Is it time to stop using desflurane?

Desflurane has a carbon equivalence 20 times greater than sevoflurane. This article discusses alternative anaesthetic techniques, including sevoflurane, xenon, total intravenous anaesthesia and regional techniques, and methods of reducing venting of gases, which might lower the environmental impact of anaesthesia.

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Current political and public attention on tackling climate change has resulted in movement towards prioritisation of sustainable healthcare. Anaesthetic gases account for 5% of the NHS's carbon footprint (Sustainable Development Unit, 2013). With approximately 3 million general anaesthetics administered in the UK annually, small changes could make a huge impact and this should be the responsibility of all anaesthetists. Desflurane, in particular, has been highlighted as environmentally noxious – is it time we discontinue its use?

Use of desflurane

Traditionally, inhalational techniques have been preferred for anaesthesia, largely as a result of availability and familiarity. Desflurane is commonly chosen for its faster offset, which is a result of its favourable blood:gas partition coefficient, particularly in long cases, difficult airways and obese patients. Studies show that patient responsiveness and time to extubation is more rapid with desflurane than with sevoflurane, and this is magnified with obese patients. However, this has not been shown to be associated with a faster discharge from the post-anaesthetic care unit to home for any patient group (Brioni et al, 2017). The potential for translation to enhanced theatre productivity depends on case mix, and how lists are staffed and planned (Franklin et al, 2010); therefore the economic advantage of desflurane over sevoflurane is unclear.

Concerns with desflurane

Inhalational anaesthetic agents, being hydrochlorofluorocarbons, act as greenhouse gases, absorbing infrared radiation and trapping it in the atmosphere, thereby causing global temperatures to rise. The global warming potential is a measurement of the radiative forces of a gas compared to carbon dioxide, it encompasses the wavelength and quantity of infrared absorption and the atmospheric longevity of the gas. It is commonly quoted as CO_2 100-year equivalents. Desflurane is a potent greenhouse gas, and 1kg of desflurane is equivalent to 2540 kg of CO_2 (Sustainable Development Unit, 2013). This means that every hour of desflurane usage, running at 5% with flows of 1 litre, is the equivalent of producing 56 kg of CO_2 emissions. Running a 7 h case would produce the equivalent of 392 kg of CO_2 emissions; after 4.2 days of comparable usage this is equivalent to a return transatlantic flight.

Alternatives

At 130 kg, sevoflurane has a CO_2 equivalence approximately 1/20th of that of desflurane (Sustainable Development Unit, 2013); because of its higher potency, the impact on the environment of using sevoflurane at 1MAC would be approximately 50 times lower than that of desflurane. In cases where rapid initial offset is considered vital, could switching to desflurane for the end of a case to allow sevoflurane washout, as is often done after induction, be a viable compromise?

Closed circuits and low flows, enabled by modern anaesthesia machines, reduce usage and thus venting of agents, but most theatre scavenging simply vents to the atmosphere. Reprocessing techniques have shown some promise in capturing and conserving anaesthetic

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agents, both within the system itself and for extraction and reuse within pharmaceutical companies (Ishizawa, 2011), but there is little robust evidence to support this possibility. Innovations in this area have recently gained impetus. Initiatives to increase awareness of the need to reduce emissions and financial incentives for reducing emissions could help improve and fund uptake.

Regional and total intravenous techniques do not directly release greenhouse gases, but establishing the carbon equivalence of total intravenous anaesthesia is complicated because of its additional use of consumables. Propofol, even assuming a 50% wastage, has the lowest carbon equivalence of the anaesthetic agents, and this primarily stems from energy expenditure in running the pump (Sherman et al, 2012). Promotion of techniques that do not use inhalational anaesthetic agents is a possible way forward.

Xenon, with its high blood:gas partition coefficient, favourable pharmacodynamic profile and inert nature, is often proposed as the ideal anaesthetic, clinically and environmentally. However, gas purification by fractional distillation of air is expensive, requiring considerable energy (220 W/h per litre of xenon) and so is not environmentally benign (Ishizawa, 2011). Work to reduce financial and environmental costs by improving recycling of the gas within a closed circuit would be required to make this a viable alternative.

The way forward?

Is education and heightened awareness enough to change practice, or is there enough evidence for an outright halt in production of desflurane? Human nature relies on familiar methods to ensure patient safety, for many this is still inhalational anaesthesia.

Some departments, including the authors' own, have opted to place alert stickers on desflurane vaporisers to highlight its environmental impact. Others have gone further – removing desflurane vaporisers from anaesthetic machines, and discouraging its use by making it request only.

Any change in behaviour is going to involve a culture shift, and a multimodal graded approach is likely to be most successful over time. What is clear is that the status quo cannot continue, and anaesthetists have to consider the wider impact of their practice on the planet.

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Conflicts of interest

The authors declare no conflicts of interest.

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