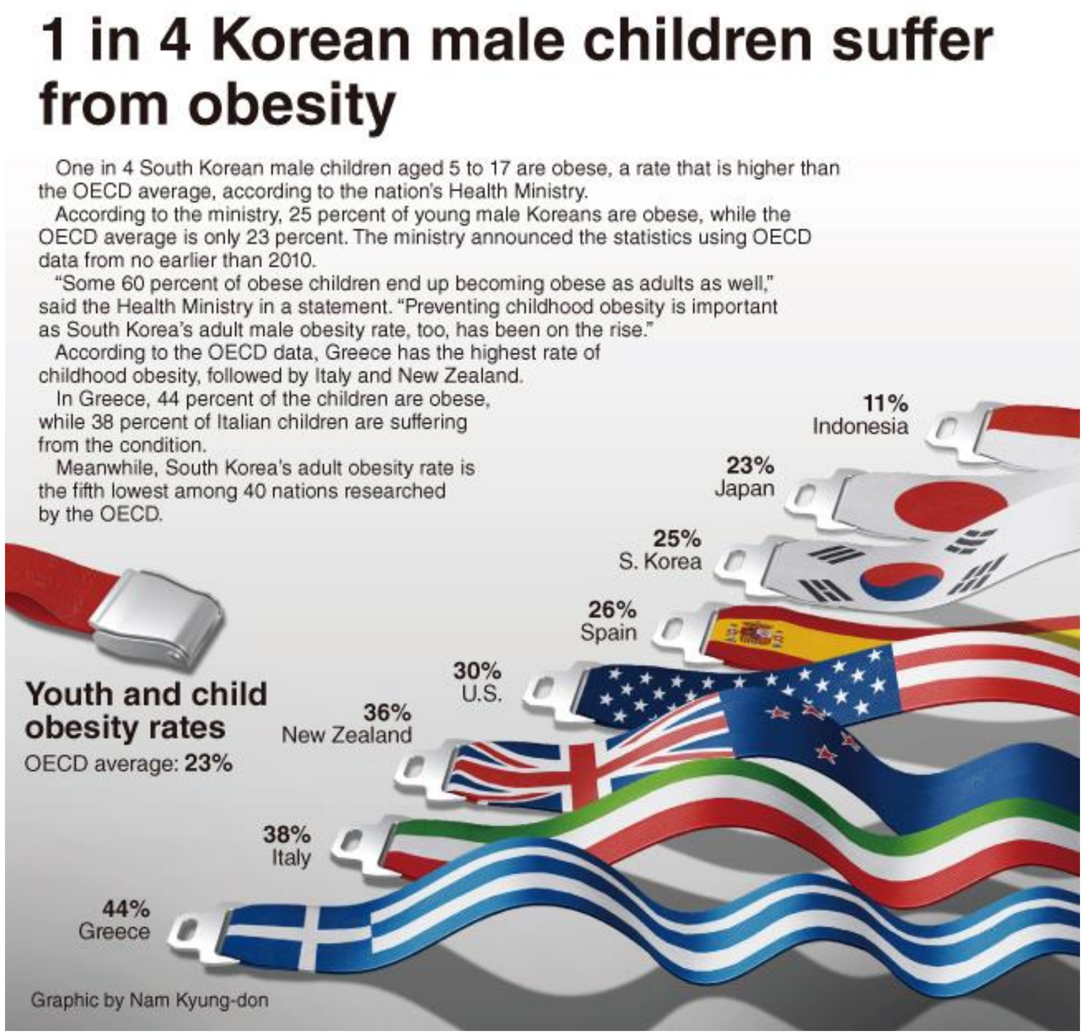
2022 KATRD 수면호흡장애 연구회 심포지엄
JUN 11, 2022

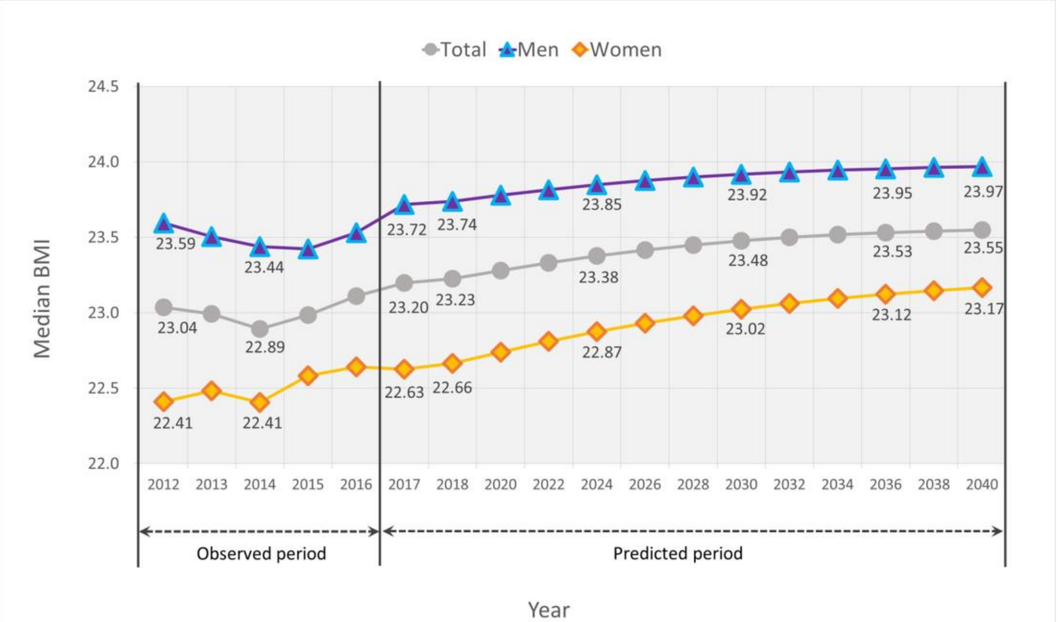
Managements of Obese patients with Respiratory failure

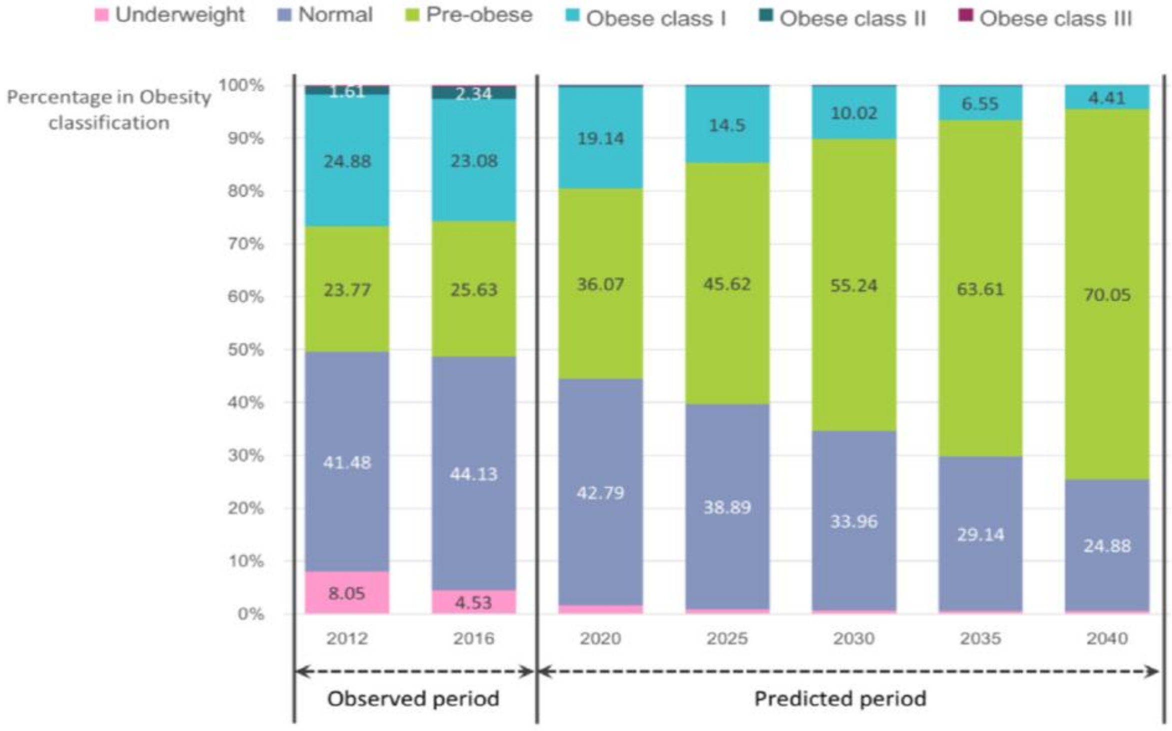
Young-Jae CHO, MD, MPH, PhD

Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, Seoul National University College of Medicine, Seoul National University Bundang Hospital

