

## CORRESPONDENCE

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*In Reply:*—First, we did not experience problems with probe rotation or spurious pressure rises during the study. The position, orientation, and accuracy of the attached probes were tested before and after use by visual inspection, by moving a finger across the probe surface with varying amounts of digital pressure, and by submerging the device in water at various depths. If there was a problem before use, the probe was reattached; if there was a problem after use, the data were discarded and the case was repeated. We did not document the number of probe reattachments, but no cases were repeated.

Second, Brain *et al.* hypothesize that the recessed position of the sensing surface will produce artificially low (mucosa-cuff) or high (mucosa-tube) pressures. We recently tested this hypothesis *in vitro* by placing the probes between a full-thickness strip of fresh pig cadaveric intestine and (1) the cuff; (2) the silicone coated metal tube of the intubating laryngeal mask (ILM); and (3) the silicone tube of the laryngeal mask airway (LMA). A pressure of 50 cm H<sub>2</sub>O was applied to the intestine-probe-tube complex using a calibrated spring weight and metal rod with a surface area of 1 cm<sup>2</sup>. This procedure was repeated on 10 occasions. We found that the mean (range) mucosal pressure was 55 (40–65) cm H<sub>2</sub>O for the cuff, 64 (53–70) cm H<sub>2</sub>O for the LMA tube, and 68 (54–86) cm H<sub>2</sub>O for the ILM tube. These data suggest that the hypothesis of Brain *et al.* is correct for the mucosa-tube pressure, but not for the mucosa-cuff pressure. However, the magnitude of error between mucosa pressure and tube pressure is insufficient to influence our findings. These higher pressures probably occur because the probe protrudes above the surface by 1.2 mm, not because the sensing surface is recessed by 0.4 mm. Although the probes were designed to measure fluid pressure, we speculate that the mucosa is sufficiently wet and compliant to behave like a fluid. In addition, there is *in vivo* evidence for the accuracy of the probes: (1) when used to measure tracheal mucosal pressures, they provide similar results to those obtained using other measurement techniques<sup>1</sup>; (2) when the pressure exerted by the ILM tube against the posterior pharyngeal wall is measured in fresh cadavers using a probe implanted within the bony surface, similar results are obtained<sup>2</sup>; (3) when the mucosal pressure readings are compared to calculated mucosal pressures for the endotracheal tube<sup>1</sup> and the cuffed oropharyngeal airway,<sup>3</sup> similar results are obtained.

Third, Brain *et al.* suggest that depression of the handle by 1 cm cannot cause an actual increase in mucosal pressure of 28–349 mmHg, and therefore the probes must be producing erroneous readings. However, a more logical explanation is that the handle or pharynx is functioning as a lever or fulcrum, and the high pressures exerted at this point are real. This view is supported by data from a cadaver study in which we demonstrated that applying a posterior force of 20 N changes the mean (95% CI) posterior pharyngeal pressure from 70 (52–91) to 295 (275–316) mmHg.<sup>2</sup> More importantly, we also showed that this force produced a 3-mm posterior displacement of the normal cervical spine.

Fourth, we do not consider that our results were related to excess force or a lack of user skill. All placements were conducted by Dr. Brimacombe, who has used the ILM more than 500 times. The characteristic “loss of resistance” was felt in the majority of patients, but in the authors view this is not a reliable sign for correct ILM placement. We did not “firmly wedge” the ILM as part of our insertion technique, but rather used this term in the discussion to explain our findings. Interestingly, if the ILM handle is pressed forcibly backward (> 100 N), transient pressures in excess of 500 mmHg can be obtained in cadavers. We postulate that these pressures could be reached by gross misuse or during vigorous coughing.

Finally, Brain *et al.* suggest that leaving the ILM *in situ* is an option and express no concerns about ILM usage in the unstable cervical spine. We think that this advice is unsound because it contravenes the currently available—though admittedly indirect—evidence. Pending the results of further studies examining pharyngeal morbidity and the unstable cervical spine, we continue to strongly recommend that the ILM be removed after its use as an airway intubator. In addition, we suggest that the ILM should only be used in the unstable cervical spine if difficulties are anticipated or encountered with established techniques.

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