Recruitment manoeuvres on high frequency oscillation ventilation

Editor—We read with interest the recent article on high frequency oscillation in adolescents by Moganasundram and colleagues.1

The article raises a number of issues regarding the initiation and use of high frequency oscillatory ventilation (HFOV) not just in adolescents but also in adults.

In our unit we have used HFOV for over 3 yr on more than 70 patients. Through experience, we have found that recruiting in a stepwise fashion whilst connected to the oscillator has resulted in better haemodynamic stability and oxygenation. We use the Sensormedics 3100B (Yorba Linda, CA). All patients are connected with a closed suction system (Vygon, Cirencester, UK) in place, to prevent derecruitment with an amplitude of 0, on a bias flow of 40 litre min−1. Mean airway pressure is then adjusted to 40 cm H2O and maintained for 40 s. The alarm on the Sensormedics 3100B can be silenced for 45 s and is therefore ideal for timing the duration of the recruitment manoeuvre. We use this pressure and duration from the evidence produced in Amato’s study.2 However, we are aware of the problems of defining optimal lung inflation.

The mean airway pressure is then reduced to 30 cm H2O on an FIO2 of 1.0 and the FIO2 reduced every 2 min till either an FIO2 of 0.4 is obtained or the saturations are 88–93%. If the PtcO2 cannot be reduced to <0.6, then another recruitment manoeuvre is performed to 40 cm H2O for 40 s on a FIO2 of 1.0, but only reducing the mean airway pressure to 35 cm H2O. The process is again repeated and if an FtcO2 of 0.6 still cannot be obtained then the recruitment manoeuvre is repeated but at a pressure of 50cm H2O for 40 s. If during recruitment any patient shows signs of haemodynamic instability, the manoeuvre is abandoned and the patient’s preload is optimized using the PiCCO system (Pulsion Medical Systems, Munich, Germany).

In our experience this technique gives a more controlled recruitment without using repeated disconnections starting at lower pressures than the manual procedures applied by Moganasundram and colleagues1 using the Mapleson C circuit. It therefore allows more control over haemodynamic stability and oxygenation. This stepwise recruitment manoeuvre avoids any risk of derecruitment on disconnection and in theory any damage to the tracheal tube during clamping. Also it is more useful in patients with tracheostomies in situ who will not be able to have their tubes clamped.

We also question the use of the prone position in these patients on HFOV for a number of reasons. First, while in small children and neonates the process of turning the patient prone may be carried out safely and with ease, the process in large adults significantly increases the risk of iatrogenic complications.3 Second, in our experience, the prone position on HFOV does not improve gas exchange if the patients have been adequately recruited initially. Recent evidence has also shown no improvement in outcome in those patients who have been placed prone on conventional ventilation.4

The greater frequencies used by Moganasundram and colleagues (6–8 Hz) may reflect their experience with the paediatric population, but in our experience have resulted in significant air trapping and hypercapnia. We tolerate a pH >7.25 and manipulate this initially by increasing the amplitude (ΔP) to a maximum of 90 cm H2O and then decreasing the frequency to a minimum of 4 Hz to control the pH. Recent evidence has also suggested that the PaCO2 level may have a prognostic value, as survivors have demonstrated a significant reduction in PaCO2 levels compared to non-survivors.5

Once again, the timing of intervention with HFOV has been brought to our attention and we agree it should no longer be used as a last resort or ‘rescue therapy’ but early to avoid further lung injury.6 We currently institute HFOV for those patients at risk of developing further acute lung injury and feel that it is an extremely useful tool in the management of ARDS. We await with interest the results of the controlled trials currently in progress.

R. G. Roberts
N. J. Stallard
P. Morgan
Cardiff, UK

Editor—Thank you for the opportunity to reply to Roberts and colleagues’ group have extensive experience with high frequency oscillation (HFO) in adults and describe an oscillator-based recruitment manoeuvre starting at 40 cm H2O, similar to that described by Amato.2 We concede that there is no consensus as to the ideal recruitment manoeuvre whilst on HFO. However, Roberts’ comment that their technique provides a ‘more controlled recruitment starting at lower pressures’ is clearly not borne out by our data. Table 1 in our paper shows that our patients had initial mean airway pressures of 33, 26 and 40 cm H2O with corresponding maximum recruitment pressures of 38, 31 and 45 cm H2O. Also, the claim to ‘better haemodynamic stability and oxygenation’ is difficult to sustain without hard data.

We would agree that repeated disconnection for suctioning runs a risk of derecruitment. However, in our experience the frequency of suctioning on HFO is reduced compared to conventional ventilation, possibly as a result of better carbon dioxide clearance with HFO. Furthermore, we would advocate caution when considering the closed suction system advocated by Roberts. This system is purported to avoid alveolar collapse during conventional ventilation;7 however, extreme negative pressure levels can result when suction flow is higher than ventilator flow.8 The significance of this may be amplified during the active expiratory (negative pressure) phase during HFO. Also, on introduction of the suction catheter into the tracheal tube, there is an increase in end-expiratory pressure that can reach more than 10 cm H2O above the set extrinsic positive end-expiratory pressure.8 The literature is lacking in information on the use of closed suction systems with high frequency oscillatory ventilation.

We have not encountered damage to the tracheal tubes during clamping, probably as a consequence of the infrequency of suctioning and the positioning of protective gauze between the clamp and the tracheal tube. This technique is obviously not suitable for the tracheostomized patient. However, this practice is not common in paediatrics.

We were somewhat surprised at the view taken by Roberts about prone positioning in the management of acute respiratory distress syndrome. First, we do not think it is correct to extrapolate the iatrogenic problems multi-trauma patients suffer in the process of turning them prone to the rest of the acute respiratory distress syndrome population. Second, the fact that prone positioning improves oxygenation has been well established since its introduction in 1976.9 To state that the improvement in oxygenation with prone positioning is not associated with a decrease in mortality on the basis of a single trial may be premature.4Gattinoni’s trial had several methodological problems: (i) the trial was stopped early because of reluctance by staff.
to forgo the prone position, resulting in decreased power; (ii) the patients were placed prone for only 7 h each day. Furthermore, other outcome measures such as duration of ventilation and length of hospital stay were not addressed.4

A final comment on our methodology relates to the relatively high frequencies (6–8 Hz) used. We have not experienced significant air trapping as a result of these frequencies. Also, as tidal volume and frequency bear an inverse relationship,10 small absolute changes in frequency in this range (for example, decreasing from 8 to 4 Hz) equate with large relative changes in frequency (50% decrease) and hence tidal volume (100% increase). This in turn may reduce lung protection. Furthermore, excessive efforts to reduce P\textsubscript{aCO\textsubscript{2}} on the basis of the lower levels found in the survivors in Mehta’s study5 may be erroneous for two reasons. First, survivors had been conventionally ventilated for a shorter period prior to initiation of HFO. Thus the lower carbon dioxide may be an epiphenomenon, reflecting less irreversible lung damage in these patients. Second, there is evidence for the lung protective aspect of hypercapnia \textit{per se}.11 12

S. Moganasundram
London, UK