

SmartCare™

Daily practice with SmartCare™ in a difficult to wean patient

Biotrauma and goals for weaning

The advances in critical care medicine have resulted in more patients surviving calamitous diseases. A considerable amount of these patients require mechanical ventilation for extended periods. Patients requiring respiratory support more than fifty days are still not a rarity, even today, in our ICU.

Weaning procedures continue to gain more importance in the Intensive Care, combined with increasing knowledge about the detrimental effects of mechanical ventilation and iatrogenic lung injury resulting in a so-called biotrauma. Apart from the pulmonary effects of ventilator induced lung injury, the systemic effects, eventually, resulting in the multiorgan dysfunction syndrome become more and more evident today. The trend, therefore, in modern respiratory therapy is increasingly moving towards assisted forms of mechanical ventilation.

The main goal for treatment of patients with respiratory failure and the necessity for ventilatory support is to minimize the



CASE STUDY

potential lung injury induced by ventilation itself. Therefore, as the saying goes, weaning begins with intubation. It's a training-process for respiratory muscles, much like athletes do in training to improve their performance. If you rest the weaning of your patient he / she will become lazy.

In consideration of the current pathophysiologic understanding of the acute lung injury,

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spontaneous breathing modes should be used as much as possible in the course of critical illness.

Adjusting the ventilator settings frequently, according to the changing demands and needs of the patient, is a major problem in the daily routine of almost every ICU.

What is “Smart Care”?

With SmartCare, Dräger Medical introduced a new weaning technique integrated into their EvitaXL ventilator, developed from a knowledge based weaning system resulting from a protocol developed by Brochard and Coworkers. This approach

includes a special innovation of a derived pressure support mode that let’s the ventilator react to the patient’s demand for an adjusted ventilatory support every two to five minutes. It’s the first ventilator with an integrated circuit that includes the patient and his ventilator. SmartCare is not only a computer

Specifications											
Time	0:00	2:00	5:00	8:50	9:10	10:30	11:45	13:30	18:00	21:20	23:40
Setting	BP 12	BP 12	BP 10	BP 10	BP 12	BP 14	SC	SC	SC	SC	BP 12
FiO ₂	35	35	30	30	45	40	40	40	40	40	40
pmax	24	24	24	23	25	25	30	36	36	36	28
PEEP	5	5	5	5	5	5	5	5	5	5	5
f	40	37	44	40	40	47	34	35	32	36	27
I:E	1:2	1:2	1:2	1:2	1:2	1:2					
MV		17.6	19.3			12.3	18.5	21.3	22.9	17.2	12.3
Vt		0.65	0.6			0.65	0.78	0.6	0.57	0.75	0.65
PaO ₂	101	101	77.1	50.4	65.9	103	112	126	122	127	144
PaO ₂ /FiO ₂	288.6	288.6	257.0	168.0	146.4	257.5	280.0	315.0	305.0	317.5	360.0
PaCO ₂	39.6	38.7	37.5	36.4	36.0	38.1	37.0	38.0	36.0	33.0	36.4
pH	7.4	7.4	7.44	7.44	7.44	7.4	7.44	7.39	7.44	7.46	7.42
SaO ₂	98.6	98.5	96.7	88.3	94.3	98.6	99.1	99.3	97.6	99.6	99.7
HCO ₃ ⁻	24.1	24.2	25	24.5	24.8	23.2	24.5	23.3	24.6	24.2	25
BE	-0.1	0.1	1.2	0.9	0.4	-0.8	0.9	-1.3	-0.1	-0.3	-0.7

Table 1: Patient ventilator settings and results of blood gases in the course of a day with SmartCare (BP=BIPAP; SC=SmartCare)

system but, also, a reliable bedside-tested clinical protocol for weaning that aims for comfortable recovery from respiratory failure.

Weaning before knowledge-based weaning at our SICU

Our previous weaning technique was based on periodical clinical judgements of the patient's respiratory status, reduction of sedoanalgesics, early use of pressure support ventilation, CPAP and ventilator independence, including spontaneous breathing trials with T-piece.

The main problem today with the consuming weaning technique is very obvious: the requirement for considerable staff in a frequently understaffed ICU environment. Nevertheless, our surgical ICU is comparatively well staffed, in contrast to many other Intensive Care Units, especially in smaller sized hospitals.

Therefore, like other ICU teams we appreciate a knowledge-based weaning system, like SmartCare, for daily clinical use.

