Pencegahan Awal ARDS pada Kasus Penyakit Paru

PRASENOHADI

Department of Pulmonology and Respiratory Medicine
Faculty of Medicine – Universitas Indonesia
Persahabatan Hospital, National Respiratory Referral Center – Jakarta

Insidens *Acute Respiratory Distress Syndrome*

	Region	Study design	Study year	ARDS patients	ARDS incidence
Rubenfeld *et al.* [11]	King County, Washington, United States	Prospective Observational	2000–2001	1113	78.9 per 100 000
Raymondos *et al.* [12▪]	Germany	Prospective Observational	2004	198	2.6% of all ICU admissions
Caser *et al.* [8]	Espirito Santo State, Brazil	Prospective Observational	2006–2007	81	6.3 per 100 000
Li *et al.* [13]	Olmstead County, Minnesota, United States	Retrospective Cohort	2001–2008	975	Decreased from 82 to 39 per 100 000 from 2001 to 2008
Villar *et al.* [14]	Spain	Prospective Observational	2008–2009	255	7.2 per 100 000 (moderate–severe ARDS)
Sigurdsson *et al.* [15]	Iceland	Retrospective	1988–2010	435	Increased from 3.65 to 9.63 per 100 000 (moderate–severe ARDS) from 1998 to 2010
Hernu *et al.* [16]	Lyon, France	Prospective Observational	2012	278	32 per 100 000
Riviello *et al.* [17]	Rwanda	Prospective Observational	2014	0 (Berlin criteria) 42 (Kigali modification)	Four percentage of hospital admissions
Bellani *et al.* [18▪▪]	Fifty countries worldwide	Prospective Observational	2014	2813	Ten percentage of all ICU admissions; 23% of all mechanically ventilated ICU patients; 5.5 cases per ICU bed per year

Studies prior to 2012 used the AECC definition of ARDS; some studies during this period confined 'ARDS' to patients with *P/F* ratios 200 or less, as specified in that definition. ARDS, acute respiratory distress syndrome.

Curr Opin Crit Care. 2017, 23:41-48.

Faktor Risiko ARDS

Langsung	Tidak langsung
• Pneumonia (bakteri, virus, jamur)	• Sindrom sepsis
• Aspirasi	• Trauma bukan paru
• Ventilasi mekanis (barotrauma, volutrauma)	• Transfusi
• Cedera inhalasi	• *Cardiopulmonary bypass*
• Kontusio paru	• Pankreatitis
• Tenggelam	• Overdosis obat
• Emboli	• Luka bakar
• Cedera reperfusi	

Clin Chest Med. 2014;35:639–53.

Patogen Penyebab ARDS

Bacteria	Virus	Fungi	Parasites
Streptococcus pneumoniae	Influenza A and B		
Haemophilus influenzae	Rhinoviruses		
Enterobacteriaceae	RSV	*Pneumocystis Jirovecii*	
Staphylococcus aureus	Parainfluenza viruses		
Legionella pneumophila	Coronavirus		*Toxoplasma gondii*
Clamydia pneumoniae	Enterovirus		
Mycoplasma pneumoniae	HSV		
Pseudomonas aeruginosa	CMV	*Aspergillus fumigatus*	
Acinetobacter baumannii	–		
Stenotrophompnas maltophilia	–		

Int J Mol Sci. 2017;18:64.

Definisi ARDS

	Murray, 1988[2]	AECC, 1994[3]	Ferguson, 2005[4]	Berlin, 2012[5]
Onset	Acute or chronic, not specified	Acute, not specified	Within 72 h	New or worsening within 1 week
Risk factor	Required	Not required	Required	Not required
Oxygenation (mm Hg)	PaO_2/FiO_2 >300 (0) PaO_2/FiO_2 225–299 (1) PaO_2/FiO_2 175–224 (2) PaO_2/FiO_2 100–174 (3) PaO_2/FiO_2 <100 (4)	Acute lung injury: PaO_2/FiO_2 <300 Acute respiratory distress syndrome: PaO_2/FiO_2 ≤200	PaO_2/FiO_2 <200	Mild: PaO_2 200–300 Moderate: PaO_2 100–199 Severe: PaO_2 <100
PEEP (cm H_20)	≤5 (0) 6–8 (1) 9–11 (2) 12–14 (3) ≥15 (4)	Not specified	≥10	Minimum PEEP of 5 required
Infiltrates on chest radiograph	No quadrants (0) One quadrant (1) Two quadrants (2) Three quadrants (3) Four quadrants (4)	Bilateral infiltrates on a frontal chest radiograph	Bilateral airspace disease involving two or more quadrants on a frontal chest radiograph	Bilateral infiltrates involving two or more quadrants on a frontal chest radiograph or CT
Heart failure	..	Pulmonary artery wedge pressure ≤17 mm Hg Absence of left atrial hypertension	No clinical evidence of congestive heart failure (based on pulmonary artery catheter with or without echocardiogram)	Left ventricular failure insufficient to solely account for clinical state
Static compliance (mL/cm H_20)	≥80 (0) 60–79 (1) 40–59 (2) 20–39 (3) ≤19 (4)	..	Static compliance <50 (with patient sedated, tidal volume 8 mL/kg ideal bodyweight, PEEP ≥10)	Removed
Severity	Mild Moderate Severe	Based on oxygenation criteria	..	Based on oxygenation criteria
Specificity for diffuse alveolar damage	Autopsy: 74%[6] (lung injury score ≥2·5)	Autopsy: 30%,[6] 50%,[7] 66%,[8] 70%[9] Biopsy: 29%,[10] 47%,[11] 40%[12]	Autopsy: 69%[6]	Autospy: 45%[13] Biopsy: 58%[14]

Lancet. April 2016.

