Alternative Operating Instructions for the Sechrist Model 500A Hyperbaric Ventilator

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Foust G, Golden EB. Alternative operating instructions for the Sechrist model 500A hyperbaric ventilator. J Hyperbaric Med 1989; 4(3):143–145—The infrequent operation of the Sechrist model 500A hyperbaric oxygen (HBO) ventilator may lead to potential error in setting the ventilator for a particular patient. The lack of calibrated controls, sophisticated monitoring, and mode capabilities common on modern-day critical care ventilators are not available on the Sechrist HBO ventilator. Using the methods described in the manual could result in inverse inspiratory to expiratory (I:E) ratios on patients. The methodology described in this paper achieves the desired rate and volume settings while maintaining the longest exhalation time compatible with those settings. We recommend this approach to decrease the likelihood of ventilator-induced barotrauma.

Introduction

In most hyperbaric oxygen (HBO) units using the Sechrist monoplace chamber the need for mechanical support of ventilation during HBO therapy is not an everyday occurrence. This infrequent operation of the Sechrist model 500A hyperbaric ventilator (Fig. 1) may lead to potential error in setting the ventilator for a particular patient. Although it is a fairly basic, time-cycled ventilator, it is quite unconventional in that it does not have the calibrated controls and sophisticated monitoring and mode capabilities that we have become accustomed to in modern-day critical care ventilators. This, coupled with the fact that the bulk of our HBO treatments are given to stable patients who do not require breathing support, creates a rather unique situation. Emergency patients requiring ventilator support arrive on short notice. If HBO personnel have not set the ventilator up in some time, they may feel somewhat awkward. Using the method of setup described in the manual has on two occasions resulted in the establishment of inverse inspiratory to expiratory ratios (I:E) on patients in our unit. These errors were promptly detected and corrected. If, however, these situations had gone uncorrected the patients could have been at considerably increased risk to develop a pneumothorax from ventilator-induced barotrauma during decompression.

Discussion

The basic sequence of setup and operation for the Sechrist model 500A hyperbaric ventilator is described on page 5 of the manufacturer's manual.
These steps seem clear enough until step 8, which suggests that the operator begin with the timing controls in the 12 o'clock position. According to step 4 this would result in an inspiratory time of about 1.75 sec and an expiratory time of about 2.5 sec. This resultant rate of approximately 15 beats/min, along with the recommended flow gauge setting of 6–8 psi, may be acceptable for most patients. The potential for confusion occurs with the statement: "Adjust controls as necessary to obtain the desired ventilatory pattern and tidal volume." If the operator chooses to increase the inspiratory time to slow the rate to perhaps 12, and/or increase the tidal volume, the resultant 2.5-sec inspiratory time required causes the inspiratory to expiratory (I:E) ratio to approach 1:1 and be on the verge of being inverse. Usual I:E ratios are in the range of 1:1.5 or 1:2. The ventilator circuitry and the endotracheal tube are abnormal resistances that can delay lung emptying. Coming up from the dive would also seem to necessitate a longer expiratory time because the patient is at greater risk of developing a tension pneumothorax (because of the gas expansion occurring in the alveoli during decompression). Underlying bronchospasm or airway edema (preexisting or secondary to some sort of smoke inhalation or noxious gas exposure) would be managed more safely with a longer expiratory time.

Methodology

With the above considerations in mind, we have used the following methodology to set up our 500A HBO ventilator:
1. Adjust ventilator to desired tidal volume by starting with inhalation time at minimum and exhalation time at maximum (results: a rate of about 8; if 10–12 is desired set the exhalation time control at the 3 o’clock position).
2. Adjust flow meter clockwise to achieve desired tidal volume.
3. If tidal volume is not adequate with flow at maximum, increase inhalation time (if exhalation time needs to be preserved then increasing source pressure to the ventilator is an option).
4. Adjust exhalation time to achieve desired rate.

This methodology achieves the desired rate and volume settings while maintaining the longest exhalation time compatible with those settings. With the aforementioned considerations in mind, we believe that this is the best approach to decrease the likelihood of ventilator-induced barotrauma.

Summary

As with any relatively infrequent procedure, there lies the potential for suboptimal performance simply because of the lack of practice. Clear instructions with the most undesirable complications in mind can help minimize the chance of any adverse occurrences.