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Utilization of an Automatic Mode of Ventilation (ASV) in a Mixed ICU population: Prospective Observational Study

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Introduction

Adaptive Support Ventilation (ASV) is an automatic mode of mechanical ventilation that has been proven to simplify postoperative respiratory management[1,2] and to improve patient-ventilator interaction[3]. Prior to this study, there was no data available on routine ASV utilization in a large population of mixed intensive-care patients.

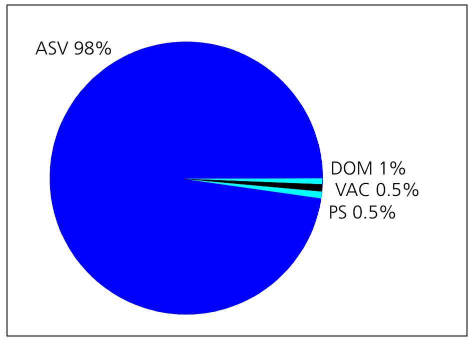

Figure 1: Modes of ventilatory support used. VAC: volume control, PS: pressure support, DOM: homecare ventilator.

Method

This prospective observational study reports the use of ASV as the primary mode of ventilation in an 11-bed mixed ICU, over a 7-month period. While the clinician sets minute volume (as a percentage of the "ideal" minute volume: %MinVol), the ASV algorithm determines tidal volume and respiratory frequency based on respiratory mechanics, in such a way as to minimize the work of breathing[4]. Moreover, ASV encourages spontaneous breathing activity, providing full or partial ventilatory support. It is therefore well suited to use in the initiation, maintenance or weaning phase of mechanical ventilation. Contra-indications for ASV were noninvasive ventilation, bronchopleural fistula and Cheynes-Stocke breathing. The clinicians were allowed to switch to another mode of ventilation if the optimal tidal volume was not achieved despite a plateau pressure above 30 cmH_2O or in the case of patient-ventilator asynchrony. Data (Table 1) were recorded on a day-by-day basis (6 a.m. daily) and analyzed each day of invasive ventilation. Results are given with mean ± SD.

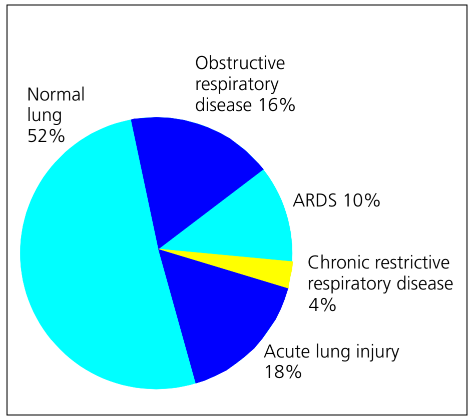

Figure 2: Indications for mechanical ventilation.

Results

Over the study period, 322 patients were admitted to the intensive care unit, amounting to 2144 days of hospitalization. The mean IGS II was 46. There were 1506 days of ventilation (70%) with 1349 days of invasive ventilation (89%).

ASV was used in 98% of invasive ventilation-days (Figure 1) including the weaning period. The %MinVol set was between 116% and 137%.

Indications for mechanical ventilation are detailed in Figure 2. Breathing pattern, mechanics and gas exchange based on the underlying

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lung disease (assessed by the physician in charge) are given in Table 1. Mean duration of ventilation and stay in intensive care are respectively 6,6 and 7,6 days. ICU mortality rate was 30% (predicted mortality 37%). No side effects were reported with the use of ASV.

Conclusions

The present prospective observational study found that the automatic mode of ventilation — ASV — was used in 98% of invasive-ventilation days, with patients suffering from very different types of underlying disease. There was only very occasional need to switch to an alternative mode of ventilation.

Although breathing patterns varied, depending on the underlying lung diseases, ASV consistently and automatically selected protective ventilation with low tidal volume for ARDS patients.

References

1. Sulzer C, Anesthesiology 2001;95:1339-45.
2. Petter A, Anesth Analg 2003;97:1743-50.
3. Tassaux D, Crit Care Med 2002;30:801-7.
4. Otis AB, J Appl Physiol 1950;2:592-607.

