# Correspondence

## *Use of the Haloxair® apparatus with an oxygen concentrator*

To the Editor:
I am working in a remote area of north-eastern Zaire where road access to major centres is virtually nonexistent. Thus to obtain cylinders of compressed gases one must use air transport; the cost is prohibitive and the supply is not reliable. I am fortunate to be in an area where electricity is available 24 hours a day. I have thus devised a simple anaesthetic circuit using the halothane-oxygen-air apparatus (Haloxair®, Cyprane, Yorkshire, England) and an oxygen concentrator (ECONO$_2$®, Mountain Medical Equipment, Littleton, Colorado).

The Haloxair® apparatus operates on the "draw-over" principle. Air is drawn through the inlet, the halothane vaporizer, valves, and corrugated tubing to the patient. It can be used for both spontaneous and controlled or assisted ventilation as well as serving as a resuscitation apparatus.[1,2] Although it can be used with air alone, cyanosis may ensue due to the depressant effects of halothane on ventilation.[3] It is preferable to add oxygen to the inspired halothane-air mixture and to assist or control ventilation. There is no rebreathing with this circuit due to unidirectional valves. The actual concentration of oxygen in the inspired gases will depend on the flow rate of oxygen and concentration of oxygen coming from the concentrator, the patient's respiratory pattern and minute ventilation.

The ECONO$_2$® oxygen concentrator delivers 95 per cent oxygen at flow rates of 1–4 L·min$^{-1}$. At 5 L·min$^{-1}$, 80 per cent oxygen is delivered with 220/240 VAC, 50 Hz units, and 90 per cent oxygen is delivered with 115 VAC, 60 Hz units. Due to air entrainment, the $F_{IO_2}$ will be much lower, depending on peak flow rates and minute ventilation.

The oxygen from the concentrator is introduced into the circuit via a T-piece connector in the inspiratory limb (Figure). I have placed this close to the machine to prevent

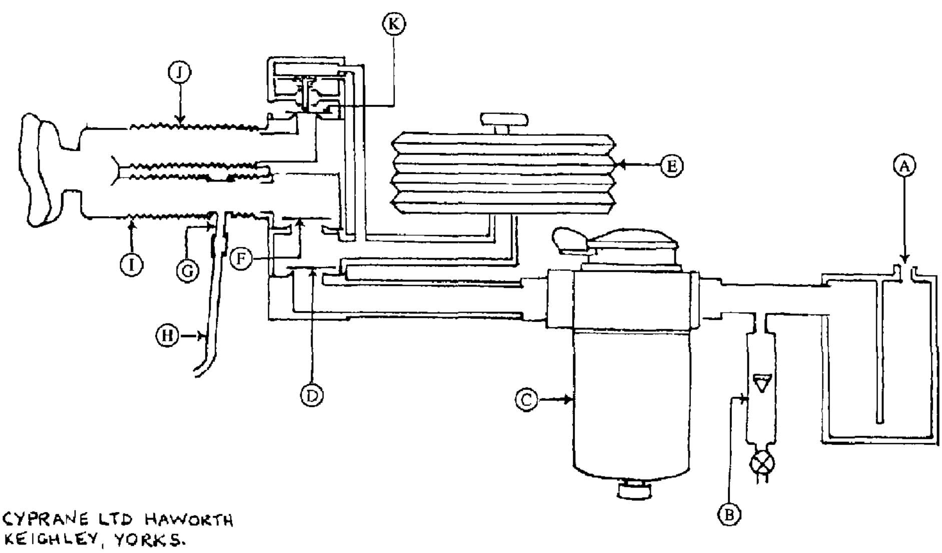


FIGURE Diagram of Haloxair apparatus with added T-piece connector for addition of oxygen from oxygen concentrator. A – air inlet to oxygen economizer; B – oxygen flowmeter; C – halothane vaporizer (0.5 to 5%O; D – unidirectional valve; E – bellows (Oxford type – fitted with internal spring); F – unidirectional valve; G – T-piece connector; H – outflow tube from oxygen concentrator; I – corrugated tubing – inspired gases; J – corrugated tubing – expired gases; K – expiratory valve.

the excess weight dragging on the patient's mask or endotracheal tube. I use a flow rate of 5 L·min$^{-1}$ for preoxygenation and on termination of the anaesthetic. To diminish the diluting effect of the added flow of oxygen to the inspired concentration of halothane, I reduce the oxygen flow to 1 L·min$^{-1}$ during maintenance of anaesthesia. This conserves our supply of halothane, also a costly item in this part of the world.

