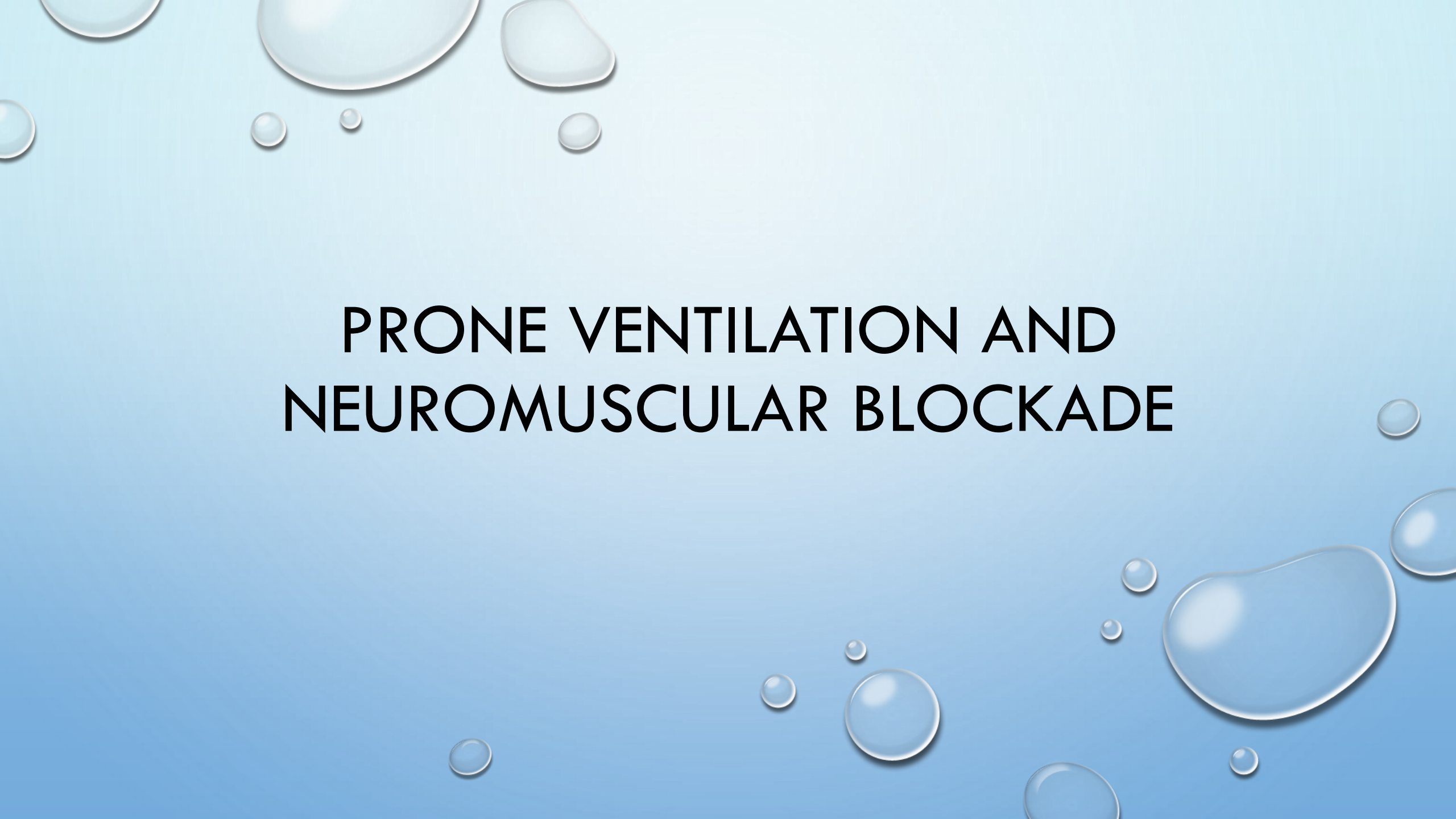
