

Prone Positioning: Examining a Key Supportive Strategy in ARDS



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11/05/2024



- Subject matter expert HRET: CAUTI, CLABSI, HAPU, Sepsis, Safety culture
- Consultant and speaker bureau:
 - Stryker's Sage business
 - Potrero Medical
- Baxter Healthcare Advisory Board

Objectives

01

Discuss the physiologic rationale and the evidence for use of the prone position in patients with ARDS

02

Identify evidence-based strategies for determining when to turn, how to turn, and how long to allow patients to remain in the prone position

03

Outline strategies for preventing complications during turning and while in the prone position

The Berlin ARDS Definition

TIMING	Within 1 week of a known clinical insult or new/worsening respiratory symptoms		
CHEST IMAGING (X-RAY OR CAT SCAN)	Bilateral opacities—not fully explained by effusions, lobar/lung collapse, or nodules		
ORIGIN OF EDEMA	Respiratory failure not fully explained by cardiac failure or fluid overload; need objective assessment (eg, echocardiography) to exclude hydrostatic edema if no risk factors present		
	MILD	MODERATE	SEVERE
OXYGENATION	<200 PaO ₂ /FiO ₂ or ≤300 with PEEP/CPAP ≥5 cm H ₂ O	<100 PaO ₂ /FiO ₂ or ≤200 with PEEP ≥5 cm H ₂ O	≤100 PaO ₂ /FiO ₂ with PEEP ≥5 cm H ₂ O
MORTALITY	27% (24% to 30%)	32% (29% to 34%)	45% (42% to 48%)

A New Global Definition of ARDS

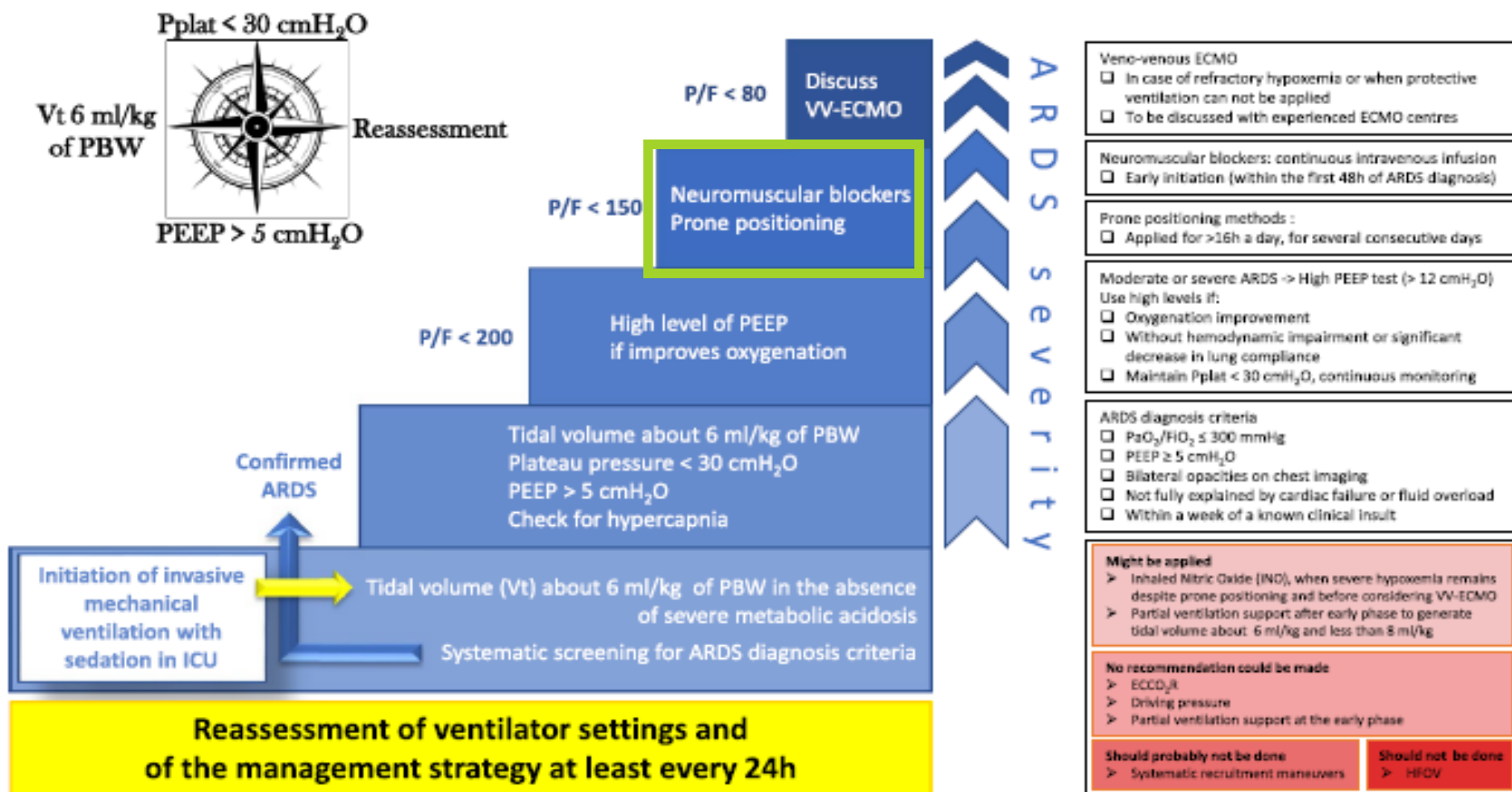
ARDS New Global Definition 2023

• new definition criteria	Classification		
	Mild	Moderate	Severe
Time to instalation	Up to seven days - known risk fator(s)		
Pulmonary edema	Not explained by cardiogenic edema or intravascular volume overload		
Radiologic features	Bilateral infiltrates on chest X-ray or CT or <u>lung ultrasound (by a trained professional)</u> (not explained by nodules, pleural effusion or atelectasis)		
Hypoxemia PaO ₂ /FIO ₂ **	201-300 with NIV/CPAP PEEP ≥ 5* or HFNO > 30l/min	101 - 200 com PEEP ≥ 5	≤ 100 com PEEP ≥ 5
Hypoxemia SpO ₂ /FIO ₂	≤ 315 with SpO ₂ ≤ 97%		

