Lung Recruitment in Obese Patients with Acute Respiratory Distress Syndrome

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Argomento: Insufficienza respiratoria acuta e ventilazione meccanica

Background: Obese patients are characterized by normal chest-wall elastance and high pleural pressure and have been excluded from trials assessing best strategies to set Positive End-Expiratory Pressure (PEEP) in Acute Respiratory Distress Syndrome (ARDS). We hypothesized that severely obese patients with ARDS present with a high degree of lung collapse reversible by titrated PEEP preceded by a lung recruitment maneuver.

Methods: Severely obese ARDS patients were enrolled in a physiological crossover study evaluating the effects of three PEEP titration strategies applied in the following order: (1)$PEEP_{ARDSNET}$: the low PEEP/FiO_2ARDSnet table, (2)$PEEP_{INCREMENTAL}$: PEEP levels set to determine a positive end-expiratory transpulmonary pressure, and (3)$PEEP_{DECREMENTAL}$: PEEP levels set to determine the lowest respiratory system elastance during a decremental PEEPtrial following arecruitment maneuveron respiratory mechanics, regional lung collapse and overdistension according to electrical impedance tomography, and gas exchange.

Results: Fourteen patients underwent the study procedures. At $PEEP_{ARDSNET}$(13±1cmH_2O) end-expiratory transpulmonary pressure was negative (-5±5cmH_2O), lung elastance was 27±12cmH_2O/L, and $PaO_2/F_iO_2$was 194±111mmHg. Compared to $PEEP_{ARDSNET,}$ at $PEEP_{INCREMENTAL}$level (22±3cmH_2O) lung volume increased (977±708mL), lung elastance decreased (23±7cmH_2O/L), lung collapse decreased (18±10%)and ventilation homogeneity increased thus rising oxygenation (251±105mmHg), despite higher overdistension levels (16±12%), all values $p< 0.05$ *vs*$PEEP_{ARDSnet}$. Setting PEEP according to a $PEEP_{DECREMENTAL}$trial after a recruitment maneuver (21±4cmH_2O, p=0.99 *vs*$PEEP_{INCREMENTAL}$) further lowered lung elastance (19±6cmH_2O/L) and increased oxygenation (329±82mmHg) while reducing lung collapse (9±2%) and overdistension (11±2%), all values $p< 0.05$ *vs*$PEEP_{ARDSnet}$and $PEEP_{INCREMENTAL}$. All patients were maintained on titrated PEEP levels up to 24 hours without hemodynamic or ventilation related complications.

Conclusions: Among the PEEP titration strategies tested, setting PEEP according toa $PEEP_{DECREMENTAL}$trial preceded by a recruitment maneuver obtained the best lung function by decreasing lung overdistension and collapse, restoring lung elastance and oxygenation suggesting lung tissue recruitment.

N=14	PEEP $_{ARDSnet}$	PEEP $_{INCREMENTAL}$	PEEP $_{DECREMENTAL}$
PEEP, cmH_2O	13 ± 1	22 ± 3 *	21 ± 4 *
P-plat, cmH_2O	26 ± 4	33 ± 4 *	31 ± 4 *
Driving Pressure, cmH_2O	13 ± 4	11 ± 2 *	10 ± 2 *#
P_LE, cmH_2O	-5 ± 5	1 ± 4 *	1 ± 4 *
Driving $P_{L,}$ cmH_2O	10 ± 4	9 ± 3 *	7 ± 4 *#
$Elastance_{RS}$, cmH_2O/ L	34 ± 13	29 ± 8 *	25 ± 6 *#
$Elastance_L$, cmH_2O/ L	27 ± 12	23 ± 7 *	19 ± 6 *#
$Elastance_{CW}$, cmH_2O/ L	8 ± 5	6 ± 4 *	6 ± 3*
R_{AW}, cmH_2O/L/sec	14 ± 2	12 ± 2 *	12 ± 2 *
EELV, mL[§]	-	977 ± 708 *	1064 ± 813 *
HR, bpm	89 ± 22	85 ± 20	87 ± 20
MAP, mmHg	83 ± 11	77 ± 7	82 ± 9 #
pH	7.35 ± 0.06	7.34 ± 0.07	7.32 ± 0.07 *#
PaO_2/FiO_2	194 ± 111	251 ± 105 *	329 ± 82 *#
$PaCO_2$, mmHg	45 ± 10	46 ± 9	49 ± 10 *#
V_D/V_T[¶]:			
Physiological, %	49 ± 11	47 ± 11	47 ± 12
Airways, %	30 ± 5	33 ± 6 *	31 ± 7
Alveolar, %	19 ± 9	15 ± 8 *	16 ± 9

Table: Ventilator settings, respiratory mechanics, hemodynamic, gas exchange

[§] EELV is expressed as volume increment from the $PEEP_{ARDSnet}$ level [¶] N=11
*p<0.05 compared to $PEEP_{ARDSnet}$ ($p < 0.05$); # p<0.05 compared to $PEEP_{INCREMENTAL}$.

PEEP=Positive End-Expiratory Pressure; Vt=Tidal Volume; IBW=Ideal Body Weight; RR=Respiratory Rate; P-Plat=Plateau Pressure; P_LE=End-Expiratory Transpulmonary Pressure; $Elastance_{RS}$=Elastance of the Respiratory System; $Elastance_L$=Elastance of the Lung; $Elastance_{CW}$=Elastance of the Chest Wall; R_{AW}=Airway Resistance; EELV=End-Expiratory Lung Volume; HR=Heart Rate; MAP=Mean Arterial Pressure; PaO_2/FiO_2=arterial partial pressure of oxygen to inspired fraction of oxygen ratio; $PaCO_2$=arterial partial pressure of carbon dioxide; V_D/V_T=Dead Space.