RACGP

Ventilation advice for clinic room use of Penthrox® inhaler

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1. Introduction to Penthrox® ('the green whistle') and its clinical use

What is Penthrox®?

Penthrox® is an inhaled analgesic containing methoxyflurane, used for short-term pain relief in conscious patients[1].

Administration method

- Self-administered by the patient via a handheld inhaler under supervision.
- A small study showed Penthrox® use during IUD/IUS insertion was acceptable to both patients and staff[2].

2. Why ventilation is recommended

Volatile anaesthetic agent

- Methoxyflurane is a volatile fluorinated hydrocarbon[1]. Although administered at low doses for analgesia, it can be exhaled and contaminate room air.

Health and safety concerns

- **Hazard classification:** Hazardous substance, non-dangerous goods[1]

Exposure risks of methoxyflurane include reversible side effects of skin, eye or respiratory irritation, dizziness, drowsiness and at higher levels, possible nephrotoxicity or hepatotoxicity[1,3]. An occupational exposure limit has not been established.

Independently reviewed human clinical and toxicity data has been used to derive a maximum exposure limit (MEL) of 15ppm[1].

A 2020 review examined current occupational exposure research for methoxyflurane analgesia, including Penthrox®[4]. A study quoted by the authors found that staff exposure during patient use of a Penthrox® inhaler for bone biopsy showed exposure levels for all staff were well below the calculated maximum exposure limit of 15ppm[5]. However, the review concluded there was a lack of evidence of the safety of cumulative doses and long-term health impacts on staff[4]. Based on available evidence, operating protocols in Australia recommend:

- Using the activated charcoal filter supplied with Penthrox®
- Considering limiting the number of doses staff are exposed to daily[7,8].
- Using Penthrox® in well-ventilated rooms[8].

Occupational exposure when pregnant or breastfeeding

Penthrox® is considered safe for clients who are pregnant or breastfeeding[9]. However, occupational exposure for pregnant or breastfeeding staff has not been thoroughly researched[3]. As cumulative effects are not known, current guidelines advise limiting the exposure of Penthrox® to staff who are pregnant or breastfeeding[3].

3. Recommended types of ventilation/filtration

1. Use of activated charcoal filters (ACF) on inhalers

- Penthrox® inhalers are designed to be used with a charcoal filter (ACF) attached to capture exhaled mehoxyflurane[10].
- This significantly reduces environmental contamination and exposure risk.

2. General room ventilation

- Ensure adequate air exchange in the room where Penthrox® is to be used – for most clinical rooms, ≥ 6 air changes per hour (ACH) is considered acceptable[11].
- Open windows (if present) or doors where safe and feasible as this can help with passive ventilation[11]. Open windows and doors can be challenging for a sexual and reproductive health service due to the need for privacy for a sensitive gynaecological examination.

3. Mechanical ventilation (preferred)

- Use of mechanical extraction systems or heating, ventilation and air conditioning (HVAC) is preferable as it ensures[12]:
  - Directional airflow
  - Fresh air replenishment
  - Exhaust to outside
- **Note on ventilation systems:** Most split-system air conditioners do not provide external ventilation, they recirculate indoor air through an internal filter, which does not remove volatile gases. Unless confirmed otherwise, assume the system recirculates air. Split systems should be used in conjunction with mechanical or natural ventilation to promote air movement[11].

4. Local exhaust ventilation (LEV)

- In high-use or poorly ventilated spaces, consider fume extraction systems, extra activated charcoal air filters or local exhaust hoods near the patients. These reduce vapour concentration at the point of release[12].

5. What about HEPA filters?

- H13 grade high-efficiency particulate air (HEPA) filters are efficient at filtering particles larger than 0.3 µm diameter through a mesh-like filter[13]. These particles include pollen, pet dander, dust, mold spores, smoke, and bacteria[13]. Methoxyflurane is a volatile organic compound and requires an activated carbon filter to absorb the vapor. Activated carbon has a large surface area that allows molecules to become adhered to carbon[13]. HEPA filters do not contain activated carbon.

4. Practical considerations for clinics

1. Room suitability assessment

- Conduct a ventilation assessment of rooms intended for Penthrox® use[12].
- Document air change rates or verify if mechanical ventilation is operational[12].

2. Standard operating procedure (SOP)

SOPs should include ventilation information:

- Requirements for ventilation.
- Use of charcoal filters.
- Number of Penthrox® inhalers to be used per day and per clinician.
- Room clearance time post- use if ventilation is suboptimal.

3. Monitoring and maintenance

- Ensure ventilation systems are regularly serviced[12].
- Spot-check air quality if high usage is expected[12].

5. Summary and recommendations

- Always use Penthrox in a **well-ventilated** clinical space.
- **Charcoal filters are essential** to reduce staff exposure.
- Mechanical ventilation or **≥6 ACH** should be the minimum standard.
- Perform risk assessments in line with local accreditation practices, and health and safety regulations.

References

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