

intubation detected by insertion depth of endotracheal tube, bilateral auscultation, or observation of chest movements: Randomised trial. *BMJ* 2010; 341:c5943

5. Vezzani A, Manca T, Brusasco C, Santori G, Valentino M, Nicolini F, Molardi A, Gherli T, Corradi F: Diagnostic value of chest ultrasound after cardiac surgery: A comparison with chest X-ray and auscultation. *J Cardiothorac Vasc Anesth* 2014; 28:1527–32

(Accepted for publication August 17, 2016.)

In Reply:

In 1834, the *Times Newspaper of London*¹ reported that the medical profession was unlikely ever to start using the stethoscope “because its beneficial application requires much time and gives a good bit of trouble.”^{2,3} In fact, Dr. Laënnec created the stethoscope by rolling up paper in the shape of a tube, secondary to his concern of placing his ear on a female patient’s chest (the common practice at the time). He reported to be “surprised” to discover an improvement in his diagnostic assessment.⁴ Today, we are at the same story with point-of-care ultrasound and the perioperative medical community.

We thank Drs. Priebe, Hester, El-Orbany, and colleagues for their insight on the topic of point-of-care airway ultrasound and their letters to the editor for the published manuscript entitled “Auscultation *versus* Point-of-Care Ultrasound to Determine Endotracheal *versus* Bronchial Intubation: A Diagnostic Accuracy Study”⁵ and its editorial by Isono *et al.*⁶ We have summarized the authors’ letters to several common themes, including (1) further discussion of the limitations of ultrasound, (2) inappropriate direct comparison between ultrasound and auscultation *only* for localization of the endotracheal tube (ETT), and (3) dismissal of the stethoscope as a diagnostic tool. We seek to address each of these concerns. Foremost, we would like to highlight that both auscultation and point-of-care ultrasound can coexist as important diagnostic tools. However, the concept of point-of-care ultrasound is very much in its infancy for the perioperative arena. We sought to demonstrate the utility of a *novel* technique of assessing the ETT location in hopes that further research in this area can develop a skillset that can serve as an *adjunct* to what is currently available to anesthesiologists.

(1) Regarding limitations of point-of-care ultrasound, as with any diagnostic test, ultrasound has its limitations. (i) There are several patient pathologies and surgical procedures that would prevent the ability to either perform the ultrasound exam or be unable to interpret the ultrasound images as described in this study. As suggested in the letters to the editor, examples include patients requiring rapid sequence intubation, cervical collar placement, patients with pleural disease, and procedures involving the area in which the Pulmonary tree and Lung expansion Ultrasound Study (PLUS) exam would be performed. Despite these limitations, there is a much larger body of perioperative patients that can have the exam performed, and we advocate that these limitations should not result in our specialty dismissing the evaluation of further utility of perioperative point-of-care ultrasound. (ii) It

is true that ultrasound is more costly and less available than the stethoscope. However, ultrasound, in particular point-of-care ultrasound, is a rapidly advancing area in medicine, with decreasing cost. Importantly, the PLUS exam was designed to utilize an ultrasound machine that is most readily available in the perioperative setting (portable/laptop system with a linear probe) for central vascular access and regional anesthesia. Since the use of ultrasound for central vascular access has been suggested to be a standard of care,^{7,8} the cost cannot be directly compared between auscultation and any isolated point-of-care ultrasound modality (same machine can have many utilities). Rather, one could suggest that by incorporating new ultrasound modalities into perioperative care, one can justify the current cost of ultrasound equipment. (iii) Performance of the PLUS exam was under 4 min. While this is longer than one would prefer for detection of tracheal *versus* esophageal intubation, Ramsingh *et al.*⁵ designed this study to evaluate the ETT location within the airway (tracheal *vs.* bronchial). For this question, the time of 4 min may be similar to the time it would require to obtain other evaluation techniques such as a portable chest x-ray or a fiberoptic evaluation.

(2) Ramsingh *et al.*⁵ directly compared auscultation to ultrasound *in isolation* to determine the diagnostic accuracy of endotracheal *versus* bronchial intubation between these diagnostics tools. The specific auscultation examination that was performed was as follows: manual ventilation was initiated with target volumes of approximately 8 to 10 ml/kg ideal body weight. This was determined by gross estimation by deformation of the standard 3-l manual ventilation bag (visual estimation of 20 to 30% deformation). The auscultation exam was performed as follows: the diaphragm of the stethoscope was placed bilaterally in the axilla at the mid-axillary line (approximately at the level of the fifth rib space). All auscultators were faculty with at least 4-yr posttraining experience.

The authors chose to directly compare auscultation to ultrasound, in isolation, to allow for a direct accuracy comparison between the diagnostic tools. It was the authors’ hope that the results of the study would indicate the high degree of accuracy with ultrasound and support further research on this topic. Since the other routine monitors used for the assessment of ETT location (pulse oximetry, inspiratory pressures, and capnography) are not impacted by ultrasound (just as with auscultation), we did not compare ultrasound to the combined information of all the standard monitors for the study. To restate, this study was simply a diagnostic comparison study between two assessment tools (auscultation *vs.* ultrasound). Finally, it is important to state that it was beyond the scope of the study to evaluate the clinical impact of incorporating this examination, and this warrants further research.

Related to this is the use of ETT insertion depth to avoid endobronchial intubation. In the letters to the editor, a referenced study by Sitzwohl *et al.*⁹ demonstrated the ETT insertion depth to be superior to chest auscultation and palpation to determine endobronchial intubation. While we do not disagree that ETT insertion depth is an important

measurement, it is not a patient-specific diagnostic technique and cannot assist evaluation for ETT location that is at risk of endobronchial intubation. Placement of the ETT to a referenced distance, no matter how reliable, does not allow for the healthcare provider to be aware of how to determine inappropriate ETT location in a specific patient.