xlung www.xlung.net

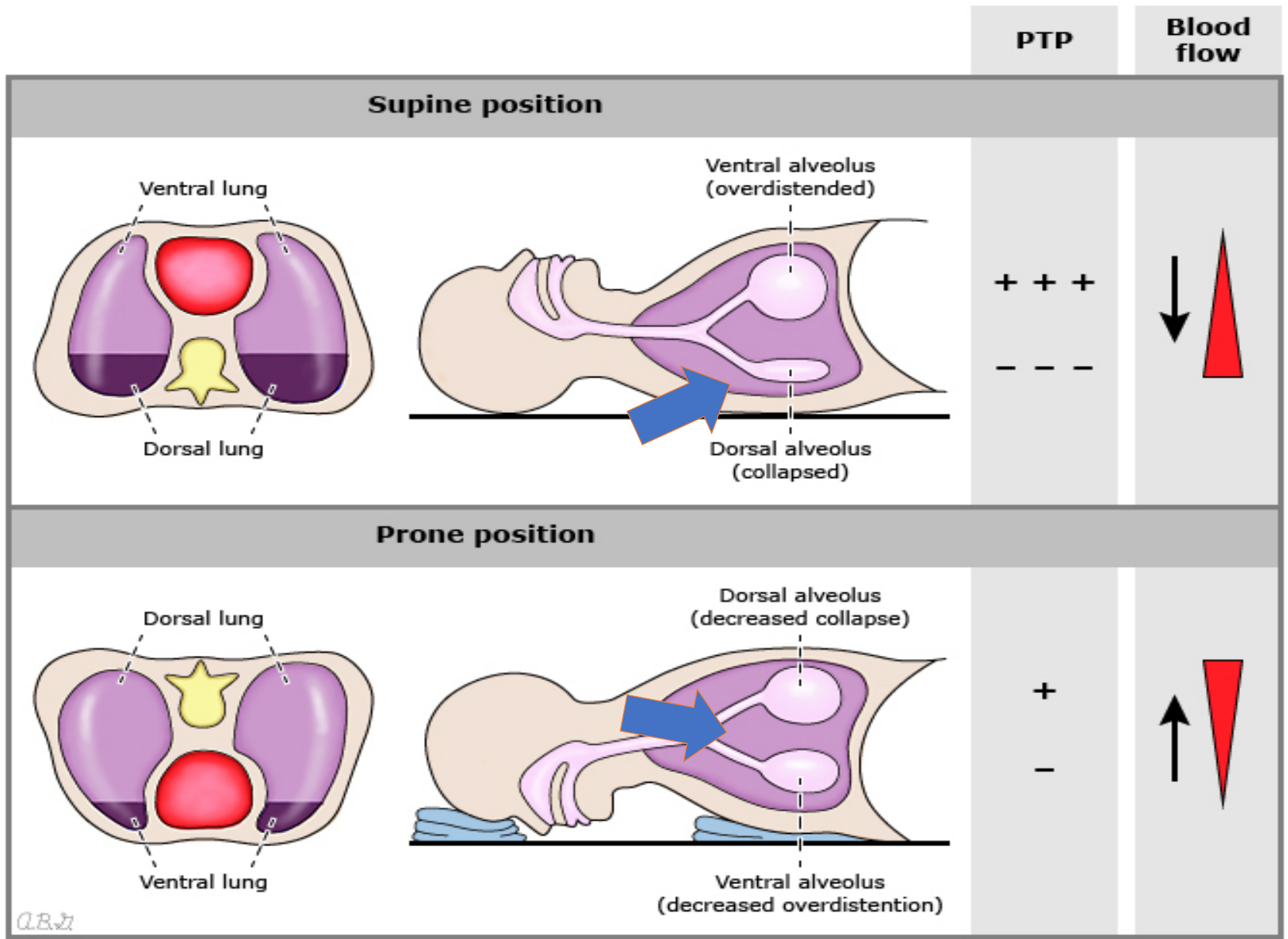
Am J Respir Crit Care Med 2023;207:A6229