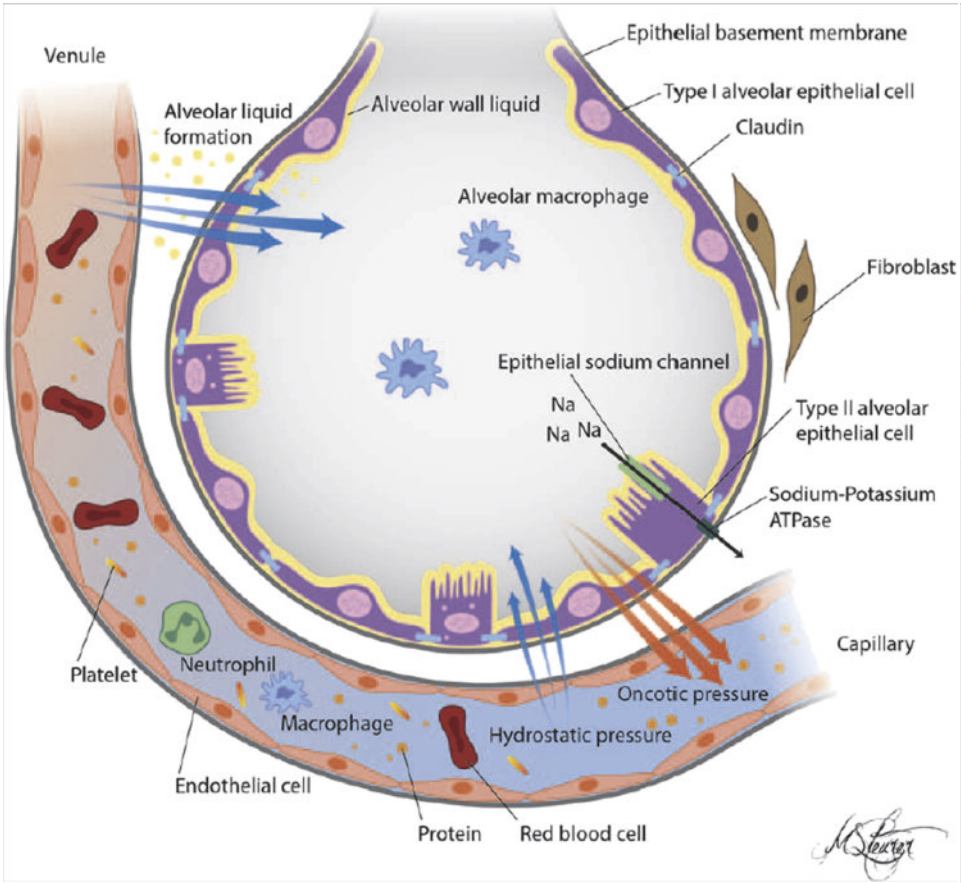
ARDS – Definisi Berlin

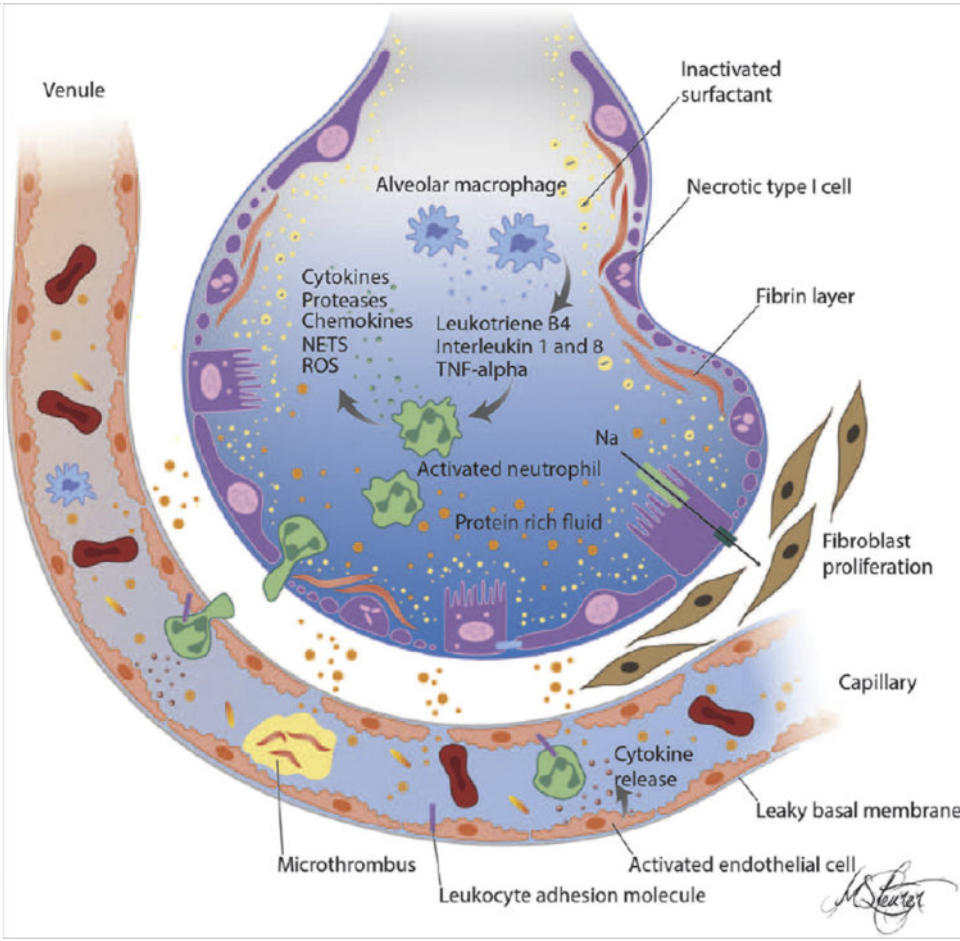
ARDS (Definisi Berlin)	
Waktu	Dalam 1 minggu pasca etiologi klinik atau muncul gejala repirasi atau perburukan gejala respirasi
Foto toraks	Opasitas bilateral — efusi pleura, kolaps lobus/paru, nodul
Edema	Gagal napas bukan karena gagal jantung atau kelebihan cairan. Penilaian objektif (ekokardiografi) untuk menyingkirkan edema hidrostatik karena faktor risiko lain
Oksigenasi	
• Ringan	200 mmHg $<PaO_2/FIO_2 \leq 300$ mmHg dengan PEEP atau CPAP ≥5 cmH_2O
• Sedang	100 mmHg < PaO_2/FIO_2 ≤200 mmHg dengan PEEP ≥5 cmH_2O
• Berat	PaO_2/FIO_2 ≤100 mmHg dengan PEEP ≥5 cmH_2O

J Thorac Dis. 2013;5(3):326-34.

