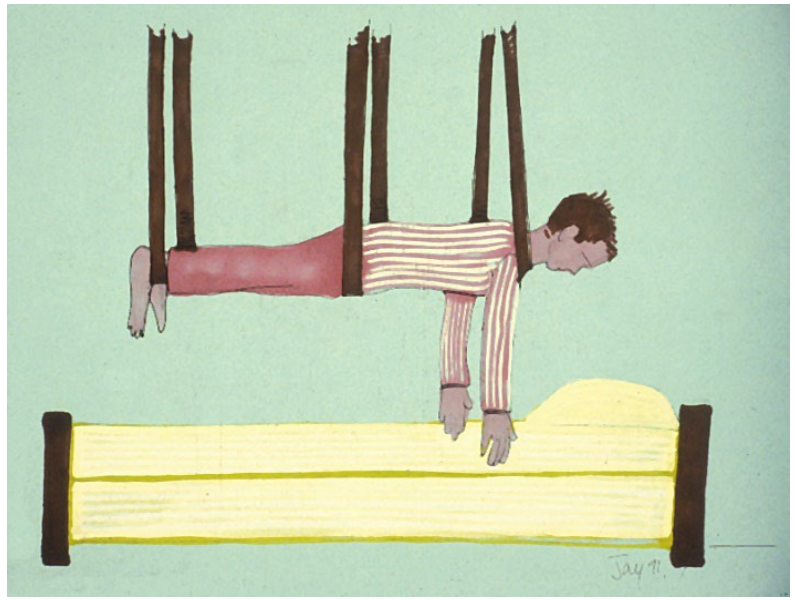
Prone Positioning: Examining a Key Supportive Therapy in ARDS



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ADVANCING NURSING THROUGH KNOWLEDGE & INNOVATION

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- Subject matter expert AHA: CAUTI, CLABSI, HAPI, Sepsis, Safety culture
- Consultant and speaker bureau:
  - Stryker's Sage business
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Objectives

- Discuss the physiologic rationale and the evidence for use of the prone position in patients with ARDS
- Identify evidence-based strategies for determining when to turn, how to turn, and how long to allow patients to remain in the prone position and tools for preventing complications.

Prone Positioning Incidence

Prone positioning (PP) was only used in 16.3% of patients with severe ARDS in the LUNG SAFE study

Bellaini G, et al. JAMA, 2016;315(8):788-800

European Prevalence Study (APRONET): Use of PP in mild 5.9%, moderate 10.3%, severe 32.9% ARDS

Guerin C, et al. Intensive Care Med, 2018;44(1):22-37

Italy and Netherlands—60% of Mechanical Ventilated ARDS COVID 19 patient were proned, 50% in the US

Stilma W, et al. *J Clin Med*. 2021;10(20):4783.
Langer T, et al. *Crit Care* 2021; **25:**128
Mathews KS, et al. Crit Care Med. 2021;49(7):1026-1037.

A New Global Definition of ARDS

ARDS New Global Definition 2023

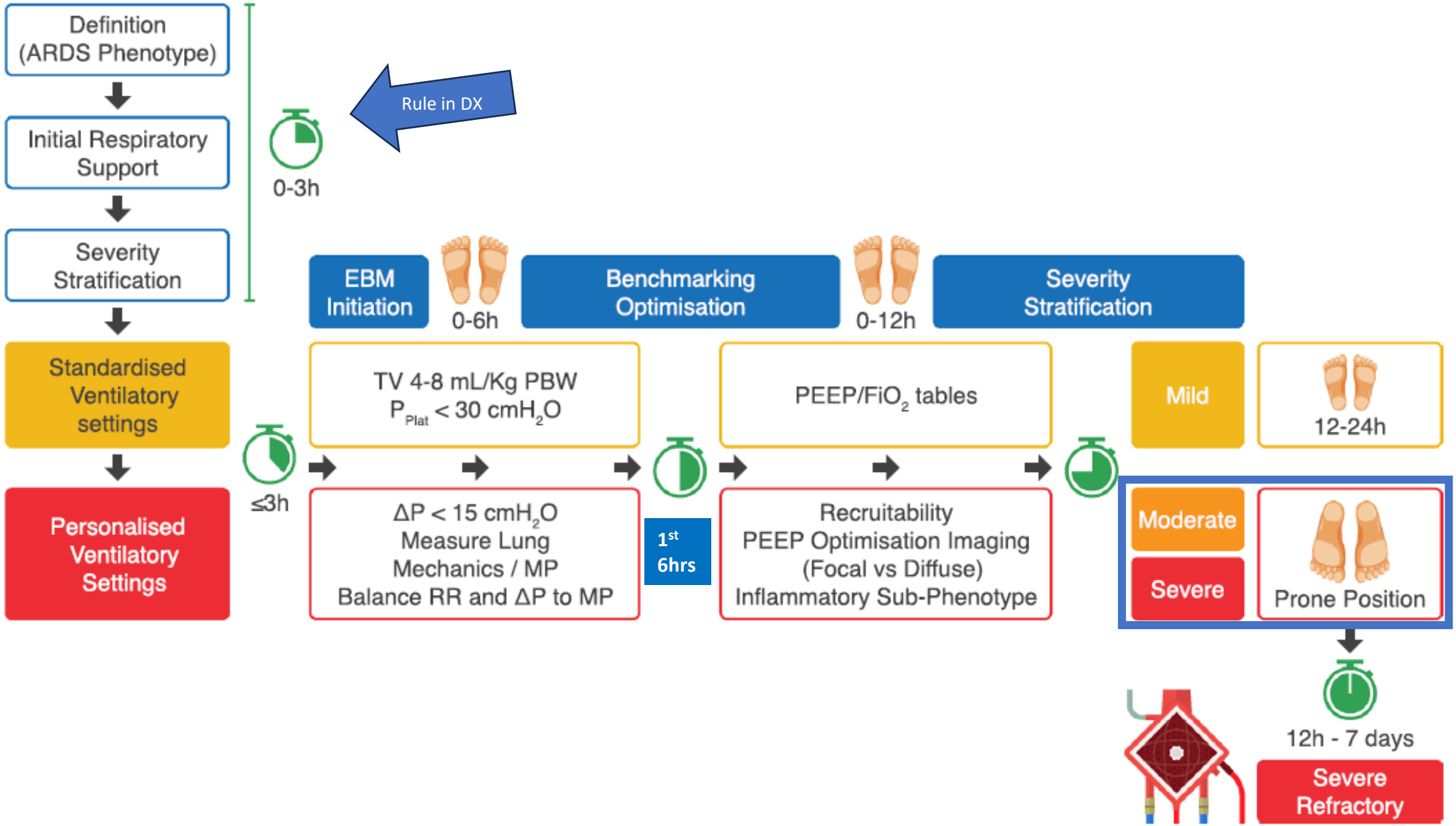
● new definition criteria	Classification		
	Mild	**Moderate**	**Severe**
Time to instalation	Up to seven days - known risk fator(s)		
Pulmonary edema	Not explained by cardiogenic edema or intravascular volume overload		
Radiologic features	Bilateral infiltrates on chest X-ray or CT or **lung ultrasound (by a trained professional)** (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%**		