Early management of ARDS in 2019



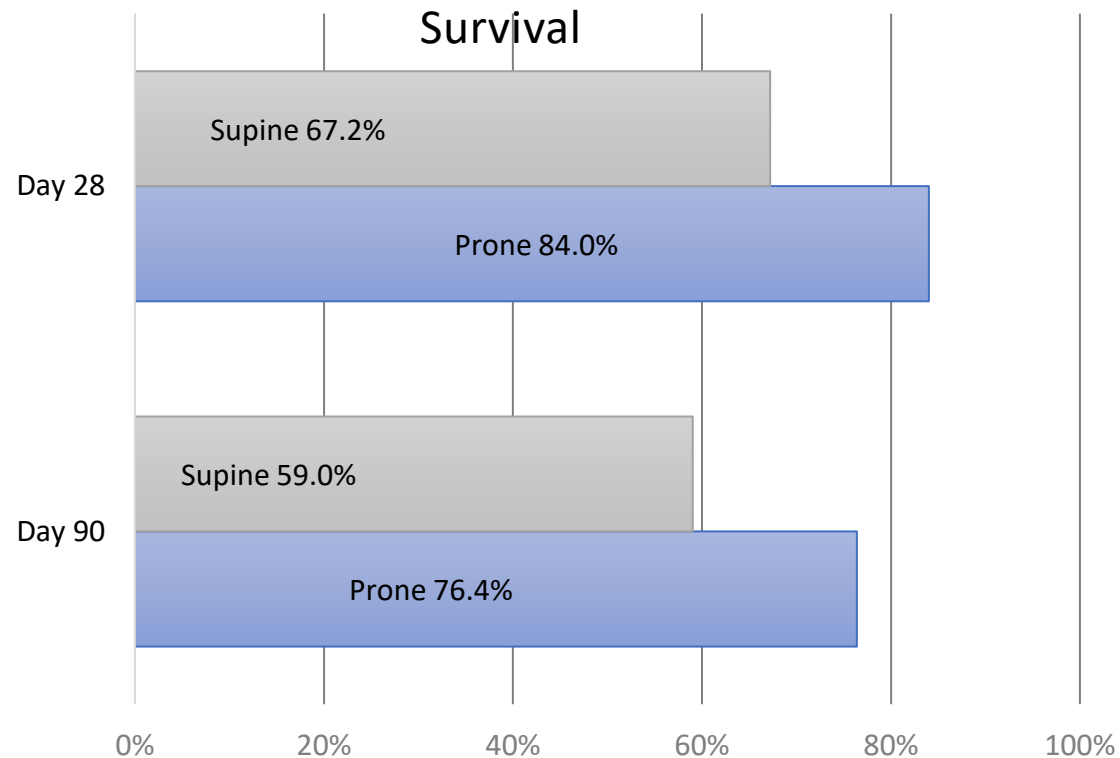
Why Prone Positioning?¹⁻²

- Improves dependent aeration recruiting alveoli
- Reduces hyperinflation of nondependent regions dramatically
- Results in more homogenous lung aeration which reduces regional shear strain...less ventilator-induced lung injury (VILI)
- Decreases barotrauma and atelectrauma by recruiting and reducing overdistension that occurs with higher positive end-expiratory pressure (PEEP)
- ↓ PACO₂ relates to net increase in recruitment / ↓ in dead space
- Drains secretions



Q.B.2

Proning Severe ARDS Patients

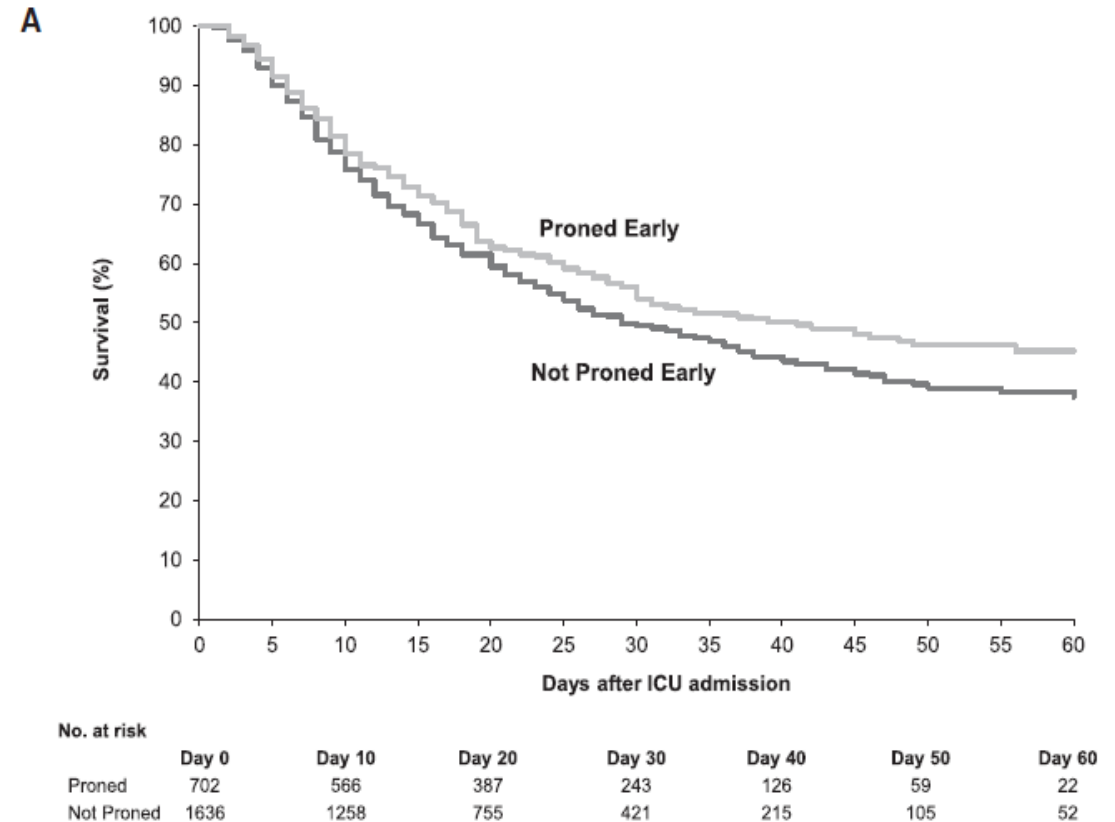


In a randomized, controlled trial of 466 patients with severe ARDS, survival was significantly higher at 28 and 90 days in the prone position group

NNT=6

Prone Positioning in COVID 19 Patients

- Data from Study & Treatment of Outcomes in Critical Ill Patients with COVID 19
- 68 hospitals (March 2020 to May 2020)
- Mechanical ventilated pts with P/F ratio < 200mmHg initiated prone positioning or not within first 2 days of ICU admission
- Results
 - 2338 eligible pts: 30% proned
 - Lower in-hospital mortality if proned early
 - 19.5% proned later in the course of illness



ESICM ARDS 2023 Guidelines Update

We **recommend** using prone position as compared to supine position for patients with moderate-severe ARDS (defined as $\text{PaO}_2/\text{FiO}_2 < 150$ mmHg and $\text{PEEP} \geq 5$ cmH₂O, despite optimization of ventilation settings) to reduce mortality.

(Strong recommendation, high level of evidence in favor)

- ARDS
- COVID ARDS

Who Not to Place in Prone Position?

