SOUTH AFRICAN SOCIETY
OF ANAESTHESIOLOGISTS (SASA)

SASA Position Statement 2024

Environmental Impact of Inhalational Anaesthetics

SASA position statement on the Environmental Impact of Inhalational Anaesthetics

Purpose

The purpose of this position statement is to:

1. affirm SASA's commitment to environmentally sustainable anaesthetic practice.
2. assist clinicians in taking environmental sustainability into consideration with daily clinical decisions regarding inhalational anaesthetic agents.
3. assist healthcare facilities in formulating environmentally sustainable policies.

Background

Introduction

Ongoing anthropogenic greenhouse gas emission is leading to an alarming increase in global surface temperatures and resultant climate change.[1-3] Human health is directly and inextricably linked to our natural environment, and climate change has been declared by the World Health Organization to be the "greatest threat to global health in the 21st century."[4] In order to avert environmental disaster and consequent threat to human health, meaningful decrease in global greenhouse gas emissions has become an emergency.[1]

Paradoxically, modern healthcare systems are extremely resource-intensive, producing large quantities of single-use, non-recyclable material which require embedded energy and raw materials to produce, and may contain toxic materials which contaminate natural resources after disposal.[2, 5] It has been estimated that healthcare is responsible for 1 -5 % of annual global greenhouse gas (GHG) emissions, or 2.4 gigatons of carbon equivalent emission (CO_2e) per year, with an appreciable contribution from anaesthetic gases.[6, 7] Calls have therefore been made to find alternative, more environmentally sustainable anaesthetic techniques without compromising patient safety.[3]

Underlying climate science

Table 1 compares various climate-related indices for commonly used inhalational anaesthetic agents and the major GHGs.[1, 8-12] Radiative forcing is the nett change in energy balance of the earth's atmosphere caused by greenhouse gases.[13]

Global warming potential (GWP), a theoretical time-integrated global mean RF for a single pulse emission of a gas versus that for the same amount of CO_2, was developed in order to quantify the warming potential of each emitted gas in a multi-gas model.[14] Despite various scientific limitations of the concept of GWP, this index remains the IPCC standard of comparison for *long-lived* greenhouse gases.[14]

Short Lived Climate Forcers (SLCF) is a heterogenous group of gases and particulate matter, which have atmospheric lifetimes of under 20 years, and includes the volatile anaesthetic agents.[15] The IPCC cautions that the use of GWP for SLCFs may be too simplistic owing to regional and temporal inhomogeneity.[14] It is likely that, whilst the volatile anaesthetic agents are potent greenhouse gases, their global impact on climate change is extremely small.[11]

Table 1 Climate indices of greenhouse gases

Greenhouse gas	Atmospheric Lifetime (years)	GWP_{100}	ODP	Atmospheric concentric (ppt)	Radiative forcing ($W.m^{-2}$)
Carbon dioxide (CO2)	100 +	1	0	420 000 000	2,16
Methane (CH4)	12,4	27	0	1 920 000	0,54
Nitrous oxide (N2O)	123	298	0,017	336 000	0,21
Isoflurane	3,5	510	0,01	0,11	0,00006
Sevoflurane	1,4	144	0	0,16	0,00003
Desflurane	14,1	2 540	0	0,37	0,00017

GWP_{100} Global Warming Potential with a 100-year time horizon; ODP, Ozone Depletion Potential with reference to CFC-11; ppt, parts per trillion

Statement

1. Patient safety and clinical outcomes remain the priority in anaesthetic decision-making. However, when two or more anaesthetic options are clinically equivalent, consideration should be given to using the technique with the lowest environmental impact.

2. Nitrous oxide (N_2O) is an important, long lived greenhouse gas and has been implicated in the destruction of atmospheric ozone. Routine use in anaesthesia is not supported and use should be restricted to specific clinical cases only. Attention should be paid to minimising unintended release of N_2O through pipe system leaks and consideration should be given to abandoning piped N_2O in preference for E-cylinders attached to anaesthetic machines, where feasible.
3. Desflurane is a potent greenhouse gas but accounts for only 0,005% of total anthropogenic greenhouse emissions. In clinically equivalent scenarios, alternative anaesthetic agents with lower environmental impact should be considered, providing these do not increase total CO_2 emissions.
4. In clinical scenarios where inhalational agents are used, their environmental effects should be mitigated by using the lowest possible fresh gas flow rate and for the shortest clinically necessary duration.

Revision

This statement should be regularly reviewed and updated as new published evidence emerges.

