The hidden dangers of anaesthetic machines

In a recent, unpublished survey of 161 practitioners in South Africa it came to light that 93.7 % of practitioners had anaesthetic machines available in their practices. Halothane was the most common inhalation agent used (91.3 %) but both isoflurane (15.5 %) and enflurane (1.3 %) were available). What is of significant concern is that only 11.8 % of practitioners applied any form of scavenging to prevent contamination of the operating room environment. Volatile anaesthetic agents and some carrier gases may pose a significant health risk to staff.

Low concentrations of volatile anaesthetics and nitrous oxide may alter cognitive and motor function of personnel in the operating theatre[1]. If this occurred, patients would be exposed to significant risk of human error. The evidence in the literature of the effects of low concentrations of anaesthetic gases is inconclusive[1]. Prolonged exposure to sub-anaesthetic concentration of halothane may lead to enzyme induction and altered metabolism of drugs[2]. Mutagenicity has not been established for the gaseous anaesthetic agents[2,4]. A 1.2- to 2-fold increase in the incidence of cancer has been reported for operating room personnel[2]. It is difficult to quantify this risk, and several authors have suggested that this risk is negligible[2,4]. Halothane, enflurane and isoflurane have been shown to be teratogenic in rats after longterm high exposure[2]. The risk for low exposure is considered small[2,4].

Several studies have found a higher incidence of liver disease in operating room personnel[4]. Halothane has been shown to cause halothane hepatitis in patients exposed to anaesthetic concentrations[2]. Unfortunately, no cause–effect relationships have been found between low concentration exposure to halothane and liver disease[4]. A similar situation exists for renal disease[4]. An increase in headaches, irritability and fatigue has been reported after exposure to volatile anaesthetic agents. There is also an associated increase in risk for spontaneous abortion after exposure to anaesthetic gases[4].

Volatile anaesthetics destroy the ozone layer and are classified as greenhouse gases[3]. With current interest in the ozone layer and the prevention of its destruction, certain European countries are considering introducing legislation to reduce volatile anaesthetic agents and nitrous oxide emission into the atmosphere.

The National Institute for Occupational Safety (NIOSH) in the United States of America lists the following as symptoms of exposure to halothane: irritation of eyes, skin and respiratory system; confusion, drowsiness, dizziness, nausea, anaesthesia; cardiac arrhythmias; liver and kidney damage; decreased audio-visual performance and reproductive effects. NIOSH recommends a maximum working limit of 2 ppm for volatile anaesthetic agents. Other European countries allow up to 5 ppm for volatile anaesthetic in the workplace[3].

The Occupational Health and Safety Act of South Africa (Act 85 of 1993 as amended by Act 181 of 1993), requires that every employer instructs employees on the hazards to their health with regard to any substance they may use, handle, store or transport. The act requires that the employer instruct the employee on the appropriate methods to handle and use hazardous substances and it also states that an employer must take appropriate measures to prevent unnecessary exposure to any hazardous substance. Failure do so is considered under the act to be an offence. Veterinarians are advised to take cognisance of this fact, as litigation may result. As part of the evaluation the South African Veterinary Council will perform on veterinary practices, scavenging will be one of the aspects to which attention will be paid.

A simple passive scavenging system may be constructed by attaching a hosepipe to the automatic pressure relief valve (pop-off valve) of the breathing circuit. This hosepipe acts as a conduit through a

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window or hole in the wall to the outside. In this way, waste anaesthetic gases are conducted out of the operating room. Active scavenging devices are considerably more expensive and are usually installed by companies specialising in hospital and theatre equipment.

Soda lime was recognised by 11 % of respondents as part of a scavenging system. Soda lime absorbs carbon dioxide through a chemical reaction that results in calcium carbonate, heat and water. Therefore soda lime is not a scavenging agent. Activated charcoal may be used to scavenge volatile anaesthetic agents but it does not eliminate nitrous oxide and hence is not suitable as a scavenging method when nitrous oxide is used.

It was worrying to note how infrequently anaesthetic machines were checked before use. Forty-six percent of respondents check their anaesthetic machine at weekly or longer intervals, 26 % of respondents checked their machines daily and 28 % of respondents before each use. The ideal situation is that the anaesthetic machine is checked every time the machine is used, to ensure patient safety. Problems that may arise even if an anaesthetic machine has been used all day are malfunctioning valves due to moisture, exhaustion of the oxygen cylinder, soda lime or halothane, and the development of leaks. These problems have resulted in anaesthetic mortality and morbidity.

Only 31 % of respondents serviced their anaesthetic machine and vapourisers yearly. Another 20 % had them serviced every 2 years. Currently there is no legal requirement to have anaesthetic machines serviced regularly. Anaesthetic machines and vapourisers are required by law to be registered with the South African Medicine and Medical Devices Regulatory Authority (Bill 114B of 1998). The registration documentation may indicate that such devices require regular maintenance. Although there is currently no inspection of the maintenance of anaesthetic machines and vapourisers, this may become legally problematic should an anaesthetic accident occur.

It can be viewed as unprofessional conduct and unethical to use poorly maintained equipment to anaesthetise a patient. A similar situation exists for failing to check an anaesthetic machine before use, especially if an anaesthetic problem should arise due to a malfunction of the anaesthetic machine. This may be construed as negligent. Failing to check and maintain anaesthetic machines appropriately may substantially weaken the defense of a case, as it may indicate a careless attitude towards the care of patients.

Out-of-circuit vapourisers require less maintenance than in-circuit prescession vapourisers. Most manufacturers currently recommend that their anaesthetic machines and vapourisers are serviced annually. It is strongly recommended that practitioners maintain their anaesthetic machines and vapourisers in accordance with the manufacturer's instructions and that anaesthetic machines are checked before use.

References

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