

Proning for Patients with COVID-19 Related ARDS: A Review of Literature and Recommendations for Practice

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ABSTRACT

Aim: To review the existing literature, guidelines and recommendations to inform the best practice of proning among patients with coronavirus disease 2019 (COVID-19) related acute respiratory distress syndrome (ARDS).

Background: Proning is one promising therapy for patients with ARDS, but clear guidelines to guide practicing health care workers, especially in low-resource settings, are missing.

Review results: Four databases were searched systematically for this review. Search criteria included any type of research papers written in the English language and publications within the last 20 years (1st January 2000 and 31st May 2021). The extracted data from various articles were tabulated to reach conclusions.

Conclusion: Turning a patient into a prone position involves multiple sequential steps, and any error may lead to potential complications. The recommendations provided here aim to guide the personnel involved in this procedure so as to ensure patient safety and minimize the risk of complications.

Clinical significance: Complications can be reduced if a standard operational protocol for proning a patient is available. This article will provide specific guidelines to health care personnel who have less experience working in critical care areas.

Keywords: Acute respiratory distress, Coronavirus disease 2019, Positioning, Proning.

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INTRODUCTION

Proning has been practiced since the mid-20th century for the management of ARDS in intensive care units.¹ It has been in the limelight during the COVID-19 pandemic with proven efficiency in improving ventilation reported in various recent case reports,² case series,^{3–5} and clinical trials.^{6–8} A number of literature reviews, commentary articles,^{1,9–14} and systematic reviews support the use of proning.^{15,16}

The current pandemic has raised the importance of the easy availability of clinically relevant and reliable information on various medical therapies and procedures. There are many unanswered questions when we think of the routine practice of proning, for example, effects on patient care in the prone position, appropriate frequency, duration, indications, contraindications, potential complications and required minimum articles, and personnel.¹² Training of health care professionals involved in proning is another unanswered question. A few major medical organizations have recently published guidelines about proning.^{17–19} Although there are very few detailed protocols for the proning procedure, none exists for the low-resource settings.^{20,21} So, this review is an attempt to undertake an audit regarding the existing evidence and guidelines in order to formulate a protocol based on these for proning patients, tailored to the low resource settings like India.

MATERIAL AND METHODS

Four databases, namely MEDLINE, Embase, Google Scholar, and EBSCO (CINAHL), were included in this review. A selection criterion for articles was any type of research paper written in the English language within the last 20 years (1st January 2000 and 31st May 2021). The primary search term, "proning," was accompanied

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by combinations with other related terms ("ARDS" or "COVID-19" or "positioning" or "prone position"). Additional articles were searched using the reference lists of the relevant studies. The extracted data from various articles were tabulated to reach conclusions. The extracted data included: (1) author names, (2) year of publication, (3) article type, (4) indications and contraindications, (5) articles required, (6) steps of the procedure, (7) duration of proning, (8) potential complications, and (9) personnel required for the procedure were recorded.

RESULTS AND DISCUSSION

Turning a patient into a prone position involves multiple sequential steps, and any error may lead to potential complications.

Therefore, there is a need for a standard operational protocol to prone a patient similar to other nursing procedures. The recommendations provided here aim to guide the personnel involved in this procedure so as to ensure patient safety and minimize the risk of complications. Complications can be reduced if such a standard operational protocol for performing the procedure is available in critical areas. The following are the key recommendations based on the conducted literature review.¹⁸

Indications and Contraindications for Proning

The scientific rationale for prone positioning in ARDS is that it helps in minimizing the mismatch between ventilation and alveolar perfusion. The gravitational effects of the prone position improve perfusion and ventilation in dorsal areas of the lungs.⁶ There are certain specific indications and contraindications that should be kept in mind while attempting to provide a prone position to a patient. These are listed in Table 1.

Articles Required for Proning

The proning requires a certain degree of preparation before attempting the procedure in an intensive care setting. A prior preparation boosts confidence in the personnel in performing the procedure and also reduces the risk of complications. A minimum requirement of articles is listed in Table 2. Being resourceful can always help in finding substitutes for the needed articles. For example, sheets can be rolled tightly to substitute pillows for supporting the patient in the prone position.

Minimum Requirement of Personnel for Proning a Patient

A recent retrospective observational study has demonstrated the usefulness of a team of five trained non-intensivist personnel in 367 successful position changes to prone or supine positions. The team consisted of a senior non-intensivist clinician positioned at the patient's head and four volunteer health care personnel placed two at each side of the bed.²² So, a minimum of five personnel with basic training are required who can assist in proning patients, thus sharing the burden of the intensivist physician. The volunteers need theoretical training as well as practical training beforehand.^{18,22}

Training of the Health Care Professionals

The prone procedure, just like any other nursing procedure, requires ample training and practice. The special team can be trained to perform the procedure on mannequins before attempting to prone a patient in an intensive care unit. The team has to be led by the intensivist, who positions himself at the headend of the patient during the change of position. We should promote coordination among the team members during the procedure to follow the commands of the lead intensivist.

