

Title : THE DYNAMIC PRESSURE RESPONSE TO ENFLURANE AND HALOTHANE

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Introduction. Most of the comparisons between enflurane (E) and halothane (H) have been performed during steady states. However, anesthetic concentrations change frequently in the course of an anesthetic administration. We have developed a method for examining the changes in mean arterial blood pressure (AP) produced by rapidly changing inspired anesthetic concentrations and for quantitating the responses to these changes in a manner which makes comparison easy. Our results show that, following a "bolus" of either agent, the depression of AP by E is faster and twice as great as that by H.

Methods. We performed 16 studies in 8 dogs, during controlled ventilation and administration of either E-O₂ or H-O₂. Direct arterial pressure was recorded. To produce the rapid changes in anesthetic concentration, we used the pseudo-random binary pulse sequence (PRBS): "binary" because the anesthetic was either off or on (3.5 "MAC"); "random" because the duration of the on and off periods was randomized; "pseudo" because the random sequence was repeated, every 26 min. in our case. If this input signal is correlated against itself at several different points, the result is as if a sudden impulse, or bolus, of the anesthetic agent is given every 26 min. This impulse in our case was equivalent to 6 MAC-seconds. The response to this impulse can be obtained by continually correlating the input (inspired concentration) against the output (mean arterial pressure) (cross-correlation). The resulting impulse response is a summary of all the responses to binary transitions during the sequence, and is similar to the response to an intravenous bolus of the drug. The computations were performed on a PDP-11/34 Computer.

Results. The impulse response to either agent consisted of a sharp drop in AP followed by a gradual recovery (Fig. 1). The Table lists the differences in response between E and H. Note that H responds more slowly and with less magnitude than E. Figure 3 shows the response to the step described in Fig. 1. Note that although H drops more rapidly, they both wind up at the same level of depression.

Discussion. 1.) E and F produce the same depression in AP at steady states (Fig. 2), a fact which is generally accepted. However, the dynamic response is considerably different, E depressing AP twice as much as H. This points out the necessity of comparing drugs in the dynamic state as well as the steady state. Much of the difference is probably due to the more rapid action of E, which in turn is due to its lower blood/gas partition coefficient. 2.) The same information could theoretically have been obtained by simply giving an impulse of H or E superimposed on a steady state. However, any random change in AP would have overwhelmed the relatively small response. Furthermore, the PRBS allows a "running" impulse, that is, the impulse can be shifted in time to continuously update it. Thus any change in the animal's status, such as changes in blood volume or the addition of other anesthetic agents, would change the impulse res-

ponse. These changes, in turn, can give valuable clues as to the status of the animal, clues which cannot be obtained with the steady state. Thus the PRBS, with smaller on-off excursions, can act as a continuous, but benign stress test. 3.) Since the impulse is so brief, little of it is taken up into the body. Similarly, although the resulting step inspired concentration is a 6 MAC, but "body" step is only about 1 MAC.

TABLE

Variable.	Halothane	Enflurane	P
Time to onset*	31.0±11.3	9.3±4.5	<.0025
Time to maximum response*	71.1±23.7	51.8±19.1	<.05
Maximum response (torr)	-0.72±0.31	-1.69±0.48	<.0005
Time constant of recovery* *Seconds	147.±57.8	99.1±35.1	<.025

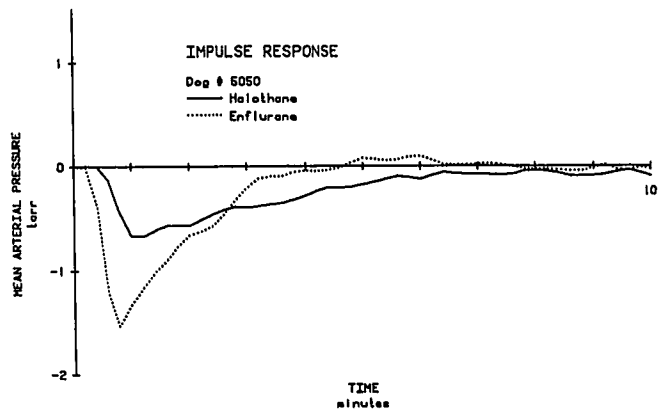


Figure 1

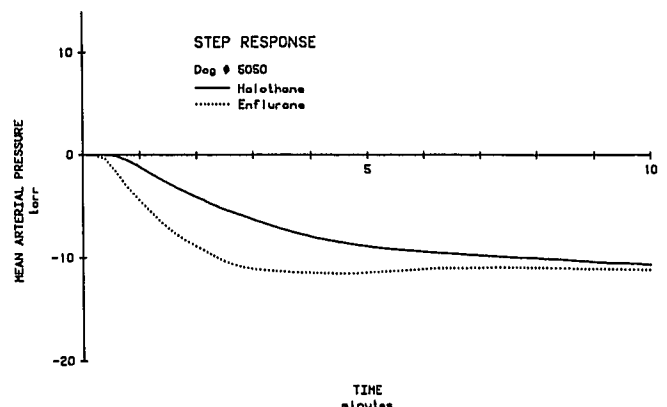


Figure 2