The prevention of hypoxia is obviously fundamental to anaesthesia, but the classification of our specialty by the defence organizations as “high risk” would suggest that we occasionally fall short of this objective. While few would dispute that anaesthesia is inherently dangerous, one wonders if the psychological profile of anaesthetists predisposes them to take risks unnecessarily, or to accept perceived risks with equanimity, in order to maintain an image of confidence or ability [1].

Anaesthesia in patients with airway obstruction from whatever cause is undoubtedly one of the greatest hazards in clinical anaesthetic practice. When the airway must be shared also with the surgeon, the risks taken may be considerable. The ignition of tracheal tubes by lasers may be prevented only by a damp swab, or surgery may be performed on an apnoeic patient without a tracheal tube. Patients with a trachea known to be difficult to intubate may be given an i.v. induction, the possibility of obstruction being accepted. The patient with epiglottitis may receive an emergency tracheostomy, having obstructed during an attempted anaesthetic induction and tracheal intubation. Why do these potentially lethal events still occur?

In the face of such advantages, why have techniques utilizing HFJV not become standard practice? After 15 years of clinical use, it should not be lack of understanding of HFJV that has inhibited its widespread adoption. Despite the almost universal use of the Sanders injector as a low frequency jet ventilation system, the ventilatory frequencies used in HFJV seem to alarm anaesthetists. This is curious because, while high frequencies may occasionally cause problems, it is the pressures involved that are the main hazard to the patient.

HFJV entails the use of gases at pressures of 25–400 kPa. Whilst it is true that the tidal volume may be only 2–3 ml/kg body weight, 200 ml of gas delivered into the wrong location can cause serious problems; this is compounded by the ventilation frequency which varies typically from 60 to 180 b.p.m. Assuming that a patient is checked every 10 s, and assuming that a problem was diagnosed and the ventilator turned off within a further 5 s, as much as 8–12 litre of gas could have been delivered. In a patient with outflow obstruction this volume would lead to barotrauma and cardiac compromise. A recent report [8] has highlighted these dangers and shown also that similar hazards occur with the use of manually operated Sanders injectors which, because they are used at low frequencies, require correspondingly high tidal volumes.

If barotrauma is to be avoided, the system of ventilation must use small tidal volumes and rapid response ventilators, which incorporate appropriate airway pressure sensing devices with immediate inhibition of gas delivery following activation of these sensors. High frequency jet ventilators exploiting these features have been available for several years. While this method is certainly effective and has been recommended in prevention of increased airway pressures [8], there is an alternative solution. In the past it has always
been necessary to introduce a second catheter into the airway for the airway pressure monitor. While this need be only a fine-bore cannula, it is still inconvenient. An elegantly simple solution to the second cannula problem has been developed by Bourgain’s group and is reported in this issue [9]. They have developed the GR 300 ventilator which uses the main gas delivery line for airway pressure monitoring. The airway pressure is recorded from the main injection cannula at the end of expiration—the end-expiratory pressure (EEP). Failure of EEP to decrease below a user-selected preset limit inhibits the next ventilatory cycle. In practice, this not only prevented the build up of dangerously high airway pressures, but also gave warning that airway obstruction was beginning to occur as the ventilator demonstrated “missed beats”.

The use of both methods of airway pressure monitoring should reduce the incidence of baro-trauma, but there is still the problem of initial misplacement or subsequent displacement of the cannula resulting in paratracheal delivery. Even the sophistication of the GR 300 could not prevent this. Ideally, the ventilator should be able to detect resistance to gas delivery before supplying even the first tidal volume.

Preliminary data from one manufacturer would appear to show that this difficulty may soon be overcome. In a new approach to this problem, a low flow (250 ml min$^{-1}$) of gas at low pressure ($< 4$ kPa) is passed through the injection cannula between the main gas pulses and measures the expiratory airway pressure. Unacceptably high EEP inhibits the ventilator (as before), but misplacement of the cannula in the paratracheal tissues produces back pressure in the delivery line caused by the low flow system, which cannot exceed 4 kPa, and may be set as low as 1 kPa. This inhibits gas delivery by both the main ventilator and the low pressure system itself. Initial results suggest that the system activation time limits the volume of gas in the paratracheal tissues to as little as 3–5 ml [Technical Department, Penlon U.K., personal communication].

Through technological advances, the design of modern ventilators has now achieved an unprecedented level of safety. One assumes that the adapted, home made or "prototype" ventilators which lack such essential refinements will be abolished, whilst HFJV using safe ventilators will become a standard method of anaesthetic management in cases of airway obstruction and airway surgery. If we are to provide our patients with maximum safety, we can offer no less.

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REFERENCES