Patogenesis ARDS

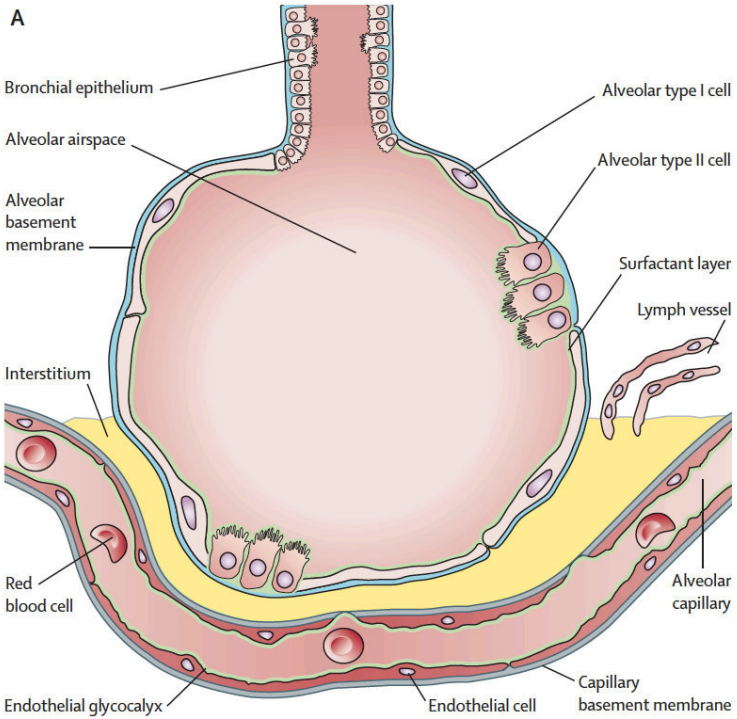
Alveolus Normal dan Patofisiologi ARDS



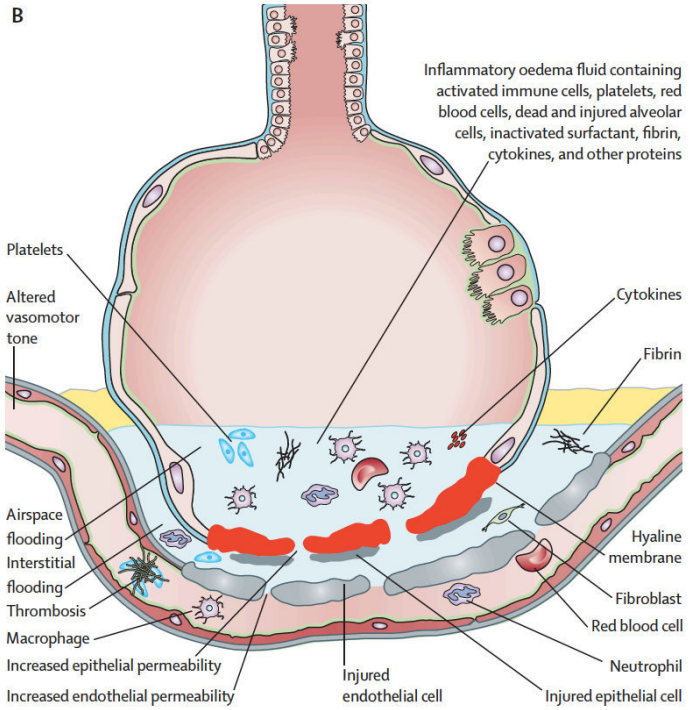


Pediatr Clin N Am. 2017;64:1017–37.

