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## Sympathetic Hyperactivity during Desflurane Anesthesia

**To the Editor:**—Although the article of the above title<sup>1</sup> contains useful information, the design of the study compromises one of its aims, a comparison with isoflurane. The investigators provided their subjects with 0.5, 1.0, and 1.5 MAC (minimum alveolar concentration) as defined by vaporizer settings. That is, the concentrations delivered to the anesthetic circuit (and from the circuit to the volunteer) equalled 0.5, 1.0, and 1.5 MAC desflurane or isoflurane. Given the differences in solubility and uptake of these anesthetics,<sup>2-4</sup> identity (in terms of MAC multiples) of delivered concentrations does not produce identity of alveolar concentrations. The alveolar MAC multiples of desflurane must be greater than those of isoflurane because the uptake of isoflurane will be greater. The difference for both the inspired-to-alveolar anesthetic concentrations and the delivered-to-inspired anesthetic concentrations will be larger for isoflurane, the latter because of the impact of rebreathing of gases from which a greater amount of anesthetic has been extracted. Therefore, the alveolar MAC multiples of isoflurane will be less, the step sizes of isoflurane will be smaller, and the rise in the alveolar concentration of isoflurane will occur over a longer period than that in desflurane. If the MAC multiples and step sizes applied were unequal and if the rates of rise in the alveolar concentrations differed, nothing can be said about the comparative effects of these two anesthetics.

Publication of the end-tidal desflurane *versus* end-tidal isoflurane concentrations and the time course of the changes in concentration might have diminished or eliminated the above concerns. Perhaps the MAC multiple differences, the differences in step sizes, and the differences in the rates of change were too small to have affected the results. However, although end-tidal concentrations were measured, they were not reported.

The manner of selection of subjects further compromises the comparison of the results with isoflurane *versus* desflurane. The data for each anesthetic were obtained from different volunteer pools (*i.e.*, no subject received both anesthetics). The anesthetics were not randomly assigned to the subjects, and it appears that the subjects given

isoflurane were studied after the subjects given desflurane: "In seven additional subjects, isoflurane was administered at time intervals and MAC equivalents identical to those employed in the subjects receiving desflurane." However, these are relatively minor flaws compared to the flaws of imposing different MAC multiples, different step sizes, and different rates of rise in end-tidal concentrations.

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**In Reply:**—Eger and Weiskopf have expressed some concerns over the experimental design of our study but admit that we have provided "useful information." Their first concern is that our comparison of desflurane to isoflurane in equivalent minimum alveolar concentration (MAC) increments during induction is scientifically invalid because the rate of rise of the alveolar concentration would be dissimilar. This is because of the different solubility and uptake of these anesthetics. We have two responses to this concern. First, it is very likely that clinicians will want to take advantage of the kinetic properties of desflurane, *i.e.*, they will attempt to rapidly deepen anesthesia to

establish a plane sufficient to obtund stress responses. Thus, our experimental design was driven by a clinically relevant desflurane administration paradigm. The rapid administration of desflurane can trigger substantial tachycardia and hypertension. Second, the suggestion that we compare the neurocirculatory responses to increasing anesthetic levels at equi-alveolar MAC is an excellent one, and in fact, we have begun work along these lines. In our first of two unpremedicated volunteers, we slowed the rate of desflurane administration to achieve 1-MAC (7.25%) end-tidal concentrations within 12 min (beginning 1 min after anesthetic induction with 2.0 mg/kg

