A METHOD FOR REDUCING THEATRE CONTAMINATION BY EXHALED ANAESTHETIC DRUGS

GEORGE M. BOFFA

M.D., B. Pharm., D.A. (R.C.P. & S. Eng.),
D.A. (Copenhagen), F.F.A.R.C.S. (Irel),
F.F.A.R.C.S. (Eng.)

Consultant Anaesthetist

Over the past few years it has been shown by different investigators that gaseous anaesthetics in the atmosphere of operating theatres are a potential danger to theatre personnel. These dangers include i) a greater incidence of abortion in female staff and increased foetal fatality in the wives of anaesthetists. (Cohen, Bellville and Brown, 1971). ii) a higher incidence of lymphoid and reticulo-endothelial malignancies in anaesthetists. (Bruce, Eide, Linde and Eckenhoff 1968). iii) hepatitis. This condition in anaesthetists has been blamed on chronic exposure to halothane — a drug which is metabolised faster by anaesthetists than by pharmacists — probably pointing to an altered reaction of the body after long exposure. (Belfrage *et al.*) iv) more recently, ophthalmic sensitization (redness and irritation of the eye) has been demonstrated (Boyd, 1972) (Brit. Med. J., Leading article, 1973).

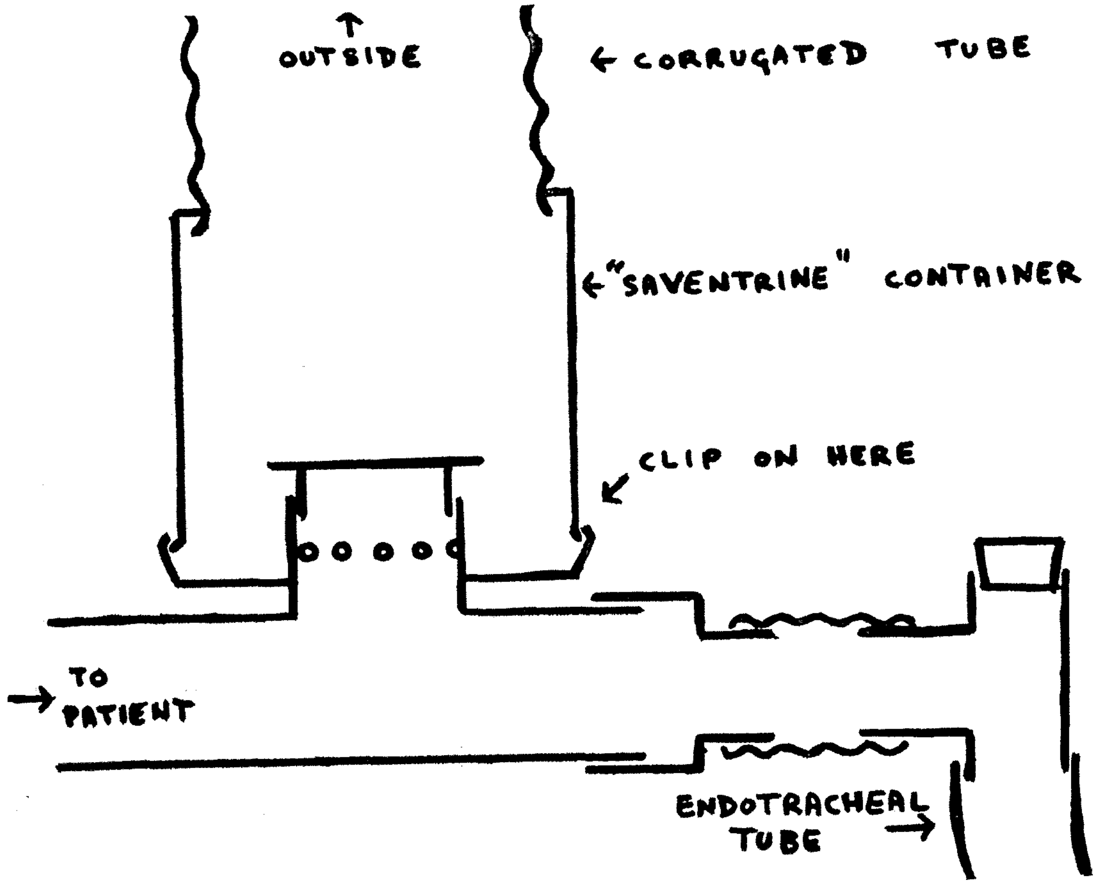
Besides these harmful effects (teratogenic and others), there is the discomfort, reduced alertness and performance associated with prolonged and repeated periods of breathing in even small concentrations of volatile anaesthetics. In one investigation (Whitcher, Cohen and Trudell, 1971) end-tidal samples from theatre personnel were shown to contain measurable halothane concentrations 16 hours after exposure. This is somewhat disturbing because it signifies a fair basic level of anaesthetics in the blood of theatre staff. In the study mentioned above, the anaesthetists had an initial end-tidal halothane concentration of 0.08 parts per million; this rose to a mean of 0.46 ppm, with six of the samples reading over 1.0 ppm.

