our paper, which is that the T_4/T_1 ratio remained constant at 20, 30, and 50 mA.

Lawson and Sosis claim that data regarding patients who did not exhibit a T_4 response were either "secluded" in the methods section or "manipulated." The data were referred to in our results, and in our discussion, we clearly stated that "in the intraoperative setting, however, stimulation at low currents did not always elicit detectable contractions in patients with a marked degree of blockade."[2] We do not dispute that when the fourth twitch is 0, the T_4/T_1 ratio is 0. We feel that to take issue with this particular point is to miss the main message of our paper. If both a T_4 and a T_1 twitch response are present, then in the range of blockade evaluated, the T_4/T_1 ratio remains constant at stimulating currents of 20, 30, and 50 mA. With respect to the nine patients who did not evidence a T_4 response at 20 mA: the T_4/T_1 ratios at 30 and 50 mA were 36.5 ± 16.7 and 34.7 ± 15.9, respectively; they differed by 1.7% (P = NS).

The potential value of our findings is that the anesthesiologist is able to test neuromuscular transmission at submaximal (and therefore less painful) currents. If a fourth twitch is not apparent in response to the less painful stimulus, then the current should be increased to obtain a detectable T_4/T_1 ratio. It should be emphasized that our findings and conclusions do not necessarily apply to visual or tactile assessment. As we stated,[2] our assessment entailed quantification with a mechanogram.

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Double-lumen Tube Design Fault

To the Editor:—We wish to bring to the attention of your readers a potential problem with the PVC Broncho-cath® Double-Lumen Tube (DLT) (Mallinckrodt Anesthesia Care Products).

Case 1

A 15-yr-old girl was scheduled for a right pneumonectomy for a destroyed bronchiectatic right lung. Initially, a size 37f left Broncho-cath® DLT was introduced but was found to be too large. This was replaced by a size 35f DLT, which was inserted after minimal resistance at the cricopharyngeus. As in all our cases of DLT insertion, correct positioning was confirmed by direct visualization with a flexible fiberoptic bronchoscope through the tracheal lumen, and by reassessment of tube positioning upon left lateral positioning. The inflation pressure was noted to be 60 cm H_2O, and an arterial blood gas determination 20 min postintubation with a fractional inspired O_2 concentration (FI_{O_2}) of 1.0 showed a pH of 7.22, a Pa_{O_2} of 569 mmHg, and a Pa_{CO_2} of 68.4 mmHg. Fiberoptic bronchoscopy was repeated with inspection through both the right and left lumens undertaken. It was noted that the tip of the endobronchial tube was occluded by the medial wall of the left main stem bronchus (fig. 1*A*). Attempts to improve patency and to reduce the inflation pressure failed. These attempts included deflation of the bronchial cuff and inward or outward displacement of the DLT. At this stage, a repeat arterial blood gas showed a pH 7.1, a Pa_{O_2} of 476 mmHg, and a Pa_{CO_2} of 93.8 mmHg (FI_{O_2} = 1.0). As a consequence, the DLT was removed and replaced by a single-lumen endotracheal tube, which resulted in a reduction of the inflation pressure to 35 cm H_2O. An arterial blood gas 15 min later showed a pH of 7.29, a Pa_{O_2} of 430 mmHg, and a Pa_{CO_2} of 49.9 mmHg. While a capnograph was not being used, the oxygen saturation measured *via* pulse oximeter remained above 97% throughout the procedure, which was otherwise uneventful.

Case 2

A 65-yr-old woman was scheduled for esophagogasterectomy for carcinoma of the esophagus. A 37f left-sided PVC Broncho-cath® DLT was inserted, and correct placement confirmed with a fiberoptic bronchoscope passed through the tracheal lumen. The inflation pressure with two-lung ventilation was 18 cm H_2O, and a left thoracotomy was performed. With the bronchial lumen clamped, the inflation pressure