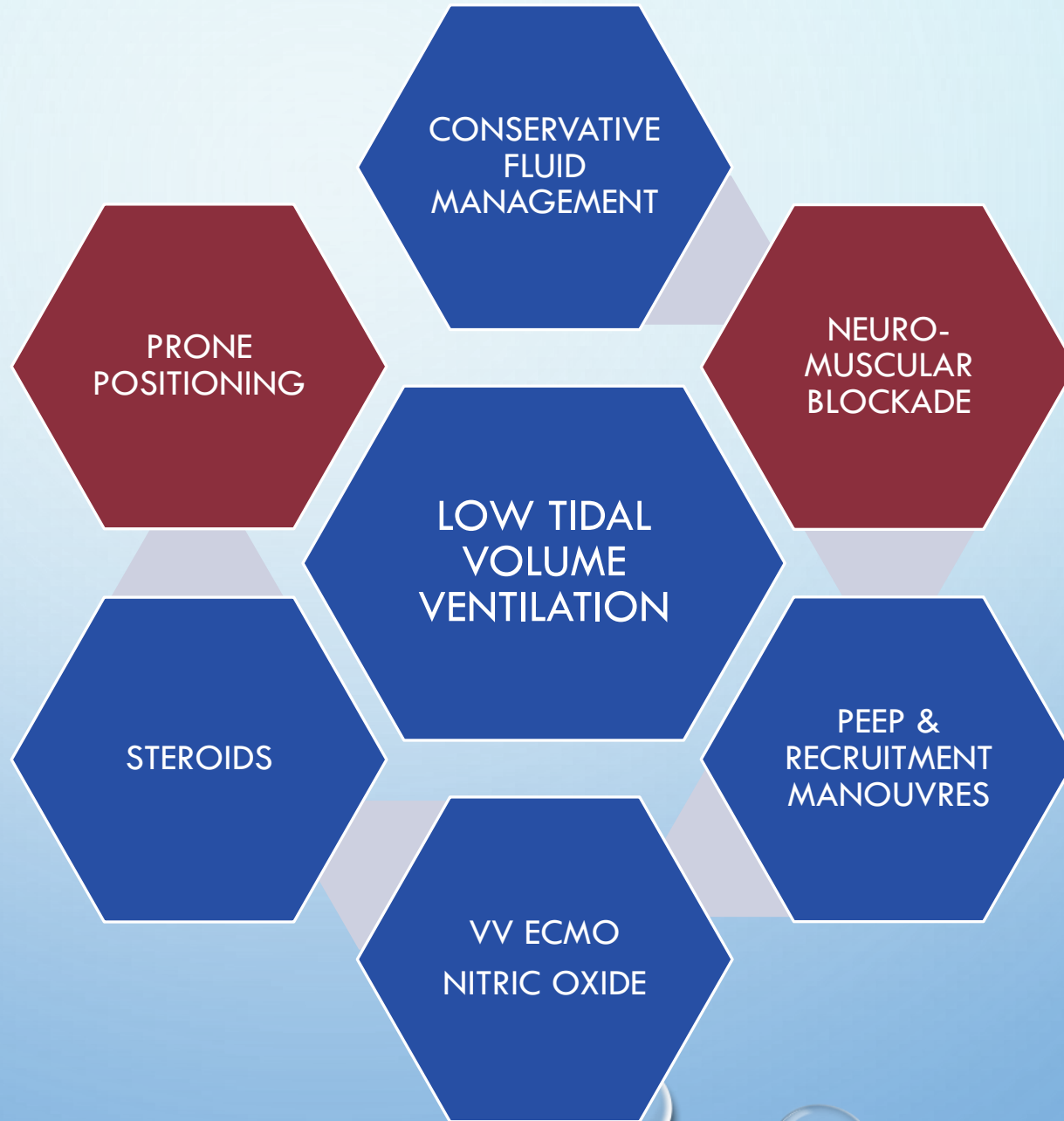