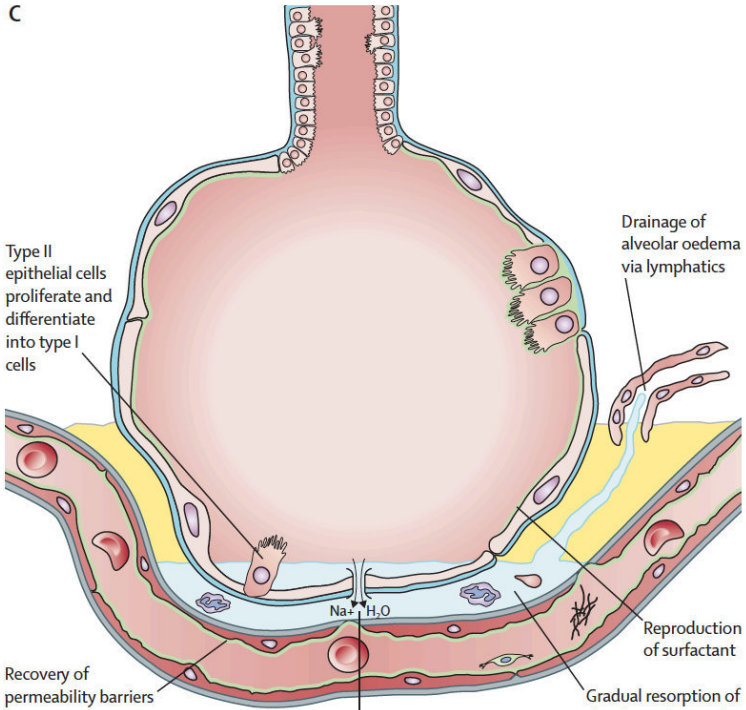
Alveolus Normal



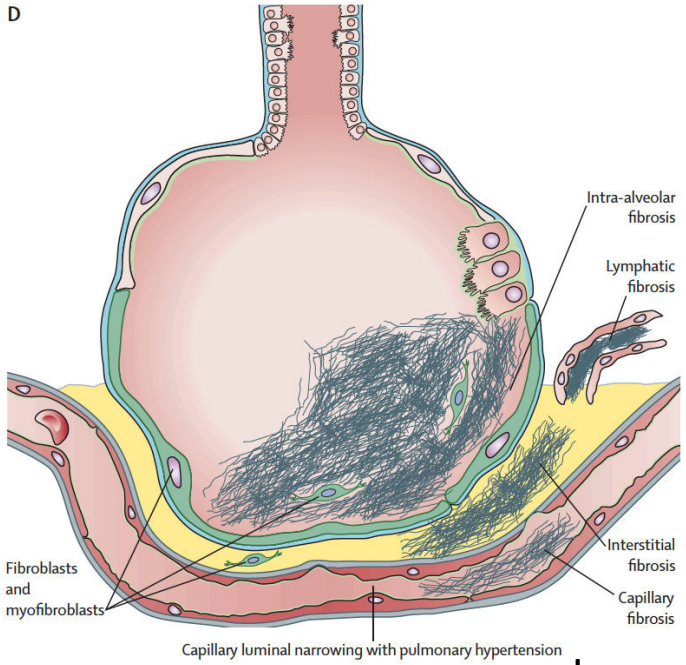
Fase Eksudatif



Fase Proliperatif

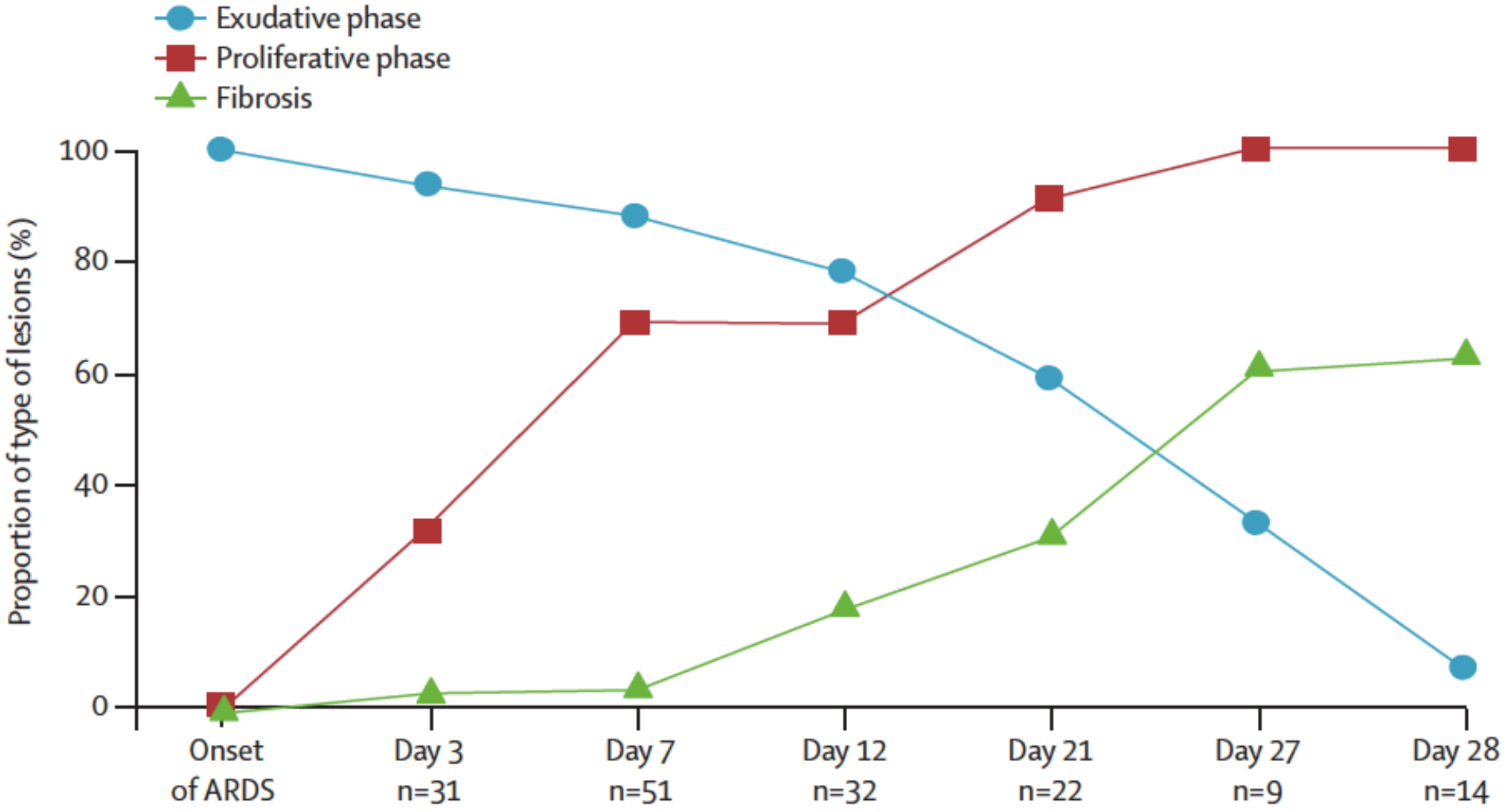


Fase Fibrotik



Lancet. April 2016.

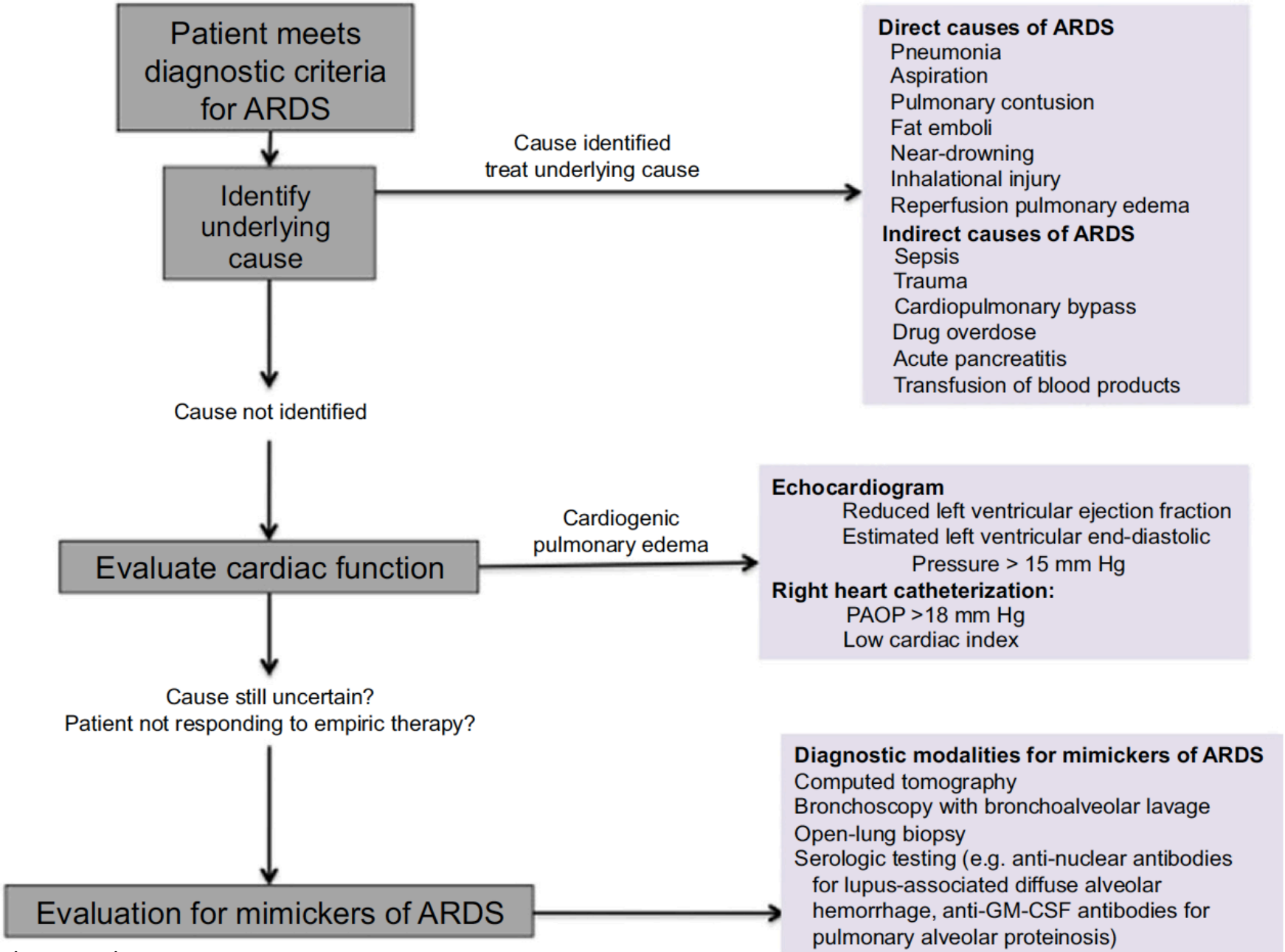
Onset dan Perubahan Histologik (Fase Eksudatif, Fase Proliferative dan Fase Fibrosis) Pasien ARDS