Obesity pandemic

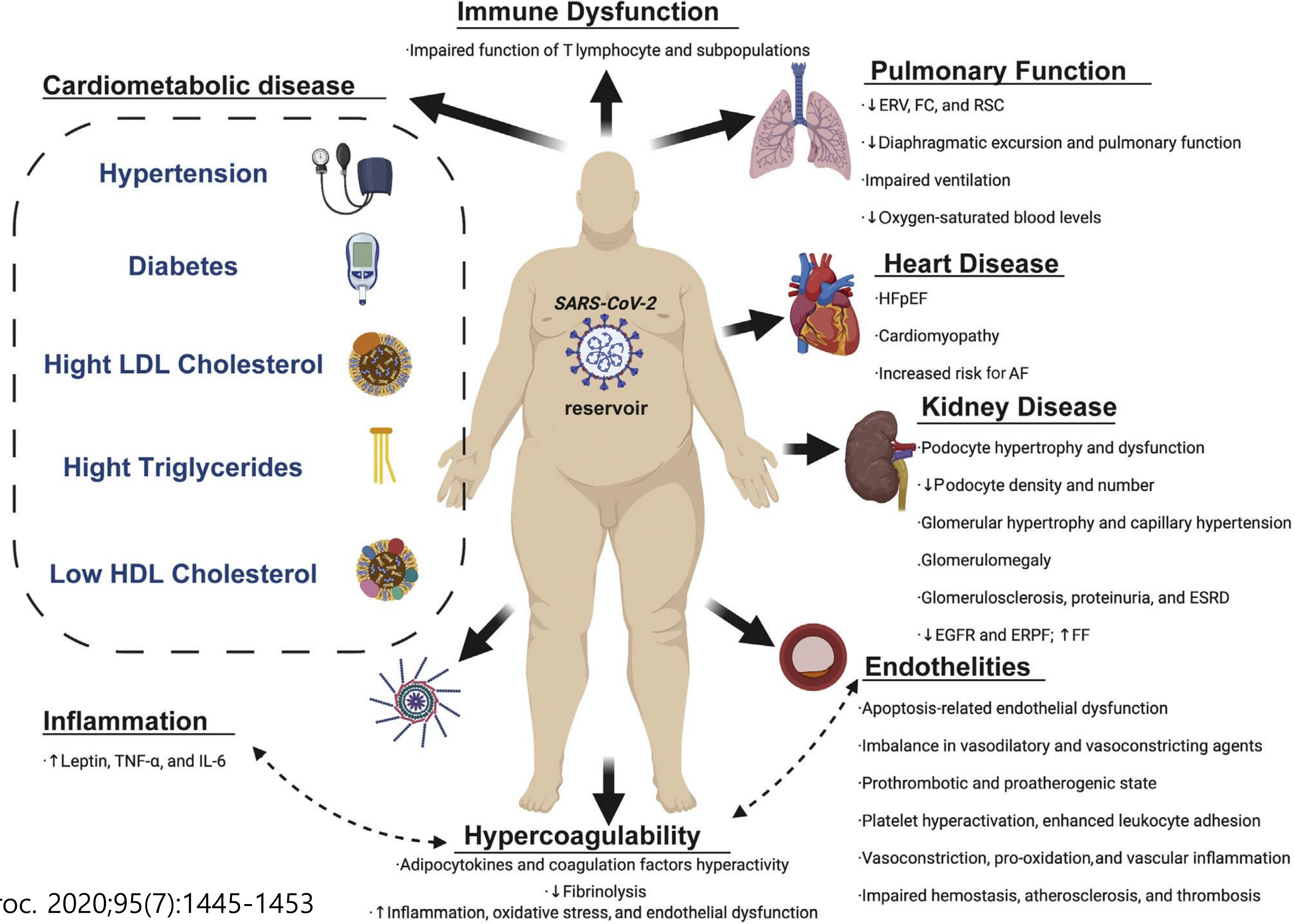






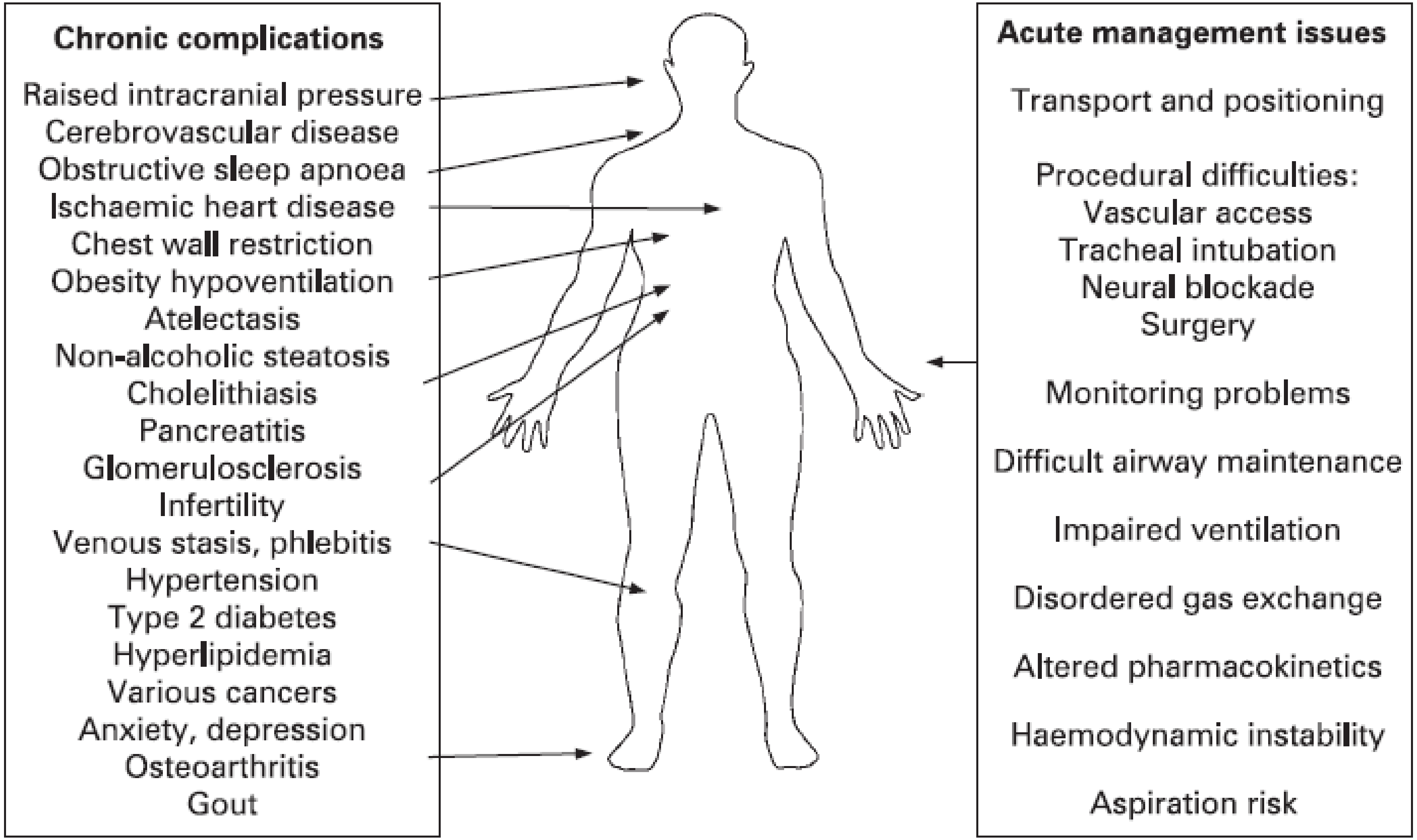
http://www.koreaherald.com/view.php?ud=20141012000167

BMJ Open 2020;10:e037629.



Mayo Clin Proc. 2020;95(7):1445-1453

Obesity-related complications



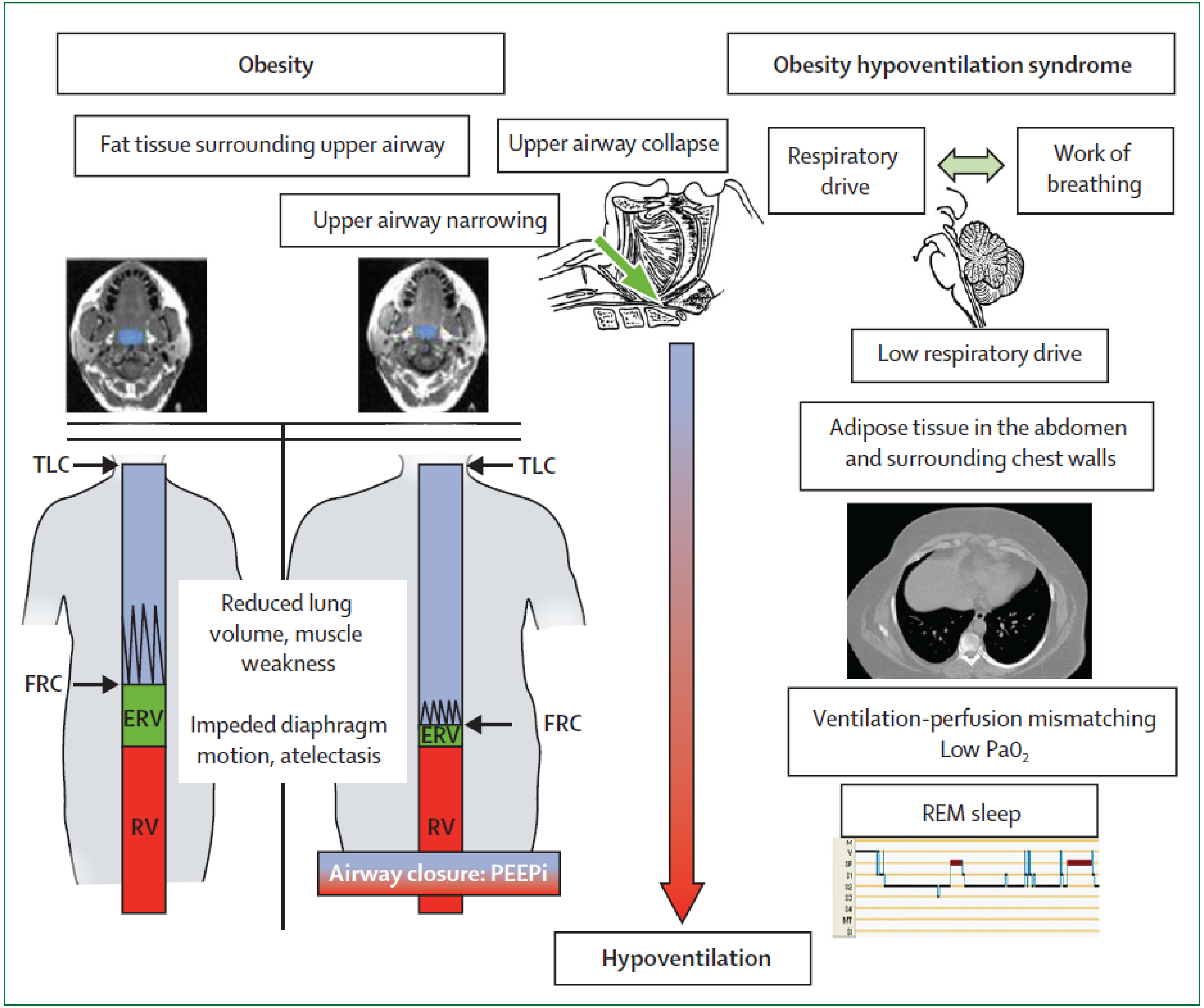
Thorax 2008;63:925–931

Pulmonary physiology in Obese patients

- Lung volumes and mechanics
  - Poor lung functions
- V/S mismatch
  - Dependent area
- Respiratory muscles
  - Easy to fatigue
- Central ventilatory drive
  - Aggravated hypoventilation during sleep in OHS