Absolute Contraindications



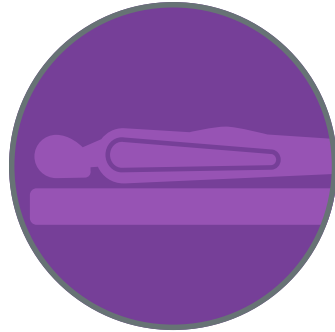
1 Patients with facial/neck trauma or spine instability

2 Goals of Care: Allow for a natural death (comfort care)

Relative Considerations

- Uncontrolled intracranial pressure or poorly controlled seizures
- Massive bleeding /hemoptysis
- Venous thrombosis treated < 48 hours
- Increased intracranial pressure
- Patient with hemodynamically unstable condition (as defined by a systolic blood pressure <90 mm Hg or MAP < 60) with fluid and vasoactive support in place
- Unstable chest wall, open abdomen
- Burns > 20% of the ventral body surface
- Cardiac abnormalities: life threatening arrhythmias, ventricular assist devices, intra-aortic balloon pump, ECMO, fresh pacemaker
- Bronchopleural fistula, Unstable airway, tracheal surgery within 2 weeks
- Pregnancy second or third trimester or extremely distended abdomen (padding above and below this distention may offset unnecessary pressure)
- Weight 160 kilograms or greater (weigh the risk benefit ratio for the patient and staff)
- Advanced arthritis

Patients Who Have Been Placed in the Prone Position Successfully



1 Patients with open abdomens

2 Patients with intracranial pressure monitoring

3 Patients with hemodynamic instability

Patients with pelvic fractures **4**

Patients with external fixators **5**

Patients with multiple traumatic injuries **6**

7 Patients with use of extracorporeal membrane oxygenation (ECMO)

8 Patients with continuous renal replacement therapy (CRRT)

Patients with morbid obesity

Pre-Prone Position Process¹⁻⁴

- Patient and family education
- Gather staff (5) and supplies, obtain pre prone measurements
- Preoxygenate, consider hold to empty stomach (1hr) if TF rate is high
- Suction endotracheal tube (if applicable)/oral cavity,
- Secure the endotracheal tube and lines (remove ET holders if in use)
- Position tubes inserted above the waist to the **top of the bed**
- Position tubes inserted below the waist to the **foot of the bed** (except chest tubes)
- Empty ileostomy/colostomy bags before the turn
- Perform eye care
- Placement of prophylactic dressings in high pressure/shear risk areas (forehead, chin, chest, elbow, pelvic, knees, dorsal feet)
- Ensure the tongue is inside patient's mouth
- Consider capnography monitoring
- Develop an exit strategy for instability while in the prone position

1. Vollman KM, et al. AACN Procedural Manual. 2016:142-163

2. FICM Guidelines for Prone Position in Adult Critical Care 2019 accessed 5/08 /2021

https://www.ficm.ac.uk/sites/default/files/prone_position_in_adult_critical_care_2019.pdf

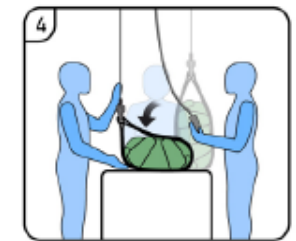
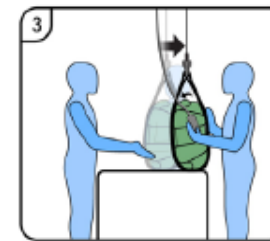
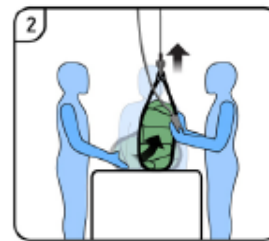
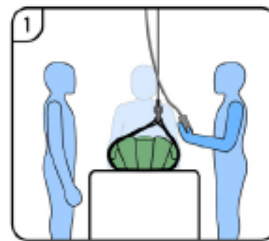
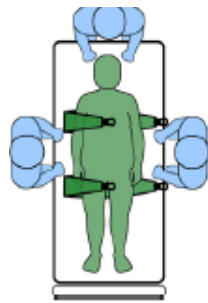
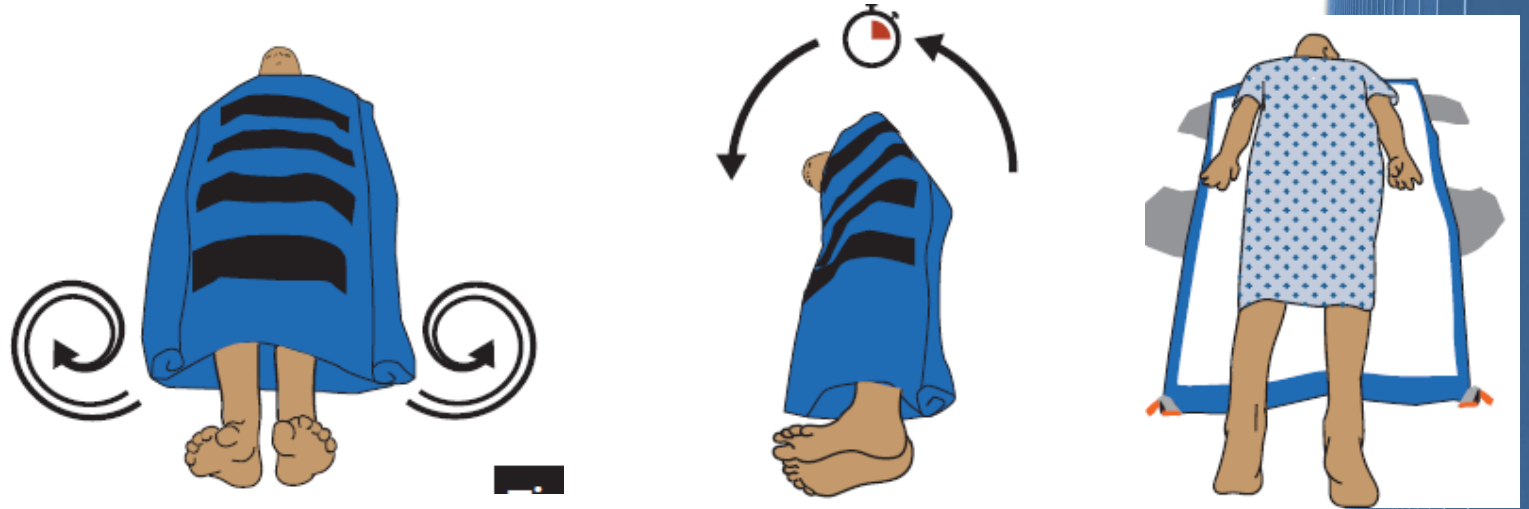
3. Gomaa D, et al. Respir Care 60(2):e41-e42, 2015.