Lancet. July 2013.

Tatalaksana dan Pencegahan ARDS

Algoritma Tatalaksana ARDS



Clin Chest Med. 2014;35:685–96.

Pencegahan ARDS

- Strategi pencegahan ARDS → TANTANGAN.
- Intervensi awal pada trauma major atau sepsis non-pulmoner → mengurangi ARDS.
- Penanganan syok pada trauma major di IGD → menurunkan *multiple organ failure*, cedera otak traumatik, *acute kidney injury* dan ARDS.
- Strategi resusitasi (limitasi cairan) pada syok septik → menurunkan insidens ARDS

Pencegahan ARDS

- ARDS dapat dicegah → Acute Lung Injury Prediction Score (LIPS) (prospektif, multisenter, penelitian observasional kohort)
- Identifikasi kondisi predisposisi terjadinya ARDS → syok, aspirasi, sepsis, pneumonia, pembedahan risiko tinggi, trauma risiko tinggi dan *risk modifiers* (alkoholism, obesitas, albumin serum rendah, kemoterapi, FiO_2 >0,35 atau >4 L/mnt, frekuensi napas >30/mnt, saturasi O_2 <95% atau pH of <7,35)

Am J Respir Crit Care Med. 2011;183:462–70.

Lung Injury Prediction Score Calculation Worksheet

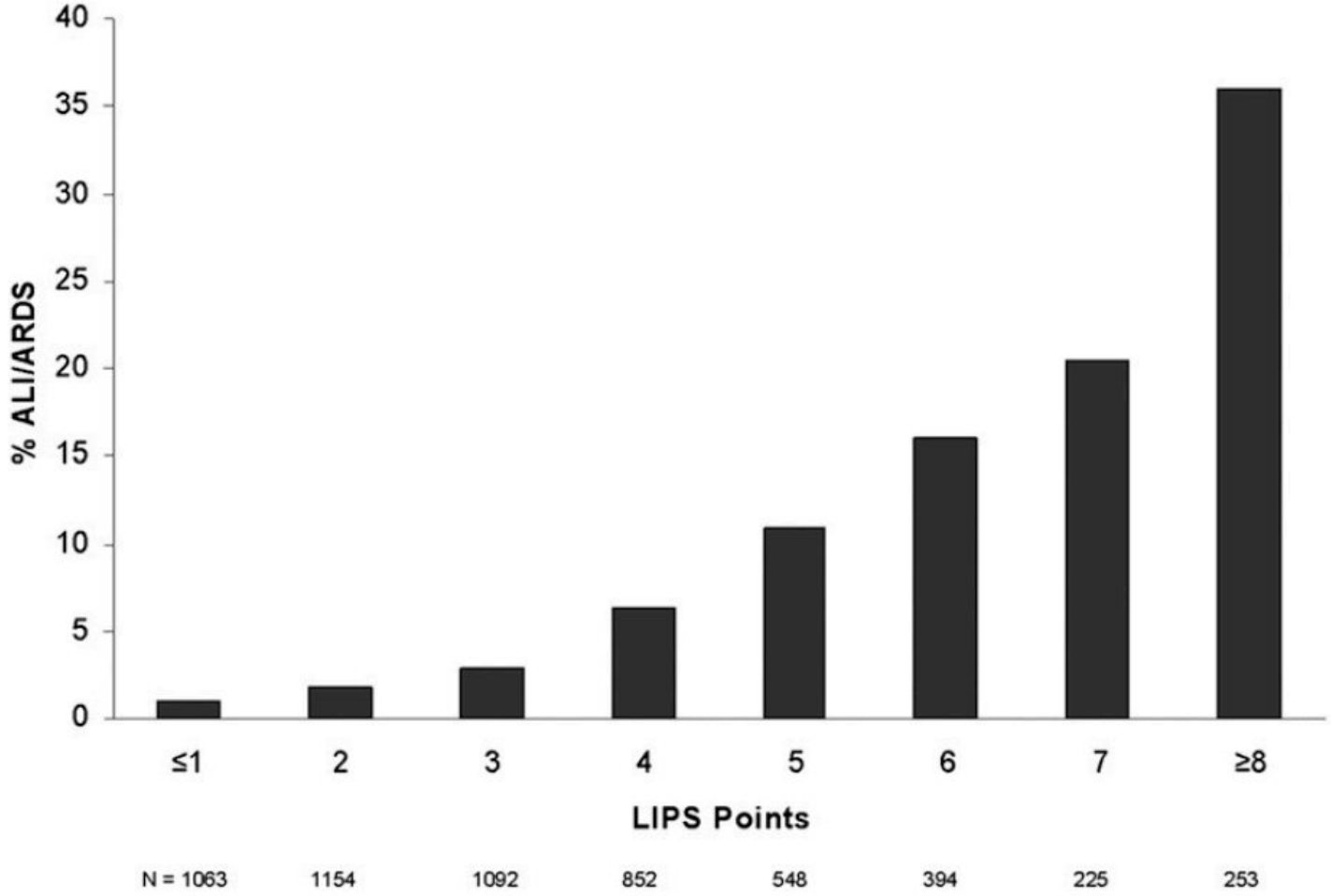
	LIPS Points	Examples
Predisposing Conditions		
Shock	2	
Aspiration	2	
Sepsis	1	(*1*) Patient with history of alcohol abuse
Pneumonia	1.5	with septic shock from pneumonia
High-risk surgery*		requiring $F_{IO_2} > 0.35$ in the
Orthopedic spine	1	emergency room: Sepsis + shock +
Acute abdomen	2	pneumonia + alcohol abuse +
Cardiac	2.5	$F_{IO_2} > 0.35$
Aortic vascular	3.5	1 + 2 + 1.5 + 1 + 2 = 7.5
High-risk trauma		(*2*) Motor vehicle accident with
Traumatic brain injury	2	traumatic brain injury, lung contusion,
Smoke inhalation	2	and shock requiring $F_{IO_2} > 0.35$
Near drowning	2	Traumatic brain injury + lung
Lung contusion	1.5	contusion + shock+ $F_{IO_2} > 0.35$
Multiple fractures	1.5	2 + 1.5 + 2 + 2 = 7.5
Risk modifiers		
Alcohol abuse	1	
Obesity (BMI > 30)	1	(*3*) Patient with history of diabetes
Hypoalbuminemia	1	mellitus and urosepsis with shock
Chemotherapy	1	Sepsis + shock + diabetes
$F_{IO_2} > 0.35$ (> 4 L/min)	2	1 + 2 − 1 = 2
Tachypnea (RR > 30)	1.5	
$Sp_{O_2} < 95\%$	1	
Acidosis (pH < 7.35)	1.5	
Diabetes mellitus†	−1	

