

In Reply:

We would like to thank Drs. Feldman and Wappler for their thoughtful comments regarding our manuscript published recently in *ANESTHESIOLOGY*.¹ The use of carbon filters suggested by Dr. Feldman and previous investigators presents an approach to quickly prepare an anesthesia workstation for a malignant hyperthermia (MH)-susceptible patient and facilitate the reduction of anesthetic gases during an MH crisis.²⁻⁴ We agree carbon filter devices have proven to be effective in reducing the anesthetic gas concentration. However, the Food and Drug Administration has never approved the use of carbon filters specifically for the purposes of reducing or eliminating the risk of anesthetic gas exposure for MH-susceptible patients. The Vapor-Clean filters (Dynasthetics, LLC, Salt Lake City, Utah) are approved by the Food and Drug Administration with a 510(k) clearance as a general-purpose device meant to scavenge volatile anesthetic gases. Therefore, we are hesitant to make a recommendation on this device without clinical studies in at least patients who are not MH susceptible, with the focus directed specifically to validating the filter's ability to reduce and maintain the residual anesthetic gas concentration at or less than the presumed safe concentration of ≤ 5 ppm. In addition, we reiterate that making such a recommendation is outside the purview of our review and instead lies with organizations such as the American Society of Anesthesiologists, the Anesthesia Patient Safety Foundation, European Malignant Hyperthermia Group, or the Malignant Hyperthermia Association of the United States (MHAUS).

As mentioned by Dr. Wappler, having a "clean" anesthesia machine in reserve for the sole purpose of caring for MH-susceptible patients was a consideration we shared. However, the additional costs involved in acquiring and maintaining an "extra" anesthesia machine and the time required to exchange the machine were concerning.^{5,6} In fact, MHAUS specifically did not recommend exchanging anesthesia machines or parts of the patient breathing system during a crisis because to do so lacked any benefit and acted as a distraction from patient care. Furthermore, one must question the reliability of the anesthesia machine involved in such a practice. As an example, a colleague had the unfortunate experience of having a machine malfunction between anesthesia cases. He quickly found another anesthesia machine that was infrequently used for patient care but was inspected daily. However, he quickly found that parts had been scavenged and the oxygen sensor needed to be replaced. This situation would be unacceptable for an MH-susceptible patient or a patient having an MH crisis. Therefore, although maintaining a clean anesthesia machine in theory represents an overt means to achieve "100% patient safety," in practice this method may pose other serious risks.

* <http://medical.mhaus.org/index.cfm/fuseaction/Content.Display/PagePK/MedicalFAQs.cfm>. How should the anesthesia machine be prepared before surgery for an MHS patient? Accessed April 24, 2011.

Lastly, we agree the maximum safe level of exposure to anesthetic gases is unknown. The often-cited cutoff of ≤ 5 ppm is derived from experiments in MH-susceptible swine.⁶ Unfortunately, the substantial morbidity and mortality associated with MH restricts its study in humans. Therefore, the true safe limit of exposure may never be known. The variability of genetic mutations, incomplete penetrance of these alleles, and the relative potencies of different volatile anesthetic agents to trigger an MH crisis, while serving as a reminder of the heterogeneity of MH, further complicate this issue and underscore the difficulties in both studying MH and recommending changes in general policy. Indeed, the maximum safe level of exposure likely will vary with different RyR1 alleles, and these differences may be further modified by the context unique to each patient's genome as well as the triggering anesthetic agent.

In summary, we would like to express our appreciation to Drs. Feldman and Wappler for sharing our interest in MH. The reduced penetrance and variable expressivity of this inherited disorder and lack of a scientifically defined value in humans for the maximum safe limit of exposure to residual anesthetic gases suggests zero tolerance for any exposure to volatile anesthetic agent would be the best practice. However, as noted by Dr. Wappler, there are no reported cases of MH in susceptible patients who were ventilated by anesthesia machines that were decontaminated according to current MHAUS guidelines. Our review of anesthesia machines was limited to published studies and thus did not include all available anesthesia machines. It was evident from our review that MHAUS recommendations need to be updated to include the newer generation of anesthesia machines.* Finally, the lack of published data or clinical experience with carbon filters and malignant hyperthermia caution the use of such devices for MH-susceptible patients as an alternative to machine preparation. We are conducting research to define the best method for standardizing the preparation of anesthesia machines and the role of carbon filters in reducing the risk of an MH crisis.

Tae W. Kim, M.D.,† Michael Nemergut, M.D., Ph.D. †The Johns Hopkins University School of Medicine, The Johns Hopkins Hospital, Baltimore, Maryland. tkim52@jhmi.edu

References

1. Kim TW, Nemergut ME: Preparation of modern anesthesia workstations for malignant hyperthermia-susceptible patients: A review of past and present practice. *ANESTHESIOLOGY* 2011; 114:205-12
2. Gunter JB, Ball J, Than-Win S: Preparation of the Dräger Fabius anesthesia machine for the malignant-hyperthermia susceptible patient. *Anesth Analg* 2008; 107:1936-45
3. Jantzen JP, Eck J, Kleemann PP: [An activated charcoal filter for eliminating volatile anesthetics. A contribution to the management of malignant hyperthermia.] *Anaesthesist* 1989; 38:639-41
4. Birgenheier NM, Westenskow DR, Orr JA: Using activated charcoal filters to prepare newer anesthesia machines for MH-susceptible patients (abstract A302). Presented at the Annual Meeting of the American Society of Anesthesiologists 2009
5. Reber A, Schumacher P, Urwyler A: Effects of three different types of management on the elimination kinetics of volatile

anaesthetics. Implications for malignant hyperthermia treatment. *Anaesthesia* 1993; 48:862-5

6. Maccani RM, Wedel DJ, Kor TM, Joyner MJ, Johnson ME, Hall BA: The effect of trace halothane exposure on triggering malignant hyperthermia in susceptible swine. *Anesth Analg* 1996; 82:S287

(Accepted for publication April 29, 2011.)