The Haloxair® has an oxygen flowmeter calibrated from 1–3 L·min$^{-1}$ to which a cylinder of compressed gas can be connected. I keep a cylinder attached, in case of power failure.

The types of cases done at our hospital using this simple circuit include an oesophagectomy, laparotomy for ruptured ectopic pregnancy, Caesarean section, and repair of an oomphalocele in a newborn. It has also been a means of using oxygen in the resuscitation of newborns, children, and adults. There have been no clinical signs of hypoxia.

I feel that in remote areas where use of the Haloxair® is appropriate and cylinders of oxygen are not readily obtainable but electricity is available, the use of an oxygen concentrator in conjunction with the Haloxair® adds an immeasurable margin of safety and offers a very satisfactory method of giving general anaesthesia.

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REFERENCES

1 *Mackay I.* A compact anaesthetic apparatus for emergency use. Can Anaesth Soc J 1965; 12: 298–305.
2 *Kay M.* General anaesthesia in the private dental office. Can Anaesth Soc J 1983; 30: 406–12.
3 *Coursey J, Wilson R.* A new draw-over halothane vaporizer. Anesth Analg 1965; 1: 147–57.

# *Oxygen concentrators*

To the Editor:

In the article on anaesthesia training in Nepal[1] the use of an oxygen concentrator to supplement air in drawover systems was mentioned. Our unreliable and inadequate supply of oxygen cylinders relates to the fact that Nepal has not developed its own medical gas industry, and all oxygen must be imported from India. This constitutes an unacceptable expense of time and money. Recently the price of oxygen has doubled. This will result in deficits in the care of particularly ill patients. Under the circumstances, as a physician, one is obliged to consider alternatives and it is my firm belief that oxygen concentrators of good design are the answer.

We have recently assessed the features of a Kinox-2 concentrator at the Military Hospital in Kathmandu.[2] The maximum oxygen concentration at different flows was studied using a Critikon Polarographic Oxygen Analyser and BOC Oxygen Flow Meters. The concentration readings were similar to the values predicted up to the recommended maximum flow. At higher flows there was an adverse linear relationship between oxygen concentration and flow rate. At a flow rate of 3 L·min$^{-1}$, for up to 8 h continuous use, the oxygen concentration was never less than 67 per cent, at 6 L·min$^{-1}$ it was 50 per cent, and at 9 L·min$^{-1}$ approximately 35 per cent. The maximum flow was 9 L·min$^{-1}$, measured by a Loosko oxygen flowmeter and respirometer calibrated for continuous flow.

The output pressure was 45–50 kpa using an aneroid manometer. This is not adequate for operating modern continuous flow anaesthetic machines equipped with regulators set to reduce cylinder pressure to 60 lb·in$^{-2}$ unless the reducing valves are bypassed and the gas source connected directly to the inlet port of the oxygen flow meter. We have used compressed air in this way when we cannot obtain nitrous oxide cylinders. For drawover systems an oxygen concentrator is an extremely useful component.

The low output pressure limits the usefulness of oxygen concentrators with ventilators requiring high-pressure gas sources. However, minute volume dividers like the Mini-vent and Auto-vent which are cheap and portable and operate by the elastic recoil of the reservoir bag are satisfactory. Similarly, electrically powered ventilators like the East Radcliffe are satisfactory and can be used with low flows of higher oxygen concentration.

We have calculated that the cost of moderate flows of oxygen in a Boyle type anaesthetic apparatus over the course of one year would be equivalent to the cost of one oxygen concentrator. It is expected that oxygen concentrators will form an important component in the operating room, recovery ward, and the intensive care units of Nepal hospitals. However, hospitals will require a stable electricity supply, which at present cannot be guaranteed, or the ability to generate it on an emergency basis. Smaller concentrators which need minimum electricity consumption can be operated by portable generators. These are not very expensive and are becoming more common in our hospitals.

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