4. Mitchell DA, et al. AACN Adv Crit Care 29(4):415-425, 2018.

Manual Proning



Mayo© 2017



Mayo© 2017

Positioning Schedule & Maintenance Care^{1,2}

Consider every 16hrs uninterrupted (more frequent turn back may cause decruitment)

Obtain post prone measurements

Restart feeding

Assess for pain & agitation minimum of q4

Q 2hr limb and head reposition (Swimmers), support feet in correct anatomical alignment

If hemodynamic monitoring, level the zero-reference point at the right atrium

Consider time periods in reverse Trendelenburg to address facial edema and reduce risk of vomiting

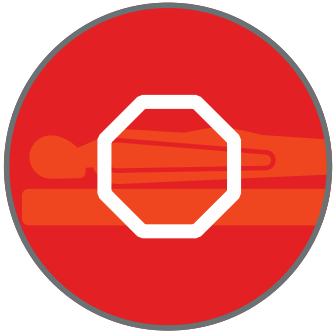
Frequent oral hygiene and suctioning and eye care as needed

CPR In the Prone Position

- AHA guidance
 - If patient has advanced airway consider initiating prone CPR until team can safely turn supine
 - Hand placement T7-T10
 - If unable to transition patient to supine & defib is required
 - Pads in anterior and posterior position



When to Stop Prone Positioning?



Research supports stopping prone positioning when $\text{PaO}_2/\text{FiO}_2$ has remained >150 mmHg 4 hours after supinating (with PEEP <10 cm H_2O and $\text{FiO}_2 <0.6$)

If there is no response after 48 hours, question whether prone positioning should continue

Awake Prone Positioning with COVID: Open Label RCT

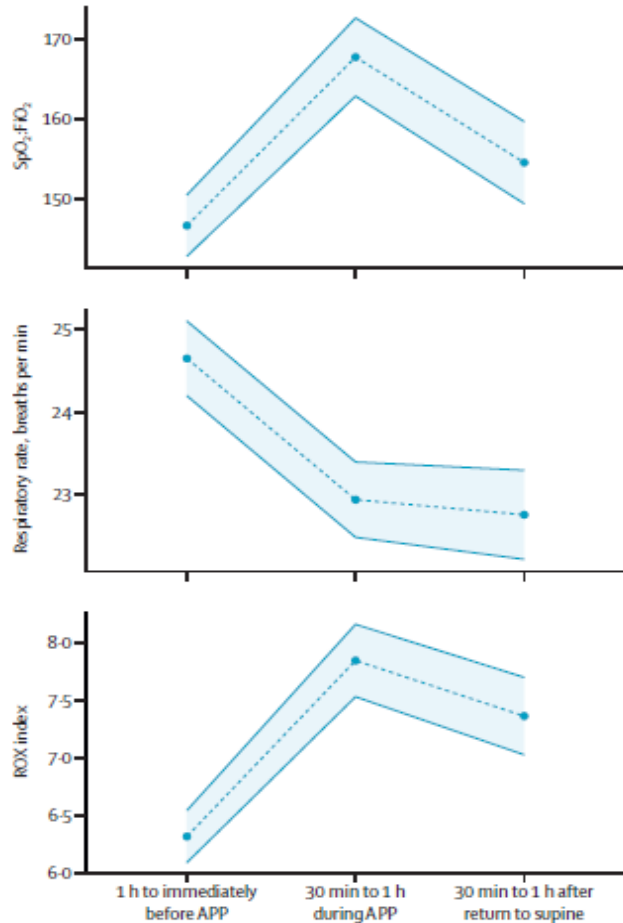
- Efficacy of awake proning to prevent intubation or death
- International open label RCT
- COVID 19 hypoxemic respiratory failure defined as: requiring respiratory support with HFNC & P/F ratio of ≤ 315 randomized to awake prone positioning or standard care
 - Awake prone (567)
 - Standard care (559)
- Patient instructed to lie in PP as frequent and as long as can be tolerated each day
- Awake proning cease when weaning HFNC because of improve oxygenation
- Pre-defined criteria for intubation was used in both group
- Outcomes:
 - Tx failure define as intubation or dying within 28 days of enrolment
 - Secondary outcome: intubation, mortality, use of non-invasive vent, time to intubation, time to death, Hospital LOS



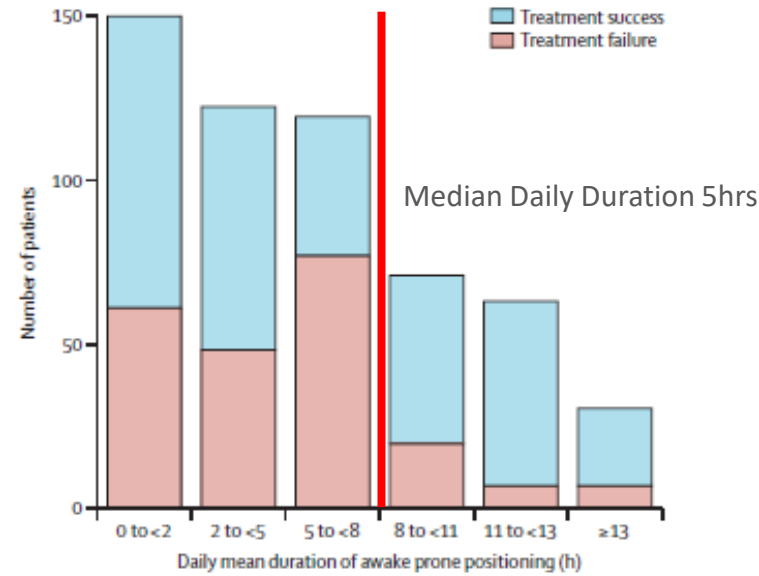
6 Countries: Mexico, US, Spain, Canada, France & Ireland

