Chemotherapy Protocol

HAEMATOLOGY – BONE MARROW TRANSPLANT BIOPSY

PENTHROX (56 day)

This is a supplementary favourites regimen for out-patient use within BMTCT unit.

Regimen

- Haematology – HSCT – Biopsy – Penthrox

Indication

- Relief of moderate to severe pain in conscious adult and teenage and young adult patients undergoing a bone marrow biopsy.
- For adult bone marrow transplant patients who undergo bone marrow aspirate and/or trephine biopsy.
- For inhalation use.

Toxicity

Drug	Adverse Effect
Penthrox (Methoxyflurane)	Dizziness, euphoric mood, headache, somnolence, dysgeusia, cough, nausea, feeling drunk, increased appetite, anxiety, depression, disturbance in attention, amnesia, paraesthesia, vision impairment, flushing, hypertension, hypotension, dry mouth, vomiting, salivary hypersecretion, renal failure.

The adverse effects listed are not exhaustive. Please refer to the relevant summary of product characteristics for further details.

Dose Modifications

Hepatic Impairment

- Cautious clinical judgement should be exercised when Penthrox is to be used more frequently than on one occasion every 3 months
- Contraindicated in patients who have a history of showing signs of liver damage after previous methoxyflurane use or halogenated hydrocarbon anaesthesia.
- Penthrox should be used with care in patients with underlying hepatic conditions or with risks for hepatic dysfunction -including interaction with other drugs (see below)

Renal Impairment

- Contraindicated in clinically significant renal impairment – eGFR < 30ml/min.
- Penthrox may cause renal failure if the recommended dose is exceeded.
- Use with caution in the elderly or other patients with known risk factors for renal disease
- Use with caution in patients diagnosed with clinical conditions which may pre-dispose to renal injury.
- Nephrotoxicity is also related to the rate of metabolism. Therefore, factors that increase the rate of metabolism include:
    - drugs that induce hepatic enzymes can increase the risk of toxicity with methoxyflurane (see below)
    - sub-groups of people with genetic variations that may result in fast metaboliser status.

The patient must be issued with an alert card due to the above listed hepatotoxicity and nephrotoxicity.

Other toxicities

Contraindications

- Clinically evident cardiovascular instability.
- Clinically evident respiratory depression.
- Altered level of consciousness due to any cause including head injury, drugs, or alcohol.
- Hypersensitivity to methoxyflurane, any fluorinated anaesthetic or to any of the excipients.
- Use as an anaesthetic agent.
- Malignant hyperthermia: patients who are known to be or genetically susceptible to malignant hyperthermia.
- Patients or patients with a known family history of severe adverse reactions after being administered with inhaled anaesthetics.

Drug interactions

1. The following drugs might increase methoxyflurane potential toxicity and concomitant use should be avoided:
    - Alcohol
    - Isoniazid
    - Phenobarbital
    - Rifampicin
    - Carbamazepine
    - Efavirenz
    - Rifampicin
    - Nevirapine
2. Concomitant use of methoxyflurane with medicines which are known to have a nephrotoxic effect should be avoided as there may be an additive effect on nephrotoxicity:
    - Contrast agents
    - Some antibiotics: tetracycline, gentamicin, colistin, polymyxin B, amphotericin B
3. CNS depressants:
    - Concomitant use of Penthrox with CNS depressants, such as opioids, sedatives or hypnotics, general anaesthetics, phenothiazines, tranquillisers, skeletal muscle relaxants, sedating antihistamines and alcohol may produce additive depressant effects.
    - If opioids are given concomitantly with Penthrox, the patient should be observed closely, as is normal clinical practice with opioids

The interactions listed are not exhaustive. Please refer to the relevant summary of product characteristics for further details.

Regimen

56 day cycle set in ARIA until intolerance or patient chooses to stop treatment (24 cycles will be set in ARIA).
The dose frequency is variable between patients due to biopsy requirements therefore the dates will be amended individually. See maximum dose information below.

Drug	Dose	Days	Administration
Penthrox (Methoxyflurane)	3ml	1	Inhalation

Dose Information

- Maximum 6ml (two doses) in one day. Administration on consecutive days is not recommended.
- Total weekly dose should not exceed 15ml (5 doses).
- One bottle of 3 ml Penthrox as a single dose, administered using the device provided. A second bottle should only be used where needed.
- Use the lowest possible dose to achieve pain relief.

Administration Information

- Penthrox should be self-administered under supervision of a person trained in its administration, using the hand-held Penthrox Inhaler.
- It is inhaled through the custom-built Penthrox inhaler.
- Onset of pain relief is rapid and occurs after 6– 10 inhalations.
- Patients should be instructed to inhale intermittently to achieve adequate analgesia.
- Patients are able to assess their own level of pain and titrate the amount of Penthrox inhaled for adequate pain control.
- Continuous inhalation of a bottle containing 3 ml provides analgesic relief for up to 25-30 minutes. Intermittent inhalation may provide longer analgesic relief.
- Patients should be advised to use the lowest possible dose to achieve pain relief
- To reduce occupational exposure to methoxyflurane, the Penthrox inhaler should always be used with the Activated Carbon (AC) Chamber which adsorbs exhaled methoxyflurane.
- After loading the Penthrox Inhaler, replace cap onto Penthrox bottle. After use, place used Penthrox Inhaler and used bottle in plastic bag provided, seal and dispose of responsibly.
- Trained staff to remain with patient throughout Penthrox use.
- Remove inhaler from patient's mouth if they are getting too sedated (recovery should be rapid)

Additional Information

- Due to the limitations on the dose of Penthrox and the duration of pain relief, Penthrox is not appropriate for providing relief of break-through pain/exacerbations in chronic pain conditions.
- Penthrox is also not appropriate for relief of trauma related pain in closely repeated episodes for the same patient.
- Patients should be advised not to drive or operate machinery if they are feeling drowsy or dizzy
- To reduce occupational exposure to methoxyflurane, the Penthrox inhaler should always be used with the Activated Carbon (AC) Chamber which adsorbs exhaled methoxyflurane.

References
1. Summary of Product Characteristics for Penthrox (Galen Limited) -Last updated 1 August 2025

REGIMEN SUMMARY

Haematology – HSCT – Biopsy – Penthrox

Day 1

1. Warning – Check last administration of Penthrox
   Maximum dose 6ml (two vials) in 24 hours. Maximum dose 15ml (5 vials) in a week.

2. Penthrox (Methoxyflurane) 99.9% Inhalation Vapour
   Administration instructions
   For pain relief associated with bone marrow biopsy. Maximum dose 6ml in 24 hours. Maximum dose 15ml in a week.
   Penthrox should be self-administered under supervision of a person trained in its administration, using the hand-held Penthrox Inhaler. Patients are able to assess their own level of pain and titrate the amount of Penthrox inhaled for adequate pain control.
   Continuous inhalation of a bottle containing 3 ml provides analgesic relief for up to 25-30 minutes. Intermittent inhalation may provide longer analgesic relief.
   Ensure Penthrox checklist has been completed, including patient's regular medicines, and patient has been issued with Penthrox treatment alert card.

DOCUMENT CONTROL

Version	Date	Amendment	Written By	Approved By
1	April 2026	New Protocol	Madeleine Norbury Pharmacist	Dr Christopher Dalley Consultant Haematologist

This chemotherapy protocol has been developed as part of the chemotherapy electronic prescribing project. This was and remains a collaborative project that originated from the former CSCCN. These documents have been approved on behalf of the following Trusts;

All actions have been taken to ensure these protocols are correct. However, no responsibility can be taken for errors that occur as a result of following these guidelines.