Importance of having a Separate Team of Proning

Having a separate team for proning with a minimum of five trained assistants is beneficial for a smooth workflow and limiting the number of staff who are being exposed to COVID-19.¹³ A special team may, in rotation, provide the change of position to all the patients in an intensive care area. They should work in coordination with the nursing personnel to decide the timing of proning a patient with respect to other procedures like feeding and personal hygiene. As prone positioning requires some degree of lifting weight, male ward attendants can be a part of the team of proning instead of female nurses.

Duration of Proning

Prone positioning is recommended to be given for 12–16/24 hours. It is also recommended that if severe hypoxemia persists in the supine position, the patient should be immediately turned back to the prone position. In such cases of severe hypoxemia in the supine position, it can be further extended to 20 hours.²¹ Duration of awake proning of >14 hours has been previously reported to be useful in improving oxygen saturation.^{2,3} Prolonged proning has many potential complications which can be prevented by vigilance on the part of the health care team.^{15,23–25}

Potential Complications of Proning a Patient

Though the benefits of proning are more than the risks by far, prone positioning patients with ARDS imposes a potential risk of certain complications like pressure sores and displacement of intravenous or endotracheal tubing. Such complications, although rare, due attention needs to be paid to prevent them as the affected patients can have undue prolonged recovery due to them.^{15,20,26} The most common complications are listed below.

Pressure Ulcers

Patients placed in the prone position in intensive care settings are at increased risk for pressure injuries in ventral anatomical locations exposed to prolonged pressure like cheekbones and the anterior thorax. Other sites reported include the iliac crests, breasts, and knees.^{27,28} Pressure injuries have been reported in a previous clinical study also.^{29,30} There are certain known risk factors for

Table 1: Indications and contraindications for proning a patient

Indications ^{21,26}	Relative contraindications
Moderate to severe ARDS with the partial pressure of oxygen in the arterial blood: the fraction of inspired oxygen ratio <150 mm Hg and the fraction of inspired oxygen ≥0.6	Surgery/trauma
Early within the course of the disease (ideally <48 hours) following 12–24 hours of mechanical ventilation allowing for treatment optimisation	Tracheal surgery or sternotomy
Absolute contraindications²¹	Facial surgery or fractures
Intracranial hypertension	Thoracic lesions or rib fractures
Spinal instability	Cardiothoracic surgery
Open chest postcardiac surgery/trauma	Abdominal surgery or stoma
<24 hrs postcardiac surgery	Respiratory
Unstable vertebral or pelvic fractures	Single chest tube with air leaks
	Massive hemoptysis
	Tracheostomy within last 24 hours
	Cardiovascular
	Cardiopulmonary arrest recently
	Cardiac pacemaker inserted within last 48 hours
	Ventricular assistive device in place
	Balloon pump (intra-aortic)
	Deep venous thrombosis treated within last 48 hours

Table 2: Articles required for proning a patient^{18,21}

Air mattress or local equivalent	Slide sheet
Airway trolley	Clean bed sheets
Closed circuit suctioning	Pillows
ETT tapes	ECG electrodes
Eye ointment	Absorbent pads

pressure injuries in the prone position. These are body mass index $>28.4 \text{ kg/m}^2$, male gender, and old age.³⁰

Feeding Intolerance

Optimal nutritional balance and skin care can ward off pressure injuries. Enteral feeding can be safely started while keeping in mind the added risk of feeding intolerance. So, they should be monitored for signs of impaired gut mobility, like aspiration and vomiting.³¹

Facial Injuries

Facial injuries include edema and pressure-related ocular complications. Elevated ocular pressure or direct trauma can even lead to loss of vision.^{32,33} Preventive techniques include the use of supportive cushions for the face, neck, and head to avoid facial pressure injuries. In time ophthalmologic intervention should always be considered if symptoms like blurry vision or impaired extraocular movements occur.^{28,32}

Neurological and Musculoskeletal Injuries

Although infrequent, cranial and peripheral nerve injuries have been reported to be related to proning previously. Facial cranial nerve injuries^{32,34} (nerves IX-XII), brachial plexus injuries, shoulder, and hip contractures,³⁵ have been reported previously. Preventive efforts include proper positioning to maintain neutral body alignment.

Endotracheal Tube (ETT) Obstruction and Accidental Extubation

Other common complications related to proning include obstruction of the ETT by secretions and accidental extubation.^{15,26} This is the most fatal but rare complication.²⁰ Although there is more risk of accidental extubation in a prone position as compared to a supine, in a previous randomized control trial, the incidence of accidental intubation was found to be the same in the supine and prone positions.²⁷ Thus, adequate preventive measures like proper fixation of the ETT and careful change of position can be helpful in mitigating this complication.

