bupivacaine is difficult to justify.[1] On the contrary, sales and revenue from liposomal bupivacaine continue to grow,[6] undoubtedly owing to an aggressive marketing campaign. We have seen first-hand the results of this campaign, as many physician colleagues who are grounded in evidence-based medicine have shifted their practice to anecdotal medicine, insisting that liposomal bupivacaine exhibits superior pain control and leads to clinically significant reduced length of stay. Perhaps the dose influences their observations: We suspect that they are injecting the maximum dose of liposomal bupivacaine (*i.e.*, 266 mg), while using a lower dose of nonliposomal bupivacaine.[1] We have additionally observed that liposomal bupivacaine usage tends to be an institutional decision: If the hospital system has decided to purchase this expensive product, then surely it ought to be used. And so, as more practices and hospitals are infiltrated with liposomal bupivacaine despite an absence of strong evidence, where do we go from here?

As physicians, we must strive to practice evidence-based medicine and use evidence such as that presented by Ilfeld *et al.*[1] and Hussain *et al.*[5] to defend against inappropriate and wasteful healthcare costs. However, distinguishing between objective data and marketing bias may pose a challenge for providers seeking to stay abreast of the current evidence in their field, given the prominent role the industry plays in medical education.[7] Not too long ago, we witnessed the perils of the pharmaceutical industry's influence on medical education and practitioners and how this ultimately helped fuel the opioid epidemic.[8,9] Nowadays, in our determination to optimize postoperative pain control with nonopioid alternatives, are we repeating the missteps of the past by allowing the industry to again influence our practice without high-quality evidence? The continued intersection of the industry with medical education places us at risk of propagating non–evidence-based practices that may translate into little benefit, potential unforeseen harm, and unnecessary costs on an already taxed healthcare system.[8,9]

Competing Interests

The authors declare no competing interests.

Ashley V. Wells, M.D., Ryan Lippell, M.D., Roniel Y. Weinberg, M.D., Tiffany R. Tedore, M.D., Michael Akerman, M.D. Veterans Affairs New York Harbor Healthcare System, NYU Langone Health, New York, New York (A.V.W.). awells2245@gmail.com

DOI: 10.1097/ALN.0000000000003882

References

1. Ilfeld BM, Eisenach JC, Gabriel RA: Clinical effectiveness of liposomal bupivacaine administered by infiltration or peripheral nerve block to treat postoperative pain. Anesthesiology 2021; 134:283–344
2. Abd-Elsayed A. Liposomal bupivacaine for surgical site infiltration. (Is it superior to plain bupivacaine?) Reg Anesth Pain Med 2021; 46:362
3. Feng JE, Ikwuazom CP, Slover JD, Macaulay W, Schwarzkopf R, Long WJ. Discontinuation of intraoperative liposomal bupivacaine in primary THA does not clinically change postoperative subjective pain, opioid consumption or objective functional status. J Arthroplasty 2021; 36:2062–67
4. Pedoto A, Noel J, Park BJ, Amar D. Liposomal bupivacaine versus bupivacaine hydrochloride for intercostal nerve blockade in minimally invasive thoracic surgery. J Cardiothorac Vasc Anesth 2021; 35:1393–8
5. Hussain N, Brull R, Sheehy B, Essandoh MK, Stahl DL, Weaver TE, Abdallah FW: Perineural liposomal bupivacaine is not superior to nonliposomal bupivacaine for peripheral nerve block analgesia. Anesthesiology 2021; 134:147–64
6. Pacira Biosciences, Inc.: News release Pacira reports record revenues for 2020 of 429.6 million. 2021. Available at: https://investor.pacira.com/news-releases/news-release-details/pacira-reports-record-revenue-2020-4296-million. Accessed February 21, 2021.
7. Kearney P, Simoons M, Ryden L, Kirchhof P, Pries A, O'Morain C, Bax JJ: The medical profession, industry, and continuing medical education: Finding the balance that's right for patients. Am J Med 2019; 132:921–5
8. Van Zee A: The promotion and marketing of oxycontin: Commercial triumph, public health tragedy. Am J Public Health 2009; 99:221–7
9. Jones GH, Bruera E, Abdi S, Kantarjian HM: The opioid epidemic in the United States: Overview, origins, and potential solutions. Cancer 2018; 124:4279–86

(Accepted for publication June 14, 2021. Published online first on July 13, 2021.)