Definition of abbreviations: BMI = body mass index; RR = respiratory rate; Sp_{O_2} = oxygen saturation by pulse oximetry.

* Add 1.5 points if emergency surgery.

† Only if sepsis.

Am J Respir Crit Care Med. 2011;183:462–70.



Frekuensi *acute lung injury* (ALI)/*acute respiratory distress syndrome* (ARDS) berdasarkan penilaian *lung injury prediction score* (LIPS).

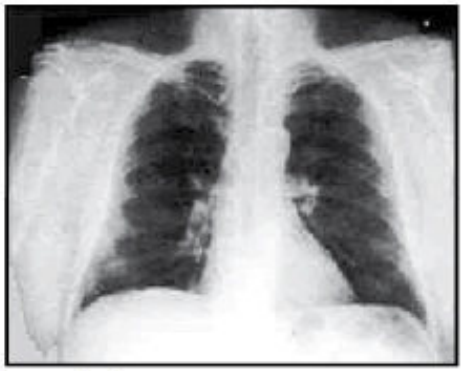
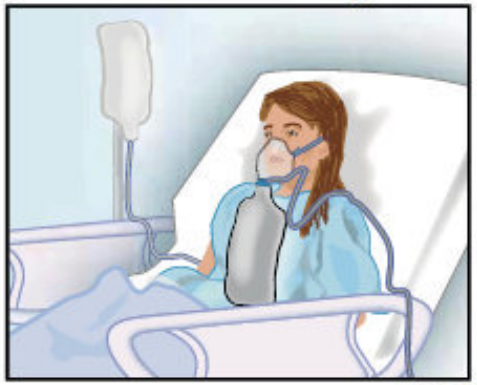
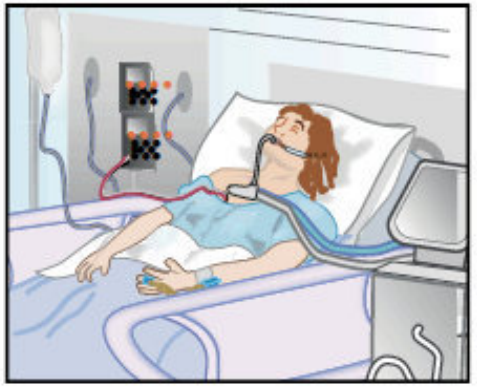
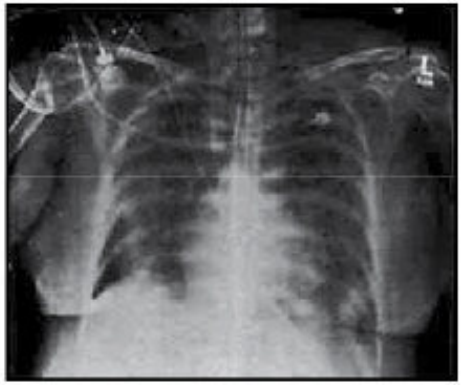
Am J Respir Crit Care Med. 2011;183:462–70.

The Checklist for Lung Injury Prevention (CLIP)

CLIP Element	Best Practice
Lung-protective mechanical ventilation	Tidal volume between 6 and 8 mL/kg predicted body weight and plateau pressure < 30 cm H_2O
	PEEP ≥ 5 cm H_2O
	Minimize F_{IO_2}, targeting Sa_{O_2} to 88%-92% after early shock
Aspiration precautions	Rapid-sequence intubation performed or supervised by experienced provider
	Elevated head of bed
	Antiseptic oral care
	Gastric acid neutralization absent enteral nutrition
Early reassessment of noninvasive ventilation	Reevaluate work of breathing and clinical status 30 min after initiating noninvasive ventilation to prevent delay in intubation if necessary
Adequate empirical antimicrobial treatment and source control	According to suspected site of infection, health-care exposure, and immune status
Optimal fluid management	Early fluid resuscitation in septic shock
	Simplified ARDS Network FACTT protocol after early shock
Restrictive transfusion	Hemoglobin target ≥ 7 g/dL absent active bleeding or ischemia
	Avoid platelet and plasma transfusions absent active bleeding
Appropriate communication during transfer of patients at risk	Structured handoff to ICU providers of at-risk patients who require ICU admission, such as through SBAR

