Adjunctive Treatments for Lung Recovery on ECMO

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SWAC ELSO 2016 ABU DHABI

Objectives

Explore the indications, contraindications, benefits, side effects and key points for the following adjunctive treatments in patients supported on ECMO

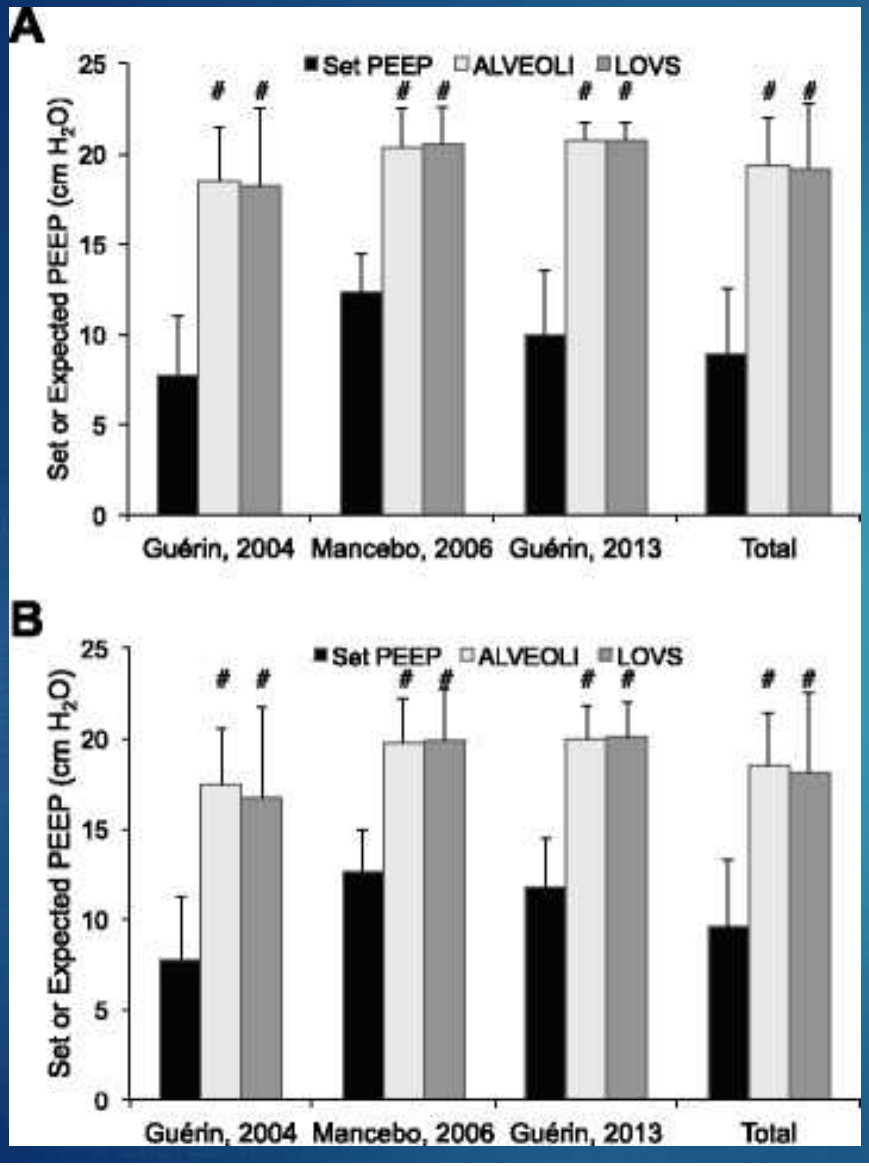
- Prone Positioning
- Bronchoscopy
- Systemic Steroids
- Surfactant
- Perfluorocarbon

Evaluate the available evidence relating to these therapies

Proning

Indications: ARDS + Posterior Consolidation (ELSO ARDS Guideline)