A challenge to wean the patient

This report outlines the application of SmartCare in a difficult to wean patient:

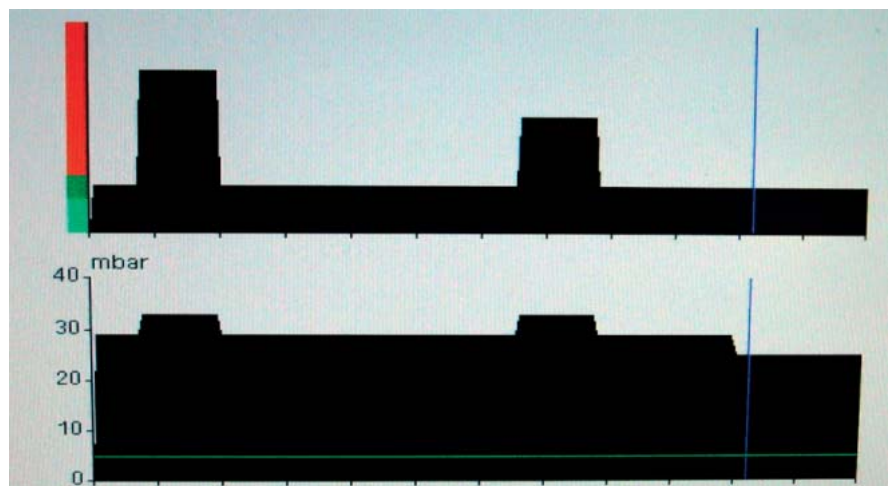


Fig. 1: The challenge to wean a patient in the comfort zone (green marked)

A 50 year old man, suffering from severe protracted ARDS, which resulted from aspiration of gastric secretion and subsequent pneumonia. The aspiration occurred after oesophageal perforation, following dilation and stenting of a stenosis, resulting from an achalasia.

The clinical course of the patient was complicated by recurrent phases of a severe candida and staphylococcus sepsis despite the use of adequate antifungal and antibiotic therapy with periodical microbiological testing at regular intervals. He was ventilator dependant with high PEEP-levels and high FiO₂, requiring positioning therapy using the prone position and kinetic

therapy over a period of about 60 days.

Frequent dramatic deteriorations of his respiratory situation with repeated phases of septic shock combined with a multiple organ dysfunction syndrome and the need for catecholamines, renal replacement therapy and liver dialysis prolonged his ICU stay considerably.

First attempts to wean the patient were commenced after 60 days of invasive ventilation. The patient had comparatively high respiratory rates starting the weaning process resulting from respiratory muscle weakness. Nevertheless, during the SmartCare period, the respiratory

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rates varied in the range of those
with BIPAP ventilation – with a
slight trend to lower frequencies.

Tidal volumes stayed within the
same range after the change
and paCO_2 remained nearly
unchanged. Despite of the change
from BIPAP to SmartCare there
seemed to be no relevant increase
of respiratory workload for the
patient. We even saw a slight
increase of the oxygenation-
index during the SmartCare
period. While using SmartCare,
the patient remained breathing,
for the most part, in the so-called
“respiratory zone of comfort”
(Fig. 1).

In summary, it can be said that in
this patient, who previously
needed a long time interval of
mechanical ventilation with
strong ventilator settings
SmartCare appeared to work
without any detrimental effect on
oxygenation and paCO_2 . Also, the
respiratory workload of the
patient seemed not to increase.
Furthermore, the patient
remained in the “respiratory zone
of comfort” for a long time.

Our impressions about SmartCare

Weaning should be considered a
process in which the goals are to
promote ventilator independence
under preservation of the
functional status. The choice of

weaning technique is an
important decision in the
convalescence of the respiratory
muscles and reconditioning.

Traditional methods of weaning,
like progressive reductions in the
number of fully supported
breaths [SIMV], continuous
positive airway pressure [CPAP]
or spontaneous breathing trials
[SBT] lack the continuous
feedback of the ventilator to the
patient’s needs – they are
mechanical and not adjustable to
the patient.

From our experience, SmartCare
seems to meet all requirements
for a knowledge-based weaning
system, even in long-term
ventilated patients. It saves
considerably time in the
strenuous weaning process. The
outstanding advantage of this
ventilator-integrated weaning
system is its less demand for
fewer ICU staff. Even if the staff
of an ICU makes every endeavour
possible to wean a patient from
the ventilator, the respiratory
therapist can not be at the
patient’s bedside every minute of
the day as SmartCare can.

Therefore, SmartCare can
minimize the momentous
consequences of mechanical
ventilation to the lung and
contribute to the reduction of
systemic effects of ventilator
induced lung injury and, thus, the
biotrauma.