HSPI The Open Access Publisher

IJCAR ISSN 2640-2866 INTERNATIONAL JOURNAL OF CLINICAL ANESTHESIA AND RESEARCH

Brief Communication

Minimising Carbon Footprint in Anaesthesia Practice

Nisha Gandhi[1] and Abinav Sarvesh SPS[2]*

[1]DA, MD Anaesthesiology, DNB, Consultant Anesthesiology, India

[2]DNB Anaesthesiology, Resident, India

Abstract

Carbon footprint refers to the total amount of greenhouse gas emitted in the atmosphere by an individual or by an organization causing global warming. There are various causes of greenhouse gas emissions and anaesthetic gases are one amongst them. Greenhouse gases warm the earth by absorbing infrared energy and slowing the rate at which the energy escapes into space. Each greenhouse gas has two important properties. One is the amount of infrared energy that a gas can absorb and the other is the lifetime of that gas in the atmosphere. Anaesthesia as a speciality contributes to carbon footprinting in three ways: direct emission, energy use, and operating room wastes and supplies. Direct emission of Waste Anaesthetic Gases (WAG) from anaesthesia workstations can either be scavenged and thrown out into the environment causing a green greenhouse gas effect or can pollute the operating room due to poor scavenging. Various techniques such as reducing direct emissions, energy use optimisation, and waste management have been tried in minimising carbon footprint in anaesthesia practice but providing safety to the patient is considered of utmost importance.

More Information

***Address for correspondence:**
Dr. Abinav Sarvesh SPS, DNB Anaesthesiology, Resident, India, Email: asarvesh007@gmail.com

Submitted: October 14, 2024
Approved: October 18, 2024
Published: October 19, 2024

How to cite this article: Gandhi N, Abinav Sarvesh SPS. Minimising Carbon Footprint in Anaesthesia Practice. Int J Clin Anesth Res. 2024; 8(1): 005-007. Available from: https://dx.doi.org/10.29328/journal.ijcar.1001025

Copyright license: © 2024 Gandhi N, et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Keyword: Greenhouse gas emission; Anaesthetic gases; Anaesthesia; Waste management

Check for updates

OPEN ACCESS

Introduction

The term carbon footprint is the total amount of greenhouse gas emitted in the atmosphere by an individual or by an organization. It is a complex process that causes global warming secondary to changes in the earth-atmosphere energy balance. As per a study done in 2021, inhaled anaesthetic gases contributed to 0.1% of total greenhouse gases causing global warming [1]. Inhaled anesthesia gases have been shown to emit 5% of acute hospital carbon dioxide emissions and 50 % of perioperative department emissions in high-income countries [2]. Even though the contribution is less, it is still important to talk about it as various strategies are available to minimise it. Up to 10,000 meters from the ground level is called the troposphere and above it is the stratosphere where the ozone layer is present. Tropopause divides the troposphere from the stratosphere. Normally, the sun emits ultraviolet, visible, and infrared light into the atmosphere that reaches the environment and gets reflected back through the narrow atmospheric window which is 8 to 14 micrometers in size. But with greenhouse gases accumulated below the tropopause, the infrared light gets trapped with it causing heat retention, thereby global warming. There are various causes of greenhouse gas emissions and anaesthetic gases are one amongst them.

Carbon footprinting in anaesthesia

Greenhouse gases warm the earth by absorbing infrared energy and slowing the rate at which the energy escapes into space. Each greenhouse gas has two important properties. One is the amount of infrared energy that a gas can absorb and the other is the lifetime of that gas in the atmosphere. Sevoflurane has a tropospheric lifetime of 1.1 years, nitrous oxide has 110 years [2]. Based on these two properties, the potency of a greenhouse gas can be estimated. The Global Warming Potential (GWP) of a greenhouse gas is a measure of how much infrared energy the emission of one ton of a gas will absorb over a given period of time, relative to the emission of one ton of carbon dioxide (CO2). It is measured over 100 years so it is called GWP100. For example, if one ton of CO2 absorbs 'X' amount of infrared energy over 100 years and if one ton of sevoflurane absorbs '130 X' amount of infrared energy over 100 years then sevoflurane is 130 times more potent than CO2. Desflurane has a GWP100 of 2540. Carbon dioxide equivalency (CO2e) is the rate at which specific greenhouse gases are released into the atmosphere and is expressed in terms of the relative amount of CO2 that would have the same global warming effect. Nitrous oxide has a CO2e of 1054 kgs while sevoflurane has 44 kgs [3]. The relative potency of various anaesthetic gases is given in Table 1. Anaesthesia as a speciality contributes

Table 1: Relative potency of various anaesthesia gases.