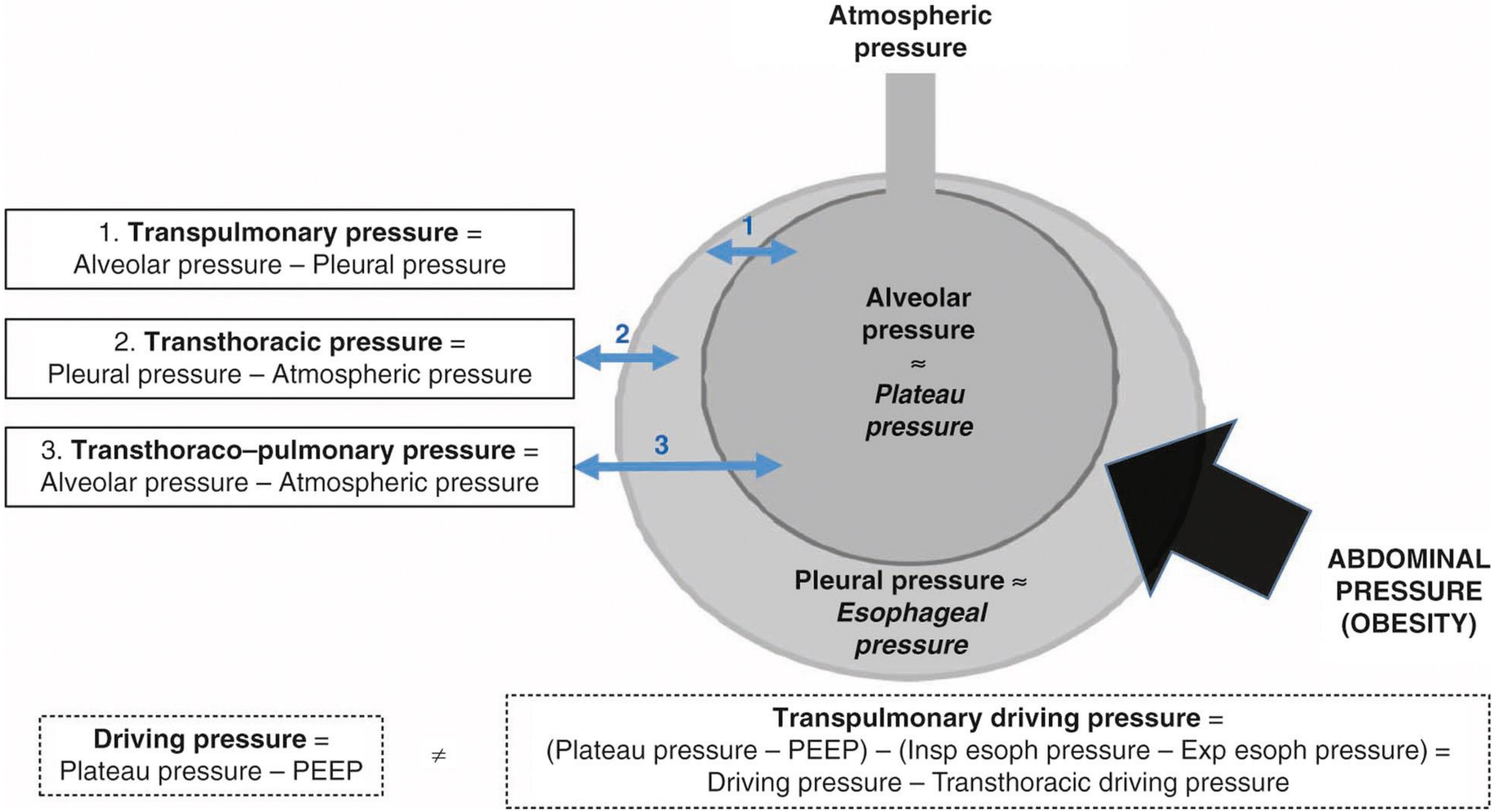
Respirology (2012) 17, 759구71

Altered physiology



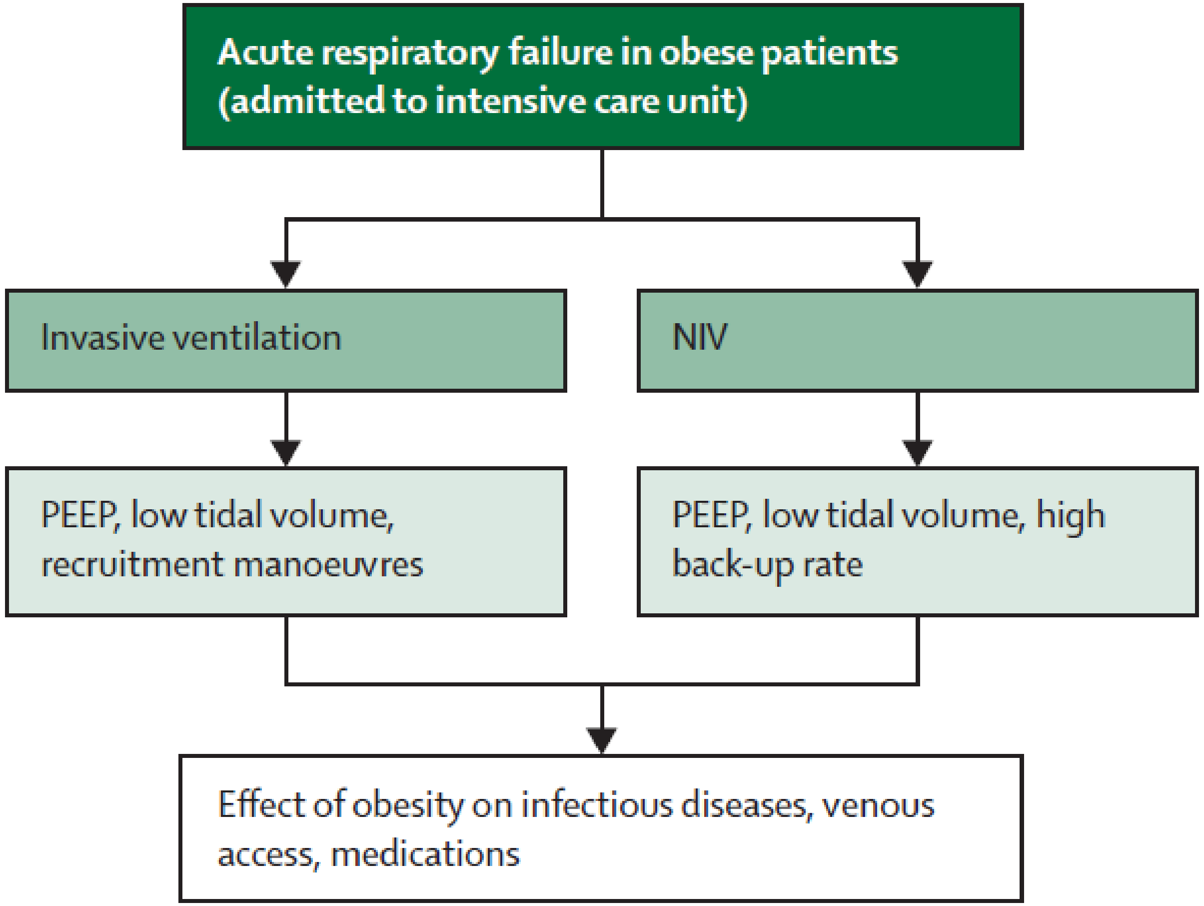
Lancet Respir Med 2016; 4: 407–18

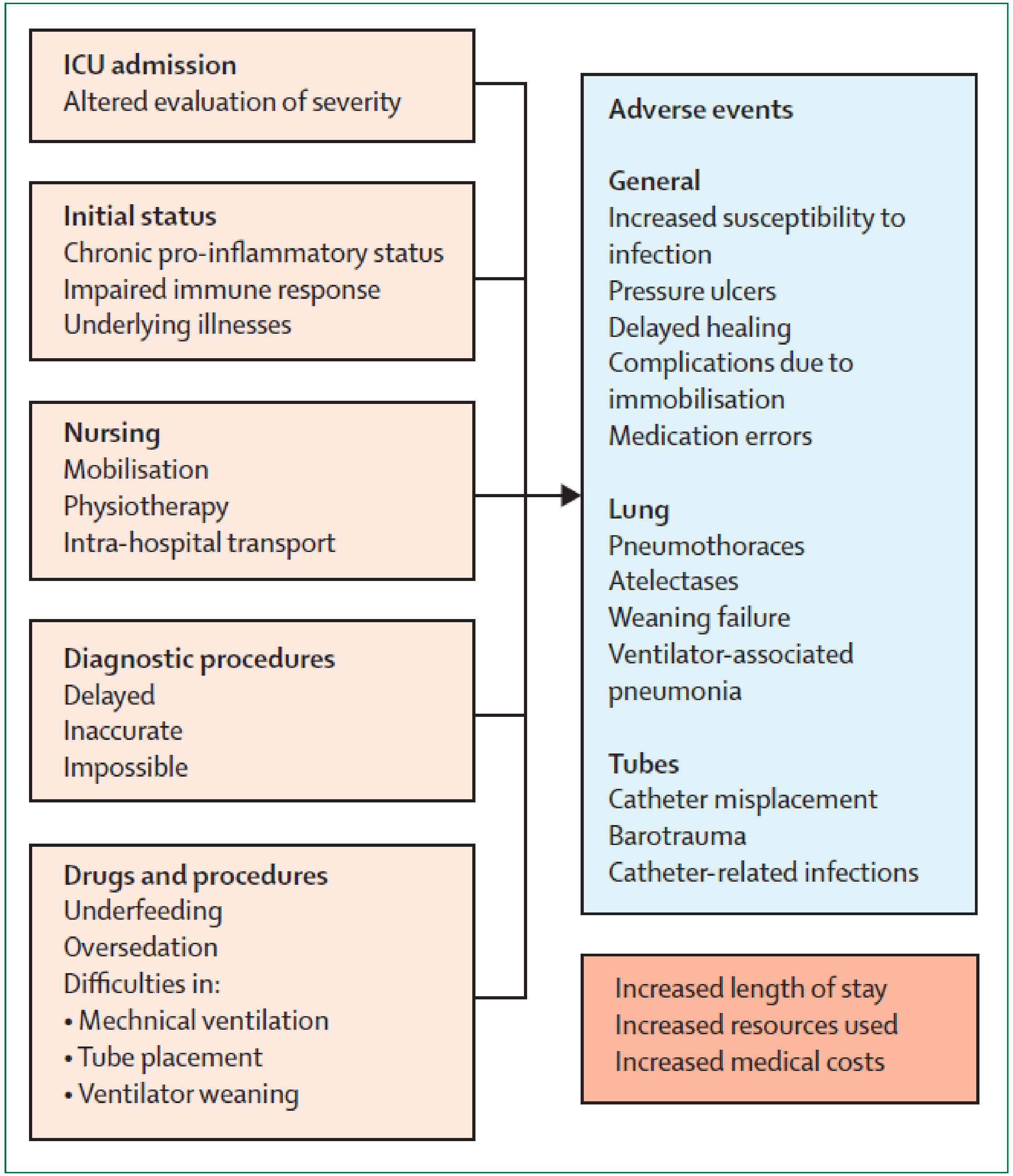
Driving, Transpulmonary and Transthoracic Pressures



Critical Care (2019) 23:74

Principles





Lancet Respir Med 2016; 4: 407–18

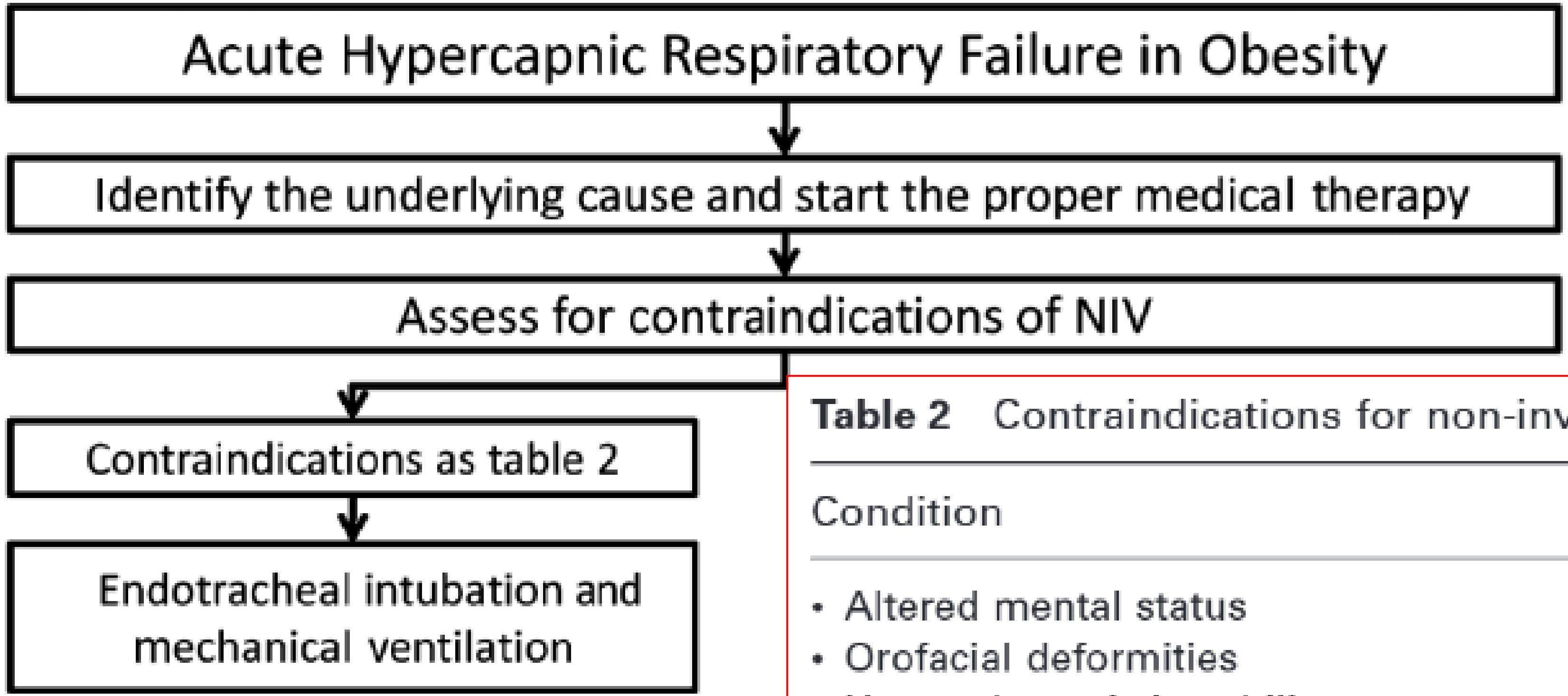


Table 2 Contraindications for non-invasive ventilation

Condition
• Altered mental status • Orofacial deformities • Haemodynamic instability • Uncooperative patient • Refractory hypoxaemia • Upper gastrointestinal bleeding • Inability to clear secretions • Large acute myocardial infarction • Uncontrolled arrhythmias • Claustrophobia • Severe abdominal distension • Acute stroke

Respirology (2012) 17, 759구71

Why NIV?

