Safe use of intraoperative high flow nasal oxygen - a surgical perspective

Intraoperative use of high flow nasal oxygen (HFNO) is a relatively new practice which broadens options available to anaesthetists and surgeons during awake procedures. As with all new medical technologies, clinicians must consider the risks and benefits to ensure safe delivery and appropriate usage of this valuable tool. Primarily, we must consider the increased risk of surgical fires in an oxygen-rich environment. While this issue has been previously addressed in the anaesthetic literature, it is important that surgeons are aware of these risks in order to ensure patient and operator safety.

Intraoperative use of HFNO has been described during endoscopic procedures,1 dentistry,2 caesarean sections with spinal anaesthesia,3 thoracic,4,5 otolaryngeal6 and neurosurgery.7

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/ans.15623
HFNO delivers humidified oxygen at up to 60L/min at 37 °C, a significant increase when compared to the maximal tolerated rate via conventional nasal cannulae of 10L/min and is better tolerated by patients than high flows via venturi masks or non-invasive ventilation. Alongside the physiological benefits, practical benefits include reduced anaesthetic times and the patient’s ability to communicate with the surgeon/anaesthetist throughout the case.

However, HFNO will create a significantly oxidiser-enriched atmosphere, which is defined as any increase in oxygen concentration above room air level (21%) and/or the presence of nitrous oxide. Although oxygen is not a flammable gas, it is an oxidiser facilitating a combustion. Mehta et al. found that oxygen was the oxidiser in 95% of electrocautery fires reported to the American Society of Anesthesiologists, and 84% of these cases used an open system for oxygen delivery, such as a nasal cannula or mask.

Surgical fires require the presence of the “fire triad”: an oxidiser (eg: oxygen or nitrous oxide), an ignition source (eg: diathermy, lasers, fibreoptic light cables), and fuel (eg: surgical drapes, alcohol prep solutions, hair, gauze).

Increasing oxygen concentrations decreases the time to ignition of surgical drapes, and in organic tissue-based models. Roy et al. used a raw chicken model to simulate oropharyngeal fires to demonstrate this concept. Electrocautery ignited a sustained flame in 15-30 seconds in the presence of 100% FiO2 at flows of 15L/min. This time-to-ignition was extended to 2-3 minutes when in the presence of 50% FiO2 at 15L/min.

Seventy-four percent of reported surgical fires implicate pooling of oxygen within the operative space or under surgical drapes. Multiple methods to reduce oxygen pooling have been proposed, including strategic ‘tenting’ of the operative drapes to create an open space around the patient’s head and neck allowing oxygen to sink to the floor. Simple interventions can be employed to mitigate the risks incurred with the use of HFNO, and to ensure patient and operator safety.

Barnes et al. established that significantly higher oxygen concentrations occurred beneath surgical drapes with each incremental change in oxygen flow rate between 0-4L/min. Regardless of the supplemental oxygen flow rate used, usage of a scavenger system connected to continuous wall suction significantly decreased the oxygen concentration beneath the drapes. Kung et al. demonstrated that the addition of vacuum suctioning in the operative field significantly decreased the time for oxygen concentrations to return to 21% after cessation of oxygen administration compared to tenting alone.

A review of the literature suggests that surgical fires is an extremely rare event, however anecdotal evidence suggests that the true number is higher. Fear of medico-legal ramifications may lead to under-reporting of these events. Of concern are two studies that demonstrated a lack of awareness of the dangers of diathermy in surgical clinicians of all levels. The introduction of mandatory reporting of surgical fires may alert surgeons and trainees to these very real risks.

HFNO can create an oxygen-enriched environment in the operative field and beneath surgical drapes, which may increase the risk of surgical fires. We believe that prevention of
surgical fires depends on clear communication between surgeons, anaesthetists and nursing staff. Surgeons and trainees must recognise this risk and may be required to change their practice if intraoperative HFNO is being used.

To prevent surgical fires in the usage of HFNO, the following recommendations have been proposed:

- Disclose use of HFNO during time-out
- Use lowest possible oxygen flow and concentration to maintain adequate oxygenation
- Limit use of diathermy in the presence of HFNO
- Considered draping technique and suctioning to prevent oxygen pooling beneath the drapes and in the operative field
- Avoid HFNO if the operative field is above the chest
- Keep water in theatre in case of surgical fire
- Regular fire training for surgeons, anaesthetists and nursing staff
- Mandatory reporting of surgical fires

Title: Safe use of intraoperative high flow nasal oxygen - a surgical perspective

Running title: Safe use of intraoperative HFNO

Authors:
Dr Alexandra T. Muirhead. BBmed, MD. Department of Surgery, Western Health, Melbourne, Victoria, Australia

Professor Steven T. F. Chan. PhD, FRACS. Department of Surgery, Melbourne Medical School, The University of Melbourne, Melbourne, Victoria, Australia

Mr Hai T. Bui. FRACS. Department of Surgery, Western Health, Melbourne, Victoria, Australia

Dr Ashley Hague. MBBS, FANZCA. Department of Anaesthetics, Western Health, Melbourne, Victoria, Australia

Word count: 1195 (including references)

Corresponding author:
Dr Alexandra T. Muirhead
Email: alexandra.muirhead@wh.org.au
Phone: 0400682238
Postal Address: 1315/1 Ascot Vale Road Flemington Victoria 3031.
Title:
Safe use of intraoperative high-flow nasal oxygen: a surgical perspective

Date:
2020-03-01

Citation:

Persistent Link:
http://hdl.handle.net/11343/275490