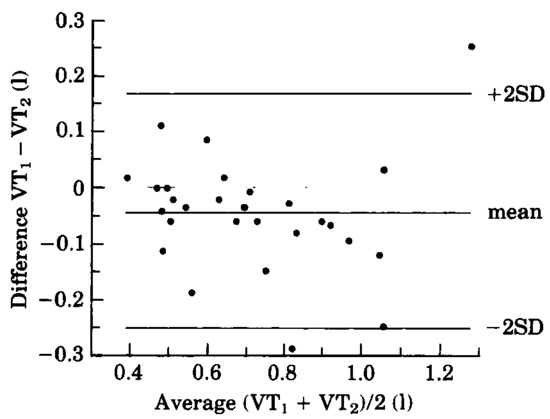

Fig. 2. The difference (l) between tidal volume measured by pneumotachograph (VT_1) and tidal volume estimated by probe device (VT_2) against the average (l) of these two values. A horizontal line is drawn at zero difference for reference. Lines for the mean and 2SD range (95%) of the difference are shown. The trend of points is down to the right, except for the outlier, indicating that bias may increase with tidal volume.

precision, which will have differing importance depending upon the circumstances.)

In Figure 1, Amin *et al.'s* graph is replotted as tidal volume measured by pneumotachograph and tidal volume estimated from probe signal. The mean difference between the two measures is −0.0441; the standard deviation (SD) of the difference is 0.1051 (Fig. 2). From these numbers, we can say that tidal volume estimated by probe is on average an overestimate by 44 ml, and that there is 95% confidence that any single measurement is within a range of 2SD, about 400 ml. With the bias, this is 225 ml above to 175 ml below the true value.

These numbers do not tell the whole story. The differences vary with the tidal volume, becoming greater overestimates as tidal volume increases. Thus bias increases with tidal volume. Precision (the spread of data) may also increase with tidal volume (it would be expected to) but there are not enough points to judge.

Figure 2 also makes the outlier more obvious. If this point is deleted, the standard deviation reduces to 89 ml, the mean bias increases to −55 ml, and the regression line of Figure 1 extrapolates much closer to the origin.

The method described by Amin *et al.* is thus considerably less accurate than other noninvasive methods of estimating ventilatory volumes [5], and no testing has been done under clinical conditions. Their conclusion that the method is 'a valuable monitoring tool for a variety of clinical applications' is premature.

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This letter was shown to the authors of the article concerned, who declined the opportunity to reply. *Editor.*

Direct laryngoscopy and cervical spine stabilisation

We read with interest the paper by Nolan and Wilson on the subject of orotracheal intubation and cervical spine injury (*Anaesthesia* 1993; **48:** 630–633). We have recently completed a similar study that observed the effect of cervical stabilisation manoeuvres on the view obtained at laryngoscopy in 78 uninjured, elective surgical patients. All the patients' airways were judged Mallampati Grade 1 [1] at pre-anaesthetic assessment.

Following induction of anaesthesia and muscle relaxation, the anaesthetist assessed the laryngeal view obtained using a size 3 Macintosh blade in the following sequence: cervical stabilisation with cricoid pressure (CS/CP); cervical stabilisation with thyroid pressure (CS/TP); cervical stabilisation alone (CS); unstabilised i.e. normal, intubating position, with a single pillow under the patient's head (N). In-line cervical stabilisation was applied in an identical fashion to that illustrated in Nolan and Wilson's study. Patients' lungs were manually ventilated between laryngoscopies CS and N, with intubation being undertaken after view N. Each laryngoscopic view was graded by the anaesthetist, using the method of Cormack and Lehane [2].

Laryngoscopic view was best (Grade 1) in the free, unrestrained, 'normal' intubating (N) position, with 77% of these views being Grade 1. The distribution and change in laryngoscopy grade, according to stabilisation technique is shown in Figure 1. Grade 3 views were obtained more frequently in the presence of cervical stabilisation whether or not cricoid pressure was applied ($p < 0.02$, or $p < 0.01$ respectively). There were similar decreases in Grade 1 views. Overall, when cervical stabilisation, or cricoid pressure, were removed to allow normal intubation, the view improved in 26 patients. In 37 patients, removal of in-line stabilisation (to allow normal intubation) resulted in a better view. When in the stabilised position, removal of cricoid pressure made the situation worse in 20 patients (25.6%). Substitution of thyroid pressure for cricoid pressure worsened the view in 25 instances (32%).

Post ATLS, the subject of airway management in trauma continues to command attention and these studies allow us to make further observations. The reduction in the use of the tracheal tube (by the introduction of the laryngeal mask airway) has resulted in trainees' exposure to the 'difficult intubation' being dramatically reduced, yet cervical stabilisation manoeuvres, with or without cricoid pressure, clearly introduces a fairly predictable degree of difficulty on the majority of occasions.

