LA VENTILATION SPONTANÉE AU COURS DU SDRA

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REVA: European Network on Mechanical Ventilation
ALMS: Medical Advisor
CONFLICTS OF INTEREST

Part Time:

Air Liquide Medical Systems

SAU Emergency and ICU department Annecy France

Research from our laboratory in Geneva was supported:

– VYGN
– MAQUET (NAVA)
– COVIDIEN (PAV+)
– DRAGER (SmartCare)
– GE (FRC)
DEFINITION

Spontaneous Ventilation: meaning what?

Spontaneous Ventilation refers to the spontaneous and sustained contraction of respiratory muscles.

Paw

Flow

Pes
DEFINITION

*Spontaneous Ventilation*: meaning what?

Spontaneous Ventilation refers to the spontaneous and sustained contraction of respiratory muscles.
MECHANICAL VENTILATION TO MINIMIZE PROGRESSION OF LUNG INJURY IN ACUTE RESPIRATORY FAILURE

Laurent Brochard\textsuperscript{1,2}, Arthur Slutsky\textsuperscript{1,2}, Antonio Pesenti\textsuperscript{3,4}

\textbf{Palv}
Paw (cm H\textsubscript{2}O)

\textbf{Pes}
(cm H\textsubscript{2}O)

\textbf{P_L = Paw - Pes}
(cm H\textsubscript{2}O)

Volume (L)

CMV
SB
Partial Assist
Do spontaneous and mechanical breathing have similar effects on average transpulmonary and alveolar pressure? A clinical crossover study

WHY IS SPONTANEOUS BREATHING DESIRABLE?

Preserve Respiratory Muscle Function (avoid VIDD)

Improve VA/Q and Regional Ventilation

Reduce sedation and days with MV

Jaber et al. Am J Respir Crit Care Med 2013
Putensen et al. Am J Respir Crit Care Med 1999
Girard et al. Lancet 2008
Higher levels of spontaneous breathing induce lung recruitment and reduce global stress/strain in experimental lung injury.

Andreas Güldner, M.D., Anja Braune, M.Sc., Nadja Carvalho, Ph.D., Alessandro Beda, Ph.D., Stefan Zeidler, M.S., Bärbel Wiedemann, Ph.D., Gerd Wunderlich, Ph.D., Michael Andreeff, Ph.D., Christopher Uhlig, M.D., Peter M. Spieth, M.D., Thea Koch, M.D., Ph.D., Paolo Pelosi, M.D., Jörg Kotzerke, M.D., Ph.D., Marcelo Gama de Abreu, M.D., M.Sc., Ph.D., D.E.S.A.

APRV with 1/1 or 1/2 IE ratio

« Higher levels of spontaneous breathing with controlled ventilation decreased the mechanical stress in lungs compared with ventilation without spontaneous breathing. »

Anesthesiology 2014
Spontaneous Effort Causes Occult Pendelluft during Mechanical Ventilation

Takeshi Yoshida¹,², Vinicius Torsani¹, Susimeire Gomes¹, Roberta R. De Santis¹, Marcelo A. Beraldo¹, Eduardo L. V. Costa¹, Mauro R. Tucci¹, Walter A. Zin³, Brian P. Kavanagh⁴,⁵, and Marcelo B. P. Amato¹

This study demonstrates that in ARDS, negative pleural pressure generated by diaphragm is not uniformly transmitted thus leading pendelluft phenomenon, with shift of air from nondependent to dependent lung regions, without changes in tidal volume.
Different working principle in pressure regulated modes

Spontaneous Breathing (CPAP)

PC + CPAP = APRV

PAC ventilation
IS SPONTANEOUS VENTILATION AND RELATED VT AFFECTED BY THE MODE OF VENTILATION?