Am J Respir Crit Care Med 2023;207:A6229

2023 ESICM Practice Guidelines

- For intubated patients with ARDS
  - Use low tidal volume ventilation (ie, 4-8 mL/kg predicted body weight) vs larger tidal volumes to reduce mortality (strong recommendation; high level of evidence)
  - Do not use prolonged high-pressure recruitment maneuvers (strong recommendation; moderate level of evidence) or brief high-pressure recruitment maneuvers (weak recommendation; high level of evidence)
- For intubated patients with moderate to severe ARDS
  - Use prone position to reduce mortality (strong recommendation; high level of evidence)
  - Do not routinely use continuous infusions of neuromuscular blockade to reduce mortality (strong recommendation; moderate level of evidence)
  - Refer patients who meet criteria for ECMO (extracorporeal membrane oxygenation) to ECMO centers (strong recommendation; moderate evidence)

Grasselli G, et al ESICM guidelines on acute respiratory distress syndrome: definition, phenotyping and respiratory support strategies. *Intensive Care Med*. Published online June 16, 2023.doi:10.1007/s00134-023-07050-7



Duggal A, et al. Intensive Care Med 50, 1133–1136 (2024). https://doi.org/10.1007/s00134-024-07412-9
Papazian L, et al. Ann Intensive Care, 2019;9:69

Physiologic Benefits to Prone Position

Better dependent aeration → recruit's alveoli via transpulmonary pressure changes