Our study also showed that cricoid pressure improves the view of the larynx when the neck is stabilised. Assistants may be asked to improve the view further, by the application of more cricoid pressure. Depending upon the mechanics of injury, such applications may be damaging. Both studies led to the clear conclusion that a gum elastic bougie will frequently be needed whenever intubation is required in those patients requiring cervical stabilisation. Departments of anaesthesia, intensive care and accident and emergency departments might usefully review the actual availability of such bougies in all their resuscitation areas.

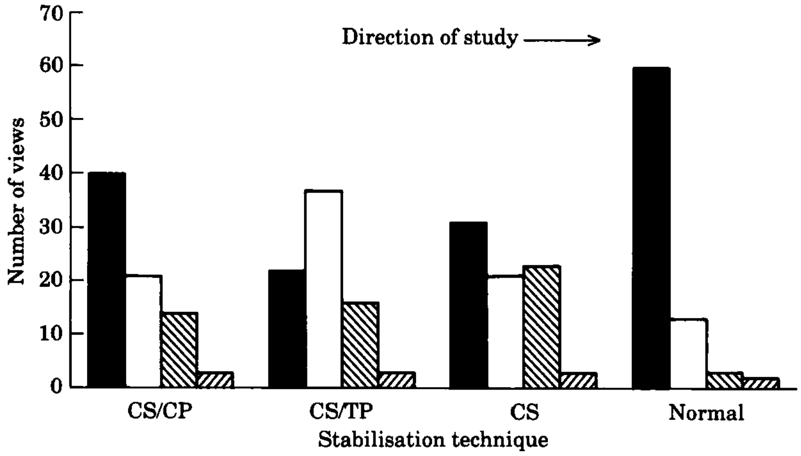

Fig. 1. Effect of manoeuvre on laryngeal view. ■ = grade 1; □ = grade 2; ▧ = grade 3; ▨ = grade 4. For abbreviations, see text.

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Depth of anaesthesia

In the recent editorial on depth of anaesthesia (*Anaesthesia* 1993; **48:** 637–638), Dr Newton describes how the various types of anaesthetics have different sites of actions on the brain, such that volatile agents act differently from the receptor-based anaesthetics such as the opioids, benzodiazipines and ketamine. He then postulates that since the effects of the anaesthetics are so different, it may be difficult to extract out of the EEG, or Auditory Evoked Response (AER) of the EEG, a single measure which will relate to consciousness. He mentions that psychologists are unhelpful in trying to relate a measure of EEG to consciousness as they equate 'perception with consciousness' and also comments that the P300 wave in the AER may be a useful monitor of depth of anaesthesia. It is with these two latter points I would like to comment first.

Perception of stimuli and their subsequent processing by the brain i.e. 'information processing' is a much more easily definable and experimentally useful definition than 'consciousness'; hence the understandable inclination of psychologists to use and test the former. However, there is a large body of psychological research that distinguishes between information processing and consciousness. Dixon [1] quotes many examples of perception without conscious awareness. The usefulness of this technique to subsequently affect behaviour is known both to advertisers in the form of subliminal propaganda as well as to psychologists. This concept has already been used to describe what may be happening during anaesthesia. Electrophysiological and metabolic evidence also support this division between information processing and consciousness. Angel and LeBeau [2] have shown that anaesthetics gate sensory information flow at the thalamus, so reducing arousal in the cortex and hence the level of consciousness. Other afferent pathways, however, such as the spinothalamic and auditory pathways are left relatively untouched suggesting sensory information may still be perceived and processed despite the lack of cortical arousal. Interestingly a similar process occurs during ordinary sleep. Neurobiological evidence also indicates the resistance of information processing and memory systems within the brain to conventional anaesthetics; for example, it is known that most anaesthetics neither inhibit long-term potentiation nor immediate early gene expression in the hippocampus, processes which are known to be required for memory formation.

Since we now can postulate a situation where information processing can occur outside of consciousness, can the EEG or the AER distinguish between these two? Particular waves within AER have been associated with information processing and in particular the P300 is associated with changes in the incoming information for example, when a subject notices a change in pitch of a sound. This appears ideal, and with nitrous oxide sedation alone, in button pressing paradigm in response to auditory stimulation, all subjects who responded had a P300 wave [3]. In another similar study during isoflurane anaesthesia, again the presence of the P300 was associated with a subject's response to changes in auditory stimuli but, however, the reverse was not true i.e. the lack of the P300 could not be used as a guarantee of lack of awareness especially on lightening of anaesthesia [4]. Again, in a recent study with sufentinil anaesthesia, the frontal P300 (P3a) was associated with registration of auditory stimuli but relationship to conscious awareness was not clear and the authors stated there was 'no consistent relationship between P300 and memory' [5].

The answer to the goal of a unifying parameter of the AER, which will distinguish between information processing and consciousness, *and also* work for various anaesthetics may lie in looking at the way individual neur-