- Survival benefit of 10-15% (Gattinoni L)
- PEEP titration in proning studies sub-optimal (Beitler J et al)
- Little Evidence for Proning on ECMO : Safe + Short term benefit
- Contraindications: Abdominal Compartment, Haemodynamic Instability, Actve Bleeding, Pressure Sore
- Low incidence of Side Effects : Dislodge Cannula/ET, Bleeding



Beitler J et al PEEP Titration and Prone Positioning for ARDS Crit Care 2015 Dec 21; 19:436

Prolonged prone positioning under VV-ECMO is safe and improves oxygenation and respiratory compliance

Kimmoun *et al. Ann. Intensive Care (2015) 5:35*
DOI 10.1186/s13613-015-0078-4

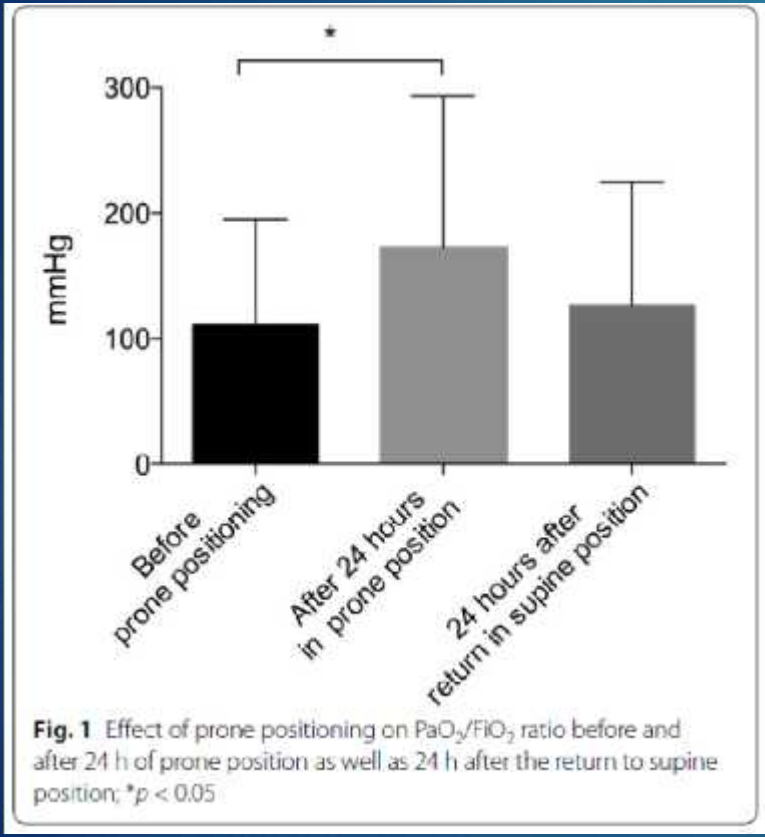


Fig. 1 Effect of prone positioning on PaO_2/FiO_2 ratio before and after 24 h of prone position as well as 24 h after the return to supine position; *$p < 0.05$