Anaesthetic agent	Infrared absorption range (micrometers)	Tropospheric lifetime (years)	GWP100	CO2e kgs (container)
Sevoflurane	7 - 10	1.1	130	44 (250 ml)
Isoflurane	7.5 - 9.5	3.2	510	190 (250 ml)
Desflurane	7.5 - 9.5	14	2540	886 (240 ml)
Nitrous oxide	4.5, 7.6, 12.5	110	310	1054 (size E)

to carbon footprinting in three ways: direct emission, energy use, and operating room wastes and supplies. Direct emission of waste anaesthetic gases (WAG) from anaesthesia workstations can either be scavenged and thrown out into the environment causing a green greenhouse gas effect or can pollute the operating room due to poor scavenging. Volatile agents such as nitrous oxide and gases containing chlorine or bromine such as isoflurane and halothane directly deplete the ozone layer thereby diminishing ultraviolet radiation shielding [4]. Agents that lack chlorine or bromine such as sevoflurane and desflurane absorb and reduce outgoing infrared thermal energy thereby warming the environment. Volatile agents that pollute the operating room can cause various health problems in the long run. It can lead to infertility, neuro-psychological symptoms, and arrhythmias and is carcinogenic [5]. Another important aspect of carbon footprinting is based on energy use in the operating room and recovery area. Unnecessary use of electricity, wastage of water during scrubbing, operating room requirement of low temperatures, and maintenance of certain drugs in the cold chain, all contribute to a significant amount of energy use. Wastage of leftover drugs, drugs expiring without using, improper waste segregation and use of single-use devices can all lead to increasing amounts of waste materials that cannot be recycled [6].

Strategies to minimise carbon footprint in anaesthesia practice

Various techniques have been tried in minimising carbon footprint in anaesthesia practice and they comply under three categories: reducing direct emission, energy use optimisation, and waste management. But whatever strategy is used, the motto should be *'primum non nocere'.* Direct emission of volatile gases can be reduced by avoiding it as much as possible. Agents like desflurane and nitrous oxide can be used whenever indicated such as in morbidly obese patients with titrations using bispectral index [7]. Total intravenous anaesthesia (TIVA) is an excellent option that can be used to minimise or avoid using volatile agents. TIVA provides the main advantages of avoiding waste anaesthetic gases. However, TIVA can cause potential negative environmental effects which are assessed by PBT scoring. 'P' stands for persistence, where the drug's ability to resist degradation in the aquatic environment is assessed. 'B' stands for bioaccumulation, where the drug's accumulation in adipose tissue of aquatic organisms is seen. 'T' stands for toxicity, where the drug's potential to poison aquatic organisms is taken note of. Combining all these three features, a scoring is given from 0 to 9 where the higher value indicates a greater environmental hazard. Propofol the most commonly used TIVA agent has a PBT score of 4 [8]. The requirement of propofol in TIVA can be minimised by the addition of various other agents such as remifentanyl or dexmedetomidine. Reducing the fresh gas flow from 2 liters to 1 liter can prevent a lot of WAG. It requires gas monitoring and a closed circle system and is best used during the maintenance phase [9]. Regional anaesthesia can be the better of all as it completely avoids WAG, uses minimal drugs, and is cost-effective. The scavenging system collects WAG from the breathing system and discharges it outside in the atmosphere. Suction-applied active systems are better than passive systems [10]. Other ways to reduce the direct emission of WAG are by completely checking the anaesthesia machine every day, assessing it for leaks, applying face masks that fit properly, avoiding volatile agents during pre-oxygenation, and filling vaporizers carefully in well-ventilated areas. Energy use optimisation can be done by keeping the operating room temperature as required for the case, operating room doors to be kept closed to prevent temperature loss, avoiding unnecessary runtime of computers and lights, and using conductive air warmers rather than convection ones [11]. Waste management can be done by avoiding single-use devices unless beneficial, checking overage and using those items first, appropriate waste segregation to help in recycling, using prefilled syringes, and using smaller volume preparation of drugs.