Table 3 Potential respiratory complications in morbidly obese patients in the intensive care unit

Respiratory problem
Sleep-disordered breathing[5]
Frequent respiratory failure[107]
Intubation/weaning difficulties and complications[48,75]
Increased risk of pneumonia[107]
Increased risk of acute lung injury/ARDS[46]
Higher rate of mechanical ventilation[76,108]
Prolonged duration of mechanical ventilation[109,110]

Respirology (2012) 17, 759구71

Start BPAP

EPAP

- Start with 4–6 cmH_2O
- Titrate pressure up by 1–2 cmH_2O to eliminate:
  - Snoring
  - Witnessed apnoeas
  - Paradoxical breathing
  - Dips in SaO_2

IPAP

- Start with 8–10 cmH_2O
- Titrate pressure up by 1–2 cmH_2O until:
  - Steady SaO_2 >90%
  - To achieve good alveolar ventilation, IPAP is usually kept 4–8 cmH_2O above EPAP

Monitor the following

Vital signs, level of consciousness, respiratory pattern, SaO_2, tidal volume, ABG

Add O_2, if the patient continues to desaturate (<90%) despite delivering high positive airway pressure

Use NIV during night and 6–8 h during daytime until daytime blood gases and pH are acceptable (pH>7.35). Then use at night.

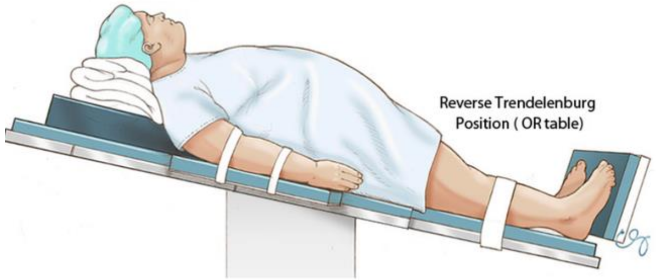
Consider intubation if the patient could not tolerate NIV or deterioration of clinical condition

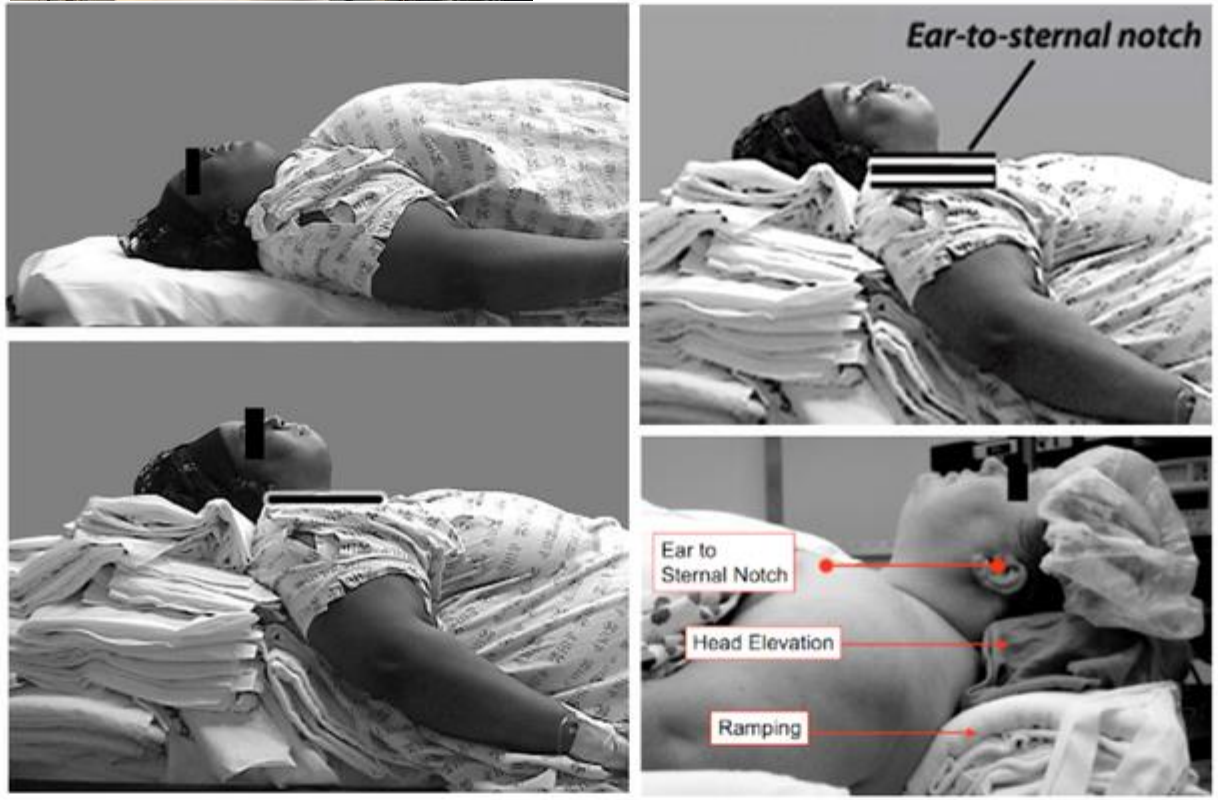
Respirology (2012) 17, 759-71

Airway management

- Difficult intubation
- Adequate pre-oxygenation

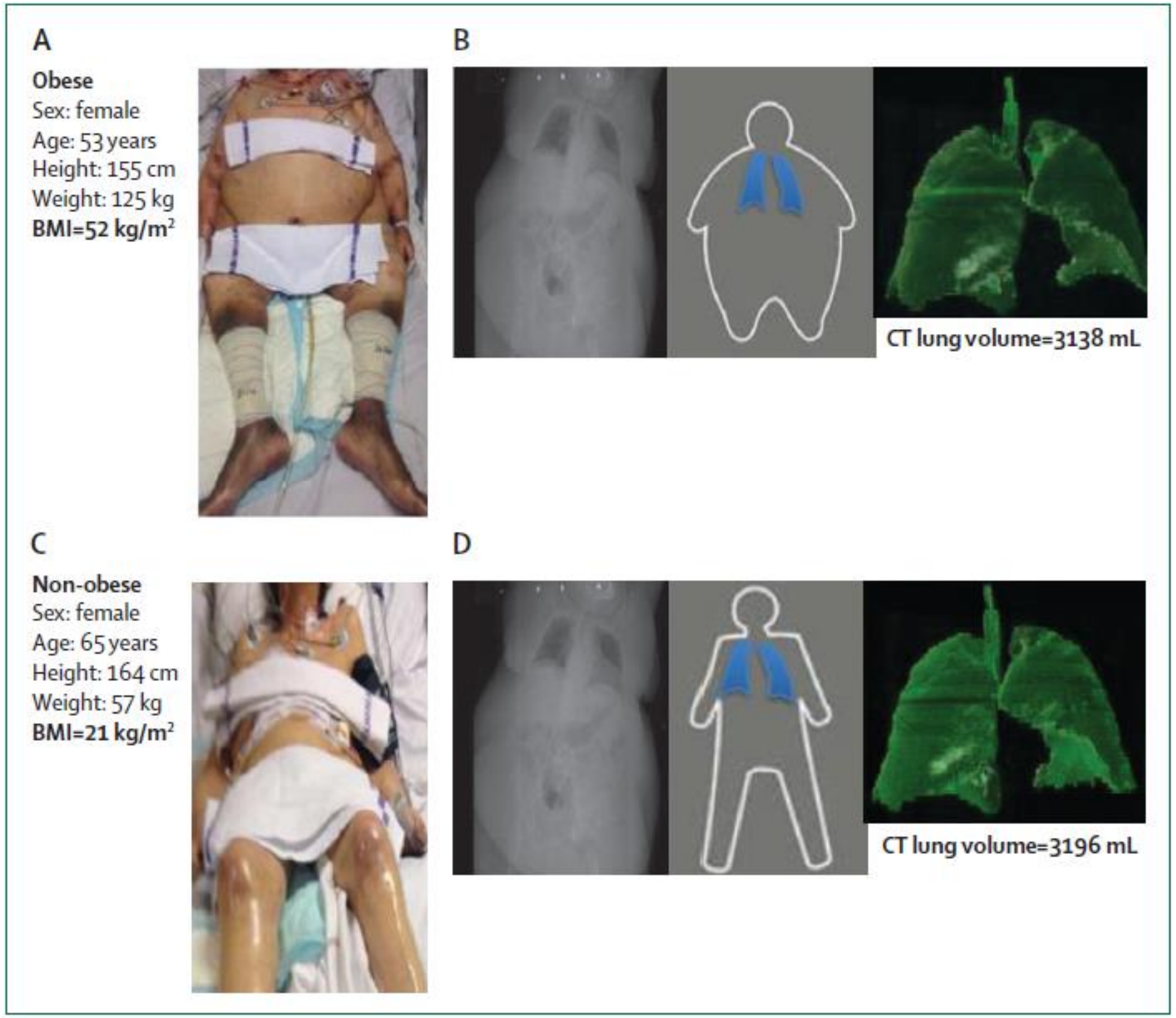
- Position!
  - Ramped position
  - Reverse Trendelenburg position
  - Ear-to-sternal notch in the horizontal line





Ventilator management: general

- Positioning
- PEEP settings
- Tidal volume
- Sedatives, Relaxants
- Tracheostomy
- Weaning



Respirology (2012) 17, 759-71; Lancet Respir Med 2016; 4: 407–18

Ventilator management: details

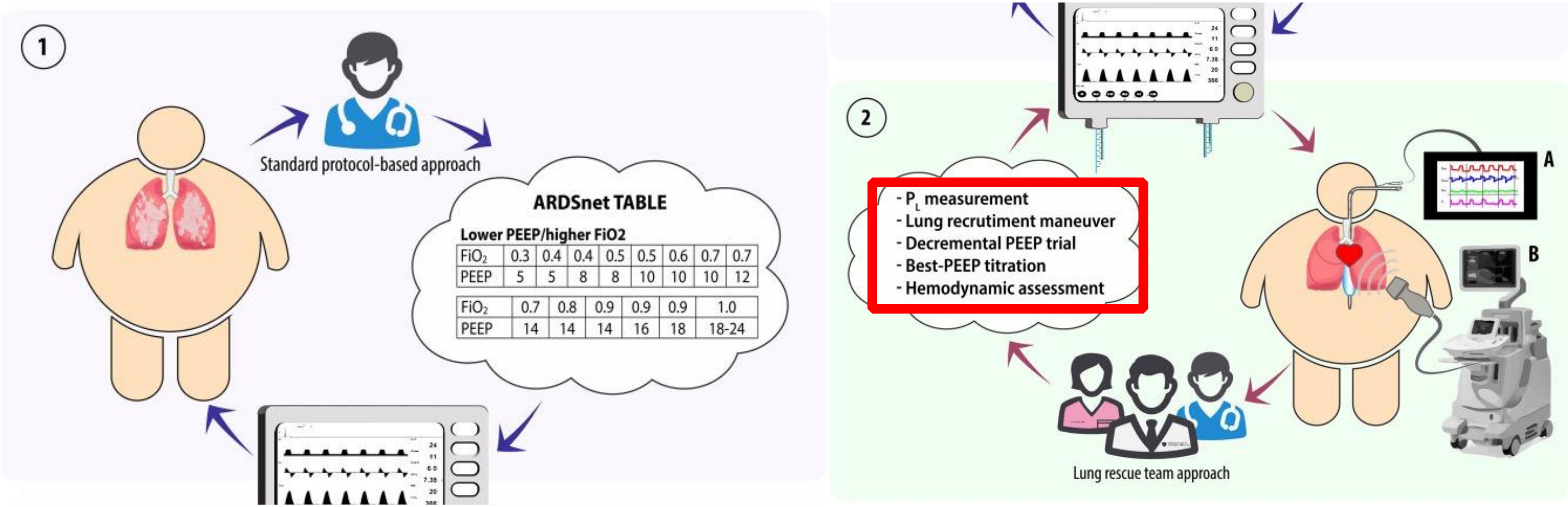
- No difference between Pressure and Volume Modes
- Low tidal volume (6 mL/kg based on ideal body weight)
- High positive end-expiratory pressure (PEEP)
  - PEEP values commonly used by clinicians (11.6 ± 2.9 cmH2O) was inadequate for morbidly obese ICU patients.
  - Mean PEEP value of 18 cmH2O was required to optimize end-expiratory lung volume
- Recruitment maneuvers, end-expiratory pressure titration
- Individualized PEEP titration using electrical impedance tomography