Awake Prone Positioning with COVID: Open Label RCT

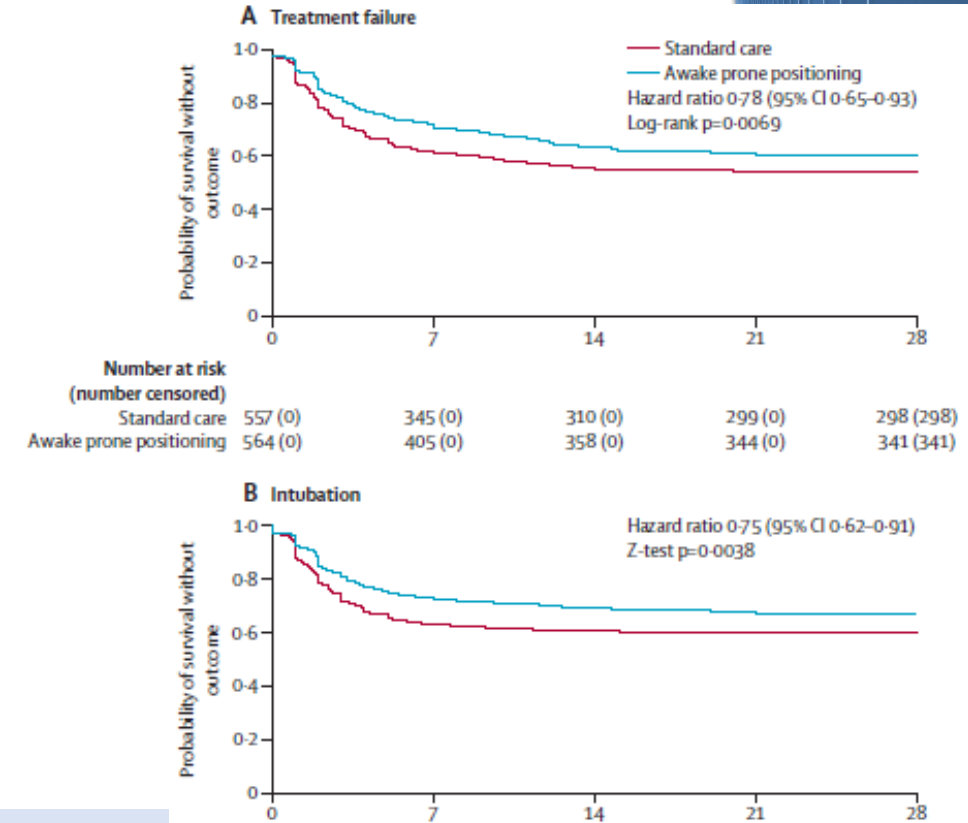
Physiologic Impact of Awake Prone Positioning



Time Spent in Prone Position



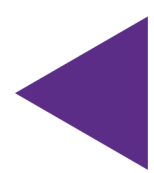
Outcomes



Awake prone position of patients with hypoxemic respiratory failure from COVID 19 reduces the incidence of treatment failure and need for intubation without any signal of harm - NNT 14

ESICM ARDS 2023 Guidelines Update

- We **suggest** awake prone positioning as compared to supine positioning for non-intubated patients with COVID-19-related AHRF to reduce intubation.
 - Weak recommendation; low level of evidence in favor.
- We are **unable to make a recommendation** for or against APP for non-intubated patients with COVID-19-related AHRF to reduce mortality.
 - No recommendation; moderate level of evidence of no effect.
- We are **unable to make a recommendation** for or against APP for patients with AHRF not due to COVID-19.
 - No recommendation; no evidence.