Related SASA Documents

Practice Guidelines 2022

References

1. Masson-Delmotte V ZP, Pirani A, Connore SL, Pean C, Berger S, Caud N, Chen Y, Goldfarb L, Gomis MI, Huang M, Leitzell K, Lonnoy E, Matthews JBR, Maycock TK, Waterfield T, Yelekci O, Yu R, Zhou B. IPCC, 2021: Summary for Policymakers. Climate change 2021: The Physical Science Basis Contribution of Working Group I to the Sixth Assessment Reports of the Intergovernmental Panel on Cilmate Change: Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA; 2021. p. 3–32.
2. Dunphy JL. Healthcare professionals' perspectives on environmental sustainability. Nursing Ethics. 2014;21(4):414-25.
3. White SM, Shelton CL, Gelb AW, Lawson C, McGain F, Muret J, et al. Principles of environmentally-sustainable anaesthesia: a global consensus statement from the World Federation of Societies of Anaesthesiologists. Anaesthesia. 2021.
4. World Health Organization. WHO calls for urgent action to protect health from climate change. Geneva: 2015. [Available from: https://www.who.int/news/item/06-10-2015-who-calls-for-urgent-action-to-protect-health-from-climate-change-sign-the-call]; [Accessed 2022/03/26]
5. Eckelman MJ, Sherman J. Environmental Impacts of the U.S. Health Care System and Effects on Public Health. PLoS One. 2016;11(6):e0157014.
6. Lenzen M, Malik A, Li M, Fry J, Weisz H, Pichler P-P, et al. The environmental footprint of health care: a global assessment. The Lancet Planetary Health. 2020;4(7):e271-e9.
7. NHS England and NHS Improvement. Delivering a 'Net Zero' National Health Service. London: 2022. [Available from: https://www.england.nhs.uk/greenernhs/a-net-zero-nhs/]; [Accessed 2023/03/12]
8. Sulbaek Andersen MPS, Nielsen OJ, Sherman JD. The Global Warming Potentials for Anesthetic Gas Sevoflurane Need Significant Corrections. Environ Sci Technol. 2021;55(15):10189-91.
9. Andersen MPS, Nielsen OJ, Wallington TJ, Karpichev B, Sander SP. Assessing the Impact on Global Climate from General Anesthetic Gases. Anesthesia & Analgesia. 2012;114(5):1081-5.
10. Sherman J, Le C, Lamers V, Eckelman M. Life Cycle Greenhouse Gas Emissions of Anesthetic Drugs. Anesthesia & Analgesia. 2012;114(5):1086-90.
11. Slingo ME, Slingo JM. Climate impacts of anaesthesia. Br J Anaesth. 2021;126(6):e195-e7.
12. Vollmer MK, Rhee TS, Rigby M, Hofstetter D, Hill M, Schoenenberger F, et al. Modern inhalation anesthetics: Potent greenhouse gases in the global atmosphere. Geophysical Research Letters. 2015;42(5):1606-11.
13. Slingo JM, Slingo ME. The science of climate change and the effect of anaesthetic gas emissions. Anaesthesia. 2024.
14. Forster PR, V. Artaxo, P. Berntsen, T. Betts, R. Fahey, D W. Haywood, J. Lean, J. Lowe, D C. Myhre, G. Nganga, J. Prinn, R. Raga, G. Schultz, M. van Dorland, R. . Changes in Atmospheric Constituents and in Radiative Forcing. In: Solomon SQ, D. Manning, Z. Chen, M. Marquis, KB, Averyt, M. Tignor, M. Miller, HL., editor. Climate Change 2007: The Physical Science Basis Contribution of Working Group I to the Fourth ASsessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press; 2007.
15. Szopa SN, V. Adhikary, B. Artaxo, P. Berntsen, T. Collins, WD. Fuzzi, S. Gallardo, L. Kiendler-Scharr, A. Klimont, Z. Liao, H. Unger, N. Zanis, P. Short-Lived Climate Forcers. In: Masson-Delmotte V ZP, Pirani A, Connore SL, Pean C, Berger S, Caud N, Chen Y, Goldfarb L, Gomis MI, Huang M, Leitzell K, Lonnoy E, Matthews JBR, Maycock TK, Waterfield T, Yelekci O, Yu R, Zhou B, editor. Climate Change 2021: The Physical Science Basis Contribution of Working Group 1 to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK and New York, NY, USA: Cambridge University Press; 2021. p. 817 - 2.