Critical Care (2019) 23:74

RESEARCH Open Access

A lung rescue team improves survival in obesity with acute respiratory distress syndrome

Gaetano Florio[1], Matteo Ferrari[1], Edward A. Bittner[1], Roberta De Santis Santiago[1], Massimiliano Pirrone[1], Jacopo Fumagalli[1], Maddalena Teggia Droghi[1], Cristina Mietto[1], Riccardo Pinciroli[1], Sheri Berg[1], Aranya Bagchi[1], Kenneth Shelton[1], Alexander Kuo[1], Yvonne Lai[1], Abraham Sonny[1], Peggy Lai[2], Kathryn Hibbert[2], Jean Kwo[1], Richard M. Pino[1], Jeanine Wiener-Kronish[1], Marcelo B. P. Amato[3], Pankaj Arora[4], Robert M. Kacmarek[1,5], Lorenzo Berra[1*], For the investigators of the lung rescue team



Florio et al. Critical Care (2020) 24:4

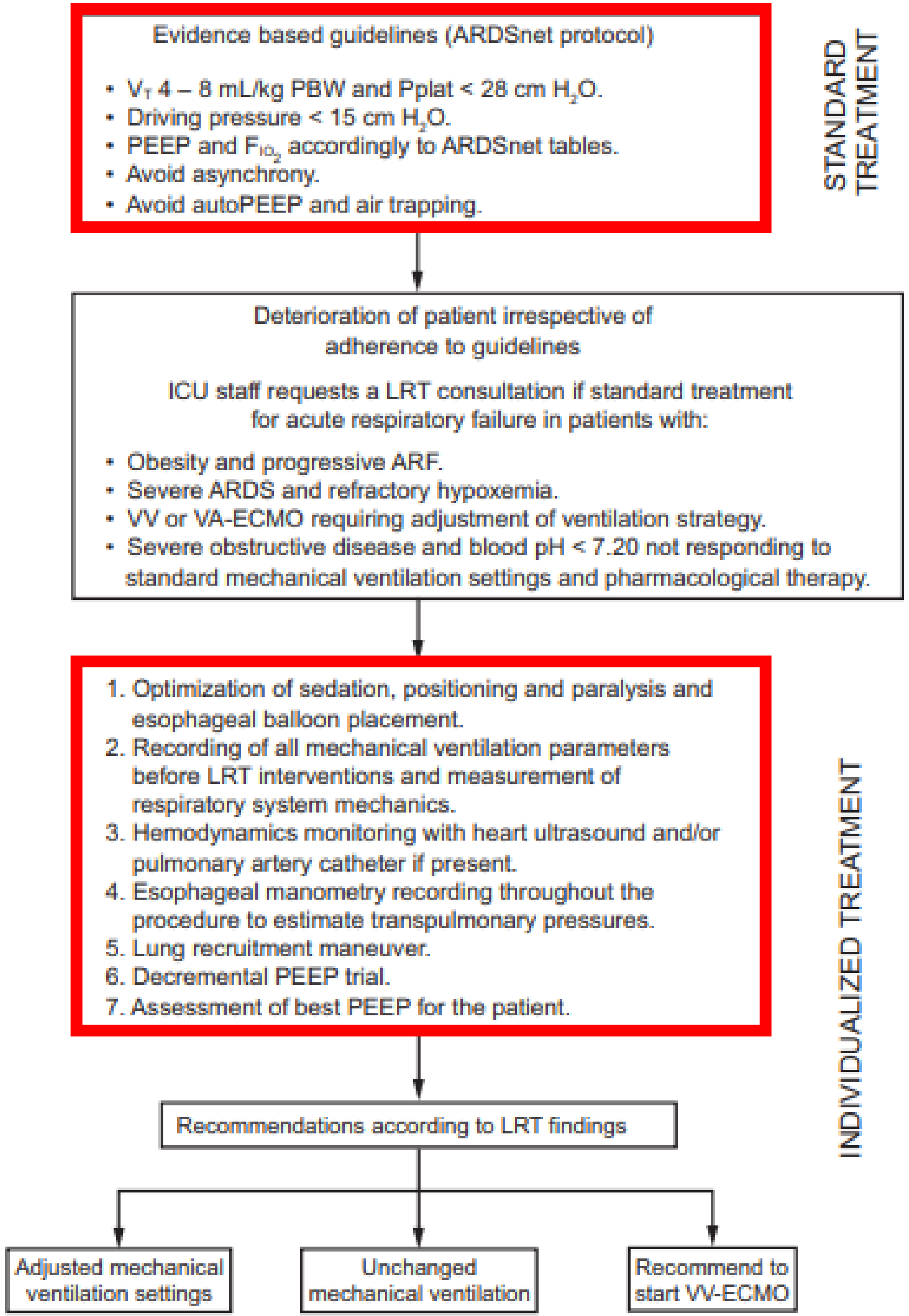


Fig. 1. Lung rescue team (LRT) consultation protocol. V_T = tidal volume; PBW = predicted body weight; Pplat = plateau pressure; ARF = acute respiratory failure; VV/VA-ECMO = venovenous/venoarterial extracorporeal membrane oxygenation.

Table 2 Ventilation settings and hemodynamics—standard protocol-based cohort and lung rescue team cohort

Variable	Group	Day 1		Day 2		Day 3		Day 4	
PEEP, cmH_2O, mean (CI 95%)	Standard protocol-based cohort	9 (8–10)	$P = 0.20$	9 (8–10)	$P < 0.001$	9 (8–10)	$P < 0.001$	9 (8–10)	$P < 0.001$
	Lung rescue team cohort	9 (9–10)		19 (18–20)		20 (18–21)		20 (18–21)	
TV/IBW, mL/kg, mean (CI 95%)	Standard protocol-based cohort	6.4 (6.2–6.6)	$P = 0.33$	6.5 (6.3–6.8)	$P = 0.10$	6.4 (6.1–6.6)	$P = 0.21$	6.5 (6.3–6.7)	$P = 0.11$
	Lung rescue team cohort	6.2 (5.9–6.5)		6.2 (5.9–6.5)		6.2 (5.9–6.5)		6.2 (5.9–6.6)	
DP[a], cmH_2O, mean (CI 95%)	Standard protocol-based cohort	13 (12.1–14.1)	$P = 0.94$	13 (12.2–14.8)	$P < 0.001$	13 (11.9–15.2)	$P < 0.001$	13 (11.8–15.1)	$P < 0.001$
	Lung rescue team cohort	13 (12.0–14.3)		10 (8.7–10.4)		9 (8.2–9.9)		8 (7.3–9.6)	
C_{RS}[b], mL/cmH_2O, mean (CI 95%)	Standard protocol-based cohort	35 (31–38)	$P = 0.41$	33 (27–39)	$P < 0.001$	36 (27–46)	$P = 0.003$	33 (27–40)	$P = 0.002$
	Lung rescue team cohort	33 (29.7–37.1)		45 (41–49)		48 (41–56)		52 (42–62)	
P_a/F_iO_2, mmHg, mean (CI 95%)	Standard protocol-based cohort	197 (177–217)	$P = 0.003$	224 (203–245)	$P = 0.001$	220 (199–242)	$P = 0.004$	218 (194–242)	$P = 0.004$
	Lung rescue team cohort	154 (127–179)		282 (252–312)		284 (256–312)		276 (243–309)	
RIV No. (%)	Standard protocol-based cohort	49/70 (70)	$P = 0.47$	51/70 (73)	$P = 0.30$	41/70 (58)	$P = 0.04$	39/70 (56)	$P = 0.005$
	Lung rescue team cohort	38/50 (76)		32/50 (64)		20/50 (40)		15/50 (30)	
VIS, mean (CI 95%)	Standard protocol-based cohort	16 (11–21)	$P = 0.79$	15 (10–20)	$P = 0.14$	14 (9–20)	$P = 0.004$	15 (6–24)	$P = 0.001$
	Lung rescue team cohort	15 (9–21)		9 (5–12)		5 (2–8)		4 (1–8)	

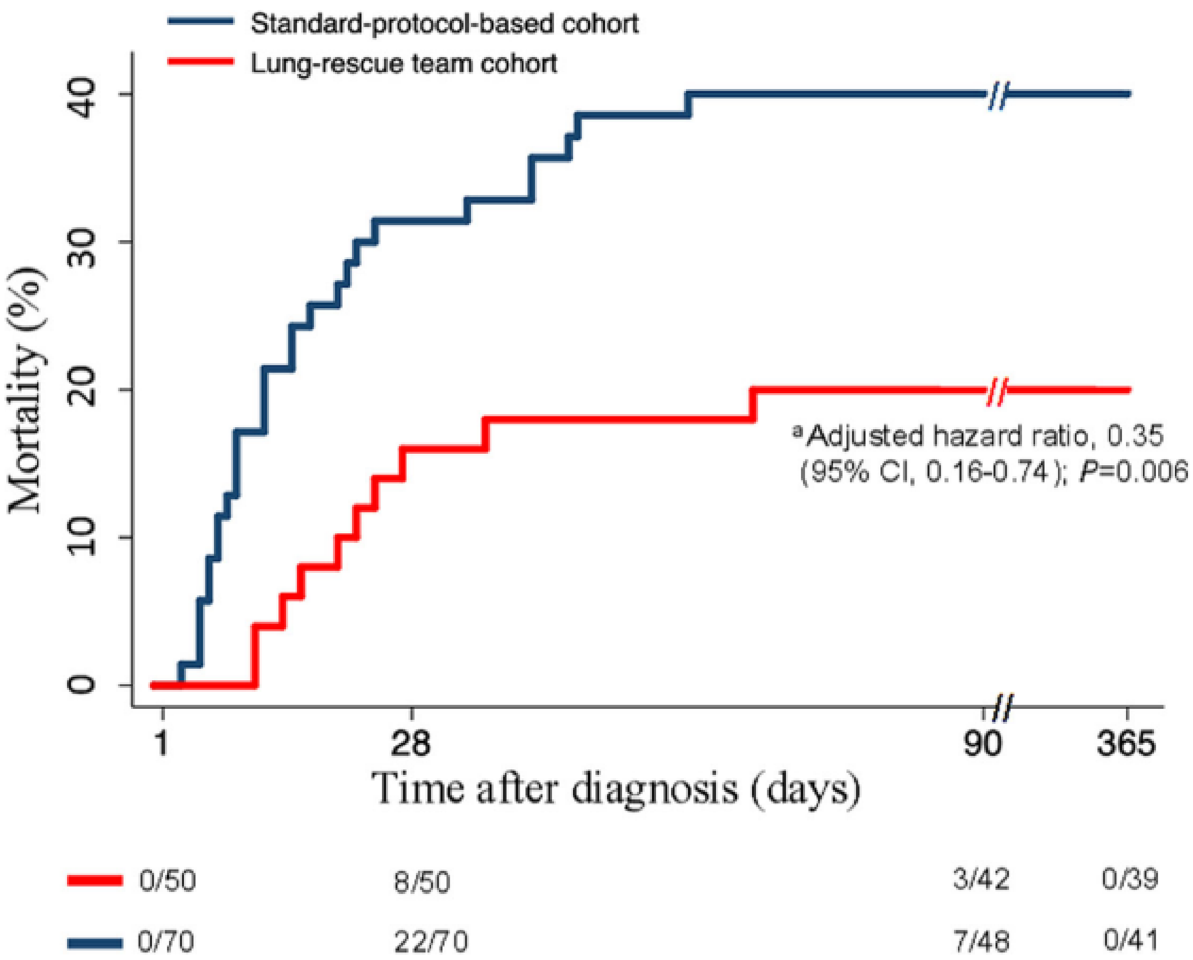
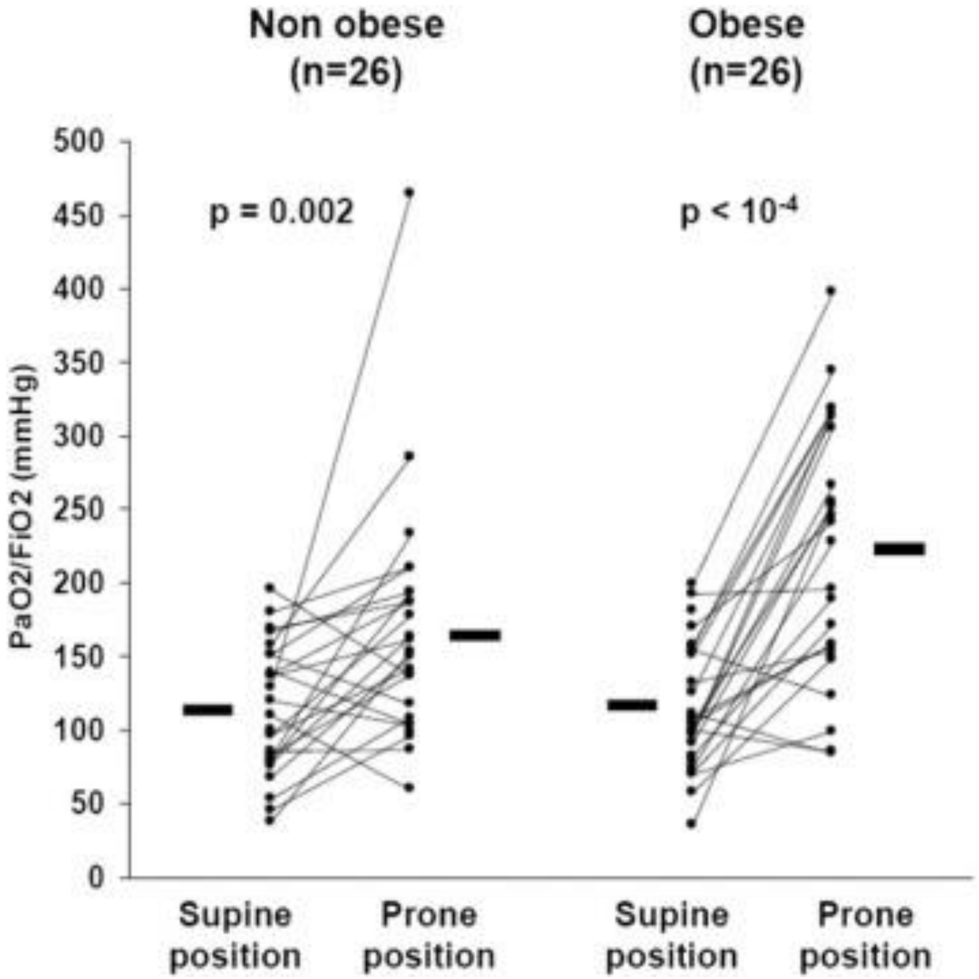