Less hyperinflation in nondependent lung regions → more homogenous distribution

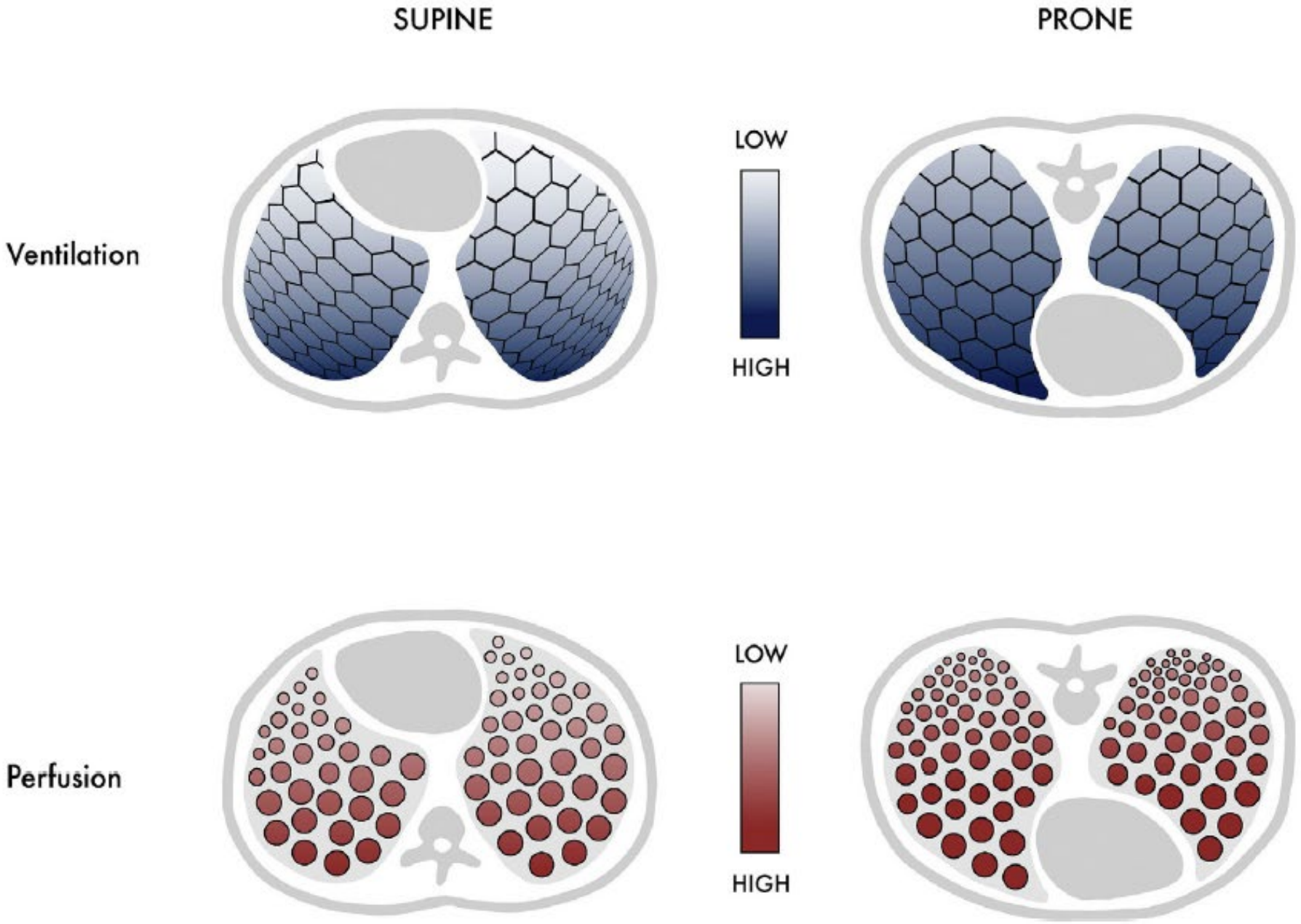
More homogenous aeration → reduces shear strain → less VILI

Lower barotrauma/atelectrauma with optimal PEEP

↓ $PaCO_2$ from increased recruitment & reduced dead space

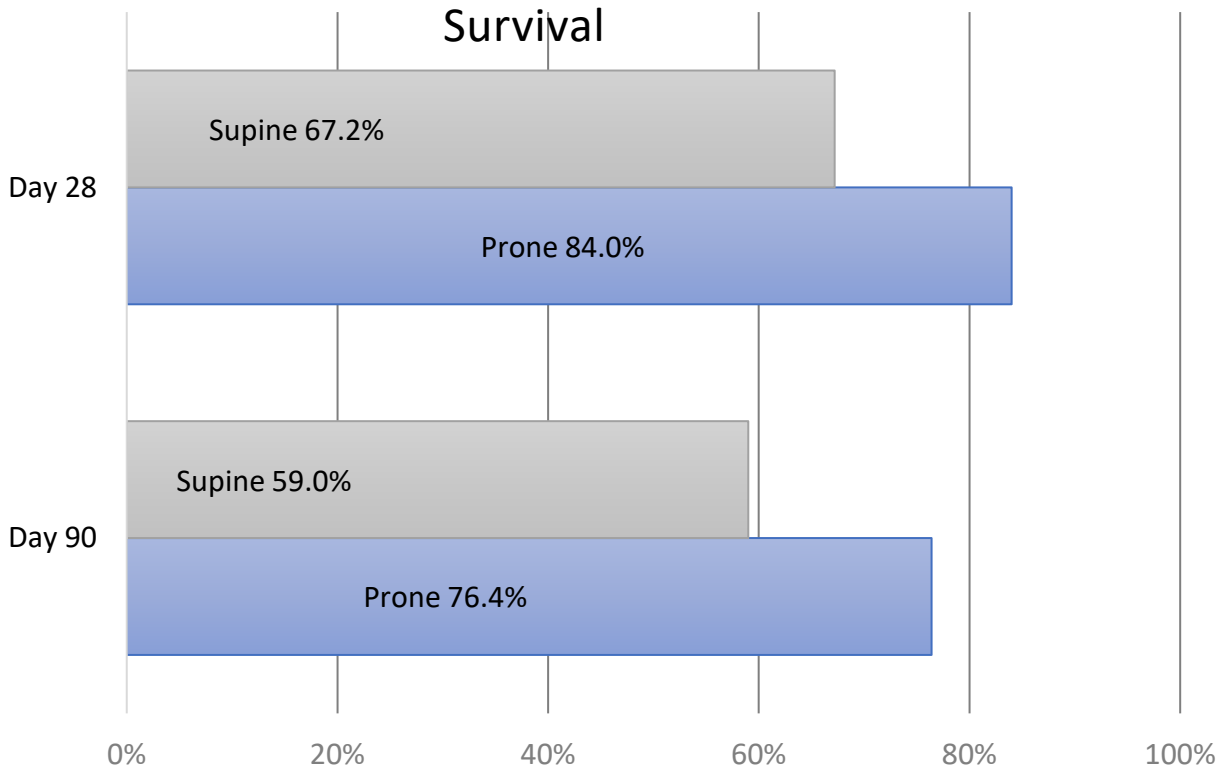
Enhanced secretion drainage

Rampon GL, et al Chest. 2023;163(2):332-340.
Scholten EL, et al. Chest. 2017;151(1):215-224
Gattinoni J, et al. Semin Resp Crit Care Med, 2019;40:94-100.