Conclusion

The objective of this article was to see the global contribution of anaesthesia towards carbon footprinting and various strategies to handle it. Though it is found to be minimal, it is significant as there are numerous measures to tackle it. Various countries have now actively started moving towards sustainable anaesthesia and we hope to see the impact of these changes in the upcoming years. As an anaesthetist, it is important to strike a balance between practicing sustainable anaesthesia and providing uncompromised anaesthetic care to patients.

References

1. Varughese S, Ahmed R. Environmental and occupational considerations of anesthesia: a narrative review and update. Anesth Analg. 2021; 133(4):826-835. Available from: https://doi.org/10.1213/ane.0000000000005504

2. Reduce carbon footprint from inhaled anesthesia with new guidance published [Internet]. Available from: https://www.asahq.org/about-asa/newsroom/news-releases/2022/06/reduce-carbon-footprint-from-inhaled-anesthesia-with-new-guidance-published

3. Richter H, Weixler S, Schuster M. The carbon footprint of anaesthesia: how the choice of volatile anaesthetic affects the CO2 emissions of a department of anaesthesiology. Anästh Intensivmed. 2020;61:154-

161. Available from: https://www.ai-online.info/images/ai-ausgabe/2020/05-2020/AI_05-2020_Originalia_Schuster_englisch.pdf

4. Bernat M, Boyer A, Roche M, Richard C, Bouvet L, Remacle A, Antonini F, et al. Reducing the carbon footprint of general anaesthesia: a comparison of total intravenous anaesthesia vs. a mixed anaesthetic strategy in 47,157 adult patients. Anaesthesia. 2024;79(3):309-317. Available from: https://doi.org/10.1111/anae.16221

5. The Royal College of Anaesthetists. Your anaesthetic and the environment [Internet]. Available from: https://www.rcoa.ac.uk/patient-information/about-anaesthesia-perioperative-care/your-anaesthetic-environment

6. Wyssusek K, Chan KL, Eames G, Whately Y. Greenhouse gas reduction in anaesthesia practice: a departmental environmental strategy. BMJ Open Qual. 2022;11(3). Available from: https://doi.org/10.1136/bmjoq-2022-001867

7. Lam S, Wong D. Moving towards green anaesthesia—strategies for environmental sustainability: WFSA - resources [Internet]. WFSA Resource Library. 2023. Available from: https://resources.wfsahq.org/atotw/moving-towards-green-anaesthesia-strategies-for-environmental-sustainability/

8. Hanna M, Bryson GL. A long way to go: minimizing the carbon footprint from anesthetic gases [Internet]. Can J Anaesth. 2019. Available from: https://link.springer.com/article/10.1007/s12630-019-01348-1

9. White SM, Shelton CL, Gelb AW, Lawson C, McGain F, Muret J, Sherman JD, et al. Principles of environmentally-sustainable anaesthesia: a global consensus statement from the World Federation of Societies of Anaesthesiologists. Anaesthesia. 2022;77(2):201-212. Available from: https://doi.org/10.1111/anae.15598

10. Ryan S, Sherman J. Sustainable anesthesia. Anesth Analg. 2012;114(5):921-923. Available from: https://doi.org/10.1213/ane.0b013e31824fcea6

11. Gasciauskaite G, Lunkiewicz J, Spahn DR, Von Deschwanden C, Nöthiger CB, Tscholl DW. Environmental sustainability from anesthesia providers' perspective: a qualitative study. BMC Anesthesiol. 2023;23(1):377. Available from: https://doi.org/10.1186/s12871-023-02344-1