The background is a light blue gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a 3D appearance. They are located in the top-left, top-center, and bottom-right areas of the slide.

PRONE VENTILATION AND NEUROMUSCULAR BLOCKADE

SUPPORTIVE MANAGEMENT FOR ARDS



PRONE POSITIONING IN ARDS

Reduces dorsal-ventral TPP difference

Improves VQ mismatch

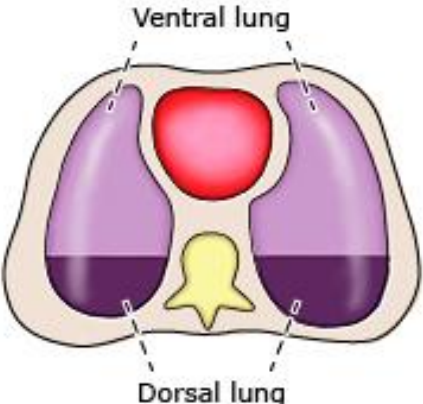
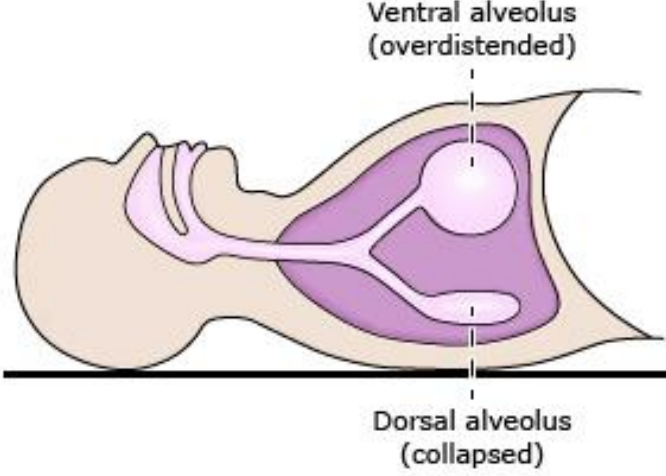
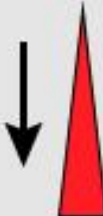
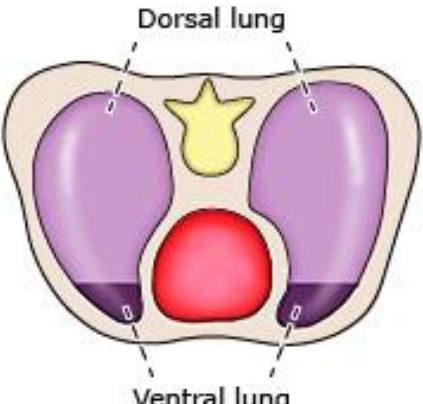
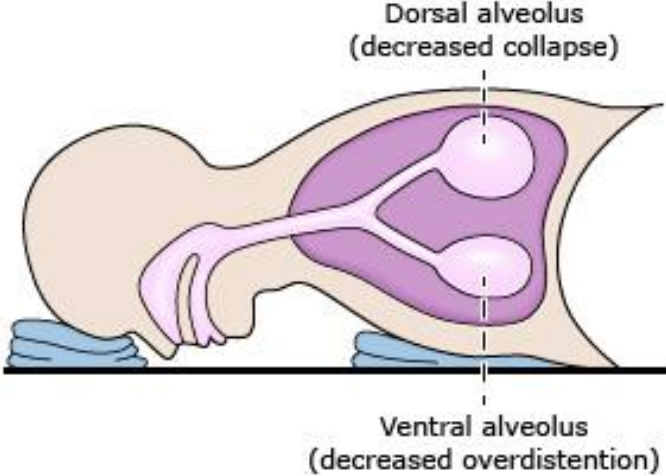
Reduces lung compression by abdominal & mediastinal organs