Fig. 2 Kaplan-Meier survival of ARDS patients. Survival of patients in the standard protocol-based and lung rescue team cohorts. [a]Hazard ratio and *P* value calculated after correction for common ICU confounders (APACHE, age, BMI, P_aO_2/F_iO_2 ratio)

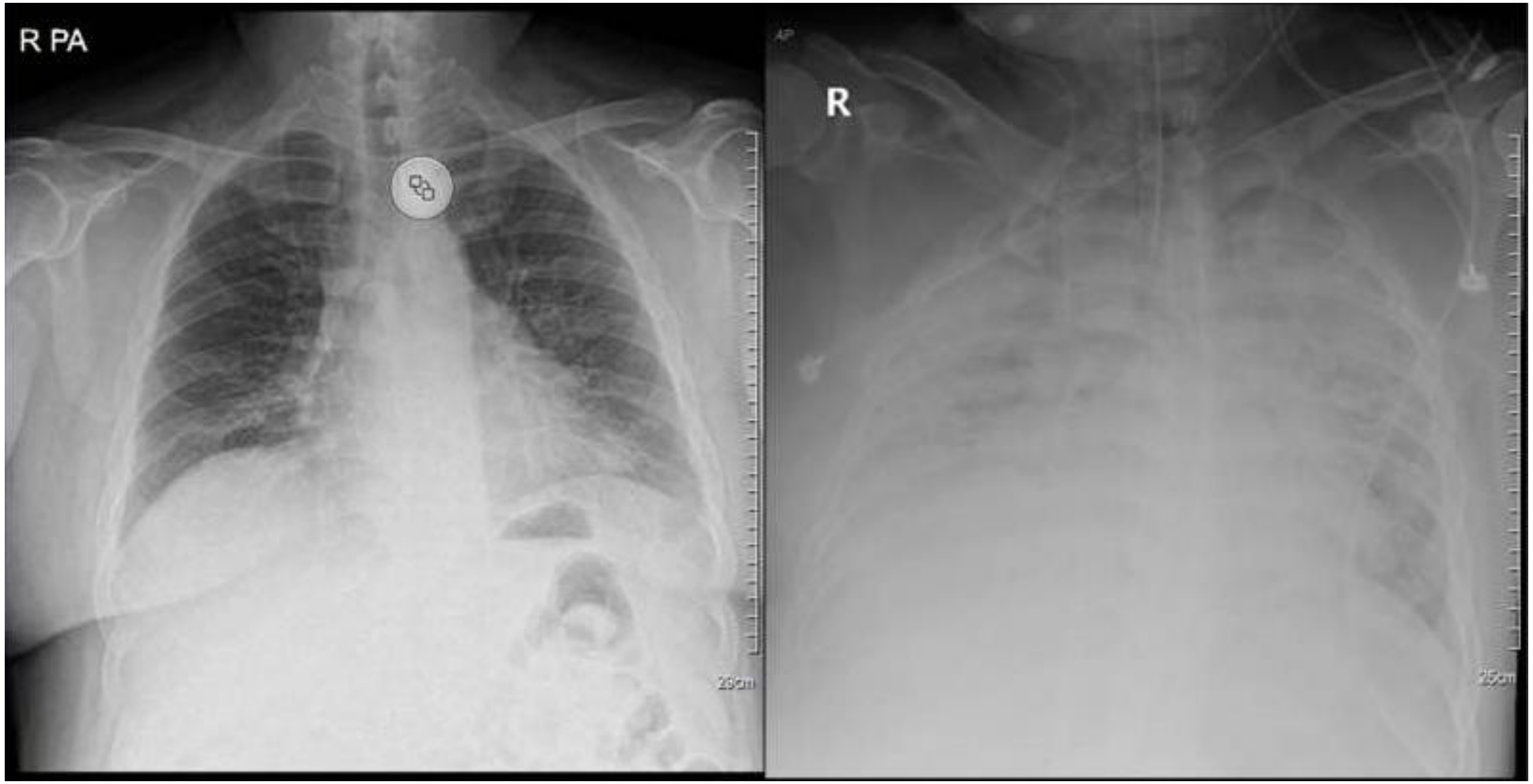
Prone?



Non obese
(n=26)
Obese
(n=26)
p = 0.002
p < 10-4
PaO2/FiO2 (mmHg)
500
450
400
350
300
250
200
150
100
50
0
Supine position
Prone position
Supine position
Prone position

ECMO first, NO try prone positioning

- **M/40, >100kg**, need to rescue for refractory hypoxemia
  → vv-ECMO for 1W, complete resolution without sequelae



VV-ECMO for Obese RF Patients

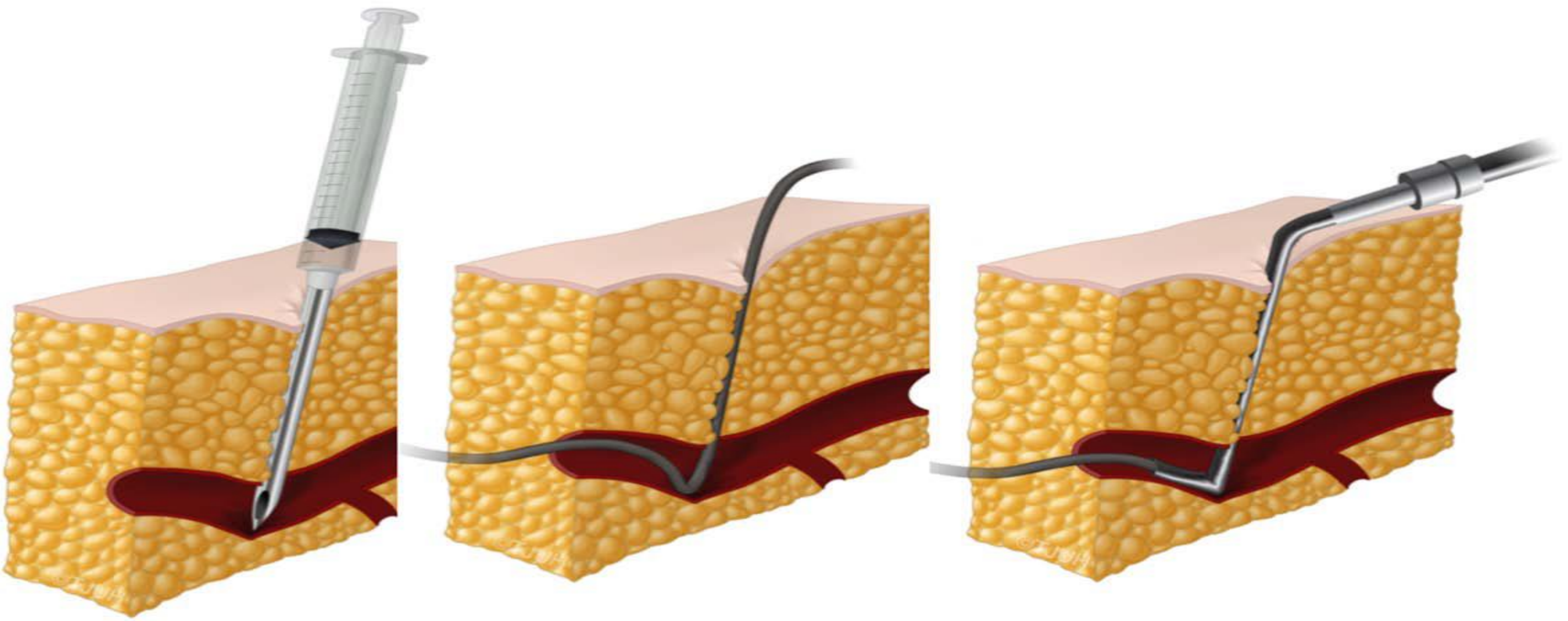
Table 4. Outcomes

Variable	BMI <40 kg/m^2 (n = 43)	BMI ≥40 kg/m^2 (n = 12)	*p* Value	BMI ≥50 kg/m^2 (n = 6)	*p* Value[a]
Intensive care unit LOS (d)	15.5 (IQR: 6–37.5)	28 (IQR: 13.5–46.5)	0.35	33 (IQR: 25–45)	0.13
Hospital LOS (d)	28 (IQR: 7–55)	35 (IQR: 13.5–50)	0.77	42 (IQR: 31–45)	0.22
Weaned from ECMO	27 (63%)	9 (75%)	0.51	6 (100%)	0.16
Bridge to recovery	26 (60%)	9 (75%)	0.50	6 (100%)	0.08
Bridge to transplantation	1 (2%)	0 (0%)	1	0 (0%)	1
Complications					
Major bleeding/thrombosis	13 (30%)	5 (42%)	0.50	3 (50%)	0.38
HITT	2 (5%)	3 (25%)	0.06	1 (17%)	0.33
CVA	3 (7%)	1 (8%)	1	0 (0%)	1
Hospital or 30-d mortality	18 (42%)	4 (33%)	0.74	0 (0%)	0.07

[a] Compared with BMI < 40 kg/m^2.