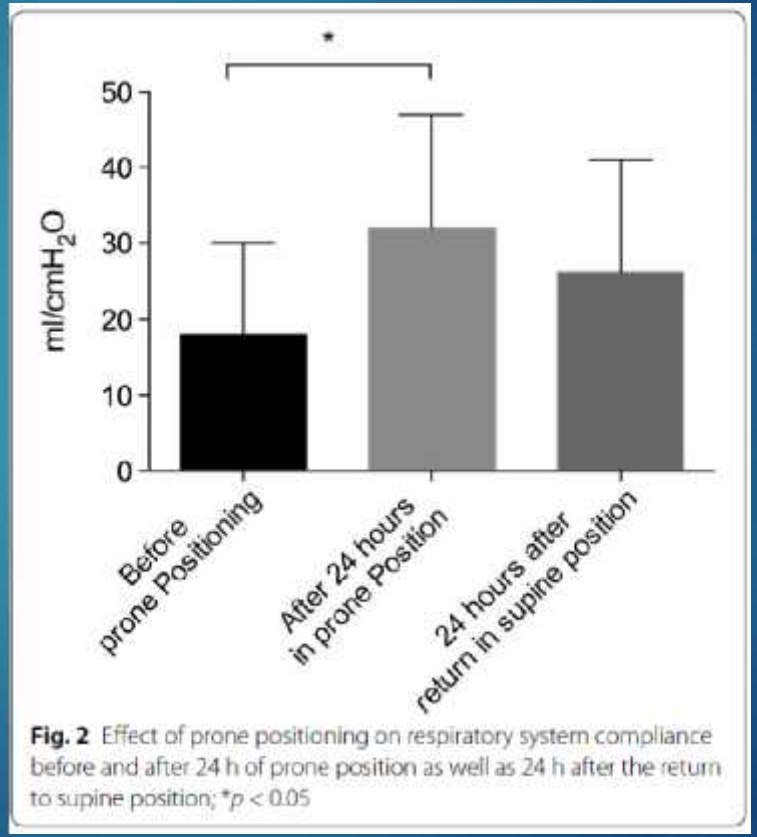


Fig. 2 Effect of prone positioning on respiratory system compliance before and after 24 h of prone position as well as 24 h after the return to supine position; *$p < 0.05$

24 treatments in 17 cases of ARDS on ECMO : 24 hr

Prone on ECMO

Key Points Proning

- Get Enough People
- Team leader(coordinator/specialist), Task allocation, clear communication/timing
- Practise/Simulate
- Optimise sedation (+/- relaxants)
- Protect/Fix cannulas: monitor positon on interval CXR/ECHO
- Prone for at least 16 hours

Complications of Prone Positioning During Extracorporeal Membrane Oxygenation for Respiratory Failure: A Systematic Review

Rachel E Culbreth MPH RRT and Lynda T Goodfellow EdD RRT AE-C FAARC

Respir Care 2016;61(2):249–254

111 patients in 7 studies (1 prospective)

No Cannula dislodgement

Cannula site bleeding in 2 studies (11 of 74 episodes in 1 study)

No ET dislodgement: 1 episode of ET obstruction

Chest tube bleeding minor (13.5% in one study

Haemodynamic instability minor/transient (17 of 74 episodes)

Safe but larger prospective trials needed

Leicester winning the Premier League: " possibly the most unlikely triumph in the history of team sport"

Gary Linneker

Bronchoscopy

- Uses diagnostic/ lavage, debris and cast removal/direct therapies (eg DNAse, Cryoprobe) little evidence in relation to ECMO
- Indicated in patients with intractable persistent consolidation
- Contraindicated high vent. on ECMO, Recent Pulm Hemorrhage
- Pro/Con: Lung recruitment/Contact bleeds, Inc. Vent. Reqt.
- Key Point: Minimise contact bleeds + maintain PEEP

Use of Flexible Bronchoscopy in Pediatric Patients Receiving Extracorporeal Membrane Oxygenation (ECMO) Support

Pediatric Pulmonology 46:1108–1113 (2011)

- Kamat P et al (Fontenberry J) Atlanta

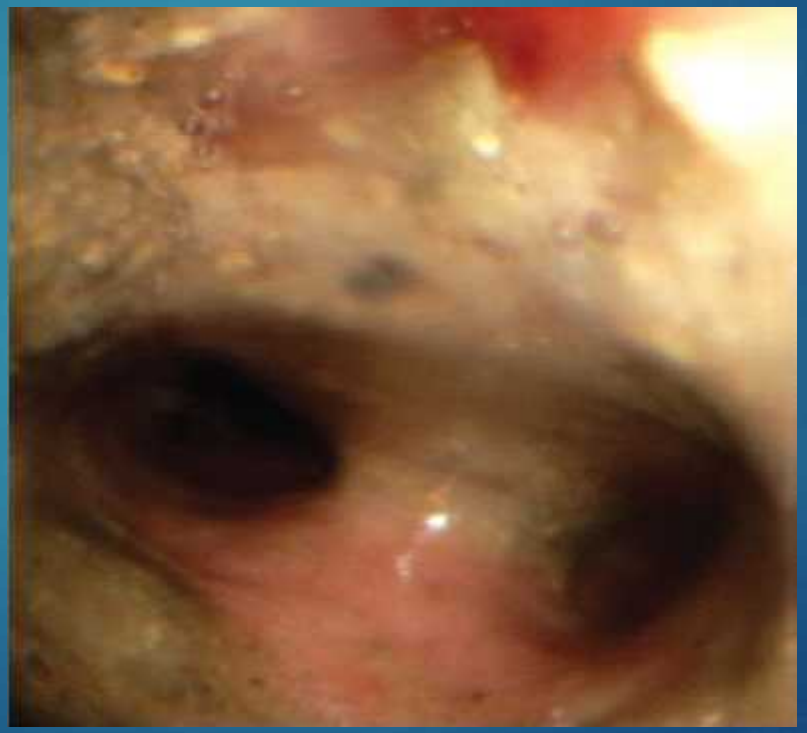
153 Bronchoscopies on 79 patients 2000-8
33/79 Culture positive BAL
3 on to HFOV post bronchoscopy
No ECMO complications