Improves drainage of respiratory secretions

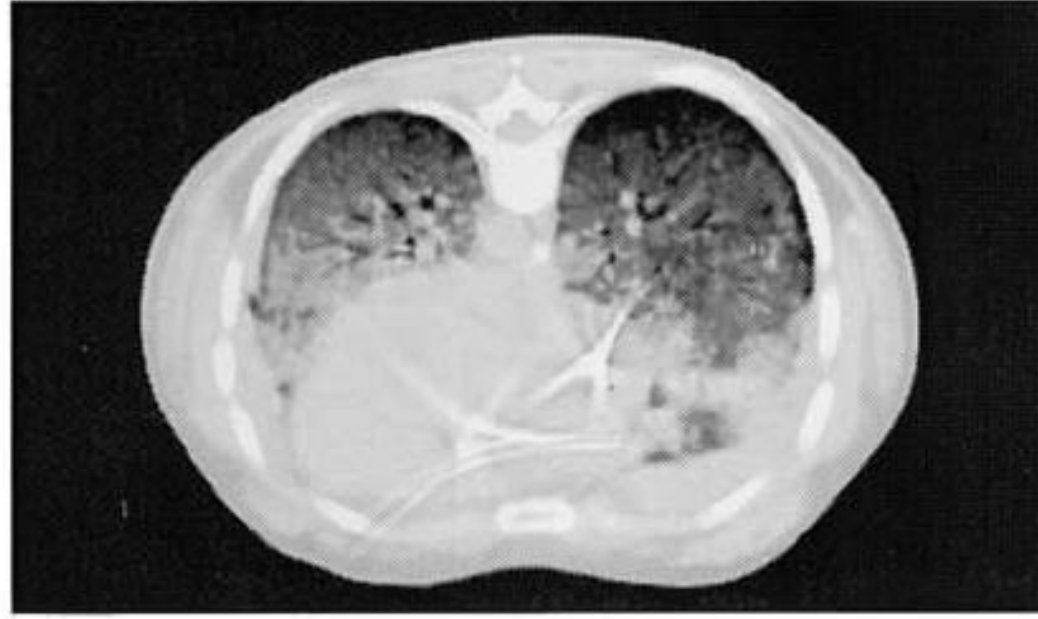
ALVEOLAR RECRUITMENT

MORE HOMOGENOUS
VENTILATION - REDUCES
VENTILATOR INDUCED
LUNG INJURY

IMPROVES V/Q
MATCHING AS DORSAL
LUNG (WHICH RECEIVES
GREATER PERFUSION) IS
BETTER VENTILATED

	PTP	Blood flow
Supine position		
		+++ --- 
Prone position		
		+ - 

Prone



Supine



COMPLICATIONS

- AIRWAY / LINE / DRAIN DISLODGE
 - PRESSURE AREAS
 - RAISED INTRAABDOMINAL / INTRACRANIAL PRESSURE
 - FEED INTOLERANCE
 - OCULAR COMPLICATIONS
-
- CONTRAINDICATED IN – OPEN ABDOMEN / CHEST, SPINAL INSTABILITY

ORIGINAL ARTICLE

Effect of Prone Positioning on the Survival of Patients with Acute Respiratory Failure

Luciano Gattinoni, M.D., Gianni Tognoni, M.D., Antonio Pesenti, M.D., Paolo Taccone, M.D., Daniele Mascheroni, M.D., Violeta Labarta, M.S., Roberto Malacrida, M.D., Paola Di Giulio, R.N., M.S.C., Roberto Fumagalli, M.D., Paolo Pelosi, M.D., Luca Brazzi, M.D., and Roberto Latini, M.D. for the Prone–Supine Study Group*

Article

Figures/Media

August 23, 2001

N Engl J Med 2001; 345:568-573

GATTINONI, NEJM 2001

- PROSPECTIVE ITALIAN MRCT
- 304 PATIENTS WITH ARDS WITH $P:F < 200$ ON PEEP 5, OR $P:F < 300$ ON PEEP 10
- PRONE FOR 6 HOURS / DAY FOR 10 DAYS
- NO SIG DIFFERENCE IN 10-DAY MORTALITY, ICU MORTALITY, OR 6 MONTH MORTALITY
- IMPROVED $P:F$ RATIO IN PRONE GROUP
- 10-DAY MORTALITY LOWER IN PRONE GROUP IN QUARTILE WITH LOWEST $P:F$ (<88)

Caring for the Critically Ill Patient

November 17, 2004

Effects of Systematic Prone Positioning in Hypoxemic Acute Respiratory Failure A Randomized Controlled Trial

Claude Guerin, MD; Sandrine Gaillard, MD; Stephane Lemasson, MD; et al

» [Author Affiliations](#) | [Article Information](#)

JAMA. 2004;292(19):2379-2387. doi:10.1001/jama.292.19.2379

GUERIN, JAMA 2004

- PROSPECTIVE FRENCH MRCT
- 791 PATIENTS WITH ARDS $P:F < 300$
- PRONE FOR AT LEAST 8 HOURS / DAY VS SUPINE
- NO DIFFERENCE IN 28 DAY MORTALITY (32.4% VS 31.5%)
- LESS VENTILATOR ASSOCIATED PNEUMONIA, IMPROVED P:F RATIO IN PRONE GROUP
- MORE ETT OBSTRUCTION, SELECTIVE INTUBATION, AND PRESSURE SORES IN PRONE GROUP

