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BREAS CLINICAL SERVICES

Nebulizing Medication During Mechanical Ventilation

What is the best nebulizer type to use? Where in the circuit is the best location to place the nebulizer? Does heated humidification affect aerosol deposition? If I use a jet nebulizer will it affect the delivered tidal volume, triggering or alarms?

These are some of the questions asked by clinicians concerned with administering nebulized medications to patients during mechanical ventilation. And while there is no "one size fits all" answer, there are answers and solutions for most situations, whether in the hospital, alternate care site or home setting. With help from guidelines published by the NIH and research done by experts in the field, most of these questions can be answered.

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BREAS Clinical Services … we're here to serve you

Breas Clinical Service's mission is to champion excellence in innovation, demonstrate clinical expertise, and provide clinical leadership to the company and the customers we serve by partnering with key opinion leaders to help design and develop products and services that are clinically relevant and beneficial in improving patient care and quality of life. Our clinical team is comprised of experienced clinicians who have worked in various care settings including hospital-based NICU, PICU, Adult ICU, ER, anesthesia, hyperbaric oxygen unit and the Sleep Lab, and in alternate care sites such as LTAC's, SNF's and home care. Learn more about us on page 3.

Administering Aerosolized Medications via the Ventilator Circuit

There are several different devices for administering medications to a patient receiving mechanical ventilatory support including, MDI, small volume nebulizer (SVN) or jet nebulizer, and ultrasonic nebulizer. Each method has its own benefits and problems associated with it. One of the main concerns for any of the methods used is where in the circuit to place the administration device. The National Institutes of Health (NIH) Critical Care Medicine Department,Critical Care Therapy and Respiratory Care Section developed a policy and procedure to guide clinicians in this procedure: Category: Clinical

Section: Aerosol Therapy Title: Delivery of Aerosolized Medications via Metered Dose Inhaler or Small Volume to Intubated Mechanically Ventilated Patients, Policy #: 03. This policy cautions that, "placing a SVN in-line with a ventilator will alter the flow characteristics of the ventilator-delivered breath. The tidal volume (Vt) must be monitored closely. Adjustments to the Vt or to the pressure setting in pressure-controlled mode

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SVN placed in-line on the inspiratory side of the circuit close to the patient wye adapter

Aerosolized medication delivery during mechanical ventilation

Metered Dose Inhaler (MDI)

An article Aerosol Therapy for Ventilator-Dependent Patients: Devices, Issues, Selection & Technique published on CLINICAL FOUNDATIONS website: www.clinicalfoundations.org 2012-1386 by Arzu Ari, PhD, RRT, PT, CPFT, FAARC details methods of medication delivery via the ventilator circuit. Ari states that, "aerosol delivery during mechanical ventilation depends on several factors. These can be divided into three categories: (1) ventilator-related factors, (2) circuit-related factors and (3) device-related factors." According to Ari, ventilator related

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J. Mark Barch, MS, RRT, RCP

The BREAS Clinical Services Team is managed by Carl Van Loey, MSc, PT (Europe) and J. Mark Barch, MS, RRT, RCP (United States).

Mark is a registered respiratory therapist and a licensed respiratory care practitioner. He has worked in the NICU, PICU, adult ICU, anesthesia, and the hyperbaric medicine units of different hospitals. Mark was the Director of Respiratory Care, Neurodiagnostics, and Hyperbaric Medicine Unit of an acute care hospital, the Director of Respiratory Care, Radiology and Anesthology at an LTAC, and he was a Division Clinical Manager for a large national home medical equipment provider. Most recently he was the Clinical Manager for GE Healthcare's Home Care Channel. Mark also serves as the President of the Texas Society for Respiratory Care (TSRC), the largest state Respiratory Care Society in the U.S.

Carl Van Loey, MSc, PT

Carl Van Loey is a physiotherapist who specialized in respiratory physiotherapy. Carl started his career in an ICU Burn Unit where he headed a team of 11 physiotherapists and was also a member of the ICU Transport Team for transportation of mechanically ventilated patients by ambulance or helicopter. After having worked in a Clinical Support role for Percussionaire Belgium, he joined Breas in 2001. Within Breas Carl has had a number of different roles both in Sales and Marketing but always with a primary focus on the clinical aspects of our business. Carl brings a wealth of knowledge of the complete line of Breas products and he is a valuable resource for our customers.