Indication	Number of bronchoscopies	Percent
Diagnosis of infection	26	17
Removal of secretions/atelectasis	118	77
Diagnosis of airway patency	7	4.6
Instillation of surfactant	4	2.6
Total	155[1]	

Secretions	Number of bronchoscopies	Percent
Thin	14	9.2
Thick	77	50.3
Mucoid	15	9.8
Mucopurulent	28	18.3
Bronchial casts	5	3.2
Blood tinged[1]	53	34.6

Pediatric sand aspiration managed using bronchoscopy and extracorporeal membrane oxygenation

Baqais K et al Can Resp J 2015:22(5):261-2 Calgary



OOH Cardiac arrest 11yr boy buried in sand at lake shore

Extracted + revived bystander CPR

Intubated local Hosp. Airlifted PICU

Fem-Fem VV ECMO Failed Rigid Bronch

Successful FB Good outcome

Systemic Steroids

- Evidence does not support routine use in ARDS: case selection
- Contraindicated active sepsis/immunodeficiency and H1N1
- Most benefit seen for use in ARDS> 5days < 14 days
- Methyl Pred 1mg/kg/day by continuous infusion 7days then tapered
- Benefit: faster resolution of ARDS shorter ECMO run
- Side effects: secondary infection, hypertension, hyperglyc., GI Bleed
- No evidence related directly to ECMO

High dose Pulse advocated (Peek et al Ch 21 p 314 in 4th edition ECMO in Critical Care - Red Book) for no resolution in prolonged ECMO run

Exploring the heterogeneity of effects of corticosteroids on acute respiratory distress syndrome: a systematic review and meta-analysis

