

unlikely to have occurred by chance. We note this simply as an observation; diagnoses recorded on death certificates were never part of our original hypothesis and cannot be used in the inferential process. We do not agree with Gross *et al.* that it is scientifically valid to include a long-term outcome (death with a cancer-related diagnosis) in a predictive model based on the perioperative physical status of the patient.

Dr. Roth's suggestion that blood transfusion and extracorporeal circulation may have synergistic adverse effects is not unreasonable. Certainly, this is one explanation for the observation that cardiac surgery is the only clinical setting where adverse transfusion-related immunomodulation effects have been conclusively demonstrated.¹⁰ Our study data does not help to clarify this suggestion, however, as most of our transfused patients were exposed to extracorporeal circulation.

None of this is any reason to promote the use of blood. The short-term risks are compelling, as are the huge costs and the ever diminishing resource. However, we should not be misinforming patients who have survived more than 2 months after coronary artery grafts that they have a serious risk of premature death as a result of a moderate transfusion of blood products.

William M. Weightman, F.A.N.Z.C.A.,* Neville M. Gibbs, M.D., Matthew R. Sheminant, R.N., Mark A. J. Newman, M.D., Dianne E. Grey, B.Sc., F.A.I.M.S. *Sir Charles Gairdner Hospital and University of Western Australia, Perth, Western Australia. wweightman@meddent.uwa.edu.au

References

1. Weightman WM, Gibbs NM, Sheminant MR, Newman MAJ, Grey DE: Moderate exposure to allogeneic blood products is not associated with reduced long-term survival after surgery for coronary artery disease. *ANESTHESIOLOGY* 2009; 111:327-33
2. Engoren MC, Habib RH, Zacharias A, Schwann TA, Riordan CJ, Durham SJ: Effect of blood transfusion on long-term survival after cardiac operation. *Ann Thorac Surg* 2002; 74:1180-6
3. Surgenor SD, Kramer RS, Olmstead EM, Ross CS, Sellke FW, Likosky DS, Marrin CAS, Helm RE, Leavitt BJ, Morton JR, Charlesworth DC, Clough RA, Hernandez F, Frumiento C, Benak A, DioData C, O'Connor GT: The association of perioperative red blood cell transfusions and decreased long-term survival after cardiac surgery. *Anesth Analg* 2009; 108:1741-6
4. Engoren M, Habib RH, Hadaway J, Zacharias A, Schwann TA, Riordan CJ, Durham SJ, Shah A: The effect on long-term survival of erythrocyte transfusion given for cardiac valve operation. *Ann Thorac Surg* 2009; 88:95-100
5. Engoren M, Arslanian-Engoren C: Long-term survival in the intensive care unit after erythrocyte blood transfusion. *Am J Crit Care* 2009; 18:124-32
6. Silliman CC, Ambruso DR, Boshkov LK: Transfusion related lung injury. *Blood* 2005; 105:2266-73
7. Sarnak MJ, Tighiouart H, Manjunath G, MacLeod B, Griffith J, Salem D, Levey AS: Anemia as a risk factor for cardiovascular disease in the Atherosclerosis Risk in Communities (ARIC) study. *J Am Coll Cardiol* 2002; 40:27-33
8. van Straten AH, Hamad MA, van Zundert AJ, Martens EJ, Schönberger JP, de Wolf AM: Preoperative hemoglobin level as a predictor of survival after coronary artery bypass grafting: A comparison with the matched general population. *Circulation* 2009; 120:118-25
9. Riva E, Tettamanti M, Mosconi P, Apolone G, Gandini F, Nobili A, Tallone MV, Detoma P, Giacomini A, Clerico M, Tempia P, Guala A, Fasolo G, Lucca U: Association of mild anemia with hospitalization and mortality in the elderly: The health and anemia population-based study. *Haematologica* 2009; 94:22-8
10. Vamvakas EC, Blajchman MA: Transfusion-related immunomodulation (TRIM): An update. *Blood Rev* 2007; 21:327-48

(Accepted for publication November 20, 2009.)

Exposure Limits to Magnetic Resonance Imaging Fields: Invisible Land Mines or Fields to Mine

To the Editor:

We read with interest the article by Roh *et al.* concerning exposure to low-frequency electromagnetic fields (EMFs) and wish to comment on another great source of exposure to EMF that anesthesiologists face in the hospital. Although the risk factors of magnetic fields are well known for patients, exposure limits to EMFs are unknown in healthcare providers who are continuously exposed to the magnetic resonance imaging (MRI) environment.^{1,2*} The MRI environment exposes anesthesiologists to static and gradient magnetic fields, with the exposure limits dependant not only on the strength of the MRI scanner (1.5 T *vs.* 3.0 T) and length of the scanning sequences but also on which anesthetic technique is chosen and whether the intravenous pumps, monitors, and anesthesia machines used are MRI compatible.

The lack of MRI safe or compatible monitors and machines forces the anesthesiologist to choose a technique that requires being in the magnet room closer to the magnet bore, and thus potential exposure to higher levels of EMF. Not only the exposure is potentially greater but also the tracking of individual anesthesiologist's exposure time during monitoring is lacking.

Because of the lack of studies of healthcare personnel to the long-term risks of EMF, certain groups are beginning to examine issues such as risk of mortality or cancer rates in personnel working in the MRI environment. Numerous groups, including the World Health Organization, National Health Service (United Kingdom), and the Health Protection Agency, are becoming involved in the design and epidemiologic studies about long-term exposure to EMF in healthcare personnel working in MRI are implemented. The European Union is also proposing a directive that will limit the exposure of healthcare workers to the EMF of MRI magnet rooms. Implementation of these directives will ban anes-

Timothy J. Brennan, Ph.D., M.D., served as Handling Editor for this exchange.