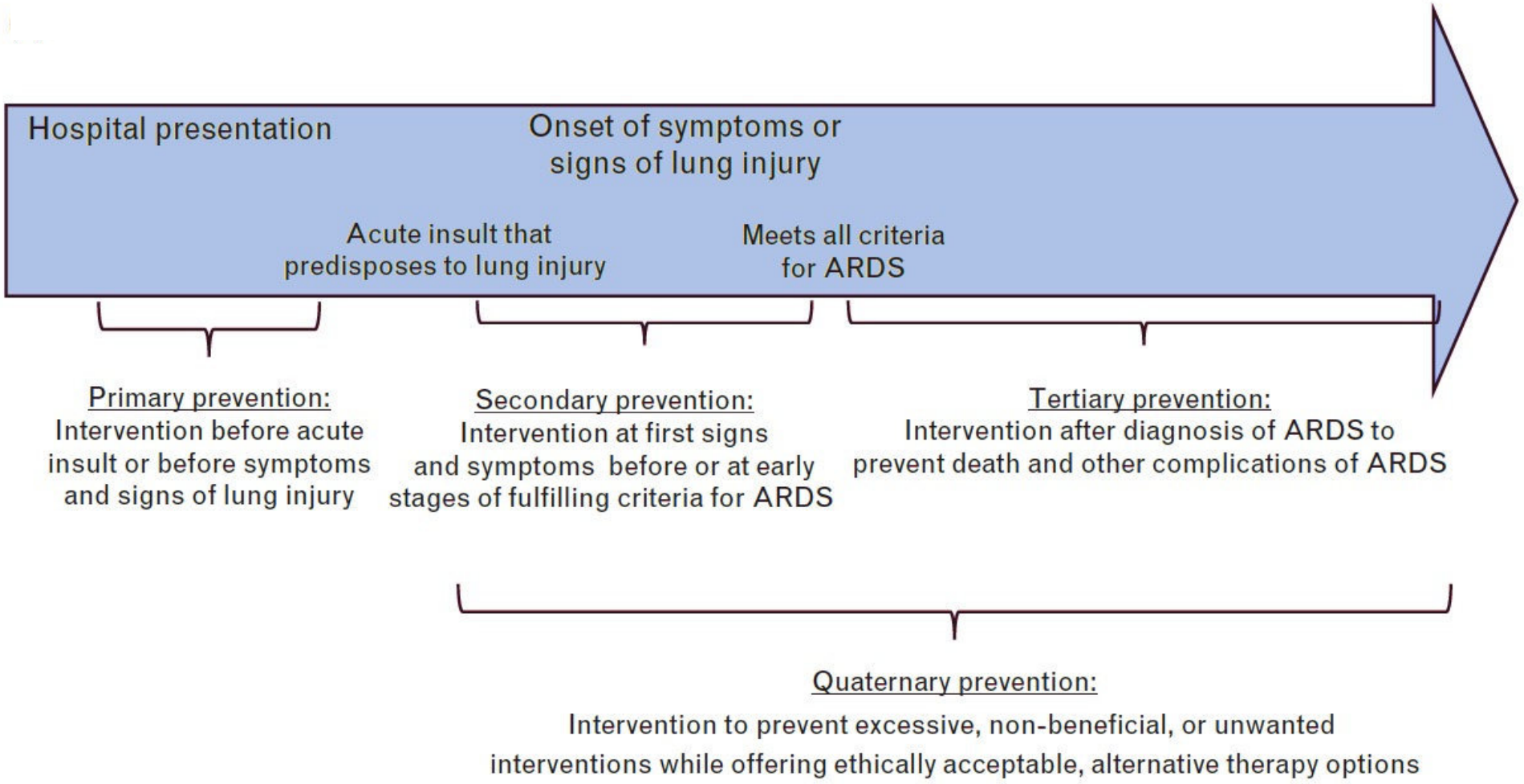
Adapted with permission from Kor et al.[39] CLIP = Checklist for Lung Injury Prevention; FACTT = Fluid and Catheter Treatment Trial; PEEP = positive end-expiratory pressure; Sa_{O_2} = arterial oxygen saturation; SBAR = situation, background, assessment, recommendation.

Chest. 2014;146(4):1102–13.

Advantages		Disadvantages
	Prevention of ARDS	
1 Some therapies might only be effective for prevention 2 Most suitable for inexpensive, low-risk therapies	 	1 Difficult to identify enough patients at high risk of ARDS 2 Majority of ARDS symptoms already present at presentation 3 Short window for enrolment and need very large sample size
	Early acute lung injury	
1 Earlier intervention might increase likelihood of benefit 2 High likelihood of progression to ARDS 3 Avoiding intubation might maximise benefit	 	1 Majority of ARDS already present at presentation 2 Short window for enrolment
	Established ARDS	
1 Longer enrolment window 2 Easier to power for hard outcomes, such as mortality 3 Many aspects of care already have existing protocols	 	1 Therapies might not be effective once ARDS is established 2 Non-pulmonary organ dysfunction could drive outcomes

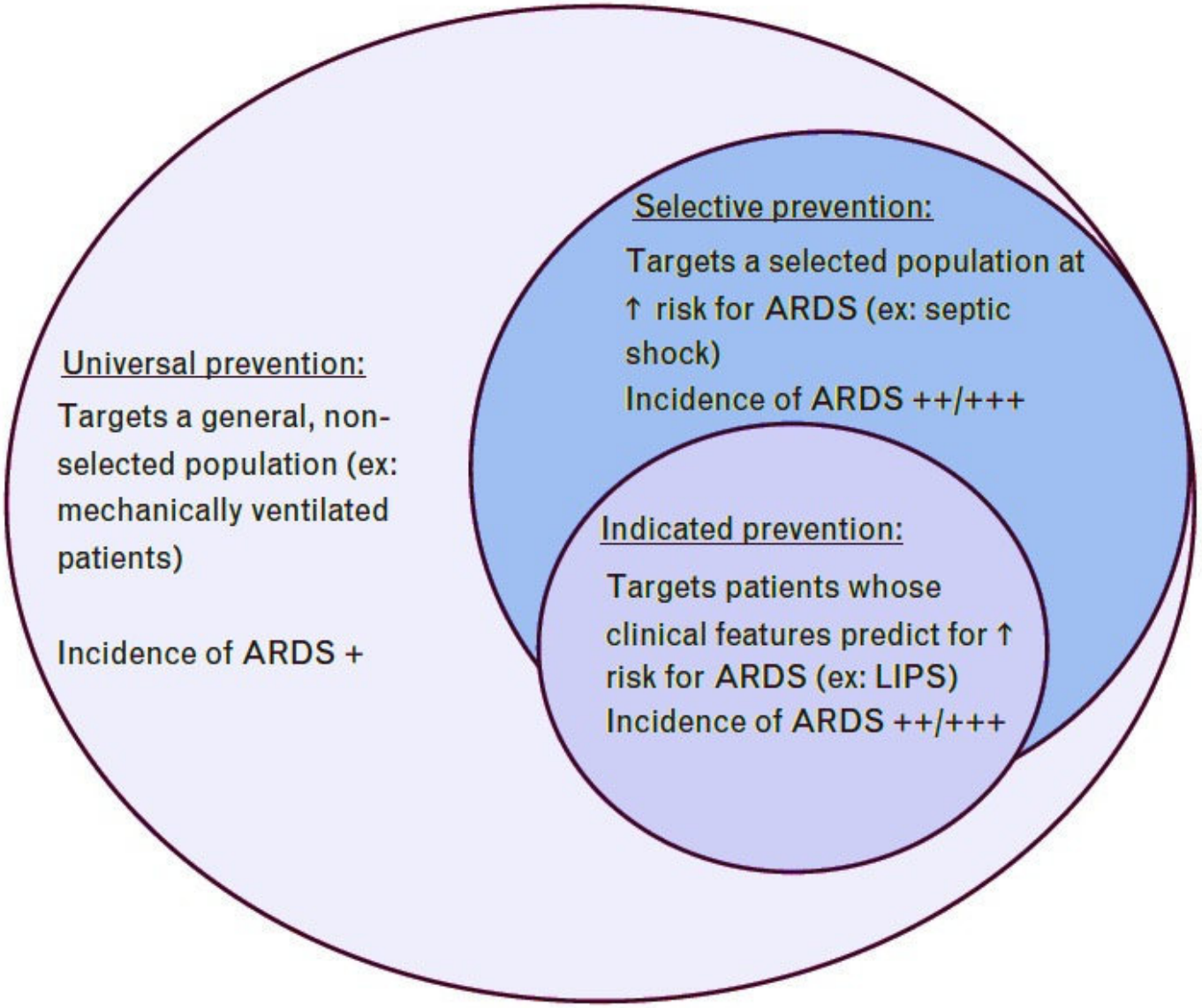
Lancet Respir Med. 2017;5:524–34.