Potentially harmful effects of inspiratory synchronization during pressure preset ventilation

- APRV (Non inspiratory synchronized)
- BIPAP (partially i synchronized)
- PAC (full i synchronized)

VT change in the presence of spontaneous breaths according to i-synchronization

APRV

BIPAP

PAC

Tidal volume [ml]
Airway pressure [cmH₂O]
Muscular pressure [cmH₂O]
Transpulmonary pressure swing [cmH₂O]

10 ml/kg/IBW
6 ml/kg/IBW
4 ml/kg/IBW

Fully i-synchronized mode
Clinical observations:
4 ARDS Patients successively ventilated with APRV and BIPAP and PAC
Clinical observations:
8 ARDS patients under APRV over 5 days

![Diagram showing tidal volume and spontaneous activity percentage]
### Long-Term Effects of Spontaneous Breathing During Ventilatory Support in Patients with Acute Lung Injury

CHRISTIAN PUTENSEN, SABINE ZECH, HERMANN WRGGE, JÖRG ZINSERLING, FRANK STÜBER, TILMANN VON SPIEGEL, and NORBERT MUTZ

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV (days)</td>
<td>21± 2</td>
<td>15± 2</td>
<td>.03</td>
</tr>
<tr>
<td>ICU stay (days)</td>
<td>30± 2</td>
<td>23± 2</td>
<td>.03</td>
</tr>
<tr>
<td>Mortality</td>
<td>26 %</td>
<td>20 %</td>
<td>ns</td>
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Ventilation settings

**H0 H3: ACV**  
$V_t = 6 \text{ ml/kg PBW}$ and $\text{PEP : pour } P_{\text{plat}} = 28 \text{ cmH}_2\text{O}$

- **Mode:** VAC
- $V_t = 6 \text{ ml/kg PBW}$
- $\text{Insp flow. : 50 à 70 L/mn}$
- $\text{PEP : pour } P_{\text{plat}} = 28 \text{ cmH}_2\text{O}$

- **Mode:** APRV
- $\text{Thigh : 1s}$
- $\text{Tlow : for } FR = FR \text{ during VAC}$
  - $\text{Plow : idem PEEP en ACV}$
  - $\text{Phigh : for } V_t=6\text{ml/kg PBW and } P_{\text{plat max}} = 28 \text{ cmH}_2\text{O}$

*Principal Investigator:*  
JCM Richard  
L Brochard  
A Mercat
BIPAP-APRV → ventilation spontanée
Management of spontaneous ventilation

BIPAP-APRV

Spontaneous Ventilation = 10 à 50 % of VM tot

Check goals (Spontaneous Vent and Vt) every 8 or 12 h

- SV < 10% and RASS < -2
  - Sedation

- SV < 10% and Sedation OK
  - pH: alcalosys?
    - If yes
      - Tlow
      - RR

- SV > 50% and Sedation OK
  - pH: acidose
    - If yes
      - Tlow
      - RR
      - Si T° > 38° C
      - +/- cooling

- SV > 50% and RASS > -2
  - Sedation
Chers investigateurs, chers collègues, chers amis,

Nous sommes actuellement à **683 patients inclus**. Plus que **17 patients** à inclure d'ici **décembre 2017** pour atteindre les **700 patients attendus** !

Vous avez réalisé **54 inclusions** entre Avril et Août 2017. Félicitations ! Un grand **merci** pour votre implication et votre motivation !
CONCLUSIONS

- At the early phase of ARDS Vt and TPP control are the priority

- Moderate level of spontaneous ventilation may be beneficial in these setting.

- Pressure modes of ventilation work differently depending of there level of inspiratory synchronization.

- APRV may be interesting to combine protective ventilation and spontaneous diaphragmatic activity.
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## Controlled ventilation in ARDS

- Heavy sedation +/- paralysis

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Drawbacks</th>
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<tr>
<td>↓ VO2 and VCO2</td>
<td>Impaired hemodynamics</td>
</tr>
<tr>
<td>↓ ventilatory requirements</td>
<td></td>
</tr>
<tr>
<td>Control of tidal volume and plateau pressure</td>
<td>Monotony</td>
</tr>
<tr>
<td>➔ Prevention of « VILI »</td>
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<tr>
<td>Avoid agitation and asynchrony</td>
<td>Atrophy and weakness of respiratory muscles (VIDD)</td>
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