The corresponding author of the original article referenced above has read the letter and does not have anything to add in a published reply.

Personal Protective Equipment: Comment

To the Editor:

Ruskin *et al.*[1] describe how personal protective equipment used because of COVID-19 impairs the performance of anesthesia clinicians and teams. They detail how reductions in the senses of sight, sound, and touch challenge

anesthesia care, but they ignore the important sense of smell. This may be the most diminished sense because the proper fit of N95 and similar face masks is often determined by whether the wearer can smell a test odor.[2]

We have recently seen complications related to failure to detect odors. An anesthetic vaporizer leaked liquid agent in an operating room, and the leak was not detected until someone without an N95 mask entered the room. Anesthetic gas, which can be smelled in operating room air, is generally above Occupational Health and Safety Administration (Washington, D.C.) permissible exposure limits.[3] This incident led us to consider other possible performance impairments from this often-overlooked sense. These include not detecting alcohol on the breath of a patient, use of methyl methacrylate by a surgeon, or bacterial infection of a wound.

Competing Interests

The author declares no competing interests.

Robert E. Johnstone, M.D., F.A.S.A. West Virginia University Health Sciences Center, Morgantown, West Virginia. johnstoner@wvumedicine.org

DOI: 10.1097/ALN.0000000000003902

References

1. Ruskin KJ, Ruskin AC, Musselman BT, Harvey JR, Nesthus TE, O'Connor M: COVID-19, personal protective equipment, and human performance. Anesthesiology 2021; 134:518–25
2. O'Kelly E, Arora A, Pirog S, Ward J, Clarkson PJ: Comparing the fit of N95, KN95, surgical, and cloth face masks and assessing the accuracy of fit checking. PLoS One 2021; 16:e0245688
3. National Institute for Occupational Safety and Health. Waste anesthetic gases. 2007; DHHS Publ 2007-151.

(Accepted for publication June 25, 2021. Published online first on August 3, 2021.)

Personal Protective Equipment: Reply

In Reply:

We thank Dr. Johnstone[1] for his insightful comments, in response to our article,[2] about the practical implications of the loss of smell caused by personal protective equipment. We agree that healthcare professionals commonly rely on their sense of smell to facilitate diagnosis of some conditions. As Dr. Johnstone reported, the first indication that a vaporizer is leaking might be when a member of the surgical team detects the characteristic odor of a potent volatile anesthetic. Physicians' use of smell has also been evaluated to diagnose pseudomonas infections,[3] and this ability might also be impaired by personal protective equipment.

N95 filtering facepiece respirators are designed to eliminate 95% of "most transmissible" particles from inspired air but are not resistant to oil and do not eliminate nuisance organic vapors.[4] A person wearing an N95 mask may therefore be able to detect the odor of potent volatile anesthetics. P100 filters remove 99.97% of airborne particles, are strongly resistant to oil, and are commonly used with elastomeric half-facepiece respirators. Manufacturers commonly include a layer of activated carbon to eliminate nuisance organic compounds.[5] Although there are currently no studies of how various respirators affect a person's ability to detect volatile anesthetic agents (*e.g.*, from a leaking vaporizer), a P100 filter would reasonably be expected to eliminate the odor of sevoflurane in low concentrations. In the authors' personal experience, P100 filters are highly effective in eliminating other offensive odors that may be found in the operating room.

We agree that use of the extensive personal protective equipment that is required to care for patients with COVID-19 or other respiratory illnesses can impair the user's sense of smell. This reduction in a critical sense suggests an important research opportunity. New technologies that detect contamination by volatile organic compounds or infectious agents without relying on a person's ability to detect an odor may help users of personal protective equipment during a future pandemic. As we stated in our review, personal protective equipment impairs human performance in sometimes unpredictable ways.[2] We thank Dr. Johnstone for pointing out yet another opportunity for improvement.

Competing Interests

The authors declare no competing interests.