Rampon GL, Simpson SQ, Agrawal R. Prone Positioning for Acute Hypoxemic Respiratory Failure and ARDS: A Review. Chest. 2023;163(2):332-340. doi:10.1016/j.chest.2022.09.020

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

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Guerin C, et al. *N Engl J Med*. 2013368(23):2159-2168.

Prone Positioning Meta-Analysis

OUTCOMES	DECREASED 30-DAY MORTALITY	REDUCED 60-DAY AND 90-DAY MORTALITY	REDUCED 28-30-DAY MORTALITY
Studies	**9 randomized controlled trials/2,242 patients**	**9 randomized controlled trials/2,242 patients**	8 randomized controlled trials / 2,129 patients
PATIENT POPULATION	ARDS patients with a PaO_2/FiO_2 ratio ≤100 mmHg (n = 508, risk ratio (RR) = 0.71, 95 confidence interval (CI) = 0.57 to 0.89; P = 0.003). Hu SL, et al. *Crit Care*. 2014;18(3):R109.	ARDS patients ventilated with PEEP ≥10 cmH_2O (60 day n = 518, RR = 0.82, 95% CI = 0.68 to 0.99; P = 0.04) and 90-day mortality (n = 516, RR = 0.57, 95% CI = 0.43 to 0.75; P < 0.0001) Hu SL, et al. *Crit Care*. 2014;18(3):R109.	ARDS patients who had duration of proning >12 hours per day (n = 1,067, RR = 0.73, 95% CI = 0.54 to 0.99; P = 0.04) Munshi L Ann Am Thorac Soc 2017;14(4)

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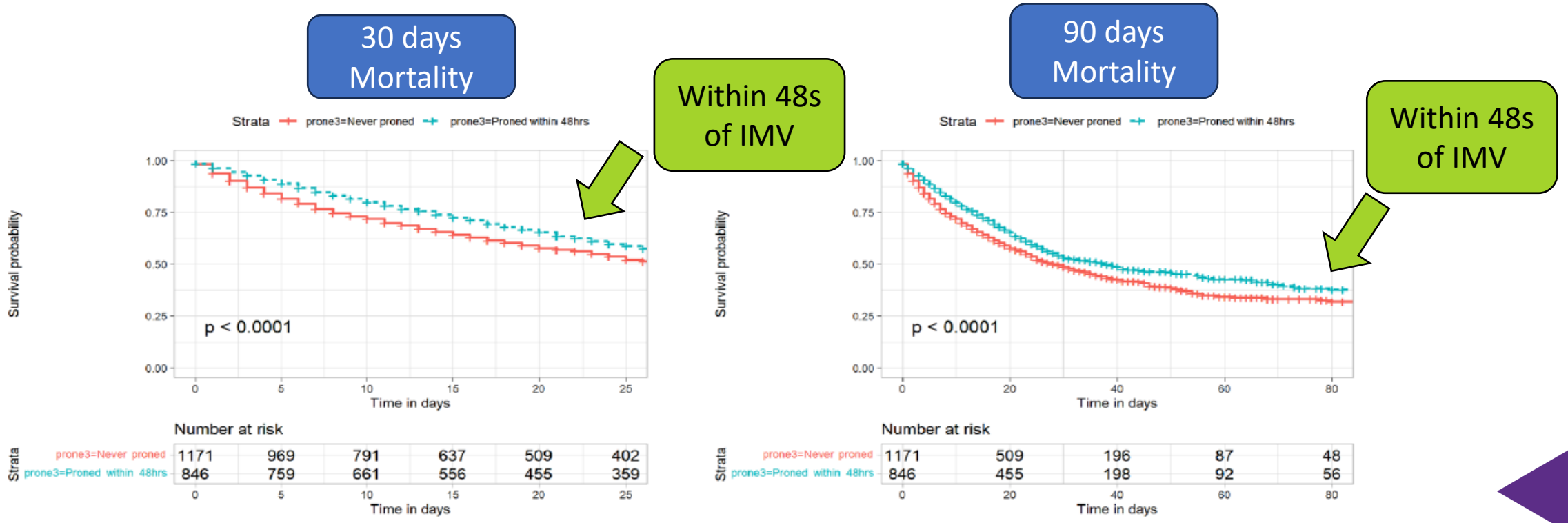
Early vs. Late Prone in Mechanically Ventilated COVID 19 patients with ARDS

- Prospective COVID-19 critical care consortium cohort study
- 3131 patients (1482 (47%) never proned, 1034 (33%) proned within 48hrs, 614 (20%) never proned



Simpkin AJ, et al. Ann Intensive Care. 2025 Feb 10;15(1):22

ESICM ARDS 2023 Guidelines Update

- We **recommend** using prone position as compared to supine position for patients with moderate-severe ARDS (defined as PaO2/FiO2 < 150 mmHg and PEEP ≥ 5 cmH2O, despite optimization of ventilation settings) to reduce mortality. (*Strong recommendation, high level of evidence in favor)*
  - ARDS
  - COVID ARDS

Grasselli, G., Calfee, C.S., Camporota, L. *et al.* ESICM guidelines on acute respiratory distress syndrome: definition, phenotyping and respiratory support strategies. *Intensive Care Med* **49**, 727–759 (2023).