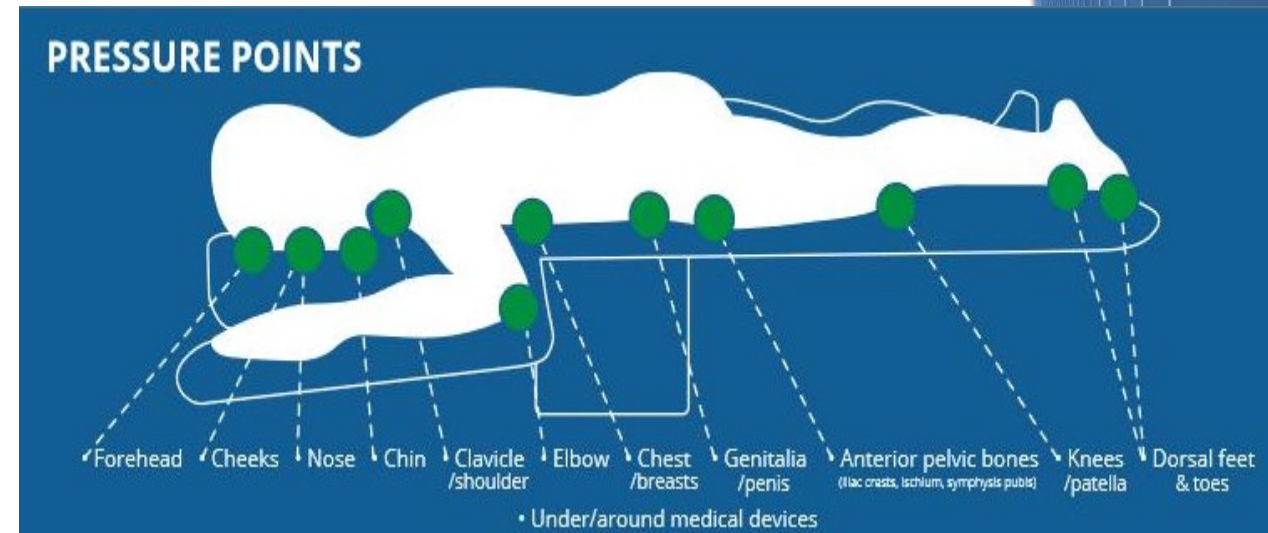


Adverse Events	No. of Trials Reporting the Outcome	Events/Prone	Events/Supine	Treatment Effect (Random-Effect Model)		Heterogeneity		
				OR (95% CI)	p	Number Needed to Treat/Number Needed to Harm	I ² (%)	p
Ventilator-associated pneumonia	6	120/567	128/513	0.76 (0.44–1.33)	0.343	26	34.4	0.192
Pressure ulcers	6	294/698	218/646	1.49 (1.18–1.89)	0.001	12	0.0	0.617
Major airway problem ^a	9	255/1,104	180/1,063	1.55 (1.10–2.17)	0.012	16	32.7	0.167
Unplanned extubation	7	113/1,091	98/1,050	1.17 (0.80–1.73)	0.421	98	25.5	0.234
Selective intubation	2	12/642	5/615	2.73 (0.29–25.46)	0.378	95	55.9	0.132
Endotracheal tube obstruction	4	130/823	77/802	2.16 (1.53–3.05)	<0.001	16	0.0	0.580
Loss of venous or arterial access	4	36/407	22/397	1.34 (0.29–6.26)	0.712	30	75.5	0.007
Thoracostomy tube dislodgement or kinking	4	14/407	14/397	1.14 (0.35–3.75)	0.827	1,154	42.6	0.175
Pneumothorax	4	29/513	33/462	0.77 (0.46–1.30)	0.333	67	0.0	0.528
Cardiac arrest	3	104/718	119/675	0.74 (0.47–1.17)	0.197	32	30.3	0.238
Tachyarrhythmia or bradyarrhythmia	3	115/663	102/634	1.08 (0.78–1.50)	0.643	80	8.8	0.334

11.9% complication rate

Pressure Injury Prevention: Prone Positioning

- Redistribution surface
- Positioning devices to offload pressure points (Do not use ring or donut-shaped positioning devices)
- Avoid shear and friction during the turning process
- Small micro turns while prone/swimmer position shifts q 2-4 hrs
- Assess skin with when doing small positioning shifts
- Placement of prophylactic dressings over all potential pressure injury risk areas



Green areas represent pressure sources while lying prone

Head Specific Interventions to Reduce PI while Proning

- Apply soft silicone multilayered foam prophylactic dressings to pressure points on the face (cheeks, forehead, chin and consider strips around the corners of the mouth)¹
- Turn the head q 2 hrs¹
- Manage moisture /oral & nasal secretions^{1,2}
 - Liquid skin protected or sealants on the face
 - Change form dressings PRN
 - Consider applying hydro fiber or calcium alginate dressings under prophylactic dressings to manage excess moisture (chin, mouth area and cheeks)
- Consider removing commercial ETT holder and use tape or twill. Places patients at risk for pressure injuries^{1,2}
- Apply thin foam dressings under medical devices—including ETT securement (tape-twill)^{1,2}



Jackson ME, et al. *Respir Care*. 2012;57(2):311-314
Kim RS, et al. *J Wound Ostomy Continence Nurs*. 2016;43(4):427-429

Smart H. *Adv Skin Wound Care*. 2021;34(7):390-391.

1. https://cdn.ymaws.com/npiap.com/resource/resmgr/online_store/posters/npiap_pip_tips_-_proning_202.pdf NPIAP 2020

2. Peko L, et al. *Int Wound J*. 2020;17(6):1595-1606. doi:10.1111/iwj.13435

Ocular & Brachial Plexus & Ulnar Safety

- Perform eye assessment daily and prior to proning.
- Clean the eyes with saline soaked gauze, apply ointment then horizontally tape the eye lids closed.
- In the presence of conjunctival or corneal exposure increase the frequency of eye ointment application as per institutional policy.
- Use of reverse Trendelenburg to reduce eye conjunctival edema
- Maintain straight spine alignment & avoid excessive arm rotation
- Avoid positions of extension of the shoulders and support the chest well to ensure shoulder is forward flexed or falling forward
- Avoid positioning arm in abduction beyond 70 degrees with elbow extension and external rotation of the shoulder beyond 60 degrees
- Avoid hyperextension of the neck by adjusting height of head chest and pelvic supports

Patterson TJ, et al. *Am J Ophthalmol.* 2021 Mar 3:S0002-9394

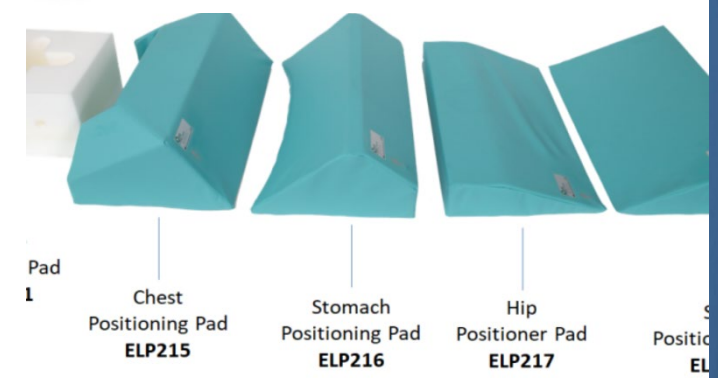
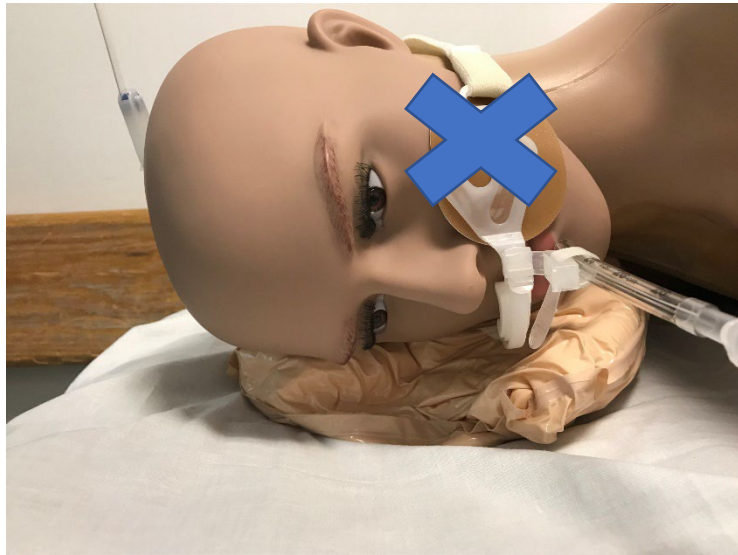
Sansome SG, et al. *British Journal of Hospital Medicine.* 2020;81(6):1-10