Ruan *et al. Critical Care* 2014, **18**:R63

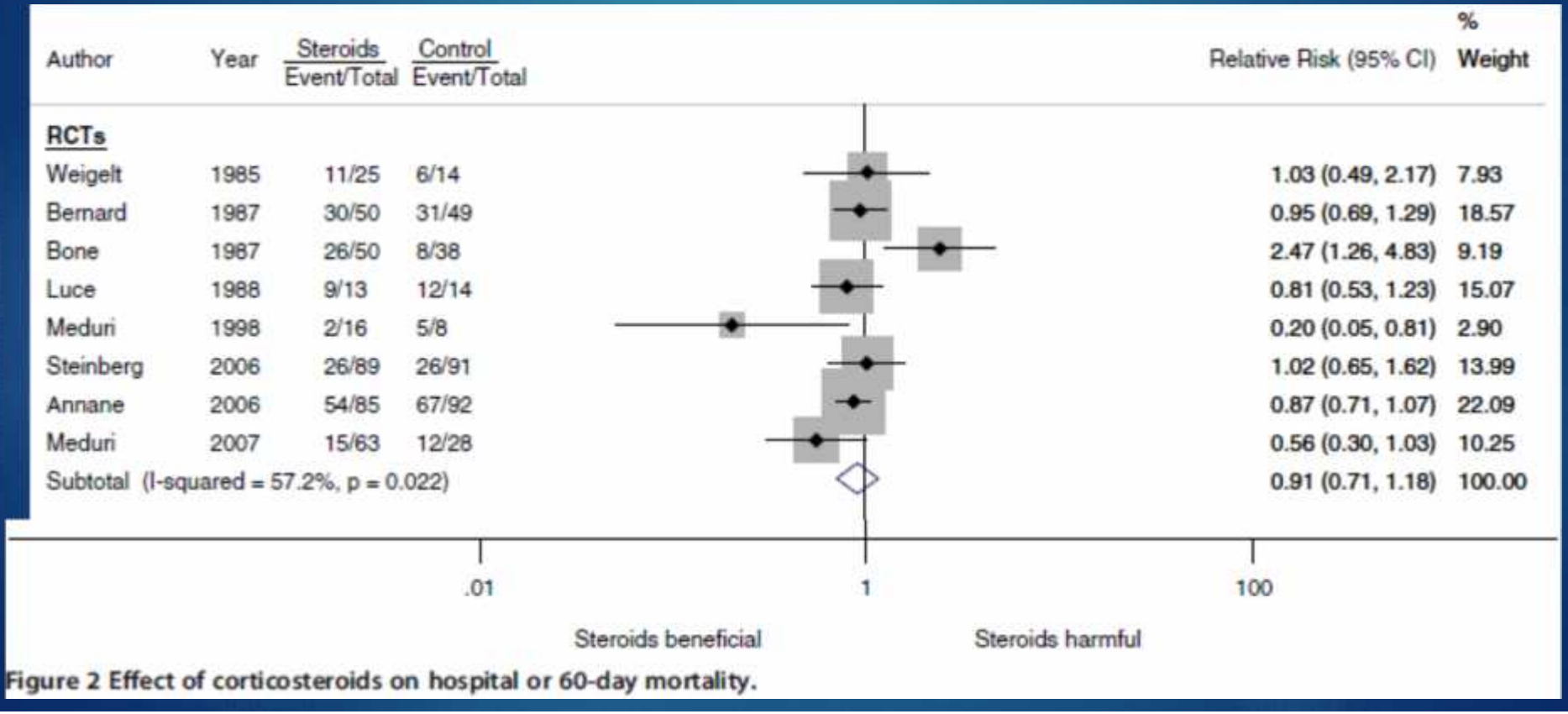


Figure 2 Effect of corticosteroids on hospital or 60-day mortality.