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.

Grasselli, G., et al. Intensive Care Med 49, 727–759 (2023).

Who to Place in Prone Position?

We **recommend** starting prone position in patients with ARDS receiving invasive mechanical ventilation early after intubation

After a period of stabilization during which low tidal volume is applied and PEEP adjusted

At the end of which the PaO_2/FiO_2 remains < 150 mmHg

Proning should be applied for prolonged sessions (16 consecutive hours or more) to reduce mortality.

Strong recommendation; high level of evidence in favor

Grasselli, G., et al. Intensive Care Med 49, 727–759 (2023).

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)

Guérin C, et al. Intensive care medicine, 2020; 46(12), 2385–2396.

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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

Guérin C, et al. Intensive care medicine, 2020; 46(12), 2385–2396.

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
4. Patients with pelvic fractures
5. Patients with external fixators
6. Patients with multiple traumatic injuries
7. Patients with use of extracorporeal membrane oxygenation (ECMO)
8. Patients with continuous renal replacement therapy (CRRT)

Patients with morbid obesity

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Mitchell DA, et al. AACN Advanced Critical Care, 2018;29(4):415-425

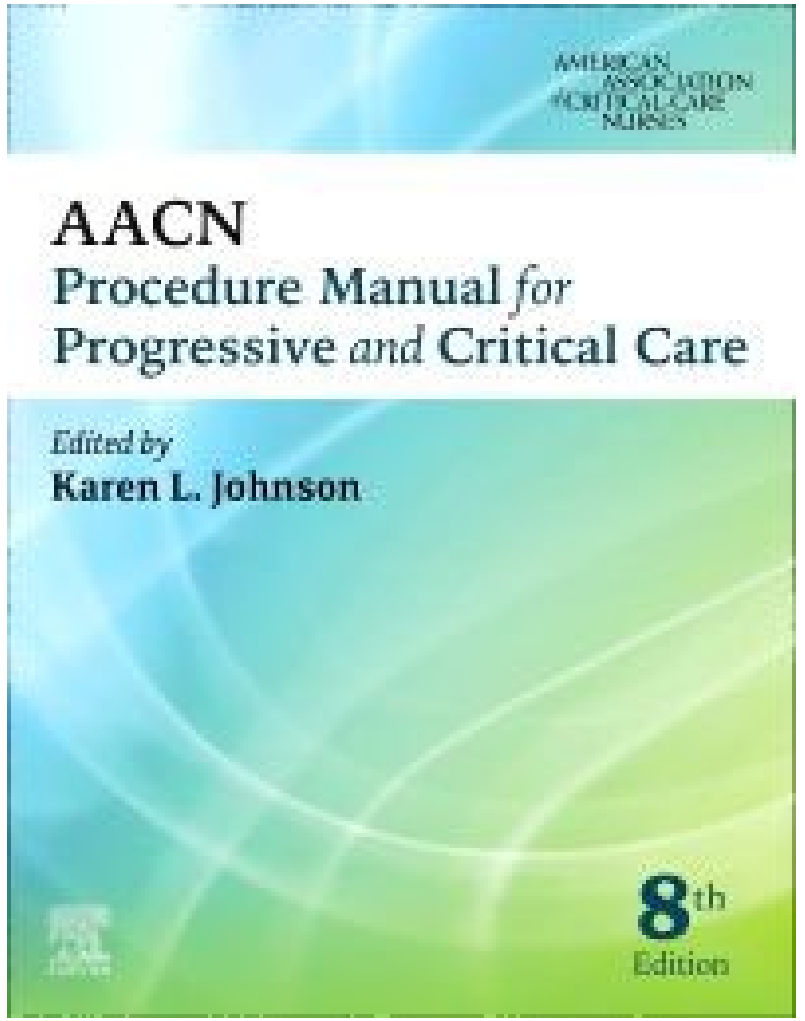
Pre-Prone Position Process[1-4]

- 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, Mitchell DA. AACN Procedural Manual, Procedure 15;2024143-156
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.