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Prone Positioning in Severe Acute Respiratory Distress Syndrome

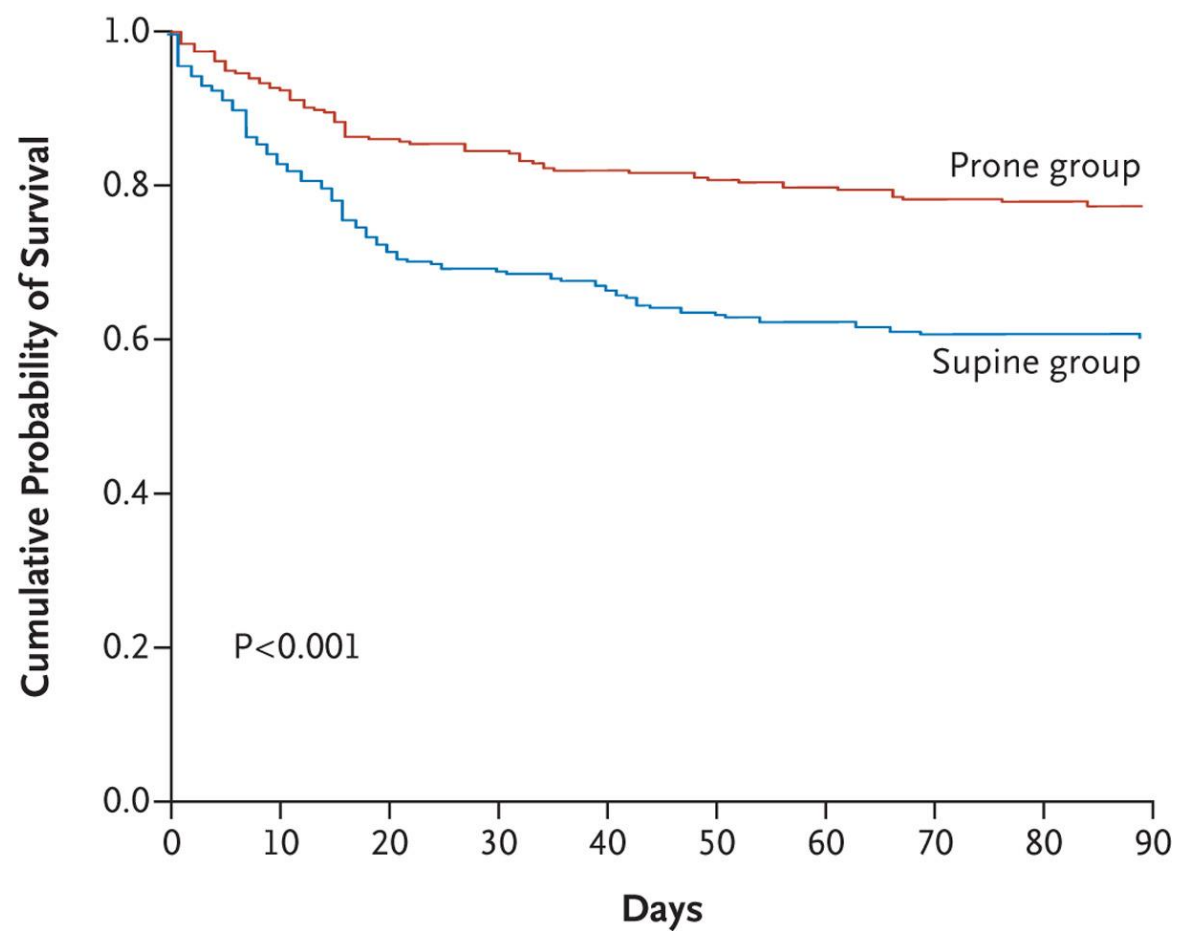
Claude Guérin, M.D., Ph.D., Jean Reignier, M.D., Ph.D., Jean-Christophe Richard, M.D., Ph.D., Pascal Beuret, M.D.,
Arnaud Gacouin, M.D., Thierry Boulain, M.D., Emmanuelle Mercier, M.D., Michel Badet, M.D.,
Alain Mercat, M.D., Ph.D., Olivier Baudin, M.D., Marc Clavel, M.D., Delphine Chatellier, M.D., Samir Jaber, M.D., Ph.D.,
Sylvène Rosselli, M.D., Jordi Mancebo, M.D., Ph.D., Michel Sirodot, M.D., Gilles Hilbert, M.D., Ph.D.,
Christian Bengler, M.D., Jack Richecoeur, M.D., Marc Gainnier, M.D., Ph.D., Frédérique Bayle, M.D.,
Gael Bourdin, M.D., Véronique Leray, M.D., Raphaele Girard, M.D., Loredana Baboi, Ph.D., and Louis Ayzac, M.D.,
for the PROSEVA Study Group*