Steps of Procedure: Turning Patient from Supine to Prone Position

Preprocedure Care

Check for contraindications and inform the patient/relatives as appropriate. Ensure the availability of adequate numbers of staff to facilitate the procedure. Any investigations or procedures that would be difficult in a prone position should be performed beforehand. Personal hygiene needs are difficult to be performed in the prone position. So, all daily activities of personal hygiene like a sponge bath, mouth care, change of dressing, etc., should be attended to prior to the procedure. The ventilator should be moved nearest to the patient. The patient should always be rolled toward the ventilator.^{18,21,26}

Airway/Breathing

- Check the resuscitation trolley.
- Mark the previous length of the ETT at the lips.
- Secure ETT firmly. Ensure adequate padding between the tie and the skin.
- Provide airway and oropharyngeal suction prior to the procedure.
- Preoxygenate the patient with 100% oxygen.

- Note tidal volume, inspiratory pressure and other ventilator settings.

Circulation

- Ensure hemodynamic stability by recording the heart rate and blood pressure prior to the procedure.
- Ensure all lines are firmly secured.
- Disconnect all nonessential lines and monitors.
- Prepare for the administration of vasopressors/inotropes in case the need arises.

Skin/Eyes

- Nursing personnel should document skin integrity before proning the patient.
- Pay special attention to bony prominences that will be under pressure in the prone position.
- Provide air mattresses.
- Eyes should be cleaned with sterile water, lubricated with eye drops, and taped to prevent drying and ulceration.

Tubes/Lines

- Do not give nasogastric (NG) feed at least 1 hour before the procedure. Aspirate the NG tube prior to the procedure.
- Measure and document NG length at the nose tip level.
- Secure the chest drains well and place them below the patient.
- Secure and tape the urinary catheter to the inside of the leg of the patient.

Turning Patient Supine to Prone

- The anesthetist should stand at the headend. She/he has to be responsible for coordinating the procedure.
- Two persons should stand at each side of the patient, one at the chest level and one at the knee level.
- Position the patient on the bed in a neutral position on a clean sheet spread over the slide sheet.
- Remove anterior electrocardiogram (ECG) electrodes.
- Tuck the arm towards the ventilator below the buttock of the patient. The palm should be kept facing anteriorly.
- Place thin pillows over the chest, iliac crests, and knees. Place them as per the patient's body shape to prevent pressure on the abdominal and thoracic organs.
- Place a sheet on top of the patient covering him up to the neck.
- Roll the edges of the top and bottom sheets together tightly. Keep the pillows in the correct position on top of the patient.
- Then, the patient is moved horizontally to lie on the edge of the bed away from the ventilator.
- As the person at the headend calls, the patient is rotated 90° to lie on his side.
- The staff on either side then holds the opposite edge of the rolled sheets as compared to the horizontal maneuver.
- Again, on the instruction of the person at the headend, the rolled-up sheet is pulled-up from below the patient putting the patient into a prone position.
- The head and neck are supported with the help of pillows.
- Check the ETT for kinking and length. Check ventilator settings. Reattach the ECG electrodes on the posterior chest wall and other monitoring devices like the thermometer and pulse oximeter.

- The patient is placed in the center of the bed, and the slide sheet is removed.
- The arms are kept in the “swimmers position” when the patient is prone. Therefore, the arm on the side where the head is facing is raised. The shoulder is abducted at 80° and the elbow is flexed at 90°. The other arm is placed beside the patient.
- Position of the head and arms are changed every two hourly.
- The bed is to be positioned as reverse Trendelenburg at 30°.

Turning Patient Prone to Supine

All the preparation and procedure remain the same. The same precautions are to be taken. The supination process (turning the patient from prone to supine) is usually easier and involves similar personnel and technique of rolling sheets.³⁶

Care of Patient in Prone Position²¹

- Monitor oxygen saturation, end-tidal carbon dioxide, and invasive arterial blood pressure every half-hourly.
- Maintain feet in dorsiflexion with the ankle at 90°; avoid contact of the toes with any hard surface of the bed.
- The use of an air mattress ensures that pressure is reduced. If an air mattress is not available, optimal use of pillows can ensure the prevention of pressure of bony prominences.
- In case of any emergency complication related to prone positioning, turn the patient back to supine immediately.

Points to Remember¹⁵

- The person at the headend is responsible for ensuring ETT stability during the procedure.
- Ensure the positioning of the pillows according to the patient's body.
- Check all pressure point areas at a fixed time interval of 2 hours.
- Ensure that the ears are not bent over and there is no pressure on his eyes.
- Ensure that the ETT is not pressed against the corner of the mouth/lips, the NG tube is not pressed against the nostril, or any other line/tubing is not pressed against the skin.

CONCLUSION

Prone positioning is of utmost importance in areas where mechanical ventilation facilities are inadequate. Specific protocols support decisions and provide the care providers the necessary confidence to perform any procedure with the limited occurrence of complications.

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