AACN Procedural Manual-8th ed

- Procedure 15 Authors
  - Kathleen Vollman
  - Dannette Mitchell



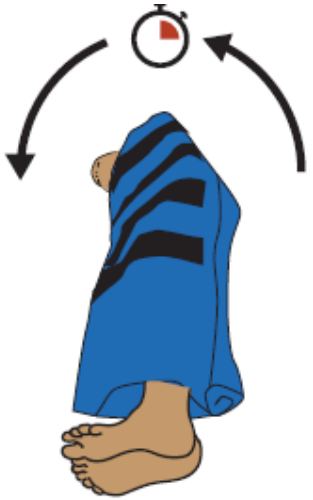
Manual Proning

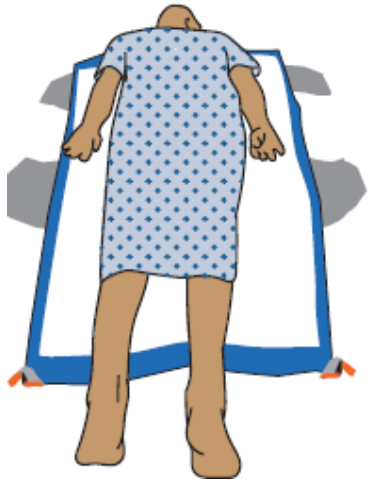
Mayo© 2017

Mayo© 2017

Prone Positioning with Positioning Sheet Using the Burrito Method

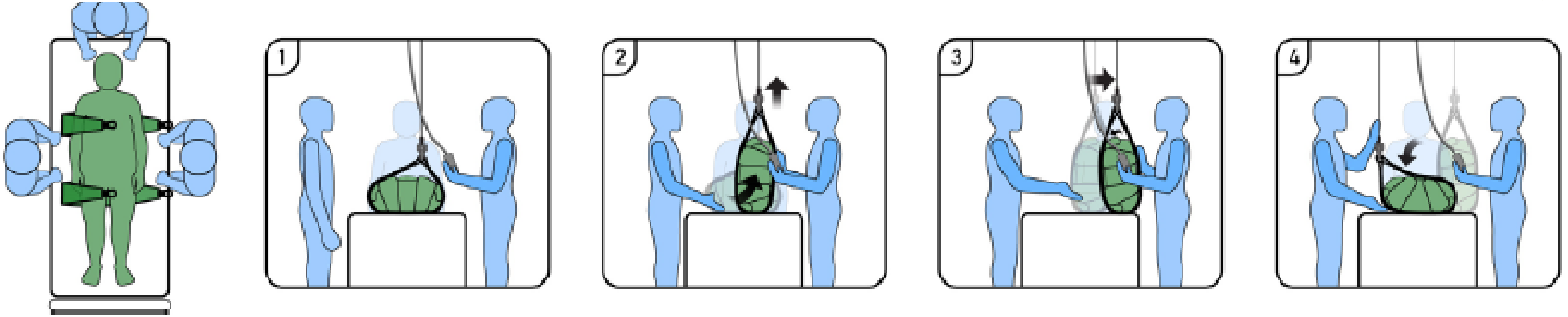
Disposable Slide Sheets





Chest and/or pelvic support can be done by placing a pillow/wedge before completing the turn.

Lift Assisted Prone Positioning



Wiggermann N, et al. Human Factors 2020 Nov;62(7):1069-1076.

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

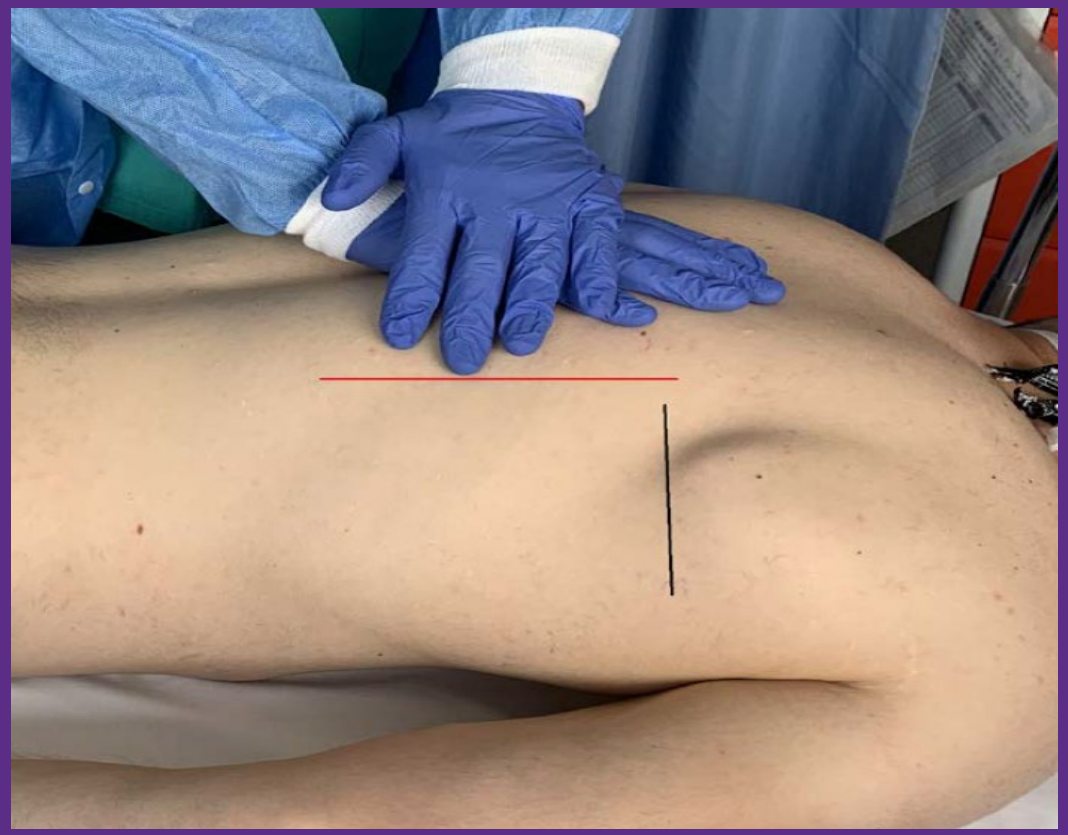
Consider time periods in reverse Trendelenburg to address facial edema and reduce risk of vomiting