PROSEVA – GUERIN ET AL, NEJM 2013

- PROSPECTIVE FRENCH MRCT
- 26 CENTRES, EXPERIENCED IN PRONING
- 466 PATIENTS WITH SEVERE ARDS, $P:F < 150$ ($FIO_2 > 0.6$, $PEEP > 5$)
- RANDOMISED 12-24 HOURS AFTER MV
- 16 HOUR PRONING SESSION
- 28-DAY MORTALITY SIGNIFICANTLY LOWER IN PRONE GROUP 16% VS 32% ($P < 0.001$)

Table 3. Primary and Secondary Outcomes According to Study Group.*

Outcome	Supine Group (N = 229)	Prone Group (N = 237)	Hazard Ratio or Odds Ratio with the Prone Position (95% CI)	P Value
Mortality — no. (% [95% CI])				
At day 28				
Not adjusted	75 (32.8 [26.4–38.6])	38 (16.0 [11.3–20.7])	0.39 (0.25–0.63)	<0.001
Adjusted for SOFA score†			0.42 (0.26–0.66)	<0.001
At day 90				
Not adjusted	94 (41.0 [34.6–47.4])	56 (23.6 [18.2–29.0])	0.44 (0.29–0.67)	<0.001
Adjusted for SOFA score†			0.48 (0.32–0.72)	<0.001
Successful extubation at day 90 — no./total no. (% [95% CI])	145/223 (65.0 [58.7–71.3])	186/231 (80.5 [75.4–85.6])	0.45 (0.29–0.70)	<0.001
Time to successful extubation, assessed at day 90 — days				
Survivors	19±21	17±16		0.87
Nonsurvivors	16±11	18±14		
Length of ICU stay, assessed at day 90 — days				
Survivors	26±27	24±22		0.05
Nonsurvivors	18±15	21±20		
Ventilation-free days				
At day 28	10±10	14±9		<0.001
At day 90	43±38	57±34		<0.001



No. at Risk

Prone group	237	202	191	186	182
Supine group	229	163	150	139	136



Cochrane
Library

Cochrane Database of Systematic Reviews

Prone position for acute respiratory failure in adults (Review)

Bloomfield R, Noble DW, Sudlow A

Outcomes	Prone vs Supine	Risk ratio (95% CI)	No. of Participants	Grade of Evidence
Short term mortality (30 days)	35.7% vs 38.3%	RR 0.84 (0.69-1.02)	2117 (8 studies)	Low
Long term mortality (180 days)	42.0% vs 47.1%	RR 0.86 (0.72-1.03)	2140 (8 studies)	Low
<i>Subgroup analysis: long term mortality</i>				
Severe Hypoxemia	41.5 vs 54.7%	RR 0.77 (0.65-0.92)	977 (7 studies)	Moderate
ARDS only subgroup	41.3% vs 48.3%	RR 0.85 (0.71-1.01)	1758 (8 studies)	Moderate
>16 hours prone	36.1% vs 38.6%	RR 0.77 (0.61-0.99)	1005 (5 studies)	Moderate
Prone <48 hrs after MV	34.3% vs 46.9%	RR 0.75 (0.59-0.94)	1024 (5 studies)	Moderate

Review: Prone position for acute respiratory failure in adults
 Comparison: 1 Mortality
 Outcome: 1 Mortality

