COSHH Guidance
for managers in the NHS

Nitric Oxide

British Occupational Hygiene Society
Working for a healthier workplace

Uses

Nitric oxide (also called nitrogen monoxide) is added to ventilator circuits in the treatment of patients with severe breathing difficulties: neonatal, pædiatric, and adult ICUs.

Harmful Effects

Nitric Oxide (NO) is a colourless gas which oxidizes slowly in air to produce red/brown nitrogen dioxide (NO_2). Emissions of NO therefore lead to exposures to both NO and NO_2. Both are irritant gases: NO_2 has caused fatalities from pulmonary œdema — levels of 90 ppm may cause œdema. NO is less severe but has similar pulmonary effects. There is also a concern that relatively low exposures to NO can cause effects on the human fœtus in its early development. There is no hard evidence for this. There is new evidence that nitric oxide exposure over a long period increases the risk of emphysema. The Chemical Hazard Alert Notice (CHAN) of April 2003 withdrew the occupational exposure standard for nitric oxide (25 ppm- 8 hour average; 35 ppm- 15 minute average) on the basis of this evidence.

No new limit has been set yet for nitric oxide but, in the CHAN, HSE advise employers to ensure 8-hour average exposures are kept below 1ppm. The 15-minute maximum would be 3x the 8-hour limit, as is the rule when no 15-minute limit has been set.

Exposure

The concentration administered varies from 5 - 80 ppm; a patient is rarely given more than 30 ppm for long. Most systems introduce NO into the ventilation circuit from (typically F-sized) cylinders, containing 400ppm NO in air, sited on the trolley supporting the instrumentation. Since the gas in the circuit may be at a concentration well above the likely new limit for NO, a filter should be placed on the exhalation tube (even though the suppliers may say this is not necessary). The main concern during administration of the gas, however, is that part of the system between the cylinder and the point where the NO is fed into the ventilation circuit. Cylinder regulators, joints and valves may all leak, thereby creating the possibility of exposures to high concentrations of the gas. There is a safeguard in that NO has a distinct odour above 1 ppm, but this could be missed or mistaken for the gas in the exhaust ventilation air stream.
Changing cylinders involves the purging of gas residues from parts of the system. Quantities should be small but may produce high concentrations for a few moments. Similarly, loose connections between the dosing instrument and the ventilation circuit could also produce brief high exposures, with the characteristic odour.
Calibrating the instrument involves the inevitable release of small quantities of gas at 400ppm. Exposures can be around 10ppm for short periods if ventilation is poor, but will not exceed 1ppm averaged over 15 minutes if the precautions described below are followed.
Exposures are therefore unlikely to produce significant risks of emphysema or of adverse effects on pregnancy, and will certainly not produce acute pulmonary effects unless there is a major release from a cylinder. There is, however, uncertainty over the nature and severity of possible chronic effects, and the worry caused to some staff is itself to be avoided if possible.

Precautions

- Administration of NO only in well ventilated rooms (8 - 10 air changes an hour)
- Use of the equipment to be restricted to authorized trained staff;
- Gas monitors with alarms to be attached to the cylinder(s): one for NO and the other for NO_2; audible alarms at 1ppm; (negotiate with suppliers to set alarms to 1ppm if possible.)
- Regular maintenance of equipment assemblies and annual calibration of monitors;
- Weekly testing of gas monitors;
- Absorbent filters to be fitted to exhausts from ventilation circuits (potassium permanganate and carbon);
- Changing of cylinders and calibration to be undertaken in well ventilated room (8 - 10 air changes an hour).
- Use table-top fan to disperse emissions.

Guidance note 0705, October 2005: by practitioners in the field to assist in assessing and controlling risks.

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