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TITLE: HUMIDIFIERS KILL BACTERIA

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A recent study suggested that the risk of nosocomial infection should be minimal when bubbler type humidifiers (BTH) are avoided[1].

To evaluate this contention, we compared a low compliance Conchatherm (RCI., Arlington Heights, IL) with a BTH (Cascade I, Puritan-Bennett Corp, Overland Park, KS). Heater controls were set to maintain distal circuit temperature (DT) at 30-35°C. Initially and each day after the BTH and the Concha reservoir were filled with water contaminated with P. cepacia (≈1.7 $X10^7$ cfu's/ml). The humidifiers (H) and circuits were ventilated at 12 bpm, V_T 750 ccs (Omnivent, Stein-Gates Medical, Topeka, KS). The study was carried out in a clean room (Comfort Air Service, Inc., Albuquerque, NM). We monitored particle counts in circuit and background (Climet CI 8060 airborne particle counter). We sampled circuit flow (Cassella and Co., Ltd., Britannia Walk, London) and the distal circuit surface for viable bacteria on day 1 at 0900, 1100, 1300, 1500 and then at 0900 daily for 4 days.

Because we found that chamber temperature (CT) in the Concha was high enough to pasteurize the contents and because far fewer viable organisms than particles were produced by the BTH we monitored CT in 6 H's of each type. Heat controls were set to maintain DTs of 30 and 35°C in a 60" circuit.

BTH's do aerosolize live bacteria (Table I). At DT's of 30 and 35°C, Concha CT's were 60/72°C, BTH CT's 49/59°C. Pasteurization occurs after 30 mins at 68.2°C or 15 secs at 71.7°C[2]. Although these T's were only achieved in the Concha at 35°C DT, Figs 1 and 2 show elimination of cfus over time in the BTH at 35°C DT.

We conclude that a) BTH's do aerosolize bacteria b) DT's of 35°C eliminate growth of bacteria in vaporizing chambers c) continuous refilling of H's with monitoring of CT may allow less frequent circuit changes.

References

1. Rhame FS, et al. Inf Contr 7(8):403-407, 1986.
2. Pelczer MJ, et al. Definition of Pasteurization Elements of Microbiol, McGraw Hill, NY, 1981, p. 630.

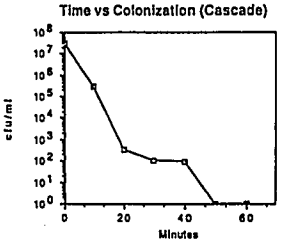
TABLE

	Concha				Cascade			
cfu's*	Day 2 1/0	Day 3 1/0	Day 4 0/0	Day 5 0/0	Day 2 423/+++	Day 3 0/++	Day 4 12/+++	Day 5 21/+++

air/swab
*cfu's - colony formng unit: - = 0 +++ = 21-50
+ = 1-5 ++++ = >-50
++ = 6-20

FIGURE 1
Time vs Temperature (Cascade)

FIGURE 2
Time vs Colonization (Cascade)



A499

TITLE: DETERMINATION OF THE OUTPUT OF MIXTURES OF ISOFLURANE AND HALOTHANE FROM A CALIBRATED ENFLURANE VAPORIZER

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When a calibrated vaporizer is filled with the wrong volatile anesthetic, a patient may receive an excessive concentration of inhalational agent. However, a detailed investigation of the output from an agent-specific vaporizer when filled with mixtures of volatile anesthetics has not been undertaken previously.

The output from an Ohio enflurane (ENF) vaporizer mounted on an anesthesia machine was measured in duplicate at the common gas outlet with a 6 $L \cdot min^{-1}$ flow of oxygen passing through the vaporizer at dial settings of 0, 1, 2, 3, and 4%. A Poet II™ (Criticare, Waukesha, WI) monitor was used for the measurements after its accuracy was verified using standard calibration gases. The vaporizer was drained and flushed for >24 hours between determinations with a high flow of oxygen. It was then completely filled with the agent(s) under study. The following anesthetic mixtures were prepared gravimetrically: Mole Fraction $(X)_{ISO}=1$, $X_{(HAL)}=0.2498/X_{Iso}=0.7502$, $X_{Hal}=0.4602/X_{Iso}=0.5397$, $X_{Hal}=0.7377/X_{Iso}=0.2623$ and $X_{Hal}=1$.

The results of this study are listed in Table 1. When the vaporizer was filled with either 100% ISO or 100% HAL, the measured output exceeded the dial setting by up to 60%. When mixtures of ISO and HAL were placed in the vaporizer, the monitor correctly identified the vapors present. The measured output of each agent as a function of the mole fraction of that agent present in the anesthetic liquid closely approximated a straight line at each of the four vaporizer dial settings tested.

Table 1. MEASURED OUTPUT FROM ENFLURANE VAPORIZER CONTAINING KNOWN MIXTURES OF ISOFLURANE AND HALOTHANE

Mixture (X) HAL/ISO	ENF 1	Vaporizer 2	Dial 3	Setting 4
0/0	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0
1/0	1.35/0.0	2.95/0.0	4.5/0.0	5.95/0.0
0/1	0.0/1.6	0.0/3.1	0.0/4.8	0.0/6.4
0.24/0.75	0.5/1.3	0.9/2.4	1.3/3.65	1.6/4.5
0.46/0.54	0.8/1.0	1.7/1.8	2.6/2.8	3.3/3.6
0.74/0.26	1.1/0.5	2.2/0.9	3.15/1.3	2.9/1.1

HAL=Halothane, ENF=Enflurane, ISO=Isoflurane

The accidental misfilling of an anesthetic vaporizer might injure a patient since an excessive concentration of a volatile agent may be administered. Such mix-ups have been noted in actual practice. However, this report marks the first systematic investigation of mixtures of ISO and HAL in a calibrated ENF vaporizer.

The Criticare monitor employed in this investigation has a rated resolution of 0.1% and a rise time of 500 msec. It can identify HAL, ISO and ENF individually over the range 0-7%. Although its rated accuracy is ± 0.3%, when checked against standard calibration gases, its accuracy was found to be ±0.1%.

When 100% ISO or HAL was placed in the ENF vaporizer, its output was up to 60% above the reading on the vaporizer's dial. This could result in the administration of unsuspected anesthetic overdose. The fact that no significant deviation from linearity was noted when the measured concentrations of either ISO or HAL were plotted against X suggests that there is no appreciable interaction between these volatile anesthetics. They appear to form an ideal solution.