- 4 Fletcher R, Malmkvist G, Veintimilla F. Arterial to end-tidal gradients. *Anesth Analg* 1988; 67: 486–8.
- 5 Fletcher R, Jonson B. Dead-space and the single breath test for carbon dioxide during anaesthesia and artificial ventilation. *Br J Anaesth* 1984; 56: 109–19.
- 6 Jones NL, Robertson DG, Kane JW. Difference between end-tidal and arterial PCO_2 in exercise. *J Appl Physiol* 1979; 47: 954–60.
- 7 Shankar KB, Moseley H, Kumar Y, Vemula V. Arterial to end-tidal carbon dioxide tension difference during Caesarean section anaesthesia. *Anaesthesia* 1986; 41: 698–702.
- 8 Bhavani Shankar K, Moseley H, Kumar Y, Vemula V, Krishnan A. Arterial to end-tidal carbon dioxide tension difference during anaesthesia for tubal ligation. *Anaesthesia* 1987; 42: 482–6.
- 9 Bhavani Shankar K, Moseley H, Vemula V, Ramasamy M, Kumar Y. Arterial to end-tidal carbon dioxide tension difference during anaesthesia in early pregnancy. *Can J Anaesth* 1989; 36: 124–7.
- 10 Nunn JF, Hill DW. Respiratory deadspace and arterial to end-tidal CO_2 tension difference in anaesthetized man. *J Appl Physiol* 1960; 15: 383–9.
- 11 Fletcher R. The single breath test for carbon dioxide. Thesis, Lund, 1980.
- 12 Jonmarker C, Nordstrom L, Werner O. Changes in functional residual capacity during cardiac surgery. *Br J Anaesth* 1986; 58: 428–32.

REPLY

Thank you for the opportunity to reply to Drs. Shankar, Mosely, and Kumar. It is always worthwhile when one realizes that a paper is not only read, but also read critically.

There are several points raised with which we are all in agreement. The 8.1% incidence of negative arterial to end-tidal carbon dioxide gradients, $P(a-ET)CO_2$, is in keeping with previously reported data. Emptying of previously closed "slow" emptying alveolar units can result in the peak-expired carbon dioxide, or $ETCO_2$, exceeding $PaCO_2$. As stated by Shankar et al., "... the slope of phase III crosses the mean $PaCO_2$ (alveolar PCO_2). As stated in our paper "The positive slope of the expired carbon dioxide results in the peak expired value exceeding the temporal mean alveolar concentration, represented by the $PaCO_2$." The full range of conditions and situations in which negative $P(a-ET)CO_2$ is present have not been fully elucidated, and, we feel, leaves room for further physiological clarification.

We stated that the $P(a-ET)CO_2$ was "... primarily a reflection of respiratory deadspace" and less so of venous admixture. It is true that substitution of $ETCO_2$ for mixed expired CO_2 ($PECO_2$) into the Bohr equation can give markedly erroneous deadspace values depending on the slope of phase III of the capnograph. It will give the minimum deadspace possible, which can be quite different. However, $P(a-ET)CO_2$ almost always increases as deadspace increases and reflects this change. It just does not allow accurate deadspace calculation.

We have not found a need to calibrate the capnometers used in this study for positive pressure ventilation after the initial calibration is done for atmospheric pressure relative to site altitude. This has been the case when this site was used as a clinical testing centre for the capnometers before widespread clinical release. It was also found in the present study that there was no difference in the $P(a-ET)CO_2$ during spontaneous ventilation with 5 cmH_2O CPAP compared with full mechanical ventilation without spontaneous respiratory efforts.

The writers state that the "... reduction of functional residual capacity and haemodilution following CPB ... may result in substantial alveoli with low $\dot{V}/\dot{Q}$ ratio." This is true for reduced FRC. However, "no worsening of regional distribution of ventilation to perfusion occurs during haemodilution."

Our paper was an evaluation of $P(a-ET)CO_2$ in acute, rapidly changing clinical conditions. For individual patients, we found there was marked variability, despite good correlation between $PaCO_2$ and $ETCO_2$ in the whole population. This relationship may be different under different conditions and should not be taken for granted.

Garfield B. Russell MD FRCPC
John M. Graybeal CRTT
Jonathon C. Strout
Department of Anesthesia,
The Milton S. Hershey Medical Center,
P.O. Box 850
Hershey,
Pennsylvania 17033,
U.S.A.