	Normal lung	Obstructive lung disease	ARDS	Restrictive lung disease	Acute lung injury
%ASV	116 ±25	119 ±29 NS	131 ±25 **	137 ±31 **	130 ±29 **
PEEP (cmH_2O)	5.2 ±1.5	6 ±2.5 **	9 ±3.3 **	5 ±1.7 NS	6.3 ±2.2 **
Peak pressure (cmH_2O)	22 ±6	24 ±7 **	30 ±6 **	27 ±6.7 **	25 ±6 **
Vt (ml)	516 ±131	585 ± 113 **	453 ± 112***	386 ± 91 **	503 ±109 NS
Ftot (C/mn)	17 ±5	16 ± 6 *	20 ± 6 **	23 ± 6 **	18 ±6 **
Fspont (c/mn)	9 ±10	9 ± 10 NS	6 ± 10 **	13 ± 13 NS	9 ±11 NS
I:E	0.50 ±0.17	0.41 ±0.15 **	0.62 ±0.27 **	0.54 ± 0.24 NS	0.48 ±0.17NS
RCe (s)	0.78 ±0.28	1.13 ±0.70 **	0.55 ±0.21 **	0.4 ±0.15 **	0.70 ±0.22 **
Cstat (ml/cmH_2O)	46 ±23	56 ±25 **	30 ±14 **	22 ±10 **	41 ±20 **
Rins ($cmH_2O.s/l$)	16 ±7	16 ±10 NS	17 ±7 NS	14 ±9 NS	16 ±7 NS
pH	7.40 ±0.07	7.37 ±0.09 **	7.29 ±0.14 **	7.37 ±0.11 NS	7.38 ±0.08 **
PaO_2/FiO_2	330 ±113	248 ±115 **	140 ±48 **	267 ±106 **	215 ±61 **
$PaCO_2$ (mmHg)	40 ±7	44 ±11 **	49 ±9 **	45 ±9 **	42 ±7 **
Vt/IBW (ml/Kg)	8.3 ±1.3	9.3 ±2.1 **	6.8 ±1.2 **	7.0 ±1.1 **	8.1 ±1.2 NS

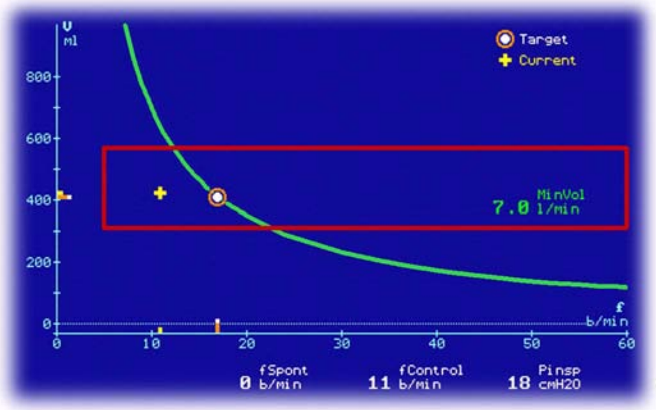
Table 1: Breathing pattern, mechanics and gas exchange based on the underlying lung disease.
* $p < 0.01$; ** $p < 0.001$ between diseased lung and normal lung (using Mann-Whitney test).
% ASV: percentage of ideal minute ventilation, Vt: tidal volume, Ftot: total respiratory frequency, Fspont: spontaneous respiratory frequency, I/E: inspiratory expiratory ratio, RCe: expiratory time constant, Cstat: static compliance, Rins: inspiratory resistance.

"It's not usual to put a personal comment in a white paper, but I really have to say how delighted I was at the reception this study received when it was presented at the last ESICM meeting.

This is the first study of a large group of patients using ASV in ICU conditions, and there were almost no failures (i.e. almost no need to use other modes of ventilation).

Perhaps most importantly, ASV consistently showed that it could select optimum ventilation for ARDS patients."

Ralph Teuber, Marketing Director, HAMILTON MEDICAL AG



The special ASV window, showing the (red) frame of maximum safety, the (green) curve indicating the range of all breath frequency/tidal volume values for the set minute volume, the (circle) Target marker indicating the frequency and tidal volume offering the lowest work of breathing, and the (cross) Current marker, showing the current status.