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Inhalation sedation - is this a potential health hazard for the dentist and his staff?

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SUMMARY

Pollution of the air with anaesthetic gases is a problem which poses a health hazard to anaesthetists. Attention is drawn to the possible hazard of the use of inhalation sedation to dentists.

OPSOMMING

Besoedeling van die lug met narkose gasse is 'n probleem wat die gesondheid van narkotiseurs raak. Die aandag van tandartse word gevestig op die moontlike gevaar van die gebruik van sedasie a.g.v. inhalasie.

The vogue for using various inhalation sedation techniques has reached South Africa. Commercial houses advertise specialized equipment which is used for this purpose and there is a great deal of interest amongst members of the profession in courses given by visiting lecturers. Both advertisers and lecturers have stressed the safety factor; that is, the safety of using inhalation sedation for the patient. The emphasis on this factor is probably related to the controversy regarding the single operator/anaesthetist or operator/sedationist as he is often called.

Practitioners are anxious about their patients' safety. They are also concerned about possible litigation against themselves should anything go wrong during the sedation procedure. What the practitioner does not consider is the effect of both short- and long-term exposure to anaesthetic gases on himself and his staff.

This short paper is intended to bring some aspects of the problem of pollution of the atmosphere by anaesthetic gases to the attention of the dental profession in South Africa.

In 1968 Bruce *et al* reviewed the causes of death in anaesthetists over a 20-year period and noted a higher incidence of death from malignancies of the lymphatic and reticulo-endothelial systems in these practitioners. These authors felt that this might be due to prolonged exposure to anaesthetic gases. The article seems to have focussed attention on the possible serious consequences of long-term exposure to anaesthetic gases and more and more quantitative exposure studies have been undertaken. In one such study, Linde and Bruce (1969) measured halothane concentrations in the air of operating rooms and the corridors outside these and found significant pollution in both. Whitcher, Cohen and Trudell (1971) have also shown that, although concentrations of halothane in the operating room were usually below detectable levels at the beginning of the day, measurable concentrations were obtained within minutes after the beginning of anaesthesia, irrespective of the type of circuit used. They found that significant pollution was present, representing a potentially serious risk.

In a study more specifically related to dentistry, Strunin, Strunin and Mallios (1973) studied halothane concentrations in a dental surgery at Kings' College Hospital Dental School. This was 9 x 5 x 4m in size and the airchanging system produced 5 changes per hour. A nasal mask was used with the expiratory valve fully open. Air samples were taken at various levels, including that at the level of the dental surgeon's face, with the airchanging system off; with an electric fan as well; and finally using in addition a scavenging apparatus. They found that halothane levels were greatly in excess of the levels in general surgical theatres. The greatest concentration of all was at the level of the dental surgeon's face and this was unchanged whether the ventilation was off or on. Addition of a fan reduced the level only slightly and a scavenging system brought it down to one-third of the original level. This was now 18,5 ppm, which is 18,5 times higher than the recommended level of 1,0 ppm (Whitcher *et al*, 1971.)

Prolonged exposure to halothane has been linked with liver damage and headache (Belfrage, Ahlgren and Axelson, 1966; Tyrrell and Feldman, 1968; Klatskin and Kinberg, 1969); bone marrow depression (Bruce and Koepke, 1966) and possibly the malignancies of the lymphoid and reticulo-endothelial systems (Bruce *et al*, 1968).

Although halothane is used in general anaesthesia, nitrous oxide and to a much lesser extent, methoxyflurane are the 2 inhalation sedation agents commonly used in dentistry.

NITROUS OXIDE

Linde and Bruce (1969) measured the concentrations of nitrous oxide in a number of operating rooms. They found that with nitrous oxide flow rates of from 0,5 to 5 l/min the average concentration was 130 ppm.