REFERENCES

- 1 Russell GB, Graybeal JM, Strout JC. Stability of arterial to end-tidal carbon dioxide gradients during postoperative cardiorespiratory support. *Can J Anaesth* 1990; 37: 560–6.
- 2 Fletcher R, Jonson B, Cumming G, Brew J. The concept of dead space with special reference to the single breath test for carbon dioxide. *Br J Anaesth* 1981; 55: 77–88.
- 3 Fletcher R, Malmkvist G, Niklasson L, Jonson B. On-line measurement of gas exchange during cardiac surgery. *Acta Anaesthesiol Scand* 1986; 30: 295–9.
- 4 Rosberg B, Wulff K. Regional lung function following hip arthroplasty and preoperative normovolemic hemodilution. *Acta Anaesthesiol Scand* 1979; 23: 242–7.

Intubation with lighted stylet

To the Editor:

Over the past two years, we have used the Tube Stat[®]* lighted oral intubation stylet without a laryngoscope for over 1200 elective intubations. The lighted stylet is especially useful in patients with extensive or expensive dental work, poor teeth, limited mouth opening or limited range of neck movement.

With experience, the Tube Stat[®] has been useful

when other methods were difficult or impossible. Where very difficult intubation is anticipated, the patient should be awake, breathing spontaneously, and given topical anaesthesia. For the normal situation our patients have been anaesthetized and paralyzed. On at least three occasions intubation with the lighted stylet was successful when another consultant could not intubate the patient with a laryngoscope.

One of us (D.G.) has recorded his last 311 intubations. The Tube Stat[®] was used in 242 (78%) of these. Fifty-four were done by residents and 22 by medical students. The Tube Stat[®] was not used for rapid sequence inductions (38), for placement of RAE or endobronchial tubes (26), or for teaching reasons (5). The endotracheal tube was placed properly on the first attempt 90.9% of the time and on the second or third attempt in 7%. In five patients (2.1%) a Macintosh laryngoscope was required after failure with the stylet. Three of those were attempts by a resident and one was anticipated in an obese man with a very thick neck. Only one case in a tiny woman was unexplained or unexpected. One patient was intubated easily with the Tube Stat[®] after he could not be intubated by another anaesthetist because of a large epiglottic cyst. Two patients were easily intubated after giving a history of difficult intubation. The Tube Stat[®] was used with cricoid pressure on several occasions and in many patients with subluxation of the cervical spine.

We strongly recommend this method of intubation. We have no difficulty in teaching it to residents and medical students. In the majority of elective cases it is our method of choice. A new Tube Stat[®] treated with care will last from three to six months.

D.H. Graham MD
W.A. Doll MD
A.D. Robinson MD
C.B. Warriner MD
Department of Anaesthesia
St. Paul's Hospital
Vancouver B.C.

*The Tube Stat[®] lighted oral intubation stylet is available from Concept Inc., Clearwater, Florida, U.S.A. The Canadian distributor is Lasswell Medical Ltd., 547 Main St., Milton, ON.

CMPA and Jehovah's Witness

To the Editor:

I read this year's CMAA annual report with particular interest in the report of the management of the Jehovah's Witness in Northern Ontario. The patient carried an undated, unwitnessed but signed "card" stating she did not want blood transfusions. The physician (unable to communicate with an unconscious patient) gave blood products and saved the patient's life. The physician was sued for negligence and assault and the verdict was that negligence did not occur but assault did and the physician was fined.

It is my opinion that the judgement in this case was incorrect and that this case should be pursued to the highest court with the objective of changing the law. I have expressed that opinion to the CMAA and would be interested in opinions from other anaesthetists who may have been faced with similar problems.

The problem in this case was that the patient held a card that was neither witnessed nor dated. Since management of the Jehovah's Witness in the case of an incompetent patient is entirely dependent on the information contained on a card to tell the physician what their current wishes are *the minimum responsibility of Jehovah's Witnesses should be to transmit their wishes on a "card" carried by them that is witnessed and dated within a reasonable period* (perhaps one year). To do otherwise is to place the physician in the impossible position of deciding (within moments) whether the card really is the current wish of an informed patient?

The implications of these "cards" will spread to "living wills." If the public want physicians to respect their wishes (and I do respect the individual's right to determine his own treatment) it must be the individual's responsibility to transmit the information in a way that can reasonably be interpreted as representing the current wishes of the patient. This must mean a signed, witnessed and recently dated statement carried by the patient. Whether the patient was correctly informed about the costs and benefits of treatment will remain a problem but at least we can be assured that the patient had recently considered the treatment they desired.

For these reasons the judgement in the Jehovah's Witness case was wrong.

In discussing similar types of cases with hospital lawyers their advice to me was "if you are going to be sued no matter which treatment course you embark on be sued for saving the patients' lives not for letting them die." I believe this is still sound advice and so believe the physician in Northern Ontario acted correctly.