TITLE: Continuous Flow Apneic Ventilation (CFAV) with Helium-Oxygen in Dogs with Bronchopleural Fistula.

AUTHORS: Cristobal Garcia, M.D., Leonid Bunegin, B.S., R. Brian Smith, M.D.

AFFILIATION: Department of Anesthesiology, University of Texas Health Science Center at San Antonio.

CFAV has shown to be as effective in producing gas exchange in dogs with bronchopleural fistula as intermittent positive pressure ventilation (IPPV). Fistula leak, however, is significantly reduced during CFAV suggesting the potential for more rapid healing of the lesions. Since carbon dioxide (CO_2) has been shown to diffuse two and a half to three fold faster in helium than in air, the present study was designed to examine CO_2 washout during CFAV with He/O_2 (FIO_2 0.4) in dogs with bronchopleural fistula.

Five dogs, mean weight 22.7kg, were anesthetized with pentobarbital 25mg/kg followed by an intravenous infusion of balanced electrolyte 3ml/kg/hr and paralyzed with pancuronium bromide 0.15mg/kg.

After intubation the dogs were ventilated with air, adjusting rate and volume to achieve normocarbia. The femoral artery and vein were cannulated and a pulmonary catheter was placed through the femoral vein. A right lateral thoracotomy was performed at the 6th intercostal space and a right bronchopleural fistula was created in the diaphragmatic lobe by advancing a 3mmID catheter into the 6th subdivision of the right bronchus until impaction. A loop of the fistula catheter was externalized and fitted with an occluder for control of the fistula leak. The tip of the fistula catheter remained within the thorax. Fistula leak was measured using a pneumotacometer attached to the atmospheric side of the water seal container. Two 1.4mm ID catheters were inserted into the endotracheal tube and advanced into each mainstem bronchus with the tips lying 3.0cm below the carina. The endobronchial catheters were angled approximately 30° from the axis of the trachea, and placement verified by fiberoscopy. Catheters were sealed during IPPV. All dogs were ventilated with an FIO_2 at 0.4 during the study and subjected to either IPPV (air-oxygen) fistula open or closed, or CFAV (0.4liter/kg/min He/O_2 fistula open or closed.

Airway pressure during CFAV (1.4±0.5 mmHg) was significantly lower $p<0.02$ than during IPPV (8.2±1.8 mmHg) fistula open. No significant differences were observed in the PaO_2 or the $PaCO_2$ between IPPV and CFAV with the fistula open. Fistula leak, however, was significantly reduced $p<0.02$ from 600±49 ml/min during IPPV to 20±17 ml/min during CFAV with He/O_2. Additionally, no significant variation in heart rate, temperature, arterial, venous, pulmonary artery pressures and cardiac output were noted.

Long periods of ventilatory support are commonly required for patients with bronchopleural fistulas. The large volumes often required to support these patients also increases the fistula leak possibly delaying healing of the fistula. Our data suggests that CFAV with He/O_2 might be useful in the ventilatory support and healing process of bronchopleural fistula, because of the considerable reduction in fistula leak that can be achieved without significant impairment of ventilation and oxygenation.

Airway pressure mmHg		Fistula Leak ml/min	
IPPV	CFAV	IPPV	CFAV
8.2±1.8	1.4±.05*	600±49	20±17*

PaO2 mmHg		PaCO2 mmHg	
IPPV	CFAV	IPPV	CFAV
74±12	92±18	48±19	61±8

* $p<0.05$

A1187

Title: **METERED DOSE INHALER ACTUATOR-ADAPTERS: A COMPARISON OF PARTICLE SIZE AND DRUG DELIVERY THROUGH AN ENDOTRACHEAL TUBE**

Authors: M.J. Bishop, M.D., R.P. Larson, RRT and D.L. Buschman, M.D.

Affiliation: Harborview Medical Center, Departments of Anesthesiology, Respiratory Therapy, and Radiology, University of Washington, Seattle, Washington 98104

Metered dose inhaler (MDI) actuator-adapters that can deliver aerosolized medication through an endotracheal tube (ETT) during mechanical ventilation are available, but the amount of medication reaching the patient is unknown. We measured the volume of particles in the respiratory range (1.0-5.0 μ, i.e. particles thought to reach the small airways) delivered to the end of the ETT using several different MDI adapters. A Hamilton Veolar ventilator was set to deliver an 800-ml V_T at 60 l/min flowrate and 15 bpm through a standard 7.5mm ETT. An MDI (Alupent; Boehringer; Ingelheim, Inc.) was manually activated just as the ventilator cycled on. The ETT was positioned at the entrainment port of a scattering-aerosol laser spectrometer (CSAS 100). The MDI delivery-adapters tested were: Intec 172275 (IT); Instrumentation Industries RCT-22 (II); and Monaghan Aerochamber In-line Spacer (MAIS). We compared the volume of drug delivered via each adapter to the volume delivered when a standard hand-held actuator (BI) was used without an ETT or mechanical ventilation.

Four samples of each brand of adapter were tested by actuating 80 puffs of Alupent through each device, and statistical comparisons of means were done using analysis of variance followed by unpaired *t* tests when significant differences were found. Results are shown below.

Mean Volume of Drug/Puff (μ^3)

	BI	IT	II	MAIS
Particle Size				
<1.0 μ	28±4	10±2	29±2	65±4
1.0-5.0 μ	2611±243	294±63	807±8	1734±274
>5.0 μ	8115±2305	2±4	3±3	7±5

Each of the ETT adapter tested delivered significantly less drug in both the respiratory range and the large particle range compared to the amount of drug delivered by the BI ($p<0.001$). The II delivered significantly more drug volume in the 1.0-5.0 μ range than the IT ($p<0.001$) but significantly less than the MAIS ($p<0.001$). The lack of large particles when the drug is delivered via the ETT presumably results from impaction of these particles in the adapters, circuit, and ETT. We conclude that: (1) The adapters, ventilator circuit, and ETT effectively prevent large, potentially toxic particles from being deposited in the proximal airways. (2) The number of puffs used should be increased, depending on the type of actuator device used, for the dose of the drug delivered to small airways to be equivalent to that administered by using the BI (i.e. 50% increase for the MAIS, 350% for the II, and 800% for the IT).