Bamford P, et al. Available from

https://www.ficm.ac.uk/sites/default/files/prone_position_in_adult_critical_care_2019.pdf.

Simpson AI, et al. *J Intensive Care Med.* 2020;35(12):1576-1582

Miller C, et al. *Phys Ther.* 2021 Jan 4;101(1)



List various equipment available for prone (Fourie A, et al. *J Tissue Viability*. 2021;30(4):466-477.

ROSE Trial: Re-evaluation of Systemic Early Neuromuscular Blockade

- Protocol: moderate to severe ARDS < 48hrs / P/F ratio < 150 with \geq PEEP 8 cm
- Cisatracurium for 48hr or usual care
- Protocol changed mid-study, removed RM

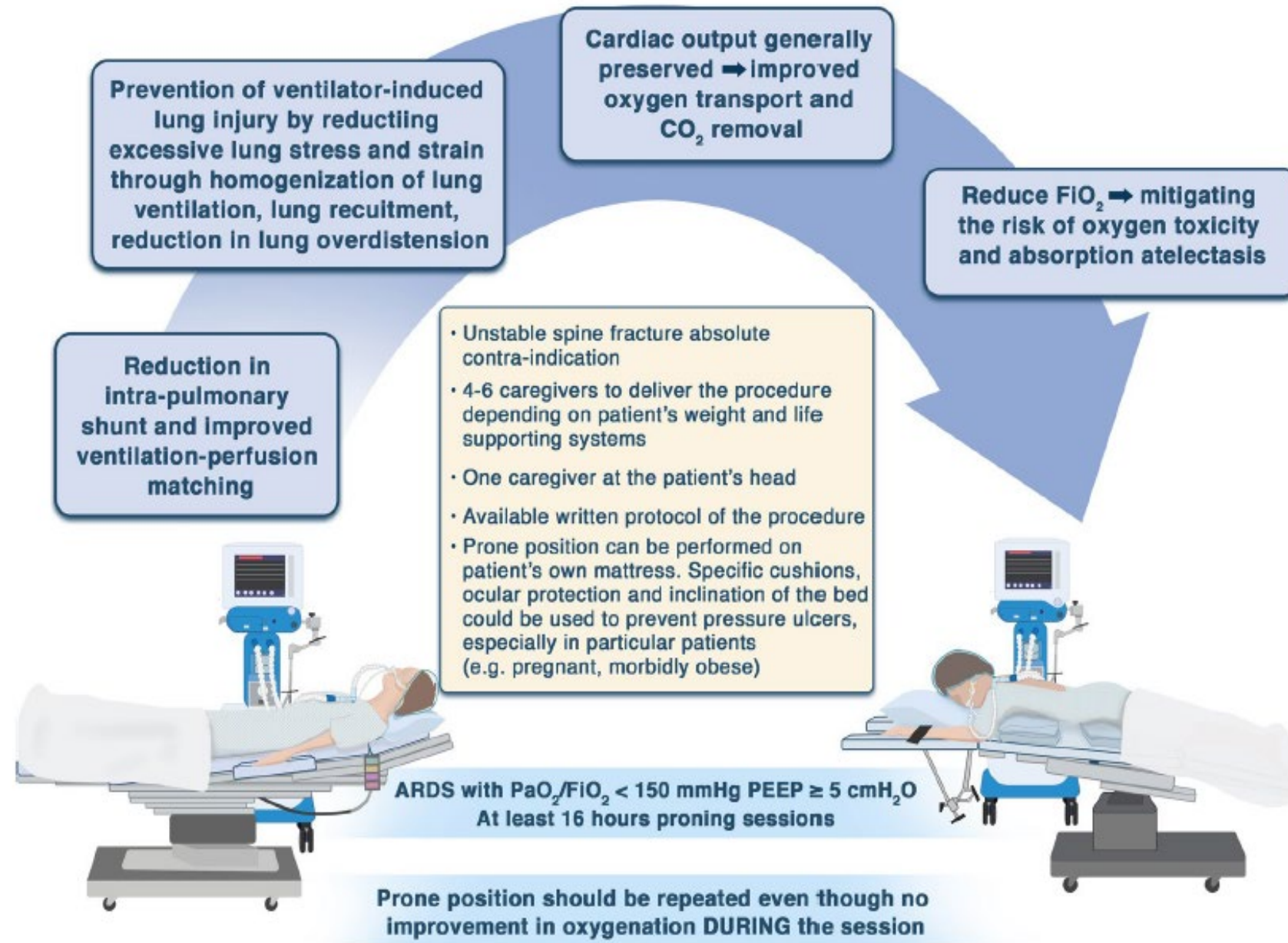
The ROSE trial at 90-day follow-up in patients with moderate-to-severe ARDS, 42.5% of the intervention group and 42.8% of the control group died before hospital discharge (between group difference -0.3%, 95% CI -6.4 to 5, $P=0.93$), -study stopped early.

Petal Network. N Engl J Med. 2019 May 23;380(21):1997

Prone Positioning used 15.8%. Equal use in both groups

Summary

- Use the prone positioning
- Implement early—don't wait
- Develop a process or protocol to minimize complication risk
- Training all providers to mastery is critical





"HAPPY TURNING"





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