

Pulmonary and extrapulmonary ARDS: morphological and functional analysis

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Argomento: Insufficienza respiratoria acuta e ventilazione meccanica

Background. ARDS can result from a "direct" lung insult (pulmonary ARDS) or from an "indirect" insult (extrapulmonary ARDS)[1]. The $\text{PaO}_2/\text{FiO}_2$ ratio defines ARDS severity and a 150 P/F threshold divides patients into two homogeneous populations that differ in anatomical and physiological characteristics[2]. Mechanical power (MP) defines the energy applied to the respiratory system in the unit of time[3].

Aim. Aim of the study is to investigate whether ARDS etiology (pulmonary or extrapulmonary) identifies two subgroups of ARDS patients that differ in anatomical and functional characteristics within ARDS severity classes.

Materials and methods. 188 ARDS patients underwent two CT scans at PEEP 5 and 45 cmH₂O to perform a quantitative CT scan analysis and obtain the amount of not, poorly, well and over inflated tissue. The same day, a PEEP test at 5 and 15 cmH₂O was performed to measure gas exchange, lung mechanical characteristics and to compute MP. Patients were divided in subgroups: pulmonary- $\text{P/F} \leq 150$, extrapulmonary- $\text{P/F} \leq 150$, pulmonary- $\text{P/F} > 150$ and extrapulmonary- $\text{P/F} > 150$ according to ARDS etiology and severity. Repeated Measures ANOVA has been used to compare groups. Data are expressed as mean (SD) or median [I.Q.] as appropriate.

Results. As shown in table 1, ARSD patients in $\text{P/F} \leq 150$ group had greater lung recruitability, lung weight, not inflated tissue, death space and MP/GAS_5 than $\text{P/F} > 150$ patients (p_{severity}); whereas PaO_2 was significative lower. Pulmonary patients had higher recruitability and total lung weight than extrapulmonary patients (p_{etiology}). No significative differences in lung mechanics or gas exchange were identified between pulmonary and extrapulmonary patients within the same severity class neither there was any significant interaction between severity and etiology ($p_{\text{sev*etiol}}$).

Conclusions. In ARDS patients, within the same severity class, lung etiology (pulmonary or extrapulmonary) do not influence functional or mechanical characteristics.

References:

1. Gattinoni. AJRCCM.1998;158:3-11
2. Maiolo. AJRCCM.2018. Ahead of print.

3. Gattinoni. ICM.2016;42:1567-1575

	P/F ≤ 150 (n= 98)		P/F > 150 (n = 90)		Pseverity	Petiology	Petiol*sev
	Pulmonary ARDS (n = 59)	Extrapulmonary ARDS (n= 39)	Pulmonary ARDS (n = 31)	Extrapulmonary ARDS (n= 59)			
Lung recruitability (%)							
Paw 5 - 45	21 (14)	16 (8)	11 (7)	8 (6)	<0.001	0.010	0.308
Total lung weight (g)							
Paw 5	1618 [1424 - 2064]	1495 [1339 - 1853]	1363 [1119 - 1390]	1224 [1033 - 1388]	<0.001	0.035	0.830
Total lung volume (mL)							
Paw 5	2857 (897)	2680 (821)	2620 (788)	2494 (684)	0.072	0.221	0.836
Non-inflated lung (%)							
Paw 5	51 (17)	47 (16)	35 (15)	35 (13)	<0.001	0.914	0.426
Paw 45	30 (14)	31 (15)	23 (12)	26 (12)			
Poorly inflated lung (%)							
Paw 5	27 [20 - 39]	28 [22 - 40]	32 [25 - 38]	28 [21 - 39]	0.020	0.134	0.814
Paw 45	34 [20 - 43]	24 [21 - 33]	21 [19 - 26]	19 [16 - 25]			
Well-inflated lung (%)							
Paw 5	18 (14)	21 (12)	32 (11)	35 (12)	<0.001	0.165	0.378
Paw 45	34 (14)	40 (14)	50 (13)	49 (11)			
Over-inflated lung (%)							
Paw 5	0 [0 - 0]	0 [0 - 0]	0 [0 - 0]	0 [0 - 0]	0.210	0.882	0.491
Paw 45	0 [0 - 3]	1 [0 - 2]	2 [1 - 5]	3 [0 - 5]			
PaO ₂ (mmHg)							
PEEP 5	62 [55 - 70]	67 [60 - 73]	77 [71 - 93]	86 [75 - 98]	<0.001	0.290	0.742
PEEP 15	90 [74 - 119]	94 [74 - 111]	97 [84 - 123]	105 [84 - 131]			
Physiological dead space							
PEEP 5	0.67 (0.13)	0.62 (0.16)	0.56 (0.10)	0.54 (0.11)	<0.001	0.109	0.651
PEEP 15	0.68 (0.13)	0.63 (0.15)	0.59 (0.10)	0.56 (0.12)			
Lung to respiratory system elastance ratio (%)							
PEEP 5	76 (14)	74 (15)	79 (7)	75 (14)	0.885	0.121	0.415
PEEP 15	76 (10)	75 (13)	77 (11)	70 (15)			
End-inspiratory airway plateau pressure (cmH ₂ O)							
PEEP 5	20 (4)	19 (3)	18 (3)	18 (3)	0.208	0.900	0.951
PEEP 15	28 (4)	29 (3)	29 (4)	28 (3)			
End-inspiratory transpulmonary pressure (cmH ₂ O)							
PEEP 5	15 (5)	13 (4)	15 (3)	14 (4)	0.984	0.160	0.540
PEEP 15	21 (5)	21 (4)	22 (6)	20 (5)			
Mechanical power (J/min)							
PEEP 5	18 (9)	18 (8)	15 (5)	17 (7)	0.139	0.702	0.728
PEEP 15	26 (11)	26 (10)	24 (8)	24 (8)			
Mechanical power/Gas ₅ (J/min*L)							
PEEP 5	21 [10 - 36]	19 [10 - 25]	12 [9 - 15]	13 [10 - 20]	<0.001	0.574	0.795
PEEP 15	30 [15 - 42]	25 [17 - 38]	19 [15 - 27]	19 [14 - 26]			

Table 1. Comparison of CT, functional and mechanical data in ARDS patients sorted according to etiology (pulmonary or extrapulmonary) and severity (P/F ≤ or > 150).