Just Who Is Burning Out ... Chairpersons or Program Directors?

To the Editor:

Dr. De Oliveira *et al.* recently published an interesting manuscript discussing the apparent high incidence of burnout in academic anesthesiology chairpersons.¹ Risk factors including low job satisfaction and spousal support were discussed at length, and the survey instrument used was attached as an Appendix (pp 189-93).

While reading the article, I began to wonder if similar burnout risks applied to program directors, and I was surprised to see that the Appendix specifically asked questions of program directors, *not* program chairs. I assume that this was either part of a larger survey, or that the wrong Appendix was included with the manuscript; however, I was hoping the authors could comment on their thoughts on program director *versus* chairperson stress and burnout. Furthermore, did the authors receive comments or data from any of the anesthesiologists who serve as both program director and chair in their departments?

Roy G. Soto, M.D., Beaumont Hospitals, Royal Oak, Michigan. roy.soto@beaumont.edu

Reference

1. De Oliveira GS Jr, Ahmad S, Stock MC, Harter RL, Almeida MD, Fitzgerald PC, McCarthy RJ: High incidence of burnout in academic chairpersons of anesthesiology: Should we be taking better care of our leaders? *ANESTHESIOLOGY* 2011; 114:181-93

(Accepted for publication April 19, 2011.)

In Reply:

Thank you for your interest in our article. The data presented¹ were part of sequential series of studies performed independently that evaluated the risk of burnout in department chairs and then program directors and more recently anesthesiology residents. The survey tool for the program director survey was similar to that used for the chair survey except that *faculty* and *resident* were used in place of *resident* and *dean* in place of *chairman* in sections 2 and 4 of the survey and *chair* replaced *program director* throughout.

We found that program directors exhibited burnout to a degree similar to that of chairs, with 52% of the respondents exhibiting moderate to high burnout risk. Risks to the development of burnout in the program directors were slightly

different from those of the chairs and included disputes with the chair and Accreditation Council of Graduate Medical Education dispute issues. It is conceivable that chair burnout could affect the program director responses because burnout in the workplace has been recognized to spread among co-workers.² Because the surveys were delinked, we were unable to test the cross-association of chairs and program directors or the potential that the same individual served both roles. We did not receive any comments regarding dual responsibility roles of the respondents and can only speculate that a chair who also serves the role of program director would be facing extreme stressors and could be at a high risk of burnout.

Gildasio De Oliveira, M.D., Robert J. McCarthy, Pharm.D.*

*Northwestern University Feinberg School of Medicine, Chicago, Illinois. r-mccarthy@northwestern.edu

References

1. De Oliveira GS Jr, Ahmad S, Stock MC, Harter RL, Almeida MD, Fitzgerald PC, McCarthy RJ: High incidence of burnout in academic chairpersons of anesthesiology: Should we be taking better care of our leaders? *ANESTHESIOLOGY* 2011; 114:181-93
2. Hyman SA, Michaels DR, Berry JM, Schildcrout JS, Mercaldo ND, Weinger MB: Risk of burnout in perioperative clinicians: A survey study and literature review. *ANESTHESIOLOGY* 2011; 114:194-204

(Accepted for publication April 19, 2011.)

Hypoxemia during One-lung Ventilation: Looking the Other Way

To the Editor:

Rozé *et al.*¹ discuss the problem of hypoxemia during one-lung ventilation in a very constructive way but omit the option of increasing the concentration of oxygen in the shunt. Their case report illustrates the difficulty that sometimes arises.

If the concentration of oxygen in the shunt is increased, the same shunt causes less arterial desaturation. Because the amount of oxygen is quite small, a small volume, *e.g.*, 50 ml with a low inflation rate, *e.g.*, 6 breaths/min of the nonventilated lung can greatly improve arterial oxygenation. This simple technique was described in 2009 and usually caused marked improvement in oxygenation without disrupting surgery on the nonventilated lung.²

W. John Russell, M.D., Ph.D., F.A.N.Z.C.A., Royal Adelaide Hospital, Adelaide, South Australia, Australia. john.russell@adelaide.edu.au

References

1. Rozé H, Lafargue M, Ouattara A: Case scenario: Management of intraoperative hypoxemia during one-lung ventilation. *ANESTHESIOLOGY* 2011; 114:167-74
2. Russell WJ: Intermittent positive airway pressure to manage hypoxia during one-lung anaesthesia. *Anaesth Intensive Care* 2009; 37:432-4

(Accepted for publication April 26, 2011.)