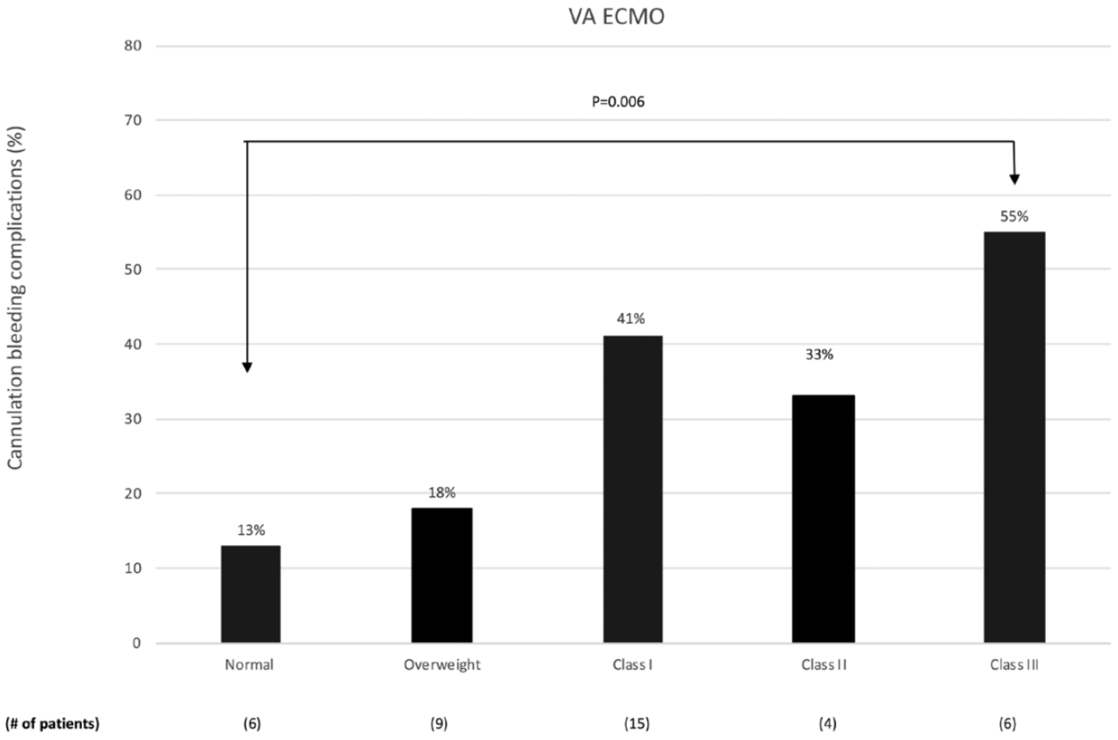
Ann Thorac Surg 2015;100:1855–60

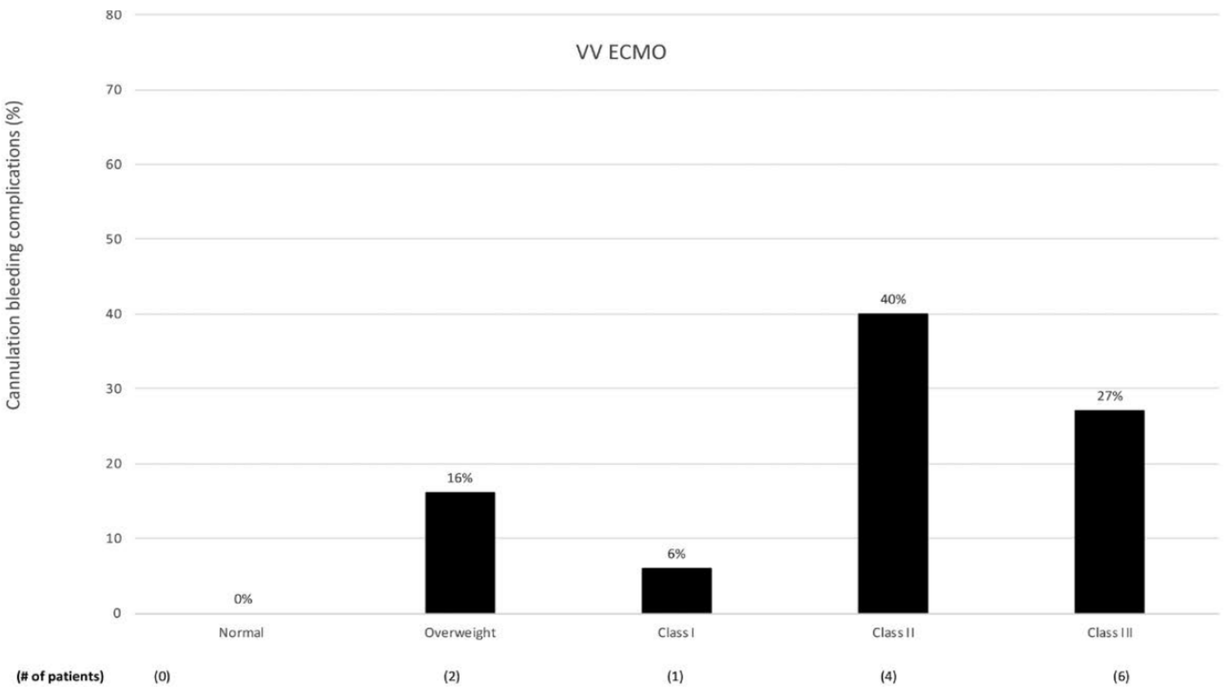
Percutaneous cannulation in obese patients



ASAIO Journal 2021; 67;1294–1300

Complications between VA vs. VV





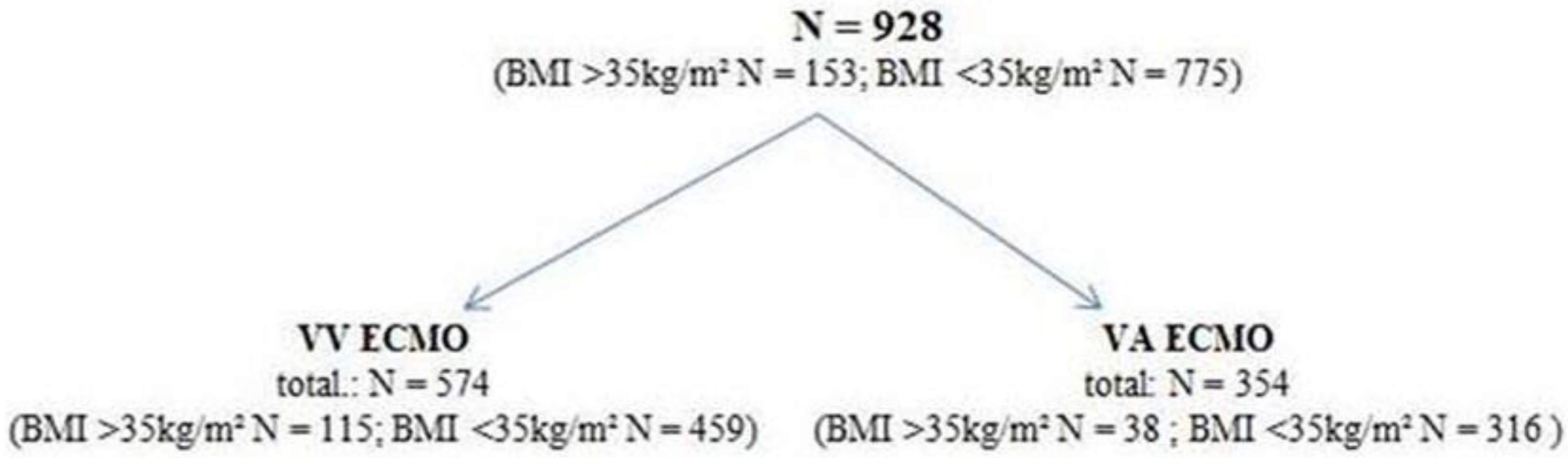
ASAIO Journal 2021; 67;1294–1300

Journal of Intensive Care Medicine
2020, Vol. 35(9) 919-926

DOI: 10.1177/0885066618801547
journals.sagepub.com/home/jic
SAGE

Percutaneous Cannulation for Extracorporeal Life Support in Severely and Morbidly Obese Patients

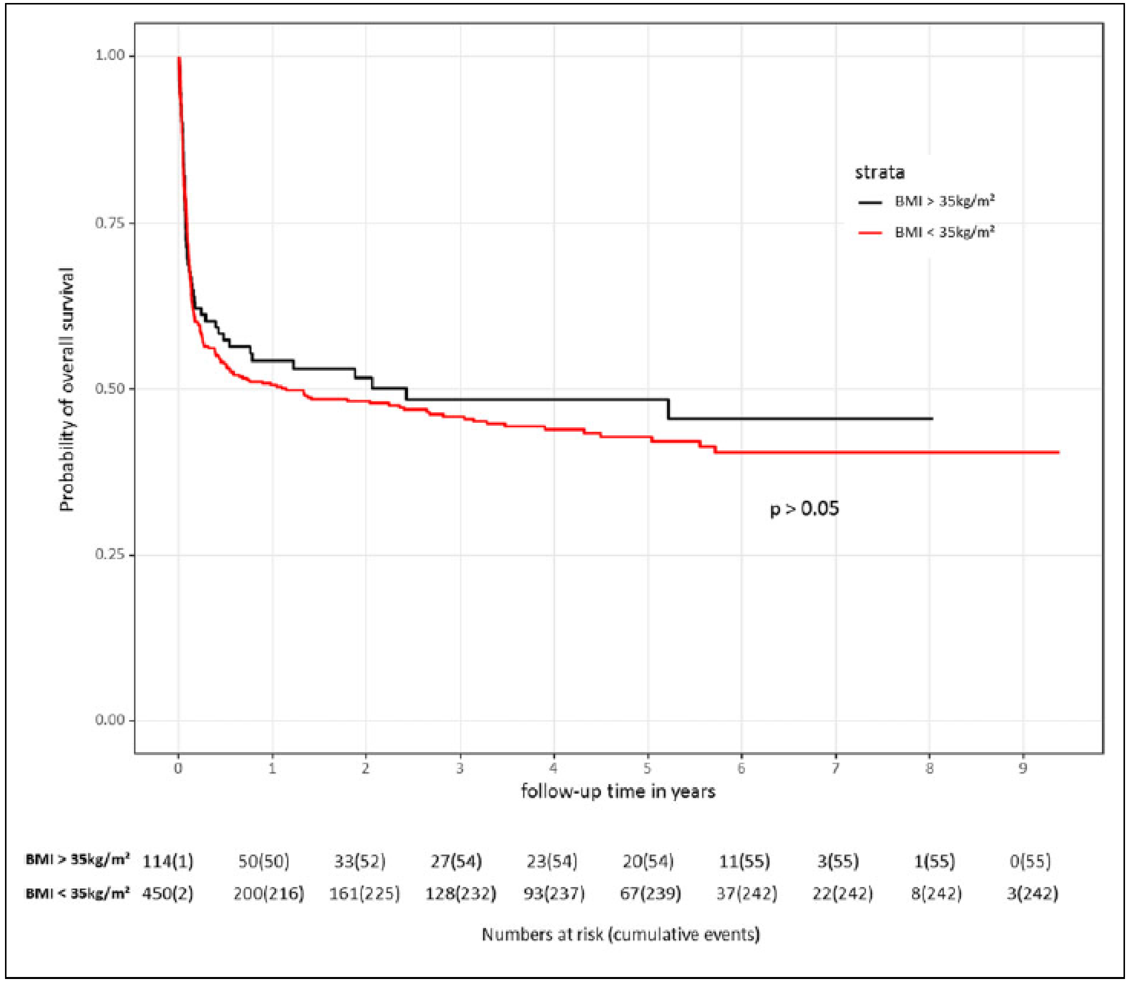
Andreas Keyser, MD[1], Alois Philipp[1], Florian Zeman, MSc[2], Matthias Lubnow, MD, PhD[3], Dirk Lunz, MD[4], Markus Zimmermann, MD, PhD[4], and Christof Schmid, MD, PhD[1]