Keith J. Ruskin, M.D., F.R.Ae.S., Anna Clebone Ruskin, M.D., Brian T. Musselman, C.As.P., Jaime Rivas Harvey, C.As.P., Thomas E. Nesthus, Ph.D., Michael O'Connor, M.D. University of Chicago, Chicago, Illinois (K.J.R.). ruskin@uchicago.edu

DOI: 10.1097/ALN.0000000000003901

References

1. Johnstone RE: Personal protective equipment: Comment. Anesthesiology 2021; 135:763–4

2. Ruskin KJ, Ruskin AC, Musselman BT, Harvey JR, Nesthus TE, O'Connor M: COVID-19, personal protective equipment, and human performance. Anesthesiology 2021; 134:518–25
3. Uçkay I, Holy D, Schöni M, Waibel FWA, Trache T, Burkhard J, Böni T, Lipsky BA, Berli MC: How good are clinicians in predicting the presence of Pseudomonas spp. in diabetic foot infections? A prospective clinical evaluation. Endocrinol Diabetes Metab 2021; 4:e00225
4. The National Personal Protective Technology Laboratory (NPPTL): Respirator trusted-source information. Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/respsource3basic.html. Accessed June 17, 2021.
5. Clinger JC, O'Shaughnessy PT: Breakthrough analysis for filtering facepiece respirators impregnated with activated carbon. J Occup Environ Hyg 2019; 16:423–31

(Accepted for publication June 25, 2021. Published online first on August 9, 2021.)

Clinical Use of Lactate Measurements: Comment

To the Editor:

We read with great interest the recent review discussing the clinical interpretation of lactate measurements by Drs. Pino and Singh.[1] The article covered the topic in great detail; however, there are several points which we also feel warrant inclusion when discussing this topic.

An additional source of lactate in surgical patients can be from red blood cell transfusion. As the authors state, red cells are completely anaerobic because they lack mitochondria and require glycolysis for maintenance of adenosine triphosphate. As a result, stored red blood cells are a source of lactate from transfusions; lactate levels and resultant patient lactate loads can increase with the use of stored red blood cells. Although many patients have adequate capability to metabolize lactate loads from transfusion, this may not be the case in massive transfusions, liver transplantation, or pediatric cardiac surgery. In particular, sudden massive boluses of red blood cell–derived lactate in pediatric cardiac surgery from older stored red blood cells can significantly impact more traditional and conventional interpretations of lactate concentration.[2]

Additionally, endogenous overproduction of lactate may represent more than a metabolic waste product. Proponents of the concept contend that lactate can function as a metabolic glucose regulator and regulator of insulin release and insulin resistance.[3] Brooks[4] reviews compelling evidence that endogenous L-lactate is actively involved in aerobic intermediary energy metabolism and signaling effects through hydroxycarboxylic acid receptor 1. In the population with obesity, new evidence suggests hormonally triggered overproduction of lactate is an essential and obligatory feature of adipocytes, even in the absence of hypoxia.[5] Adipocyte lactate production may therefore alter interpretations of elevated lactate levels in obesity and insulin resistance, although this concept is too recent for correlative studies in the perioperative period to define the magnitude and significance of these metabolic pathways.

The authors state that typical measurements of lactate, as conventionally performed with a blood gas machine, do not detect D-lactate, which has been shown to produce numerous deleterious effects. Some formulations of lactated Ringer's solution have historically contained DL lactate,[6] and although most formulations today are likely to contain only L-lactate, compositions may vary between countries and manufacturers. Additionally, although the consumption of fermented foods may contribute only a small proportion of total lactate as D-lactate, the presence and significance of D-lactate in pathologic states is not limited to gut ischemia or short bowel syndrome. Small intestinal bacterial overgrowth, in the absence of short bowel syndrome, has been associated with D-lactic acidosis with central nervous system symptoms. In fact, half of probiotic strains have been shown to ferment carbohydrates to D or DL lactate and may be responsible for gastrointestinal and central nervous system symptoms from D-lactic acidemia in some patients.[7] Because D-lactate levels are not customary measurements, it is conceivable that many cases can be missed with routine laboratory investigations.

Competing Interests

The authors declare no competing interests.

Harvey J. Woehlck, M.D., Brent T. Boettcher, D.O., Ricardo P. Dorantes, B.S. Medical College of Wisconsin, Milwaukee, Wisconsin (H.J.W.). hwoehlck@mcw.edu

DOI: 10.1097/ALN.0000000000003905

References

1. Pino RM, Singh J: Appropriate clinical use of lactate measurements. Anesthesiology 2021; 134:637–44
2. Bojan M, Desplanque L, Albinni S: Increased lactate load of older red blood cell preparations increases blood lactate concentrations in infants during cardiac surgery. Paediatr Anaesth 2018; 28:185–6
3. Sola-Penna M: Metabolic regulation by lactate. IUBMB Life 2008; 60:605–8