(3) As the technology of point-of-care ultrasound becomes more available, it is on each specialty to identify how this advancing modality can provide patient benefit. This study was created to evaluate if airway ultrasound to assess the ETT location could be one modality that should be evaluated in this manner. Clearly, the stethoscope remains a rapid assessment modality, but other specialties such as emergency medicine and critical care have spent the last decade “evaluating” point-of-care ultrasound as another rapid assessment tool. For example, critical care has demonstrated utility with ultrasound for evaluation of pulmonary edema,¹⁰ while anesthesiologists more often rely on auscultation. In fact, emergency medicine has adopted point-of-care ultrasound training as a “core competency” for residency training and provides a year of fellowship training in clinical ultrasonography.¹¹

In summary, both auscultation and point-of-care ultrasound can currently coexist as important diagnostic tools. Innovation in medicine does not mean replacement, and until the availability and cost are equal, one cannot replace the stethoscope with ultrasound. However, this day may come, and we should create room on our diagnostic tool belt for point-of-care ultrasound and evaluate how it can positively impact perioperative care.

Importantly, however, we need to understand that just as all medical students and training physicians receive years of training on the stethoscope, so should we develop appropriate training for ultrasound. Dr. Filly¹² wrote an Editorial in *Radiology* in 1988 entitled “Ultrasound: The Stethoscope of the Future, Alas” in which he stated: “As we look to the proliferation of US [ultrasound] instruments into the hands of untrained physicians, we can only come to the unfortunate realization that diagnostic sonography truly is the next stethoscope: used by many, understood by few.” With thoughtful research, perhaps we can define the role of perioperative point-of-care ultrasound before this occurs.

Competing Interests

Dr. Ramsingh declares no competing interests relevant to the material above. He is a consultant for Edwards Life Sciences (Dallas, Texas). Dr. Cannesson declares no competing interests.

Davinder Ramsingh, M.D., Maxime Cannesson, M.D., Ph.D. Loma Linda Medical Center, Loma Linda, California (D.R.). dramsingh@llu.edu

References

1. Laënnec RTH: A treatise on the diseases of the chest. Translated from French to English by John Forbes, Translator's Preface by John Forbes, 1st American edition. Philadelphia, James Webster, 1823, pp 13–14. Available at:

<http://www22.us.archive.org/stream/65340230R.nlm.nih.gov/65340230R#page/n23/mode/2up>.

2. Abu-Zidan FM: Point-of-care ultrasound in critically ill patients: Where do we stand? *J Emerg Trauma Shock* 2012; 5:70–1
3. Grais IM: Proper use of the stethoscope: Three heads and one tale. *Tex Heart Inst J* 2013; 40:120–2
4. Roguin A: Rene Theophile Hyacinthe Laënnec (1781-1826): The man behind the stethoscope. *Clin Med Res* 2006; 4:230–5
5. Ramsingh D, Frank E, Haughton R, Schilling J, Gimenez KM, Banh E, Rinehart J, Cannesson M: Auscultation *versus* point-of-care ultrasound to determine endotracheal *versus* bronchial intubation: A diagnostic accuracy study. *ANESTHESIOLOGY* 2016; 124:1012–20
6. Isono S, Sandberg WS, Jiang Y: Do you believe what you see or what you hear? Ultrasound *versus* stethoscope for perioperative clinicians. *ANESTHESIOLOGY* 2016; 124:989–91
7. AHRQ issues critical analysis of patient safety practices. *Qual Lett Healthc Lead* 2001; 13:8–12, 1
8. Hind D, Calvert N, McWilliams R, Davidson A, Paisley S, Beverley C, Thomas S: Ultrasonic locating devices for central venous cannulation: Meta-analysis. *BMJ* 2003; 327:361
9. Sitzwohl C, Langheinrich A, Schober A, Krafft P, Sessler DI, Herkner H, Gonano C, Weinstabl C, Kettner SC: Endobronchial intubation detected by insertion depth of endotracheal tube, bilateral auscultation, or observation of chest movements: Randomised trial. *BMJ* 2010; 341:c5943
10. Lichtenstein DA, Mezière GA: Relevance of lung ultrasound in the diagnosis of acute respiratory failure: The BLUE protocol. *Chest* 2008; 134:117–25
11. Thomas HA, Beeson MS, Binder LS, Brunett PH, Carter MA, Chisholm CD, McGee DL, Perina DG, Tocci MJ; 2007 EM Model Review Task Force: The 2005 Model of the Clinical Practice of Emergency Medicine: The 2007 update. *Ann Emerg Med* 2008; 52:e1–17
12. Filly RA: Ultrasound: The stethoscope of the future, alas. *Radiology* 1988; 167:400

(Accepted for publication August 17, 2016.)

Assessing the Effect of Exogenous Albumin on the Incidence of Postoperative Acute Kidney Injury in Patients Undergoing Off-pump Coronary Artery Bypass Surgery

To the Editor:

In a prospective, randomized, and placebo-controlled trial, Lee *et al.*¹ recently showed that administration of 20% exogenous albumin immediately before surgery increases urine output during surgery and reduces the risk of acute kidney injury (AKI) after off-pump coronary artery bypass surgery in patients with a preoperative serum albumin level of less than 4.0 g/dl. Many things in this study were done correctly. But to differentiate the effects of one factor on study endpoints, all the other factors have to be standardized in the study design. Several important factors in this study were not addressed well.

First, contrast angiography or ventriculography was not included in data analysis. Actually, preoperative contrast angiography or ventriculography was not rare among