Surfactant

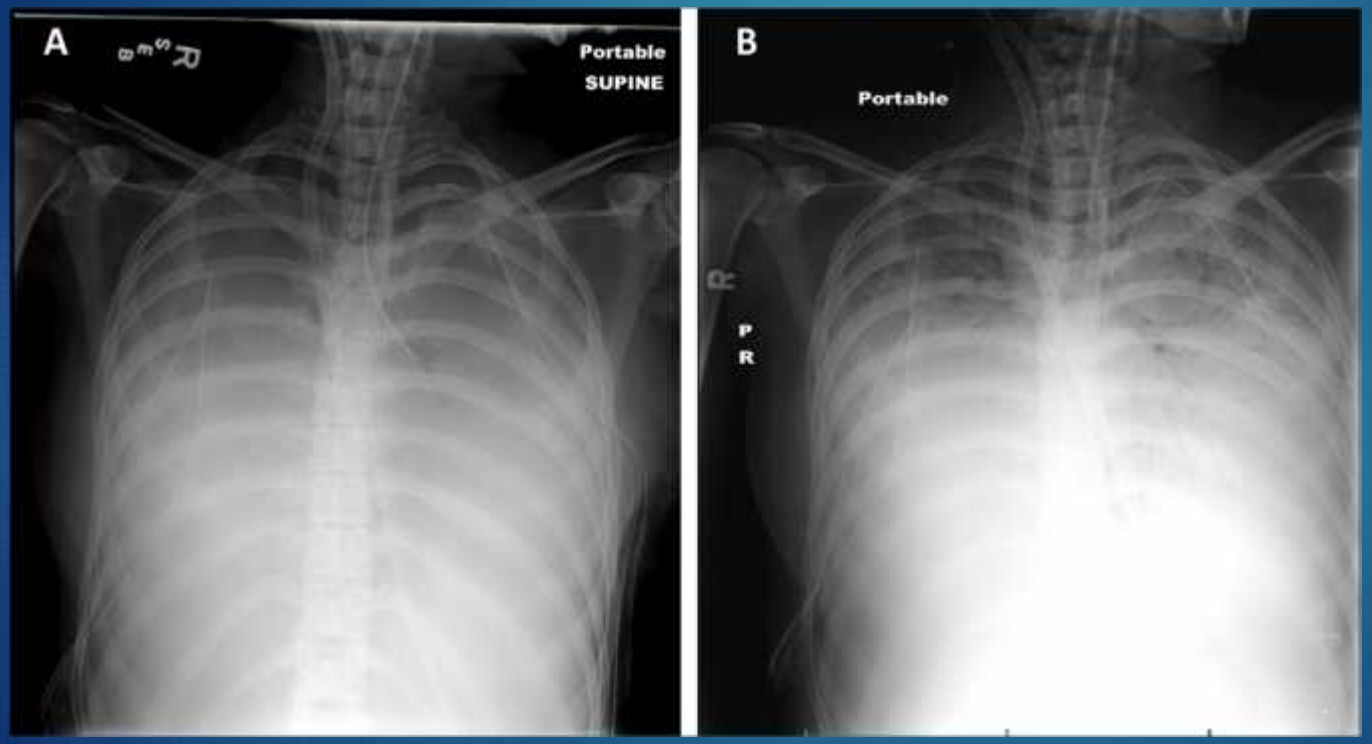
- Adult and Padiatrc Calfactant in ARDS RCT's negative
- Main use in MAS: Evidence mainly in preventing need for ECMO
- Contraindations: Pulmonary Hemorrhage, DIC
- Benefits: Increases Lung Compliance
- Side effects: Pulmonary Hemorrhage
- Key Point: Use after re-aeration pre-trial off

Perfluorocarbon

- Perfluorocarbon: limited license for lung recruitment/lavage in patients on ECMO
- Not licensed for liquid ventilation
- High density and low viscosity: float debris out of alveoli/small airways and reopen collapsed segments
- Published use for lung recruitment in CDH + pulmonary hemorrhage
- Evidence: case reports +1 recent small RCT in CDH patients
- Key Point: suction out airway/debris and fluid together + keep well topped up

Perfluorocarbon lavage for Pulmonary Haemorrage

Horvat CM Resp Med Case Rep 2015 Mar 11;15: 7-8 (Carcillo J Pittsburgh)



17 yr Girl Ventilated Pneumonia

Pigtail insertion for PTX caused Pulm Haem + Haemothorax D2

D10 VV ECMO: FB thrombi in both Main bronchi Saline lavage unsuccessful

Small Vol PFC trial OK : 4ml/kg 250 ml + left on 20/10 significant thrombus cleared 3 /4 reaerated on HFOV

Double Lung Transplant
Staph Aureus Necrosis

Safety and efficacy of perflubron-induced lung growth in neonates with congenital diaphragmatic hernia: Results of a prospective randomized trial

George Mychaliska*, Benjamin Bryner, Ronald Dechert, Jeannie Kreutzman, Mike Becker, Ronald Hirschl

Journal of Pediatric Surgery 50 (2015) 1083–1087

Outcome measurements of PILG and CMV groups of infants with CDH requiring ECMO.

	PILG (n = 8)	CMV (n = 8)	P-value*
Survival to discharge	4 (50%)	6 (75%)	0.36
ECMO run length	17.8 ± 6.2	11.1 ± 7.3	0.066
Ventilator-free days (of 60 days)	16.6 ± 17.9	15.7 ± 17.3	0.93
Pulmonary hypertension (systemic pulmonary artery pressures) on echocardiogram	4 (50%)	3 (38%)	1

* From Fisher's exact test, Mann–Whitney *U* test, or t-test.

Rapid lung growth achieved IN PILG group
No improvement in outcomes
Vascular remodelling not achieved
Michigan

References

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