

The Physiologic and Financial Benefits of BiLevel Ventilation

Case Study
840 Ventilator

BiLevel

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Introduction

The treatment of respiratory failure secondary to a number of causes has led to a multitude of ventilation approaches. Not all of these approaches have been effective at improving patient outcome or lowering costs. Recently, a new ventilator modality, *BiLevel*,[™] was released by Puritan Bennett for the 840[™] Ventilator. Although the *BiLevel* mode resembles SIMV pressure control, it offers the significant advantage of allowing

patients to breathe without restriction at any phase of the respiratory cycle. The potential benefits to the critically ill patient requiring ventilatory support include improved cardiac delivery; enhanced patient-ventilator synchrony, oxygen exchange and CO₂ removal; as well as reduced costs and clinical concerns associated with the use of neuromuscular blocking agents.

Profile

A 57-year-old male was admitted to the hospital because of an upper and lower gastrointestinal bleed. An exploratory laparoscopy revealed a perforated duodenal ulcer. He

subsequently experienced respiratory failure secondary to sepsis. The patient was placed on the 840 Ventilator using the *BiLevel* mode.

Time, Ventilator Settings and ABG Results

11:10 am

The patient had been on the ventilator with *BiLevel* mode for a couple of days. The ventilator settings were as follows:

Resp. Rate	18 bpm
High PEEP	30 cmH ₂ O
Low PEEP	16 cmH ₂ O
FiO ₂	0.9
PSV	16 cmH ₂ O
Insp. Time	1.55 sec
I:E	1:1.5

ABG:

pH	7.35
PaCO ₂	49 mmHg
PaO ₂	86 mmHg
SpO ₂	96%
HR	92/min
BP	151/92
Cardiac Index	5.7

12:15 pm

The physician felt that by eliminating some of the work of breathing the patient was exhibiting, oxygenation would improve. Therefore, chemical paralysis was initiated with Norcuron.

ABG after paralysis:

pH	7.26
PaCO ₂	62 mmHg
PaO ₂	75 mmHg

Cardiac Index dropped 24% to 4.3.

2:00 pm

Due to the profound effect on hemodynamic and pulmonary parameters, the administration of Norcuron was stopped. Cardiac index then rose to 5.5.

5:00 am

Blood gases improving. Results of an ABG reveal a pH 7.37, PaCO₂ 44 mmHg, PaO₂ 99 mmHg on 70% FiO₂.

The patient remained on ventilation for five more days without the use of paralyzing agents.

Indications

With past ventilator technology, patients often required prolonged chemical paralysis to accomplish oxygenation and ventilator goals. With the advent of new technology, previous practices need to be reevaluated. This patient experienced a significant drop in cardiac index and oxygenation resulting from chemical paralysis. Once the paralysis was stopped, his cardiac index and oxygen levels returned to their prior levels. Allowing the patient to breathe without restriction enhanced hemodynamic and ventilatory function; the reduction in intrathoracic pressure allowed venous return to increase.

Studies have examined the cost of using paralyzing agents. One study determined there was a higher mean healthcare expense (\$91,000 vs. \$22,000) for patients suffering from prolonged muscle weakness after the use of paralyzing agents.¹ In this case, if the patient had remained on Norcuron for another five days, it would have cost between \$515 to \$954 per day based on a dose of 3.4 to 6.3 mg per hour. Therefore a savings of approximately \$3,500 was realized on just one patient.

Discussion

Traditional approaches to ventilating the most critically ill patients include the use of chemical paralysis. We have found that the use of the *BiLevel* mode on the 840 Ventilator eliminates a substantial amount of medication. Our hospital realized significant savings by discontinuing

paralysis for this patient. More importantly, objective measurements of the patient's status showed improvement after paralysis was terminated. Using *BiLevel* ventilation has now become a standard approach for ARDS patients at our institution.

1. Rudis MI, Guslits BJ, Peterson EL, et al. Economic impact of prolonged motor weakness complicating neuromuscular blockade in the intensive care unit. *Critical Care Medicine*. 1996;24:1749-1756.

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