These levels would probably not be accepted in industry. The law "Factories (Heath, Safety and General Welfare) Regulations, 1945", seems to be relevant. Article 3 of the Health Section states "Effective and suitable provision shall be made for securing and maintaining by the circulation of fresh air in......each workroom......the adequate ventilation of the room......and for rendering harmless, so far as practicable, all fumes and other impurities that may be injurious to health......"

With all the above factors in mind, several people have during the past years produced a number of devices to reduce contamination from the anaesthetist's inhalatory zone. Some have confined themselves to drawing off excess gas to floor level, but the effectiveness of this is controversial. Whereas Askrog and Petersen (1970) found that this method resulted in a reduction of up to 90% of anaesthetic gas in the anaesthetist's inhalatory zone, Brendstrup's, (1972) findings showed only minimal reduction. A lot obviously depends on theatre ventilation, changes of air per minute, currents, size of theatre, etc.

Whatever one's opinions about inhaling noxious substances and on the possible deleterious side effects, I believe that an immediate pleasant result of precautions would be that all in the theatre would feel less tired and irritable even after sessions lasting several hours.

Because of all the above factors which are accentuated when one works



single handed (i.e. with no break during a session) I feel that a solution should be found, preferably one which involves little or no expense. In a hospital where I have worked I tried with success venting of exhaled gases.

The theatre had no system of modern ventilation and was relatively small. The presence of an operating table, anaesthetic and oxygen trolleys, diathermy, sucker and instrument trolleys left little space for the staff (at least 5) and was not conducive to easy movements of air currents.

The location of the theatre was advantageous — at least in this respect. It was bounded on one side by a hospital yard and with a one storey drop. This side was used for venting so that the exhaust pipe jutted out well above head level, in a large open yard, with no offices, workshops, or similar occupied rooms below. The size of the theatre and its situation resulted in a pathway between the patient and outside which measured about 2½ metres.

Corrugated tubing was used to provide a channel of adequate diameter and to minimise the risk of kinking. The metal pipe fitted in a specially drilled downward tilting (to prevent entry of rain) bore in the theatre wall (almost at floor level) was covered with nylon netting on the outside to prevent entry of insects or wind borne material.

The main problem was how to obtain a tight enough fitting around the expiratory valve without causing obstruction and with easy and prompt access when the need arose for adjusting the valve.

We fitted the clip-on plastic cap of a "Saventrine" container on the expiratory valve (see diagram). The bottom of the container was cut away so that the corrugated tubing would fit in tightly. The exhaust system could thus be clipped on and off with a minimum of effort and with no loss of time. A similar cap was fitted to the exhaust of the East Freeman Automatic Vent.

The results were very good with no changes in B.P., Pulse Rate or Respiratory Rate. The contamination was reduced markedly so that even when ether was used nobody in the theatre noticed. I tended to deliver a slightly higher minute volume in an attempt to minimise rebreathing should the expiratory valve not function efficiently.

The expense in setting up the system was negligible but there was, of course, no potential saving of anaesthetic agent as in Mushin's adsorbent (Mushin 1973).

One disadvantage was that the usual expiratory hiss through the valve was completely silenced — an audible monitoring aid was lost.

Despite this such a system has many advantages and favourable factors:

i. Expiratory resistance is not unduly affected because the pathway between patient and outside is relatively short.

ii. Obstruction either by kinking or from the outside is extremely difficult, if not impossible.

iii. The change from spontaneous to controlled respiration is uncomplicated and quick.

iv. The system — where adopted — is easy to operate, easily positioned into an anaesthetic system, and can be cleaned effortlessly.

However, it must be borne in mind that unless the anaesthetic apparatus is completely air tight no system of venting will be sufficient because a certain volume of gas would escape through the leakages and thereby not lend itself to be drawn off. In one investigation which was carried out at a leading anaesthetic centre (Berner 1973) it was shown that none of the apparata in daily use was completely airtight. In fact all the conical connections and 60% of the respiration bags were leaking.

The conclusions to be drawn are:

i. that even a simple system will reduce contamination.

ii. that the fewer the number of connections in an anaesthetic apparatus the less the possibility of leaks.

iii. reliance must be made on theatre ventilation, venting and frequent servicing of apparatus with prompt replacement of faulty parts.

iv. that many problems can be solved often at minimal cost.

v. that venting and efficient ventilation (at least 10 changes per minute) should increase efficiency all round and therefore result in greater safety for the patient — which is our very raison d'être.

This brings us to two more points. How would the definite concentration of anaesthetic in theatre staff affect tests of skill — e.g. driving? What synergistic effect would there be with alcohol? And why is it that anaesthetists have a lower incidence of bronchial carcinoma (smoking is usually not encouraged in theatres even when non-explosive techniques are used), and of coronary artery disease — even though anaesthetists lead rather a sedentary occupation? (Bruce, Eide and Linde, 1968) Does the chronic concentration of anaesthetic in the blood act directly on the coronary blood vessels, or could it act as a sedative?

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