* Keevil S. The EU physical agents (electromagnetic fields) directive and its impact on magnetic resonance imaging. Available at: <http://www.ipem.ac.uk/docimages/1581.pdf>. Accessed September 3, 2009.

thesiologists from staying in the magnet room during MRI scans. We have not found any studies of MRI-induced injury to healthcare personnel from long-term exposure to EMFs or any studies correlating exposure levels to disease. Anesthesia personnel who provide limited or occasional care in the MRI environment run a risk of exposure to EMFs.^{3,4} Anesthesia providers should carefully consider their anesthetic technique to minimize the time spent in the MRI magnet room. In the future, exposure limits to EMFs should be recorded by anesthesia personnel to facilitate future epidemiologic studies to determine EMF exposure rates. More research is required in developing anesthetic techniques to minimize the EMF exposure limits.

Yvon Bryan, M.D.,† Lauren Hoke, B.S., T. Wesley Templeton, M.D., Leah Templeton, M.D., Thomas A. Taghon, D.O. †Wake Forest University School of Medicine, Winston-Salem, North Carolina. ybryan@wfubmc.edu

References

1. Roh JH, Kim DW, Lee SJ, Kim JY, Na SW, Choi SH, Kim KJ: Intensity of extremely low-frequency electromagnetic fields produced in operating rooms during surgery at the standing position of anesthesiologists. *ANESTHESIOLOGY* 2009; 111:275–8
2. Riches SF, Collins DJ, Charles-Edwards GD, Shafford JC, Cole J, Keevil SF, Leach MO: Measurements of occupational exposure to switched gradient and spatially-varying magnetic fields in areas adjacent to 1.5 T clinical MRI systems. *J Magn Reson Imaging* 2007; 26:1346–52
3. Henderson M. EU directive doesn't scan; junk medicine MRI scans. *The Times* (London) December 20, 2008: 53
4. Smith R. MRI scanners to be examined for cancer risk. *The Daily Telegraph* (London) May 22, 2008: 8

(Accepted for publication November 23, 2009.)

In Reply:

We appreciate the comments from Bryan *et al.* regarding our article¹ that is related to electromagnetic fields (EMFs) in operating rooms, but magnetic resonance imaging (MRI) magnetic rooms. The anesthesiologists have been exposed to a large amount of EMFs in MRI magnetic rooms because of the recent lack of EMF-safe monitors and machines in an MRI environment. However, there is no specific study about the amount of EMFs in MRI magnetic rooms related to the anesthesiologist and long-term effects of EMFs to the anesthesiologist in an MRI environment. We agree with your opinion that anesthesiologists should consider minimizing the time spent in the MRI magnetic room and should start an epidemiological study for the anesthesiologists working in an MRI environment.

European directive 2004/40/EC on occupational exposure to EMFs was to be implemented in the Member States of the European Union by 2008. Because of some unexpected problems, the deadline was postponed until 2012.² Now is the time, we think, for all anesthesiologists to be interested in their working environment, especially EMFs in operating rooms, MRI magnetic rooms, and intensive care units.

Jang Ho Roh, M.D., Ph.D., Deok Won Kim, Ph.D., Sung Jin Lee, M.D., Ph.D., Ji Young Kim, M.D., Sung Won Na, M.D., Ph.D., Seung Ho Choi, M.D., Ph.D., Ki Jun Kim, M.D., Ph.D.* *Anesthesia and Pain Research Institute, Yonsei University College of Medicine, Seoul, Korea. kjkj0063@yuhs.ac

References

1. Roh JH, Kim DW, Lee SJ, Kim JY, Na SW, Choi SH, Kim KJ: Intensity of extremely low-frequency electromagnetic fields produced in operating rooms during surgery at the standing position of anesthesiologists. *ANESTHESIOLOGY* 2009; 111:275–8
2. Hansson MK, Alanko T, Decat G, Falsaperla R, Gryz K, Hietanen M, Karpowicz J, Rossi P, Sandström M: Exposure of workers to electromagnetic fields. A review of open questions on exposure assessment techniques. *Int J Occup Saf Ergon* 2009; 15:3–33

(Accepted for publication November 23, 2009.)

Implicit Memory Phenomena under Anesthesia Are Not Spurious

To the Editor:

I read with great interest the article by Hadzidiakos *et al.*¹ in the August issue of *ANESTHESIOLOGY*. These investigators conducted a study of memory function under anesthesia using the process dissociation procedure (PDP), a method that my colleagues and I have used in the same context in the past.^{2–4} In contrast to our studies, Hadzidiakos *et al.* report no evidence of memory function in terms of word stem completion test performance, a discrepancy for which the authors provide plausible explanations such as the depth of anesthesia and midazolam premedication. However, notwithstanding their null finding, one of the PDP models—the original—produced parameters suggesting the presence of controlled (explicit) and automatic (implicit) memory processes. By extending the model to include guessing parameters, the authors go on to show that the original model produces faulty estimates and that other published results using the original model are faulty. That is, Hadzidiakos *et al.* find no evidence of any memory processes in three of the four inspected studies when the extended measurement model is applied. They conclude that in these studies there was no contribution (*i.e.*, evidence) of memory at all and that past findings are spurious.

I take issue with this conclusion for several reasons. Foremost, a model that generates discrepant parameters depending on its assumptions or underlying structure should not invalidate the behavioral findings it attempts to model. When significant differences are found in patients' postoperative behavioral responses to old material presented under anesthesia *versus* new material not presented before, this difference is real and evidences memory for old material regardless of how the underlying process is labeled. Dismissing these behavioral observations ignores an overwhelming body of evidence in favor of implicit memory ("priming") phenomena in the cognitive psychology and neurology literature and surely cannot have been the intent of Hadzidiakos *et al.*