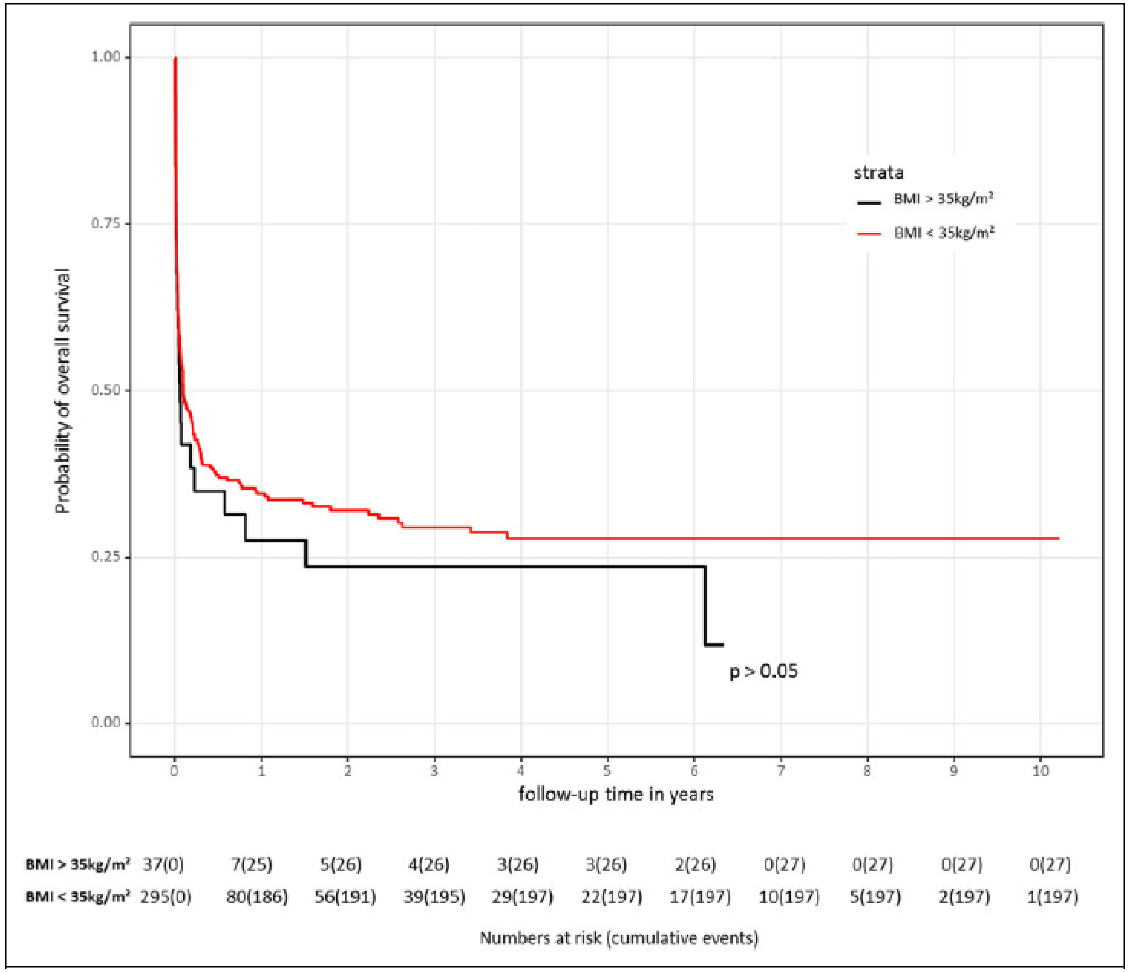
Journal of Intensive Care Medicine 2020, Vol. 35(9) 919-926

Table 3. Cannulation.

Variable	VV ECMO			VA ECMO		
	BMI < 35 kg/m^2	BMI > 35 kg/m^2	*P* Value	BMI < 35 kg/m^2	BMI > 35 kg/m^2	*P* Value
Mode of cannulation						
Puncture and Seldinger technique	447 (97%)	113 (98%)	>.05	250 (79%)	33 (87%)	>.05
Seldinger technique via pre-existing access*	12 (3%)	2 (2%)		66 (21%)	5 (13%)	
Drainage vessel						
Femoral vein	385 (84%)	82 (71%)	<.05	307 (97%)	34 (89%)	<.05
Jugular vein	74 (16%)	33 (29%)		9 (3%)	4 (11%)	
Return vessel						
Jugular vein	412 (90%)	103 (90%)	>.05			
Subclavian vein	47 (10%)	12 (10%)				
Femoral artery				316 (100%)	58 (100%)	
Distal perfusion of limb						
Yes				97 (31%)	9 (24%)	>.05
No				219 (69%)	29 (76%)	
Classic VV or Avalon						
Classic VV	397 (86%)	89 (77%)	<.05			
Avalon	62 (14%)	26 (23%)				



VV-ECMO

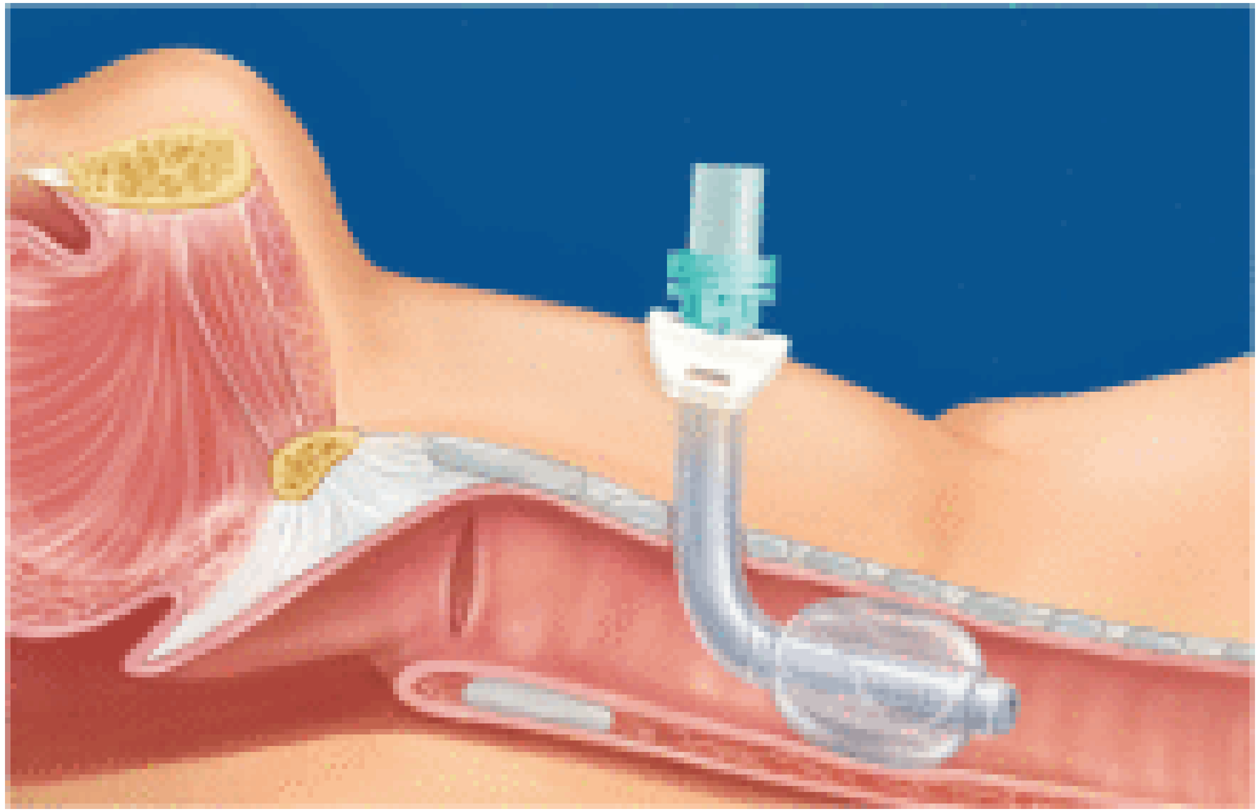


VA-ECMO

weight patients (*P* > .05). **Conclusion:** Percutaneous vessel cannulation for extracorporeal life support systems is generally feasible. Therefore, percutaneous cannulation may well be performed in severely and morbidly obese patients. Patient outcome rather depends on appropriate support than on anatomy.

Journal of Intensive Care Medicine 2020, Vol. 35(9) 919-926

Tracheostomy in obese patients



JAMA Otolaryngology–Head & Neck Surgery | Original Investigation

Tracheotomy Outcomes in Super Obese Patients

Ryan V. Marshall, MS; Patrick J. Haas, MD; John M. Schweinfurth, MD; William H. Replogle, PhD

Table 3. Patient Outcomes

Outcome	Value[a] Super Obese (n = 31)	Value[a] Obese (n = 34)	P Value
Days receiving ventilator support, mean (SD)	15.0 (15.5)	16.9 (17.9)	.65
FiO_2 before tracheotomy, mean (SD), %	50.6 (19.0)	47.7 (12.8)	.52
Failed extubations	10 (32)	8 (24)	.43
Postoperative bleeding	2 (7)	2 (6)	.92
Tracheotomy tube dislodged	1 (3)	0	.29
Tracheitis	3 (10)	0	.06
Percutaneous dilated tracheotomy	9 (29)	32 (94)	<.001
Cervical neck defattening	10 (32)	0	<.001
Standard tracheotomy tube	21 (68)	30 (88)	.04
Extended-length disposable inner cannula tracheostomy tube	16 (52)	2 (6)	<.001
Disposition			
Home	9 (29)	9 (27)	.82
Health facility	17 (55)	22 (65)	
Death	4 (13)	3 (9)	
Tracheotomy status			
Tracheotomy dependent	25 (81)	16 (47)	<.001
Ventilator dependent	7 (23)	4 (12)	.23
Decannulation	2 (7)	15 (44)	<.001

OBJECTIVE To determine the outcomes, complications, and mortality after tracheotomy in super obese patients (those with a body mass index [BMI] greater than 50).

DESIGN, SETTING, AND PARTICIPANTS A retrospective review was conducted of billing records from a tertiary care academic medical center from November 1, 2010, through June 30, 2013, to identify patients undergoing tracheotomy. Medical records were reviewed to identify patients with a BMI (calculated as weight in kilograms divided by height in meters squared) greater than 50 and a control group with a BMI of 30 to 50. Patient characteristics, including BMI, age, race/ethnicity, primary diagnosis for hospitalization, medical comorbidities, and surgical technique, were measured.

MAIN OUTCOMES AND MEASURES The primary outcome measure was dependence on tracheostomy at discharge. Secondary outcomes included rates of ventilator dependence, mortality, postoperative complications, and discharge disposition.

RESULTS The super obese population included 31 patients and was predominantly African American (20 patients [65%]) and female (21 patients [68%]). Mean BMI of super obese patients was 64.0 (range, 50.2-95.5). The obese patient population was mainly African American (25 patients [74%]) and female (17 patients [50%]). Twenty-five of 31 super obese patients (81%) were discharged with a tracheotomy tube in place, compared with 16 of 34 obese patients (52%). Seven patients (23%) in the super obese group were ventilator dependent at discharge, compared with 4 patients (13%) in the obese group. Only 2 of the super obese patients (3%) were decannulated before discharge, compared with 15 (44%) in the obese group. In-hospital mortality was similar for the 2 groups (super obese, 4 patients [13%] and obese, 3 patients [9%]). The overall complication rate was 19% in the super obese group (6 patients) compared with 6% in the obese group (2 patients). Super obese patients were less likely to be discharged to a health care facility (17 patients [55%]) compared with patients in the obese group (22 patients [65%]).

CONCLUSIONS AND RELEVANCE Tracheotomy in super obese patients is a safe and effective strategy for airway management. Critically ill, super obese patients have a high likelihood of remaining dependent on a tracheotomy or ventilator at the time of discharge.

JAMA Otolaryngol Head Neck Surg. 2016;142(8):772-776.

Take home messages

- Negative impact of obesity on the respiratory system and ventilatory control for managing respiratory failure
  - Under-recognized disorder of acute hypercapnic respiratory decompensation secondary to obesity hypoventilation
- Early recognition as a medical emergency
- Essential initiation of NIV to avoid intubation and invasive mechanical ventilation
- Challenging management of mechanical ventilation in morbidly obese patients : reconsidering PEEP and RM