Pencegahan dan Strategi Tatalaksana ARDS



Curr Opin Crit Care. 2016, 22:21–37.

Pencegahan dan Strategi Tatalaksana ARDS



Curr Opin Crit Care 2016, 22:21–37.

Epidemiological characteristics, practice of ventilation, and clinical outcome in patients at risk of acute respiratory distress syndrome in intensive care units from 16 countries (PRoVENT): an international, multicentre, prospective study

Lancet Respir Med. 2016;4:882–93.

*Ary Serpa Neto, Carmen S V Barbas, Fabienne D Simonis, Antonio Artigas-Raventós, Jaume Canet, Rogier M Determann, James Anstey, Goran Hedenstierna, Sabrine N T Hemmes, Greet Hermans, Michael Hiesmayr, Markus W Hollmann, Samir Jaber, Ignacio Martin-Loeches, Gary H Mills, Rupert M Pearse, Christian Putensen, Werner Schmid, Paolo Severgnini, Roger Smith, Tanja A Treschan, Edda M Tschernko, Marcos F V Melo, Hermann Wrigge, Marcelo Gama de Abreu, Paolo Pelosi, Marcus J Schultz, for the PRoVENT and the PROVE Network investigators**

Summary

Background Scant information exists about the epidemiological characteristics and outcome of patients in the intensive care unit (ICU) at risk of acute respiratory distress syndrome (ARDS) and how ventilation is managed in these individuals. We aimed to establish the epidemiological characteristics of patients at risk of ARDS, describe ventilation management in this population, and assess outcomes compared with people at no risk of ARDS.

Methods PRoVENT (PRactice of VENTilation in critically ill patients without ARDS at onset of ventilation) is an international, multicentre, prospective study undertaken at 119 ICUs in 16 countries worldwide. All patients aged 18 years or older who were receiving mechanical ventilation in participating ICUs during a 1-week period between January, 2014, and January, 2015, were enrolled into the study. The Lung Injury Prediction Score (LIPS) was used to stratify risk of ARDS, with a score of 4 or higher defining those at risk of ARDS. The primary outcome was the proportion of patients at risk of ARDS. Secondary outcomes included ventilatory management (including tidal volume [V_T] expressed as mL/kg predicted bodyweight [PBW], and positive end-expiratory pressure [PEEP] expressed as cm H_2O), development of pulmonary complications, and clinical outcomes. The PRoVENT study is registered at ClinicalTrials.gov, NCT01868321. The study has been completed.

Epidemiological characteristics, practice of ventilation, and clinical outcome in patients at risk of acute respiratory distress syndrome in intensive care units from 16 countries (PRoVENT): an international, multicentre, prospective study

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Findings Of 3023 patients screened for the study, 935 individuals fulfilled the inclusion criteria. Of these critically ill patients, 282 were at risk of ARDS (30%, 95% CI 27–33), representing 0·14 cases per ICU bed over a 1-week period. V_T was similar for patients at risk and not at risk of ARDS (median 7·6 mL/kg PBW [IQR 6·7–9·1] *vs* 7·9 mL/kg PBW [6·8–9·1]; p=0·346). PEEP was higher in patients at risk of ARDS compared with those not at risk (median 6·0 cm H_2O [IQR 5·0–8·0] *vs* 5·0 cm H_2O [5·0–7·0]; p<0·0001). The prevalence of ARDS in patients at risk of ARDS was higher than in individuals not at risk of ARDS (19/260 [7%] *vs* 17/556 [3%]; p=0·004). Compared with individuals not at risk of ARDS, patients at risk of ARDS had higher in-hospital mortality (86/543 [16%] *vs* 74/232 [32%]; p<0·0001), ICU mortality (62/533 [12%] *vs* 66/227 [29%]; p<0·0001), and 90-day mortality (109/653 [17%] *vs* 88/282 [31%]; p<0·0001). V_T did not differ between patients who did and did not develop ARDS (p=0·471 for those at risk of ARDS; p=0·323 for those not at risk).

Interpretation Around a third of patients receiving mechanical ventilation in the ICU were at risk of ARDS. Pulmonary complications occur frequently in patients at risk of ARDS and their clinical outcome is worse compared with those not at risk of ARDS. There is potential for improvement in the management of patients without ARDS. Further refinements are needed for prediction of ARDS.

KESIMPULAN

- ARDS adalah suatu kondisi klinis yang mengancam jiwa dengan mortalitas yang tinggi.
- Pencegahan terjadinya ARDS dilakukan sedini mungkin dengan melakukan penilaian klinis.
- Identifikasi pasien sedini mungkin terhadap risiko terjadinya ARDS berhubungan dengan penurunan mortalitas.

TERIMA KASIH