Frequent oral hygiene and suctioning and eye care as needed

1. Vollman KM, Mitchell DA. AACN Procedural Manual, Procedure 15;2024143-156
2. Mitchell DA, et al. AACN Advanced Critical Care, 2018;29(4):415-425

CPR In the Prone Position

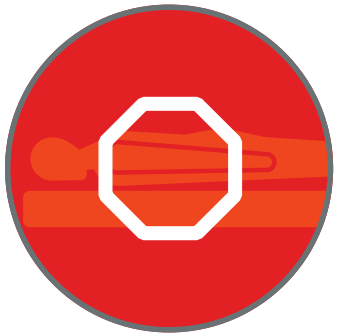
- AHA guidance
  - If patient has advanced airway consider initiating prone CPR until team can safely turn supine
  - Hand placement T7-T10
  - If unable to transition patient o supine & defib is required
    - Pads in anterior and posterior position



Anez C, et. al *Anesth Analg*. 2021;132(2):285-292.

Atkins et al.; 2022 Guidance for BLS/ACLS in COVID-19 Patients

When to Stop Prone Positioning?



Research supports stopping prone positioning when PaO_2/FiO_2 has remained >150 mmHg 4 hours after supinating (with PEEP <10 cm H_2O and FiO_2 <0.6)

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

Scholten EL, et al. *Chest*. 2017;151(1):215-224.

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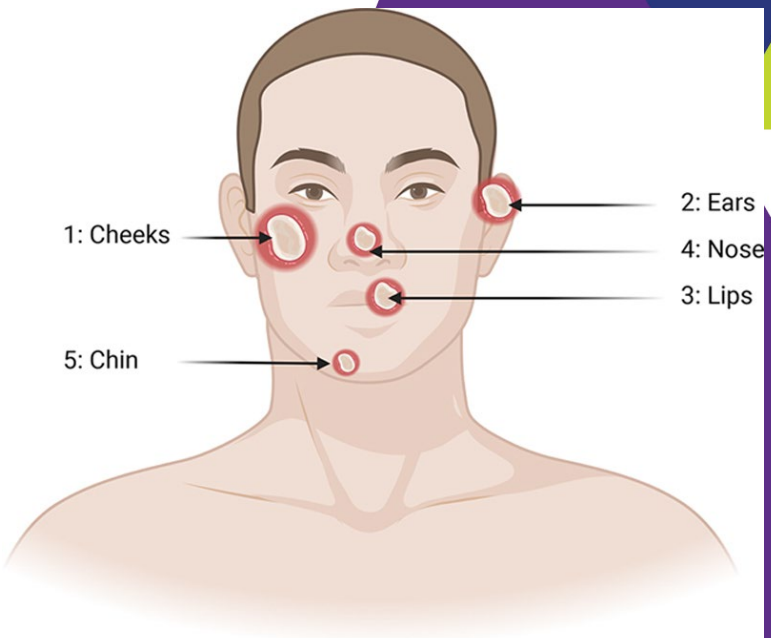
RISK
MITIGATION

Pressure Injuries in Prone Positioning

- 10 systematic reviews synthesized
- 15,979 adult patients
- Cumulative incidence of PI: 25.7% to 48.5%
- 1 study included locations
  - Face, chest, iliac crest and knees
- Targeted interventions needed

Critical Care cumulative incidence of PI: 6.6% to 12.2%

Chaboyer WP, et al. Crit Care Med 2018;46:

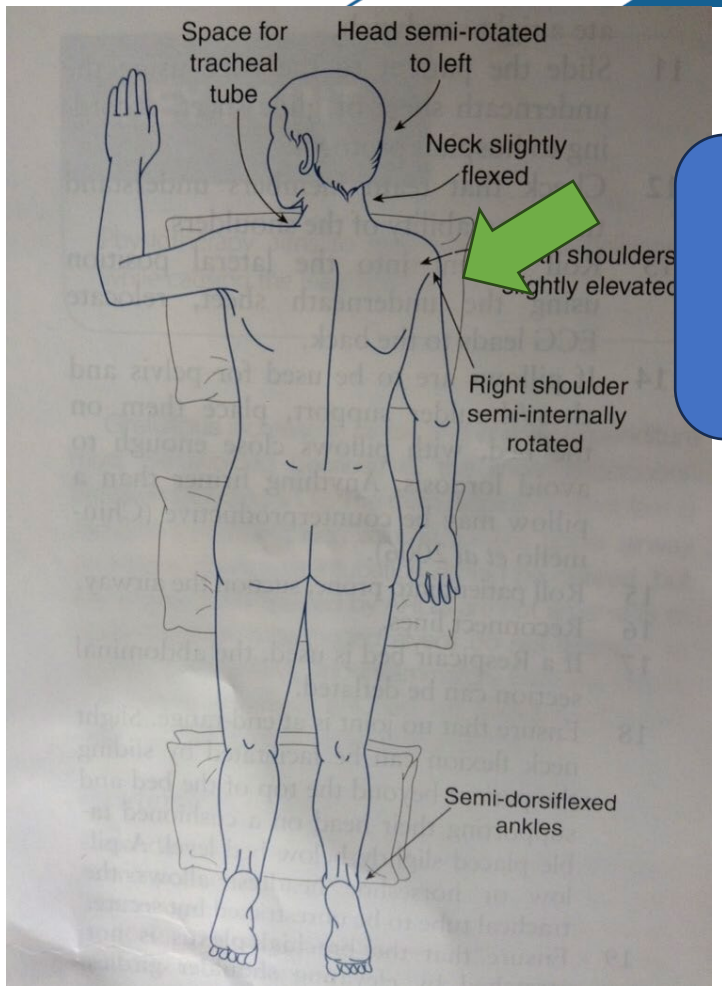


T, et al. *Plast Reconstr Surg Glob Open. 2022;10*(10):e4610.

Patton D, et al. Aust Crit Care. 2022;35(6):714-722.

Global Prevention Recommendations

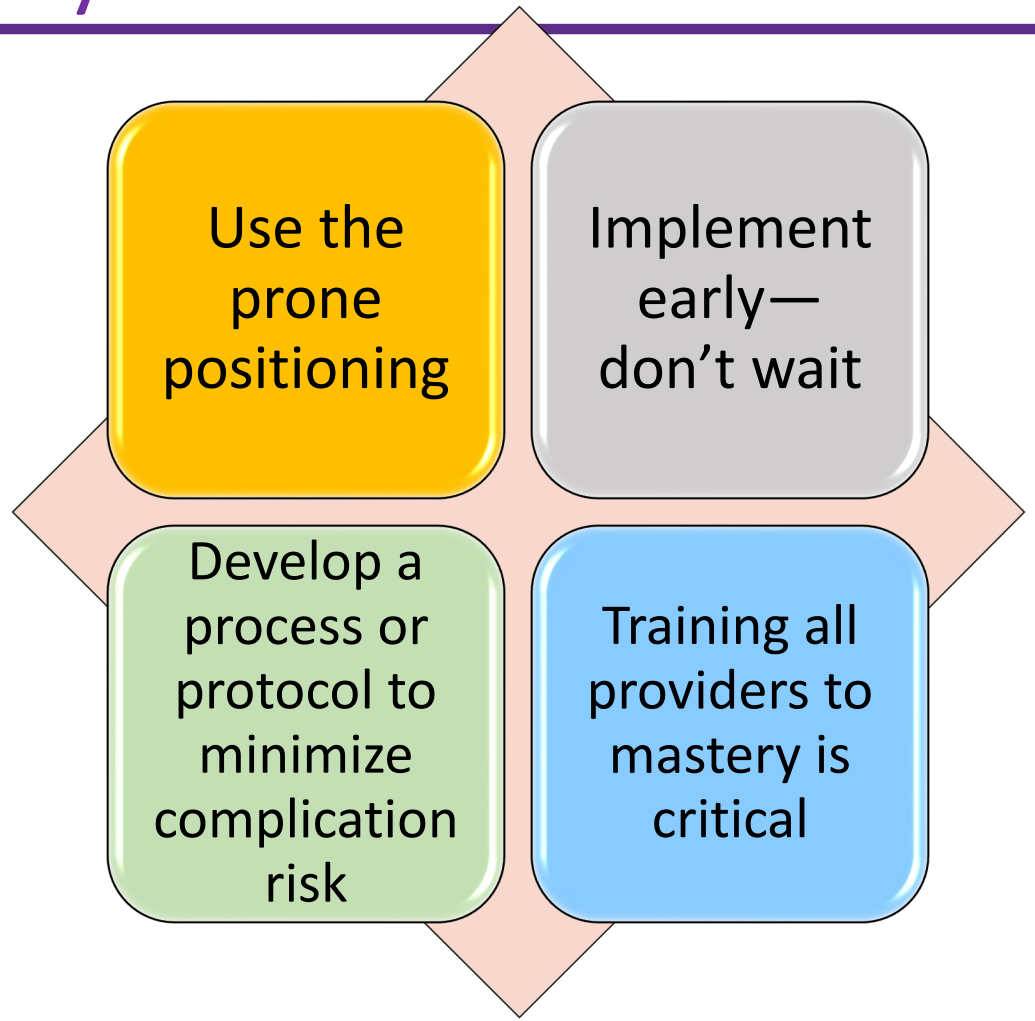
- Assess skin before, during and after prone position
- Redistribution surface
- Placement of prophylactic dressings over all potential pressure injury risk areas (Prone kit)
- Protect and secure the airway with tape or twill ties to minimize risk of pressure injuries
- Avoid shear and friction during the turning process
- Small micro turns while prone/swimmer position shifts q 2-4 hrs
- Eye care



Preventing Brachial & Ulnar Nerve issues

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

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


Jay '91
"HAPPY TURNING"