Is Methoxyflurane an Effective, Safe, Eco-Friendly Alternative Analgesic to Nitrous Oxide for Procedural Pain?

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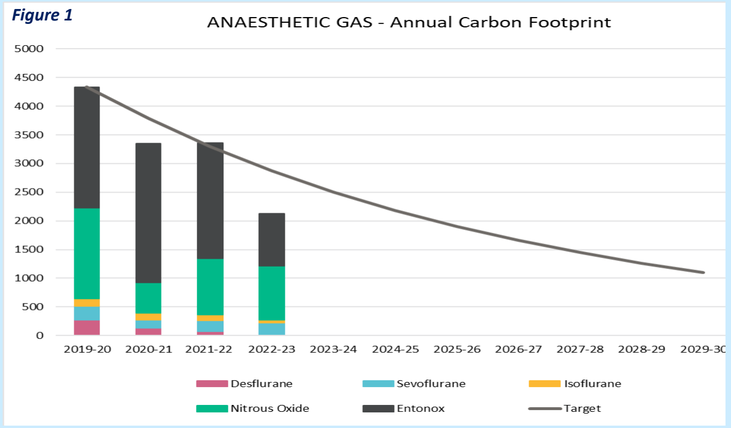
INTRODUCTION

At the Newcastle-upon-Tyne NHS Foundation Trust (NuTH) Nitrous Oxide (Entonox®) analgesia is often utilised to relieve acute procedural pain. However, it is a powerful greenhouse gas with a recognised Global Warming Potential (GWP) of 310[1,2]. Inhaled Methoxyflurane (Penthrox®) is known to provide effective pain relief in emergency situations but, with a GWP of 4, it potentially provides a less carbon-intense analgesic alternative to Entonox® [1, 3].

NuTH is committed to the ambitious goal of becoming a net-zero carbon organisation by 2030. Entonox® makes up a significant proportion of our anaesthetic gases carbon footprint (Figure 1), and as such it is an important area to target if we are to make improvements.

Figure 1



The aim of this audit was to assess if Penthrox® could provide a viable analgesic alternative to Entonox® for patients undergoing painful procedures, where moderate to severe pain is expected and where Entonox® has previously been recommended.

Methoxyflurane (Penthrox®)

Methoxyflurane is a non-opioid, non-controlled analgesic, inhaled as a vapour. Penthrox® is licenced for emergency relief of moderate to severe pain in conscious adults, aged over 18[4]. It provides rapid onset of effective analgesia with minimal side effects.

Penthrox® is self-administered via a green whistle-shaped handheld device. It must be used with caution in patients with certain conditions such as severe renal or hepatic impairment (See Figure 2 checklist for contra-indications).

METHOD

In the UK, Penthrox® is licensed solely for management of acute pain in emergency trauma situations for adults. Therefore, approval was gained from our regional Medicines Management Committee to use Penthrox® off-license for procedural pain relief. Paediatric and maternity areas were excluded from the audit. A specific Trust Penthrox® guideline was implemented to promote safe practice and appropriate patient selection.

The introduction and benefits of Penthrox were advertised across NuTH. Departments were invited to be involved in the audit. Education and training was provided for staff by a Penthrox® trainer.

Data were collected prospectively using a standardised audit form incorporating audit questions, exclusion criteria and a QR code link to a video demonstrating correct administration of Penthrox® (Figure 2).

Figure 2

PENTHROX AUDIT

Patient Details			
Indication for use			
Checklist for administration of Penthrox **(must tick No to all to administer)**:		Yes	No
C – Cardiovascular instability?			
H – Hypersensitivity to methoxyflurane or any inhaled anaesthetics?			
E – Elevated temperature –family history of adverse reactions to anaesthesia?			
C – Consciousness reduced (e.g. from alcohol, drugs, head injury?			
K – Any clinically significant Kidney impairment?			
A – Age below 18 years?			
L – Lung – any respiratory depression?			
L - Any clinically significant Liver impairment?			
L – Last administration (no more than 2 doses in 24 hours and no more than 5 does in a week)			
Was analgesia effective?		Administration Video Link	
No. of doses(vials) administered (1 or 2)			
Additional analgesic requirements			
Side effects/comments			

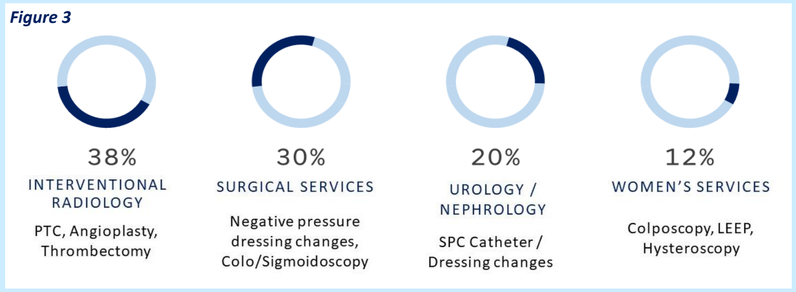
Patient records were reviewed retrospectively to collect additional data including:

- Reviewing if Penthrox® had been prescribed correctly.
- Reviewing if exclusion criteria was adhered to.
- Review of patient's renal and hepatic function 72 hours post-administration.

RESULTS

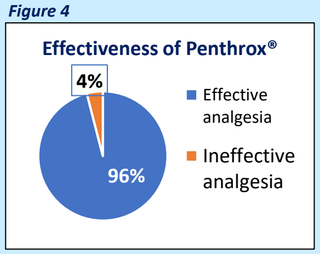
Data were collected for the first 50 administrations of Penthrox® (Figure 3)

Figure 3



- Only 1 patient required 2 inhalers. Their pain was caused by lying flat for an extended period whilst undergoing a femoral angioplasty.
- 28% of patients required additional analgesia. This ranged from oral paracetamol to IV fentanyl.
- Patient satisfaction was high. 48/50 patients described effective pain relief (Figure 3). The 2 patients who described their analgesia as ineffective did not require additional analgesia. They had previously received Entonox® for procedural pain and described this as providing superior pain relief.

Figure 4



- The audit demonstrated 100% adherence to the guideline criteria, accurate prescribing of Penthrox® and appropriate monitoring of patients.
- Penthrox® was well-tolerated. 14% of patients reported mild adverse effects: slight nausea (12%) and headache (2%).
- No detrimental effects were noted to any patients renal or hepatic function.

Staff feedback was that the Penthrox® device was easy to use but also much easier to manage and store than Entonox® as it is more compact and lightweight. The QR code access to the video ensured that staff felt confident in using the inhaler and could access the information at any time.

CONCLUSION

Penthrox® was an effective short-acting analgesic for a variety of painful procedures with no serious adverse reactions reported.

The introduction of Penthrox® to NuTH has been successful in significantly reducing the requirement for Entonox® administration and therefore is reducing our carbon footprint.

Our aim is to roll out the use of Penthrox® to most adult areas over the next year. Although a minority of patients will not be able to have Penthrox® administered due to exclusion criteria, we hope that by 2025 Entonox® use within NuTH will be minimal, thereby helping us to reach our goal of become a net-zero carbon emissions Trust.

CONTACT DETAILS

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