Communique – Total Intravenous Anaesthesia (TIVA)

Purpose

The purpose of the communique is to provide anaesthetists working in facilities across Queensland with information about the advantages of Total Intravenous Anaesthesia (TIVA) over inhalational anaesthesia from an environmental and carbon emission reduction perspective.

Issue

Anaesthetic practice, through use of anaesthetic agents and energy consumption, contributes to the significant burden of healthcare on the environment through global warming[1].

Since the 1960s the effects of Greenhouse Gases (GHGs), predominantly CH_4, N_2O, O_3, and halogenated compounds, have contributed as much to global warming as increasing CO_2 itself[2].

Expressed as the 100-year Global Warming Potential (GWP_{100}), 1 kg of N_2O equals the emission of 273 kg CO_2, 1kg of sevoflurane equals the emission of 144 kg CO_2 and1 kg of desflurane equals 2590 kg CO_2 with atmospheric lifetimes of 114, 1.1 and 14 years respectively[3]. (For further information refer to the SWAPNet nitrous oxide and desflurane communiques).

As a proportion of total anthropogenic Carbon Dioxide emissions (CO_2e), volatile anaesthetics used in human healthcare may be responsible for 0.1% of global warming, equivalent to 1 million cars on the road in the United States[2].

As a non-inferior alternative for general anaesthesia, TIVA is an option with a much more favourable environmental profile even taking into consideration the energy required and waste generated.

Supporting information

Inhalational techniques contribute directly and indirectly to global warming. Most inhalational techniques are not used in isolation and also employ the use of energy, single use plastics, propofol and other aqua toxins (refer to the SWAPNet pharmaceutical waste communique).

Using TIVA reduces this direct contribution and has been shown through modelling studies to indirectly have less of an environmental impact when compared to using volatiles (refer to Appendix 1, Table 1)[4,5]. A recent large retrospective observational study in France assessing the carbon dioxide equivalent footprint associated with TIVA versus mixed methods (TIVA and Volatile) found a 20-fold difference in favour of TIVA[6].

TIVA as a choice of anaesthetic has not been shown to negatively affect patient outcomes and may confer financial benefits when considering lower incidence of postoperative nausea and vomiting (PONV) and faster discharge from recovery wards[7].

For practical considerations for new users of TIVA, please refer to the international TIVA guidelines[8]. To improve interpretation of Electroencephalogram (EEG) monitoring while using TIVA to prevent awareness, please refer to the International Consortium for EEG Training of Anaesthesia Practitioners. https://www.icetap.org/ [9].

Fresh gas flow recommendations balance the cost and footprint of CO_2 absorber exhaustion versus energy needed to produce medical oxygen.

Investigation into the optimum fresh gas flow needed with TIVA to be most cost effective and environmentally friendly vary in the literature. Variation being mainly found due to the regional methods of energy production which affects the cost/environmental impact of medical oxygen production[10-12].

Recommendations

- Consider using TIVA for the delivery of general anaesthetic.
- When using TIVA, be mindful of FiO_2 settings and Fresh Gas Flow (FGF) settings to balance financial and environmental costs.
- Note current recommendations/studies for Australia suggest between 4-6 litres FGF per minute with FiO_2 30%.
- Avoid desflurane and N_2O (refer to the SWAPNet nitrous oxide and desflurane communiques).

Such considerations must always be in the context of achieving optimal patient outcomes in any individual case.

References

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Table 1. Carbon footprint calculations for components of a 7-h anaesthetic using propofol/remifentanil total intravenous anaesthesia (TIVA) or inhalational anaesthesia (desflurane or sevoflurane)

	Global warming potential	Weight per 7-h anaesthetic	kg CO_2e per 7-h anaesthetic
Propofol LCA	21	0.004 kg	0.084
Remifentanil LCA	103	0.000004 kg	0.000412
Plastic production	3.25	0.443 kg	1.44
Glass production	0.895	0.472 kg	0.42
Waste incineration	1.179	0.915 kg	1.079
		Energy per 7 h anaesthetic	
Electricity usage (UK grid)	0.4	0.45 kWh	0.18
TIVA total			3.2
Desflurane	2540		820.2
Sevoflurane	130		69.9

CO_2e, carbon dioxide equivalent; LCA, life cycle assessment.