for 90 mins daily for dressing changes because of necrotizing fasciitis.18

Brachial plexus injuries often develop in patients whose shoulders are positioned in abduction with external rotation and posteriorly displaced.18 This position causes compression and stretching of the brachial plexus, usually affecting the upper nerve roots or trunk.19 As such, unilateral deficits in sensation or strength should alert clinicians to the possibility of brachial plexus injury. Preventive efforts with proper positioning can mitigate the risk of neurological injury. Rehabilitation of plexus injuries should focus on preventing muscle atrophy, managing pain, and addressing impairments related to activities of daily living or previous occupation.20 The optimal multidisciplinary team may include physiatry for oversight of therapy services, medication prescriptions, and pain control procedures; physical therapy for mobility, functional electrical stimulation, and strengthening; occupational therapy for activity and work-related modifications; and psychology for adjustment and coping mechanisms.

Other Complications

Critically ill patients with COVID-19 are at risk for a multitude of neurological and musculoskeletal conditions, including critical illness polyneuropathy and myopathy, intensive care unit–acquired weakness, and contractures.1 It is noted that shoulder and hip contractures, in particular, have been reported as complications of prone positioning.1,8

CONCLUSIONS

Prone position may improve oxygenation and survival among patients with ARDS secondary to COVID-19 infection. As rehabilitation professionals are increasingly being called upon to provide care to the critically ill as well as survivors of the disease, it is essential for them to be aware of potential complications of prone positioning, including airway obstruction, pressure injuries, and brachial plexopathies. Preventive measures, including instruction in breathing techniques, offloading pressure points, and avoidance of pressure and traction on the shoulder while pruning, should be implemented in intensive care settings whenever possible. Rehabilitation physicians caring for COVID-19 survivors who were kept in prone position should be vigilant in the inspection of skin of the face and anterior body as well as the examination of the upper limbs to identify and treat resulting pressure and brachial plexus injuries.

REFERENCES

1. Simpson R, Robinson L: Rehabilitation after critical illness in people with COVID-19 infection. Am J Phys Med Rehabil 2020;99:470–4
2. WHO Coronavirus Disease (COVID-19) Dashboard. World Health Organization. Available at: https://covid19.who.int/. Accessed May 28, 2020
3. Chen N, Zhou M, Dong X, et al: Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 2020;395:507–13
4. Guérin C, Reignier J, Richard J, et al: Prone positioning in severe acute respiratory distress syndrome. N Engl J Med 2013;368:2159–68
5. Pan C, Zhang W, Du B, et al: Prone ventilation for novel coronavirus pneumonia: no time to delay [in Chinese]. Zhonghua Nei Ke Za Zhi 2020;59:E007
6. Munihi L, Del Sorbo L, Adhikari N, et al: Prone position for acute respiratory distress syndrome: a systematic review and meta-analysis. Ann Am Thorac Soc 2017;14(suppl 4):S280–8
7. Ambrosino N, Malabah DD: Comprehensive physiotherapy management in ARDS. Minerva Anestesiol 2013;79:554–63
8. De Jongh B, Shamsar T, Lefaucheur JP, et al: Groupe de Réflexion et d’Études des Neuromyopathies en Réanimation: Parésies acquired in the intensive care unit: a prospective multicenter study. JAMA 2002;288:2859–67
9. Girard R, Baboi L, Ayaz L, et al: Proseva trial group: The impact of patient positioning on pressure ulcers in patients with severe ARDS: results from a multicentre randomised controlled trial on prone positioning. Intensive Care Med 2014;40:397–403
10. Gattinoni L, Togioni G, Pesenti A, et al: Effect of prone positioning on the survival of patients with acute respiratory failure. N Engl J Med 2001;345:568–73
11. Dudek NL, Biemer UR, Trudel G: Bilateral anterior superior iliac spine pressure ulcers: a case report. Arch Phys Med Rehabil 2002;83:1459–61
12. Saiz de la Fuente I, Saiz de la Fuente J, Quintana Estelles MD, et al: Enteral nutrition in patients receiving mechanical ventilation in a prone position. J Parenter Enteral Nutr 2016;40:250–5
13. Guérin C, Beuret P, Constantin JM, et al: Investigators of the APRONET Study Group, the REVAd Network, the Réseaux recherche de la Société Française d’Anesthésie-Réanimation (SFAR-recherche) and the ESCIM Trials Group: A 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
14. Kwes MM, Ho YH, Rozem WM: The prone position during surgery and its complications: a systematic review and evidence-based guidelines. Int Surg 2015;100:292–303
15. Trejo-Gabriel-Galan JM, Perea-Rodriguez ME, Aicua-Rapun I, et al: Lower cranial nerves paralysis following prone-position mechanical ventilation. Crit Care Med 2017;45:e686–6
16. Kim RS, Mullins K: Preventing facial pressure ulcers in acute respiratory distress syndrome (ARDS). J Wound Ostomy Continence Nurs 2016;43:427–9
17. Parks BJ: Postoperative peripheral neuropathies. Surgery 1973;74:348–57
18. Goettler CE, Pryor JP, Reilly PM: Brachial plexopathy after prone positioning. Crit Care 2002;6:540–2
19. Kamel I, Barnette R: Positioning patients for spine surgery: avoiding uncommon position-related complications. World J Orthop 2014;5:425–43
20. Simian N, Ibero G, La Marchina E, et al: Rehabilitation of brachial plexus injuries in adults and children. Eur J Phys Rehabil Med 2012;48:483–506