A135

TITLE: PULMONARY EXCRETION OF ACETONE: CONDUCTING AIRWAYS AND TIME COURSE

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The multiple inert gas elimination technique (MIGET) has been used to quantify the effects of inhaled anesthetics, vasodilator therapy, and pulmonary diseases on the distribution of ventilation/perfusion (V/Q) ratios in the lung (1,2). Acetone, the inert gas with the highest solubility in the series of six inert gases, is thought to provide information about dead space and lung units of high V/Q.

Two fundamental assumptions of the method are that the inert gas, infused at a constant rate, has reached a steady-state of excretion in exhaled gas, and that the inert gas is not excreted by the conducting airways (2). We tested both of these assumptions by infusing acetone intravenously in normal human subjects, and recording the inert gas expirograms.

All studies were approved by the Human Studies Subcommittee at the Philadelphia VAMC. We have described our experimental apparatus previously (3). This system accurately measures acetone in the 50 ppm range with a 10-90% response time of 40 msec for a step input. We infused 30 ml of acetone dissolved in 500 ml of saline at a rate of 350 ml/hr, for 90 min in two normal adult males, and recorded the inert gas and CO_2 expirograms at ten minute intervals.

We assessed acetone excretion in the upper airways by comparing the areas under the CO_2 and acetone expirograms (normalized to mixed expired tension) from a tidal volume of zero to the volume at which CO_2 tension reached 2.5 Torr. In this interval, 2.3 ± 0.7 percent of the total acetone was excreted, compared to 0.23 ± 0.1 per cent of the total CO_2 ($P<10^{-8}$, Wilcoxon sign rank). We assessed the time to achieve steady-state by plotting the end tidal inert gas tension divided by the maximum end tidal tension versus time.

We conclude that acetone is excreted from upper airways in early exhalation, and that acetone excretion is not at a steady state at 30 minutes. Data from the MIGET technique for high V/Q compartments and dead space should be interpreted with caution.

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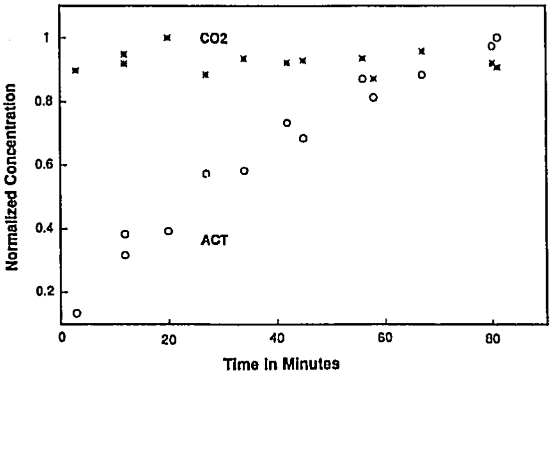
Refer: 1) J Appl Physiol 56:1-7, 1984; 2) Ann Rev Physiol 42:235-47, 1980; 3) Respir Physiol, in press, 1991



A136

TITLE: DYNAMIC RESPIRATORY PATTERNS AFTER LAPAROSCOPIC CHOLECYSTECTOMY

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Open cholecystectomy may reduce the patient's abdominal breathing(1). Laparoscopic cholecystectomy is a new procedure allowing for the removal of the gallbladder without a subcostal incision. Although avoiding this incision may be advantageous, animal studies suggest that diaphragmatic dysfunction may be induced by manipulation of the gallbladder and its bed(2). This study, which has been approved by the Institutional Review Board, was undertaken to evaluate chest wall and abdominal motion after laparoscopic cholecystectomy.

Having given their informed consent, eight otherwise healthy patients (ave. age= 47±13 yrs, range=30-66) scheduled to undergo laparoscopic cholecystectomy were enrolled in this study. Prior to and one day after surgery, respiratory inductive plethysmography (Respitrace mod no.300SC) was used to measure the respiratory frequency(f), tidal volume (Vt), minute ventilation(Vmin) and to determine the ratio of chest tidal volume(Vc) to Vt. The plethysmograph was calibrated with a spirometer (Med Science Wedge mod no.570). Vc was calculated as the product of Vt and (Vc/Vt). The abdominal tidal volume (Vab) was calculated from the formula Vab=Vt-Vc. Patients were studied at their normal breathing pattern and during coached abdominal breathing. Differences between the preoperative and postoperative values for each breathing pattern were evaluated using a paired Students t-test.

Laparoscopic cholecystectomy resulted in a significant decrease of abdominal motion as reflected in a decrease in Vab and an increase in Vc/Vt in both types of breathing. The Vab changes are similar in magnitude to those reported after open cholecystectomy(1).

	Normal Breathing		Abdominal Breathing	
	Preop	Postop	Preop	Postop
f (bpm)	18 ± 5	22 ± 3	14 ± 7	19 ± 2
Vt (ml)	445 ± 269	323 ±178*	632±418	314 ±200*
Vmin (L/min)	7.0 ± 2.9	6.8 ± 3.2	7.6± 4.4	5.7 ± 3.2*
Vc (ml)	195 ± 107	184 ± 80	72 ± 76	114 ± 77*
Vab (ml)	249 ± 198	139 ±140*	560±373	200 ±135*
% Vc/Vt	38 ± 20	62 ± 18*	12± 8	37 ± 20*

All values are mean ± s.d.
* = P<.05 when compared to the preoperative value

As in animal studies, manipulation of the gallbladder bed in humans may produce changes in the dynamic respiratory patterns. It appears that the laparoscopic removal of the gallbladder without an extensive surgical incision still produces significant reduction in abdominal motion.

1. Chuter TAM, Weissman C, Mathews DM and Starker PM. Diaphragmatic breathing maneuvers and movement of the diaphragm after cholecystectomy. Chest 97:1110-1114, 1990.

2. Ford GT, Grant DA, Rideout KS, Davison JS and Whitelaw WA. Inhibition of breathing associated with gallbladder stimulation in dogs. J Appl. Physiol. 65:72-79, 1988.