

Title: COMPARISON OF A HYGROSCOPIC CONDENSOR HUMIDIFIER WITH A CASCADE HUMIDIFIER IN MECHANICALLY VENTILATED PATIENTS

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Introduction: The optimal humidity level of inspired gases has not been firmly established.¹ The humidity and temperature levels during Hygroscopic Condensor Humidifiers (HCH) usage have been measured to be 32.5 mm Hg PH₂O and 30.5°C. respectively.² These levels compare favorably with measurements taken in the trachea.³ In addition, differences in bacteria colonization between HCH and Heated Bubble Diffusion Humidifier (HBDH) has been postulated.^{4,5} Our experience using the Servo 153 HCH leads us to believe that it is an effective substitute for HBDH during extended periods of mechanical ventilation. **Methods.** Patients (n=27) were randomly placed on a Servo 153 HCH (Siemens-Elema) or a HBDH Puritan Bennett cascade I). The assigned humidifier was maintained for the entire course of mechanical ventilation. Inspired gas temperature of the HBDH was kept at 35-37°C. Daily measurements were taken and recorded on serum osmolarity and sodium, fluid balance, patient temperature, A-aDO₂, FIO₂, V_E, Static lung compliance, airway resistance, PaCO₂, and V_T. Daily Chest X-Ray (CXR) was evaluated by a blinded radiologist. Any radiologic evidence of infiltrate or atelectasis was recorded as positive and calculated as a sample proportion. Sputum cultures were aspirated by aseptic technique 3x weekly and cultured. The positive cultures were calculated as a sample proportion. The variables having ordinal value were tested for significance by unpaired T-test. The variables calculated as sample proportions were compared by Z-values. **Results.** The sample proportions of positive sputum cultures and positive CXR were significantly greater in the HBDH group than the HCH group (P<.01). Although the PaCO₂ was not statistically different between the groups, the pertinent variables of alveolar ventilation (V_T, V_E, Inspiratory flowrate) were significantly higher for the HBDH (P<.01). There was no significant difference in the net fluid balance, serum osmolarity, serum sodium, patient temperature, static lung compliance and total days of ventilation. Airway resistance was significantly higher for the HCH sample than the HBDG sample (P<.01).

Discussion. We have presented evidence that HCH systems are beneficial relative to HBDH systems in long term mechanical ventilation. The maximum period of HCH usage for study patients was 28 days. The higher proportions of positive sputum cultures and chest X-rays in the HBDH group with the accompanying elevated A-aDO₂ may be accounted for by the

respective bacteriological properties of the two systems^{4,5}. Although both systems may become contaminated with oropharyngeal flora within a few hours, the HCH colonization is less likely to be mobilized as liquid or aerosol. The mean PaCO₂ was the same for the two groups but the mean V_E for the cascade group was 5 L/min greater than the HCH group. The higher compression factor of HBDH circuits accounts for this disparity. The elevated airway resistance of the HCH is explained by gas passing through the HCH device. This has been previously noted in a study using a simulated lung system.⁶ This study was approved by the University of Maryland Committee on Human Volunteers. It was supported in part by a grant from Siemens-Elema.

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TABLE I (mean ± s.e.)

	HBDH		HCH	
	Mean		Mean	
+ Chest X-Ray	60%		33%	§
+ Sputum Culture	71%		63%	§
A-aDO ₂ (mm hg)	134.5 ±	30.5	78.5 ±	16.9§
Serum Osmolarity(mOs)	295.2 ±	4.5	297.5 ±	5.0
Fluid I-O (ml)	748.2 ±	432.5	642.9 ±	344.8
C _{ST} (cc/cm H ₂ O)	47.6 ±	4.0	46.2 ±	3.5
R _{AW} (cm H ₂ O/L/sec)	7.7 ±	1.1	14.2 ±	1.4§
V _E (l/m)	17.0 ±	1.4	11.6 ±	.8§
PaCO ₂ (mm hg)	31.7 ±	1.1	32.7 ±	1.7
Days of CPPV	10.4 ±	2.0	12.0 ±	2.1

§ P<.01 t-test for independent groups HBDH compared with HCH.