Study or subgroup	Prone group n/N	Supine group n/N	Risk Ratio M-H,Random,95% CI	Weight	Risk Ratio M-H,Random,95% CI
1 Short-term mortality					
Leal 1997	5/8	6/8		6.5 %	0.83 [0.43, 1.63]
Gattinoni 2001	77/152	73/152		18.7 %	1.05 [0.84, 1.32]
Guerin 2004	134/413	119/378		19.6 %	1.03 [0.84, 1.26]
Mancebo 2006	33/76	35/60		14.6 %	0.74 [0.53, 1.04]
Chan 2007	4/11	4/11		2.9 %	1.00 [0.33, 3.02]
Fernandez 2008	8/21	10/19		6.2 %	0.72 [0.36, 1.45]
Taccone 2009	64/168	73/174		17.4 %	0.91 [0.70, 1.18]
Guerin 2013	38/237	75/229		14.2 %	0.49 [0.35, 0.69]
Subtotal (95% CI)	1086	1031		100.0 %	0.84 [0.69, 1.02]

Total events: 363 (Prone group), 395 (Supine group)
 Heterogeneity: $\tau^2 = 0.04$; $\chi^2 = 17.29$, $df = 7$ ($P = 0.02$); $I^2 = 60\%$
 Test for overall effect: $Z = 1.74$ ($P = 0.081$)

2 Longer-term mortality					
Gattinoni 2001	96/152	90/152		20.3 %	1.07 [0.89, 1.28]
Guerin 2004	179/413	159/377		21.1 %	1.03 [0.87, 1.21]
Voggenreiter 2005	1/21	3/19		0.6 %	0.30 [0.03, 2.66]
Mancebo 2006	38/76	37/60		14.7 %	0.81 [0.60, 1.10]
Chan 2007	5/11	6/11		3.7 %	0.83 [0.36, 1.94]
Fernandez 2008	8/21	10/19		5.2 %	0.72 [0.36, 1.45]
Taccone 2009	79/168	91/174		18.6 %	0.90 [0.73, 1.11]
Guerin 2013	56/237	94/229		15.7 %	0.58 [0.44, 0.76]
Subtotal (95% CI)	1099	1041		100.0 %	0.86 [0.72, 1.03]

Total events: 462 (Prone group), 490 (Supine group)
 Heterogeneity: $\tau^2 = 0.03$; $\chi^2 = 18.05$, $df = 7$ ($P = 0.01$); $I^2 = 61\%$
 Test for overall effect: $Z = 1.67$ ($P = 0.095$)

0.01 0.1 1 10 100
 Favours prone Favours supine



NEUROMUSCULAR BLOCKADE IN ARDS

RATIONALE

- REDUCE VENTILATOR DYSSYNCHRONY
- ALLOW ADJUSTMENT OF VT / PPLAT
- REDUCE OXYGEN CONSUMPTION

RISKS

- ICU ACQUIRED WEAKNESS
- INCREASED SEDATION REQUIREMENT
- PTSD / POST ICU SYNDROME

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Neuromuscular Blockers in Early Acute Respiratory Distress Syndrome

Laurent Papazian, M.D., Ph.D., Jean-Marie Forel, M.D., Arnaud Gacouin, M.D., Christine Penot-Ragon, Pharm.D., Gilles Perrin, M.D., Anderson Loundou, Ph.D., Samir Jaber, M.D., Ph.D., Jean-Michel Arnal, M.D., Didier Perez, M.D., Jean-Marie Seghboyen, M.D., Jean-Michel Constantin, M.D., Ph.D., Pierre Courant, M.D., Jean-Yves Lefrant, M.D., Ph.D., Claude Guérin, M.D., Ph.D., Gwenaél Prat, M.D., Sophie Morange, M.D., and Antoine Roch, M.D., Ph.D.,
for the ACURASYS Study Investigators*

ACURASYS - PAPAZIAN ET AL, NEJM 2010

- PROSPECTIVE BLINDED FRENCH MRCT
- 340 PATIENTS WITH SEVERE ARDS, P:F <150, ONSET WITHIN 48 HRS
- CISATRACURIUM INFUSION FOR 48 HRS VS PLACEBO
- HAZARD RATIO FOR 90-DAY MORTALITY IN CISATRACURIUM GROUP: 0.68 (95% CI 0.48-0.98) P=0.04
- ACTUAL 90 DAY MORTALITY 31.6% (CISATRACURIUM) VS 40.7% (PLACEBO) P=0.08
- CISATRACURIUM GROUP HAD MORE VENTILATOR FREE DAYS AND ICU FREE DAYS
- PLACEBO GROUP HAD MORE PNEUMOTHORAX (7 VS 19 P=0.01) AND BAROTRAUMA (9 VS 19 P=0.03)
- NO DIFFERENCE IN ICU-ACQUIRED PARESIS