Recently a preliminary report on air pollution with anaesthetic gases was made public by an Ad Hoc Committee of the American Society of Anaesthesiologists and the National Institutes for Occupational Safety Health. This said that although the conclusions were tentative there was sufficient justification for warning professional people to ensure that all operating rooms are effectively protected against contamination by escaping anaesthetic gases. One member of this committee, Whitcher, said that dental teams were subjected to a very high risk because of the lack of a closed circuit and escape of gases directly into the operator's face. He found that the waste nitrous oxide inhaled by the dental team is in the region of 6 000 ppm (American Dental Association News, 1973).

It has clearly been established by these authors that the dental surgeon is exposed to a highly polluted atmosphere and one must ask the question what are the effects of this exposure? These may be considered under headings of long-term and short-term exposure.

(a) Long-term exposure

Long exposure to nitrous oxide has been known to produce bone marrow depression (Lassen *et al*, 1956, Eastwood *et al*, 1963). Nitrous oxide is also teratogenic resulting in congenital anomalies (Rector and Eastwood, 1964; Smith, Gaub and Moya, 1965; Fink, Shepard and Blandau, 1967). Nitrous oxide may be associated with the increased spontaneous abortion rate reported in female doctors and nurses (Vaisman, 1967; American Dental Association News, 1973).

(b) Short-term exposure

The problem that arises here is whether the operating ability of the dental team is affected. Vaisman (1967) has reported functional disturbances in Russian anaesthetists using nitrous oxide as well as other anaesthetic gases. The only study thus far on the effect of nitrous oxide on performance is that of Bruce (American Dental Association News, 1973). He studied young volunteers exposed to a mixture of halothane and nitrous oxide and nitrous oxide alone. Accuracy in the noting of changes simultaneously in an oscilloscope pattern and in a sound signal coming through earphones was the same whether the volunteers were exposed to air or the anaesthetic gases. However, after 4 h exposure to the anaesthetic gases, the speed of reaction was reduced.

METHOXYFLURANE

Methoxyflurane has also been used for inhalation sedation in dentistry (Dragon and Goldstein, 1967; Josephson and Schwartz, 1974). This gas has been associated with renal toxicity (Lee and Atkinson, 1973) and Josephson and Schwartz (1974) have said that this may occur if more than 16 ml is administered which is equivalent to more than 2 h administration with a Cardiff inhaler. While the risk of renal damage may not be excessively large in patients, it may be harmful to practitioners after long-term exposure.

In a study of methoxyflurane, Corbett and Ball (1971) found air pollution with this gas in the region of the anaesthetist to vary between 1,3 and 9,8 ppm. Anaesthetists exposed to these levels gradually excreted the methoxyflurane. This gas could be detected in the end expired air of the anaesthetists for as long as 30 h after exposure. In the same anaesthetists, fluoride ion concentration in their urine was increased five-fold 6 h after withdrawing from the polluted atmosphere.

DISCUSSION

Pollution of the air in rooms in which anaesthetic gases are used is now well accepted and attention is being directed towards methods to reduce this. Whitcher *et al* (1971) recommended air conditioning that produced at least 10 air changes per hour. A second line of attack is the use of scavenging systems that trap the exhaled gases. An example of such a system, the only one reported for nasal masks, is that of Evans-Prosser (1972). All the scavenging devices are designed for an anaesthetic circuit with a tight seal around the mask or endotracheal tube used. No devices have yet been reported for use with the loose fitting masks used today in inhalation sedation in dentistry.

These facts emerge from the literature. Firstly, the dentist using any form of inhalation sedation will inhale quantities of the gas he uses. Secondly, as yet no specific gas scavenging devices are available for the leaky circuits used in the sedation techniques. Thirdly, air conditioning by virtue of its great cost is probably neither a cheap nor practical solution in reducing air pollution.

While the short- and long-term effects of the inhalation of anaesthetic gases on dentists, are not yet clearly established, the literature suggests that a health hazard is present. It would be appropriate to sound a word of caution concerning the over-enthusiastic use of inhalation sedation techniques. It is clear that the less these techniques are used the less air pollution will occur and this lessens the risk of health hazards to the dental team. Sedation techniques should only be used when really indicated.

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