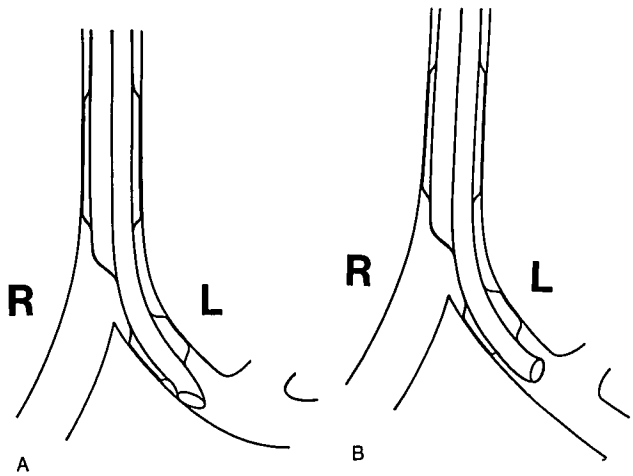

FIG. 1. (*A*) Left-sided Broncho-cath® DLT with bevel facing toward medial wall of left main stem bronchus. (*B*) Left-sided DLT with suggested alteration to bevel of bronchial lumen.

increased to 28 cm H_2O, and the surgeon complained that the left lung could not be completely deflated. The position of the DLT was checked again *via* the tracheal lumen. When the fiberoptic bronchoscope was subsequently introduced through the bronchial lumen, it showed the tip occluded by the medial wall of the left main stem bronchus. No attempt was made to reposition the tube. The left lung could be ventilated once the operation had been completed, but unfortunately bronchoscopy was not done after ventilation of the left lung was recommenced.

These two cases illustrate what we feel is a design fault of the left Broncho-cath® DLT in that the endobronchial portion has been cut such that the lumen faces the medial wall of the left main stem bronchus (fig. 1*A*). We have recently had three other cases similar to case 1 above, and the feature common to all four cases has been the left lateral position of each patient. We postulate that in this position the weight of the right lung and mediastinum exacerbates the problem by pressing the medial wall of the left main stem bronchus against the endobronchial lumen. However, case 2 above demonstrated a similar occlusion when the patient was in the right lateral position.

We would like to suggest to the manufacturer that in the future, tubes should be altered so that the endobronchial lumen faces laterally, as in the Robertshaw tube (fig. 1*B*). This design will have additional advantages, in that fiberoptic visualization of the left upper lobe bronchus will be easier and the margin of safety for obstruction of the same bronchus will be increased slightly. The only disadvantage that we can think of is that insertion of a redesigned tube could be slightly more difficult, with the possibility of bronchial wall trauma from the leading edge of the endobronchial tube.

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In Reply:—In a 1983 clinical trial, Burton *et al.* reported a six-fold reduction in frequency of complications when the Mallinckrodt Broncho-Cath® tube was compared with the Robertshaw tube.[1] The tip design of the Robertshaw tube includes a 45° taper, which may account for a number of complications reported by Read *et al.* in 1983,[2] and by Heiser *et al.* in 1979.[3] Indeed, Robertshaw himself notes that "if the tube is pushed too far down, the left upper lobe may become obstructed." And further, that "such obstruction is possible owing to anatomical variations."[4]

The tip of the Mallinckrodt Broncho-Cath® tube has a flatter 63° taper to minimize the risks identified by earlier designs, and faces medially to facilitate bronchial intubation. Over 500,000 successful procedures have been completed with the Mallinckrodt Broncho-Cath® tube over the past 10 yr, and we have received no product complaint reports or related FDA Medical Device Reports during this period regarding occlusion of the tip by the wall of the left main stem bronchus.

Clinical evaluations of new Mallinckrodt designs have been in progress over the past 6 months to test a yet flatter 90° taper, which may be more appropriate for use with fiberoptic guided bronchial intubations. These evaluations contain some of the recommendations identified by Benumof in 1988[5] to increase the positioning margin of safety and to facilitate entry into the left main stem bronchus. Similar recommendations were raised also by Klippe *et al.* in 1989.[6]

Even these new designs have raised issues such as the potential of bronchial wall trauma caused by the leading edge of the tube. Much work is still required to prove the safety and efficacy of these modifications.

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Markers Other Than Epinephrine To Avoid Intravascular Injection of Local Anesthetic in the Obstetric Patient Require More Study

To the Editor:—The studies of Leighton *et al.* on the epinephrine test dose deserve careful appraisal.[1–3] Stating that "epinephrine injection lacked specificity"[1] and citing Cartwright *et al.*[4] for support is questionable.[5] Furthermore, when the 15-μg epinephrine test dose described for a surgical patient[6] is used in a parturient, the following alterations must be made. When a contraction and the maternal heart rate peak