



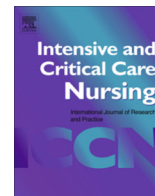
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## Intensive &amp; Critical Care Nursing

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Current insights in intensive &amp; critical care nursing

## Avoiding complications during prone position ventilation

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## Keywords:

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Prone position (PP) is frequently used in patients with acute respiratory distress syndrome (ARDS), during non-invasive ventilation (Longhini et al., 2020), invasive mechanical ventilation for moderate to severe ARDS (Guerin et al., 2013) and even in conjunction with extra-corporeal membrane oxygenation (ECMO) treatment (Giani et al., 2021). PP adjusts pulmonary perfusion diverting flow towards high Va/Q areas allowing a redistribution of aerated and non-aerated areas. If applied early, for prolonged (>16 hours) sessions, PP improves gas exchange in patients with an arterial partial pressure to inspired fraction of oxygen (PaO<sub>2</sub>/FiO<sub>2</sub>) < 150 mmHg thereby reducing 28-days mortality (Guerin et al., 2013).

PP requires fluent and smooth movement of the patient by a small group of personnel. There is a positive learning curve relative to accumulating experience. Complications may occur during and after the postural change, including: 1) accidental extubation and/or obstruction of the endotracheal tube; 2) accidental loss of vascular access (including ECMO cannulas), drainage bags and catheters; 3) pressure injuries; 4) facial, palpebral and/or conjunctival oedema; 5) corneal injuries; 6) muscular-skeletal spasm; 7) brachial plexus injury; 8) regurgitation and/or intolerance of enteral nutrition and 9) alterations in haemodynamic and/or respiratory state.

Since the responsibility for PP lies with nursing staff, it is fundamental to avoid or anticipate the occurrence of these potential but rare complications, (Mancebo et al., 2006). To avoid complications, nursing staff should prepare patients appropriately (Jove Ponseti et al., 2017). A checklist for the procedure is identified in Table 1.

Firstly, in order to avoid accidental extubation, the endotracheal tube position and fixation must be verified. The endotracheal tube cuff pressure should also be monitored. In the unlikely event of an accidental extubation during the procedure, the patient must be promptly returned to a supine position. All the materials required

for an emergency reintubation, such as a resuscitation bag connected to oxygen and suction system must be available at the bedside (Jove Ponseti et al., 2017).

Secondarily, it is important to prepare and check all vascular catheters, assuring their fixation and where possible, increasing the available length. Similarly, the urinary catheter, nasogastric feeding tube and all drainage bags must be secured and checked to avert accidental displacement. Whenever possible, lines, tubes and drainage bags should be disconnected.

After proning, it is important to move the electrocardiogram electrodes from the thorax to the shoulders and prepare the monitoring system. During and soon after proning haemodynamic instability and/or desaturations may occur, therefore the invasive arterial blood pressure and peripheral oxygen saturation (SpO<sub>2</sub>) monitoring should be retained.

Finally, before proning ensure deep sedation and full neuromuscular blockade to avoid coughing, muscular spasm or unplanned extubation. Additionally, the inspired fraction of oxygen should be increased for a period of pre-oxygenation (Jove Ponseti et al., 2017). Which side to turn the patient must be also considered; this depends on vascular access, catheters and drainage bags. During the turn, the patients' arms must be aligned against the body, with the palms up. The leader co-ordinates the patient's movement and assures the endotracheal tube. Two operators per side help with turning the patient. All movement must be synchronised according to the leader's indications. Where the patient is awake and pronation is performed during spontaneous breathing and/or non-invasive ventilation, staff should ask the patient to collaborate (Longhini et al., 2020).

After proning, personnel must: 1) check the endotracheal tube for displacement or obstruction (including auscultation to assure bilateral ventilation); 2) check the monitoring and reconnect all the system; 3) check and/or reconnect all infusion lines, paying attention to possible kinking; 4) check the position of the arms and head, to avoid brachial plexus injury and to assure venous drainage of jugular veins; 5) protect pressure area with dedicated pillows and specific prevention measures to avoid pressures ulcers

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**Table 1**  
Checklist for prone positioning.

Before the procedure
Check endotracheal tube position and fixation
Check endotracheal cuff pressure (20–30 cmH <sub>2</sub> O)
Prepare for emergency reintubation (resuscitation bag, laryngoscope, tube, suctioning system)
Check arterial and venous catheter fixation
Lengthen lines for vascular access
Check ECMO cannulas
Check other catheters (urinary), drainages and tubes
Disconnect all catheters, drainage bags or tubes whenever possible
Prepare and check patient's monitoring
Check sedation and neuromuscular blockade (if intubated)
Explain to the patient the maneuver (if awake)
Assure pre-oxygenation
During the turn
Align arms to the body with palms up
One operator positioned at the head (coordinator)
Two operators positioned per side
Gain patient's collaboration (if awake)
After the maneuver
Check endotracheal tube (displacement, obstruction)
Check vital parameters' monitoring
Check or reconnect the vascular lines (kinking?)
Check patient's position (arm and head)
Protect pressure areas with dedicated materials and air mattress
Restart (and monitor) enteral nutrition

(include foam, water, gel and air mattresses) (Alshahrani et al., 2021; Jove Ponseti et al., 2017).

The expertise of the nursing staff is fundamental to prevent pressure or corneal ulcers (Alshahrani et al., 2021). Pressure injuries have been reported to occur in about one quarter of patients, often located on the ears, cheeks, chin, the front of the feet, eyelids, chest, abdomen and genitals (mainly stage 1 and 2). Facial and conjunctival oedema are also frequent (in 23% and 15% of the patients, respectively) (Jove Ponseti et al., 2017). Corneal lesions may also occur and they must be prevented by a series of measures such as care using eye drops, ointment or polyethylene film and keeping the patient's eyelids closed (Werli-Alvarenga et al., 2013; Carneiro e Silva et al., 2021). The patient's position and pressure areas require frequent monitoring to avoid the occurrence of pressure injuries.

If the patient has been turned in PP while receiving non-invasive ventilation, personnel should check the presence of unintentional air-leaks and the occurrence of patient-ventilator asynchronies (Bruni et al., 2019, Garofalo et al., 2018). Low doses of sedatives such as remifentanyl (Costa et al., 2017) or dexmedetomidine (Conti et al., 2016) may be considered to increase the patient's tolerance.

Finally, enteral nutrition must be also restarted. In prone patients, nurses should frequently monitor, recognize and manage possible complications, such as enteral nutrition intolerance, high gastric residual volume, vomiting or regurgitation, which may require its discontinuation (Bruni et al., 2020). The development

of protocols including strategies to increase enteral nutrition tolerance (head-of-bed elevation, use of prokinetic agents, continuous administration over 24 hours) may be effective to reduce complications related to intolerance and to increase the total enteral nutrition volumes (Bruni et al., 2020) which in turn may reduce the risk of pressure injuries (Wenzel and Whitaker, 2021; Taticu-Babet and Ridley, 2021).

In conclusion, before PP, personnel must appropriately prepare the patient to avoid preventable complications. After proning, the patient must receive a full head to toe check and be monitored for possible complications.

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