Administering Aerosolized Medications via the Ventilator Circuit (continued from page 2)

must be made accordingly. In some circumstances, it may be advantageous to increase the rise time to temper the effects of the increased flow such that turbulent flow is minimized. The addition of flow for powering the nebulizer to the circuit also renders the ventilator less sensitive to the patient and may require an increase in the sensitivity for the duration of the treatment. These effects are especially important when ventilating pediatric patients."

The NIH policy recommends positioning the nebulizer within the circuit in the inspiratory limb approximately 18 inches from the patient airway and bypassing the humidifier. According to the policy, bypassing the humidification system is necessary to minimize the tendency of water vapor to increase particle size. Also recommended in that policy is to decrease the set Vt to account for the additional flow through the nebulizer for pediatric patients whose set Vt is less than 250 ml, "the delivered Vt should remain relatively unchanged after the ventilator adjustment with minimal increase in PIP."

A final recommendation in the NIH policy is to note the exhaled Vt and make adjustments to the PIP as necessary to maintain the exhaled Vt at pre-treatment levels for patients on pressure-controlled modes.

It should be noted that the NIH policy was last revised in 2000 so the policy should be weighed against newer research published since that time.

OTHER AEROSOL DEVICES

AeroNeb Pro-X
by Aerogen

"Multisonic"
InfraControl
Flores Medical GmbH

Research into aerosolized medication delivery via ventilator **(continued from page 2)**

factors such as inspiratory flow rate, ventilator mode, inspiratory time, tidal volume, bias flow and wave patterns make a significant difference in aerosol drug delivery to ventilator-dependent patients.

The flow rate at which the aerosol is delivered is an important factor in deposition of the medication in the patient's lungs. According to Ari, "since high inspiratory flow rates increase turbulent flow and inertial impaction of aerosol particles, aerosol deposition with high inspiratory flow rates is less than with lower flow rates. Peak flow rates of 40-50 L/min may be used to improve drug delivery during mechanical ventilation as long as this is tolerated by the patient."

Inspiratory time (I-Time) may also have an effect on deposition of the aerosol into the lungs – a longer I-Time is usually recommended when using a small volume nebulizer (SVN) whereas metered dose inhalers (MDI) do not seem to be affected by I-Time.

Ari suggests that since the filter in the HME is considered a barrier to aerosol delivery, it should not be placed between the aerosol device and the patient. However there are HME devices that are designed to be used in-line with aerosol therapy.

Several studies suggest that patient position is a key factor in deposition of aerosolized medication. It is recommended that a semi-fowler position with the head of the bed elevated to 20 to 30 degrees above the horizontal should be used for aerosol administration during mechanical ventilation.

In contrast to the NIH policy stating the nebulizer should be placed 18" from the patient airway and bypassing the humidifier, some researchers suggest that placement of the jet nebulizer closer to the heated humidifier and keeping it in-line during the aerosol treatment is a more optimal method [Ari A, Areabi H, Fink JB. Evaluation of position of aerosol device in two different ventilator circuits during mechanical ventilation. Respir Care. 2010;55(7):837-844]. The researchers explain their recommendation by stating that "when the jet nebulizer is placed closer to the ventilator and operated continuously under heated/humidified conditions, the aerosol tubing acts as a reservoir because continuous output of the jet nebulizer charges the inspiratory limb of the ventilator circuit between inspiration and minimizes aerosol loss during the expiratory phase of the breathing cycle." However when using nebulizers that do not add a gas flow to the ventilator circuit (e.g., MDI and mesh or ultrasonic nebulizers) the researchers suggest that the most efficient placement is in the inspiratory limb of the circuit 6" from the wye adapter.

Research has also shown that with the addition of continuous bias flow in the ventilator circuit, placement of aerosol generators near the ventilator may be more efficient [Ari A, Atalay OT, Harwood R, Sheard MM, Aljamhan EA, Fink JB. Influence of nebulizer type, position, and bias flow on aerosol drug delivery in simulated pediatric and adult lung models during mechanical ventilation. Respir Care. Jul 2010;55(7):845-851].

Many factors can either adversely influence or optimize the effectiveness of aerosolized medication delivery during mechanical ventilation. Physicians and respiratory therapists must have a good understanding of those factors to ensure the patient receives the

BREAS/HDM Z1 portable CPAP Device

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