IN VITRO PERFORMANCE OF A NEW COLLAPSIBLE HOLDING CHAMBER FOR THE DELIVERY OF AEROSOLIZED MEDICATION BY PRESSURIZED METERED-DOSE INHALER

Mark Nagel, Valentina Avvakoumova, Cathy Doyle, Rubina Ali and Jolyon P. Mitchell
Trudell Medical International, London, Ontario

Dom P. Coppolo
Monaghan Medical Corp., Syracuse, NY

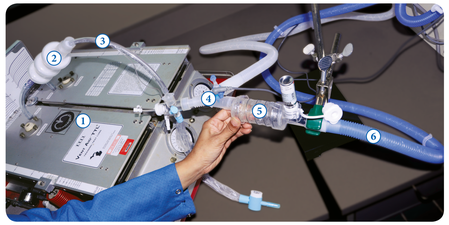
BACKGROUND

- It is desirable not to break the ventilation circuit during the delivery of aerosols to patients receiving inhalation therapy whilst on mechanical ventilation
- The ***AeroVent**** Collapsible Holding Chamber (CHC) (Monaghan Medical Corp., Plattsburgh, NY) was developed several years ago to combine the benefit of a holding chamber when expanded with the convenience of being able to collapse the device when not in use, thereby minimizing water trapping
- The present *in vitro* evaluation of a new version (***AeroVent Plus****), in which the pMDI canister receptacle has been offset from the CHC axis to reduce internal impaction, and which can also accept GSK pMDI canisters having a dose counter, provides comparative data with other in-line adapters
- The purpose of the present study was to assess how the new device performed in a laboratory assessment of its function in an adult ventilator circuit

AeroVent Plus* CHC

MATERIALS AND METHODS

- The ***AeroVent Plus**** CHCs (n=5) were each inserted in the inspiratory limb of an adult mechanical ventilation circuit
  - Humidification was provided in circuit via a Model MR850JHU (Fischer & Paykel, Auckland, NZ)
- The distal end of the CHC was coupled to the wye-connector to which a 7.0 mm diameter endotracheal tube (ETT) was attached
- An aerosol collection filter was located at the distal end of the ETT, and the far-side of the filter was coupled to an adult test lung (Michigan Instruments, Grand Rapids, MI) simulating the patient



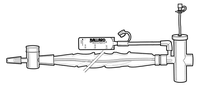
1 – Test lung
2 – High efficiency filter for aerosol recovery
3 – ETT
4 – Wye connector
5 – CHC on test
6 – Inspiratory limb of adult breathing circuit

- The circuit was humidified near to body conditions (T = 37°C, 100%RH)
- An adult patient tidal-breathing simulation was created
  - Servo ventilator (Siemens, Sweden, model 900C)
    - Tidal volume = 600 mL
    - Duty cycle = 33%
    - Rate = 10 breathing cycles/min
- 5-actuations of Ventolin† (GSK Canada, 100 µg salbutamol ex-valve) were delivered, each time followed by 6-complete breathing cycles, shaking the canister between actuations
  - Salbutamol recovered quantitatively and assayed by HPLC-UV spectrophotometry to establish Total Emitted Mass (TEM)
- Similar measurements (n=5/device) were also performed, replacing the CHC with the folllowing

AirLife† Dual Spray MiniSpacer†
Cardinal Health, Dublin, OH

OptiVent†
Philips Healthcare, Andover, MA

Adult universal in-line pMDI adapter, model RTC 24-V
Instrumentation Industries Inc., Bethel Park, PA



Ballard suction catheter with pMDI port
Kimberly-Clark Healthcare, Roswell, GA

Hudson ventilator adapter
Hudson RCI, Research Triangle Park, NC

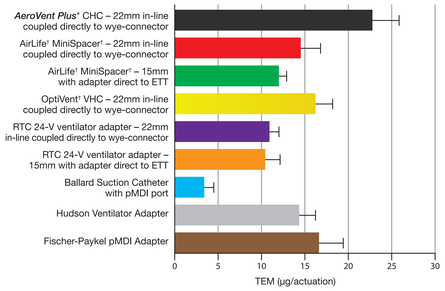
pMDI adapter
Fischer & Paykel

RESULTS

- TEM salbutamol/actuation via each of the devices (mean ± S.D.) is summarized in the Table

Device	Ventilator Circuit Tubing Outside Diameter (mm)	Mass salbutamol/ actuation (µg)
AeroVent Plus* CHC	22 mm in-line, coupled directly to wye connector	22.7 ± 3.1
AirLife† MiniSpacer†	22 mm in-line coupled directly to wye connector	14.5 ± 2.3
	15 mm with adapter direct to ETT	12.0 ± 0.9
OptiVent† VHC	22 mm coupled directly to wye connector	16.2 ± 2.0
RTC 24-V ventilator adapter	22 mm coupled directly to wye connector	10.9 ± 1.1
	15 mm with adapter direct to ETT	10.4 ± 1.7
Ballard suction catheter with pMDI port	Coupled direct to ETT	3.4 ± 1.1
Hudson ventilator adapter	22 mm coupled directly to wye connector	14.3 ± 1.9
Fischer & Paykel (F&P) pMDI adapter	Coupled to wye connector with F&P adapter	16.6 ± 2.8

pMDI-DELIVERED SALBUTAMOL FROM VARIOUS IN-LINE AEROSOL DELIVERY DEVICES FOR THE ADULT PATIENT ON MECHANICAL VENTILATION



CONCLUSION

- The ***AeroVent Plus**** CHC delivered significantly more medication to the distal end of the ETT compared with the other adapters (un-paired t-test, $p < 0.001$)

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