## CORRESPONDENCE

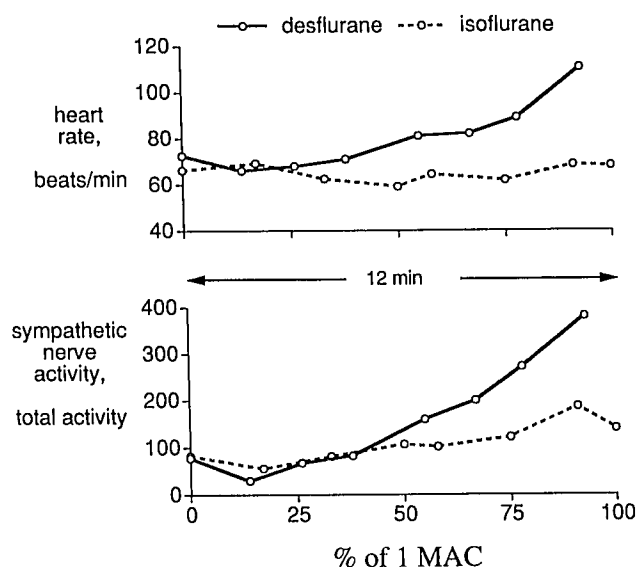


Fig. 1. Heart rate and sympathetic nerve activity responses of two healthy young volunteers receiving isoflurane ( $n = 1$ ) or desflurane ( $n = 1$ ) by mask. No premedication was given and, in each, anesthesia was induced with 2.0 mg/kg propofol. The inhaled anesthetic was added to the inspired oxygen and titrated so that the rate of rise of the end-tidal anesthetic concentration over a 12-min period to a desired 1 MAC was identical in each volunteer. Total activity is calculated as the frequency of sympathetic bursts per 100 cardiac cycles times the mean burst amplitude.

propofol). In our second volunteer, we matched the end-tidal rate of rise to 1 MAC with isoflurane by giving high inspired isoflurane concentrations (3–4%) at a high fresh gas flow rate (8 l/min, 100%  $O_2$ ). We cannot be certain that the anesthetic uptake in the central nervous system was similar, and admittedly, two subjects do not constitute a study, but despite a matched (equipotent) rise in alveolar concentration, we noted profound sympatho-excitation and tachycardia with desflurane (fig. 1).

The second concern expressed by Eger and Weiskopf was that subject randomization was poor and that the same subjects did not participate in both limbs of the study. The isoflurane group was added for comparison to the desflurane study as dictated by the expert reviewers that critiqued the original manuscript submission. The concern that subjects were chosen from different volunteer pools is unwarranted because all subjects were from the same population, *i.e.*, young, healthy students. Appropriately, unpaired statistical comparisons were employed.

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## Factors Affecting Outcome in Patients Undergoing Peripheral Vascular Surgery: I

*To the Editor:*—I applaud the efforts of Rosenfeld *et al.*<sup>1</sup> and Christopherson *et al.*<sup>2</sup> for addressing the complex and controversial issue of regional *versus* general anesthesia for patients undergoing peripheral vascular surgery. Unfortunately, these studies disregard the role of the surgeon in the overall rate of early graft failure in patients undergoing vascular surgery. For example, their overall incidence of early graft failure (13%) is very high when compared to results from other major medical centers. Bandyk *et al.*,<sup>3</sup> in a consecutive series of 353 patients undergoing lower extremity revascularization procedures, reported an early graft failure rate of 5%. The major causes of early graft failure in this series were related to inadequate outflow, poor-quality vein, and technical errors on the part of the surgeon. In another series, Bandyk *et al.*<sup>4</sup> found that 79% of early graft revisions were necessary to correct specific anatomic

problems with the graft and that relatively few (<7%) were secondary to unexplained thrombosis. Unfortunately, Rosenfeld *et al.* and Christopherson *et al.* did not report on the type of graft used (synthetic *vs.* natural vein) or the quality of the anastomosis as demonstrated by intraoperative angioscopy or angiography. Lacking such crucial information, it is difficult to conclude that general anesthesia alone was the major contributory factor to their observed high early graft failure rate.

Bode *et al.*<sup>5</sup> recently presented the results of 307 patients random-

\* Bode RH, Lewis DP: Graft occlusion after peripheral vascular surgery *vs.* regional anesthesia, *Manual of the Society of Cardiovascular Anesthesiologists*. 1993, pp 244–245.