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Early Neuromuscular Blockade in the Acute Respiratory
Distress Syndrome

The National Heart, Lung, and Blood Institute PETAL Clinical Trials Network*

ROSE: NEJM 2019

- PROSPECTIVE MRCT USA
- ENROLLED 1006 PATIENTS WITH MOD-SEVERE ARDS (P:F < 150), ONSET WITHIN 48 HOURS
- 48 HOURS OF CONTINUOUS NMB VS USUAL CARE WITH LIGHTER SEDATION TARGETS
- PLANNED FOR 1408 PTS FOR 90% POWER, ASSUMING 27% (INTERVENTION) VS 35% (CONTROL) MORTALITY – STOPPED AT SECOND INTERIM ANALYSIS FOR FUTILITY
- 90 DAY MORTALITY WAS 42.5% IN INTERVENTION GROUP VS 42.8% IN CONTROL GROUP
- NO DIFFERENCE IN SECONDARY END POINTS (VENTILATOR FREE DAYS / ICU FREE DAYS / SOFA SCORES / BAROTRAUMA)
- NO DIFFERENCE IN ADVERSE EVENTS OR ICU ACQUIRED WEAKNESS

COMPARING THE TWO...

ACURASYS 2010

ACURASYS	Intervention	Control
Prone position	50 (28%)	47 (29%)
Inhaled NO	50 (28%)	53 (33%)
PEEP (Day 1)	9.6 +/- 2.7	9.7 +/- 2.8
PEEP (Day 3)	8.3 +/- 2.9	8.8 +/- 3.2

ROSE 2019

ROSE	Intervention	Control
Prone position	84 (16.8%)	75 (14.9%)
Inhaled NO	4 (0.8%)	12 (2.4%)
PEEP (Day 1)	12.5 +/- 4.4	13.4 +/- 4.2
PEEP (Day 3)	10.3 +/- 4.4	10.7 +/- 4.6

WHY DOES POSITION MATTER?

- SUPINE + SPONTANEOUS RESPIRATION
 - DIAPHRAGM DISPLACES DORSALLY
 - IMPROVES VENTILATION IN DEPENDENT LUNG REGION (WHICH IS BETTER PERFUSED)
- SUPINE + PARALYSIS
 - FLACCID DIAPHRAGM – ATELECTASIS OF DORSAL LUNG
 - GAS PREFERENTIALLY DISTRIBUTES TO VENTRAL (NON-DEPENDENT) LUNG
 - VQ MISMATCH OCCURS BECAUSE PERFUSION IS GREATER IN DORSAL (DEPENDENT) LUNG
 - CAN BE IMPROVED BY PEEP

ACURASYS 2010

- HEAVY SEDATION IN BOTH GROUPS

	NMBA	Placebo
During the first 48 hours		
<i>Sufentanil equivalents (mg)</i>	1.9 [1.0-2.9]	1.9 [0.7-3.6]
<i>No. of patients</i>	177	162
<i>Midazolam (mg)</i>	432 [240-720]	480 [269-770]
<i>No. of patients</i>	157	140
<i>Ketamine(mg)</i>	11782 [4806-12000]	9600 [3840-12000]
<i>No. of patients</i>	28	38
<i>Propofol (mg)</i>	4800 [2925-9325]	4800 [1920-7800]
<i>No. of patients</i>	68	71
During the first 7 days		
<i>Sufentanil equivalents (mg)</i>	3.8 [1.8-9.7]	5.0 [1.7-10.0]
<i>No. of patients</i>	177	162
<i>Midazolam (mg)</i>	997 [459-2236]	1200 [657-2217]
<i>No. of patients</i>	157	140
<i>Ketamine (mg)</i>	28968 [12855-44125]	14220 [8125-31000]
<i>No. of patients</i>	28	38
<i>Propofol (mg)</i>	13575 [3380-22475]	9960 [2800-23450]
<i>No. of patients</i>	68	71

ROSE 2019

- LIGHT SEDATION IN CONTROL GROUP

