



21-25 OCTOBER

# Evaluation of expiratory humidity with different heated humidifiers circuits

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#### INTRODUCTION

The optimisation of the inspiratory and expiratory circuits used with heated humidification is necessary to avoid condensation and related problems, such as auto-triggering, difficulties to trigger the ventilator, or increase in expiratory resistances<sup>1</sup>.

### **OBJECTIVES**

To compare humidity in several expiratory circuits of different heated wire humidifiers.

## **METHODS**

On a bench model simulating humidified expired gas (absolute humidity of 35 mgH<sub>2</sub>O/L), we measured hygrometry of expiratory gases at proximal and distal side of expiratory circuits (figure 1). The evaluated circuit were Inspired ref. 51005683 (Vincent medical), FP950 (ref:950A81J, Fisher&Paykel), MR850 (RT210, F&P) and Evaqua2 (RT380, F&P), at different room temperatures (22-24°C and 28-30°C).

Ventilator settings (Evita XL): TV 400ml; RR 25/min; PEEP 5 cmH<sub>2</sub>O; FiO<sub>2</sub> 0.21; Flow 60 lpm. 3 hygrometric measurements were performed for each condition with the psychrometric method.

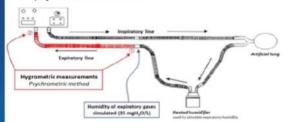


Figure 1: Bench model to simulate expiratory gases at 35 mgH<sub>2</sub>O/L Declaration of interest:

#### **RESULTS**

Main results are shown on the figure 2. The absolute humidity was reduced along the expiratory circuit with the FP950 and the Evaqua circuits (RT380). To avoid condensation in the expiratory limb, the VHB20 increases the temperature along the expiratory limb (leading to a reduction of relative humidity with stable water content). A similar functioning was observed with the MR850/RT210 circuit. No condensation was found along the expiratory limb for the different tested circuits in the bench study conditions. Results at different ambient temperatures were very closes.

With an HME (Hygrobac DAR) at the Y-piece and usual simple tubing: the humidity after the HME and at the expiratory port of the ventilator was low as expected. After Y-Piece = AH:7.7±0.4 mgH<sub>2</sub>O/L (RH=27.2%). At expiratory port = AH:7.8±0.3 mgH<sub>2</sub>O/L (RH=28.7%).

## CONCLUSIONS

Different strategies are used to avoid the occurrence of condensation in the expiratory limb. Two circuits (FP950 and Evaqua2) use "porous" materials allowing a reduction of the humidity along the expiratory line. Two circuits (VHB20 and RT210) use a strategy of increased temperature allowing a reduction of the relative humidity to limit the risk of condensation. However, this strategy may alter the tidal volume measurements (which has not been shown with the ventilator used in the study), and may increase the resistance if HME filters are used instead of filters (with low hygrophobic/hygroscopic properties)<sup>1</sup>.

#### REFERENCES

Tonnelier A, Lellouche F, Bouchard PA, L'Her E. Impact of humidification and nebulization during expiratory limb protection: an experimental bench study. Respiratory care 2013; 58(8): 1315-22.

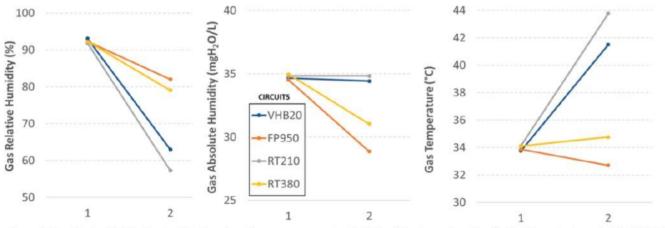


Figure 2: Mean Relative Humidity, Absolute Humidity and gas Temperature measured at the Y-piece ① and at ventilator inlet ② with different circuits used with VHB20, FP950 and MR850 (RT210 and RT380, Evaqua2) heated humidifiers. When a performing HME is at the Y-piece, RH is ① ② , AH is ① ② and temperature is ① ②.

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