FEASIBILTY OF ADMINISTERING A BRONCHIODILATOR CONTINUOUSLY VIA VIBRATING MESH NEBULIZER AND SYRINGE PUMP DURING MECHANICAL VENTILATION

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Background

- Aerosolized medications (AM), (bronchodilators, antimuscarinic) may be administered via nebulizer (NEB) to treat episodic bronchospasm during mechanical ventilation (MV).
- Lung model (LM) studies suggest that aerosolize medication delivery (AMD) is suboptimal.
- Use of the vibrating mesh nebulizer (VMN) "Aerogen®" allows administration of albuterol continuously through a syringe pump (SP) without the need of an external gas source.
- The aim of this study was to determine if there were any undesirable impact from rate of nebulization (RON) on MV when used in conjunction with a SP+VMN.

Methods

- The Servo-I ventilator (SV) was used in conjunction with a SP plus VNM for the study.
- A pre-use performance check was performed on each individual device to verify that they were operating within manufactures specifications.
- The pharmacy downloaded software information for **"Albuterol 0.5%, 5 mg/mL Continuous"** into the **Medfusion 4000 SP** drug library; dose range (**5 mg/h to 20 mg/h**).
- A 60 mL syringe was filled with 20 mL of (0.9%) NaCL to simulate (0.5%) undiluted albuterol.
- The syringe was then attached to the SP: (Illustration #1).
- The investigation evaluated MV+SP+VMN performance at different RON; 15 and 20 mg/h.
- Before each simulation, a new ventilator circuit was installed along with a new SP set-up, fluid from the syringe was used to prime the SP tubing with 1 mL of fluid "bolus" or "wasted" directly into the VMN reservoir chamber to "**START NEBULIZATION".**
- 3.25 mL of fluid is needed to prime the SP connection tubing.
- The SV was connected to a LM, the VMN was "**inserted on the dry side"** of the Fisher & Paykel® Humidifier chamber (HC), (Illustration #2).
- The VMN control timer was set for **"CONTINUOUS".**
- SV settings; Tidal Volume (V_T) – 0.45 mL, Volume Control (VC) – 12 breaths/min, Peak Airway Pressure (P_{AW}) – 22 cm H_2O, plateau pressure (P_{plat}) – 14 cm H_2O, Positive End Expiratory Pressure (PEEP) - +8 cm H_2O.
- Acceptable MV+SP functionally was verified by observation of each individual device on-board monitoring systems, before and after initiation of MV with nebulization.
- Performance were monitored at 1 h and 4 h nebulization at different mL/h:

Results

- The RON is converted from mg/h into mL/h; 15 mg/h = 3 mL/h and 20 mg/h = 4 mL/h.
- Total AMD in 4 h; 12 mL $\pm$ 1 at 15 mg/h and 16 mL $\pm$ 1 and 20 mg/h.
- Test results demonstrated that RON volumes had a nominal effect on MV; V_T – 0.45 mL $\pm$ 0.08, P_{AW} – 22 $\pm$ 2 cm H_2O, P_{plat} – 14 $\pm$ 4 cm H_2O, PEEP - +8 cm H_2O.
- There were no notable adverse events related to set versus measured parameters; compliance, resistance, auto-PEEP, auto-cycling, minute ventilation, changes to waveform graphics or flow volume loops detected.

Conclusion

- This study confirmed that continuous delivery of Beta-agonist (β_2), albuterol via SP is feasible during MV.
- RON volumes were stable during the 4 h study intervals, medication dilution was not required which may improve AMD efficiency.
- In general, use of a SP for $\leq$ 1 h **may not be advantageous** at administering enough AM volume to optimize therapeutic objectives, therefore, clinically impractical.
- The interactions between the different equipment did not have an undesirable effect on the overall functionality of the SP+MV. Also, RON was not adversely altered.
- Further study is needed to determine RON effect on AMD deposition during MV.

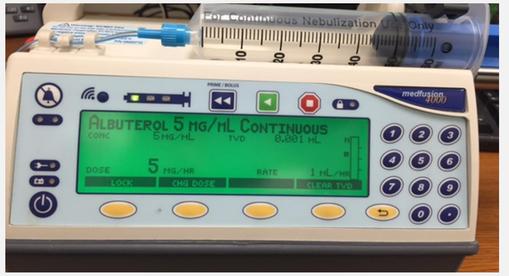

Illustration 1 - SP operations configuration

Illustration 2 - SP connected to VMN on dry side of HC.

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