

Awareness about Methoxyflurane among Allied Health Science Students

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Introduction: Methoxyflurane is an inhaled analgesic and anaesthetic agent. As an analgesic agent, methoxyflurane is used extensively within a number of ambulance services and It has the advantage of being compact and easy to use. Methoxyflurane in anaesthetic concentrations was found to cause hepatotoxicity and irreversible, dose-dependent nephrotoxicity. Methoxyflurane is an inhaled medication primarily used to reduce pain relief following trauma; it may also be used for short episodes of pain as a result of medical procedures.onset of pain relief is rapid and of a short duration. Use is only recommended with direct medical supervision. **Aim:** Methoxyflurane is an inhaled analgesic and anaesthetic agent this study aims to analyse the awareness of methoxyflurane among allied health students. **Materials and Methods:** This cross-sectional research was conducted with a self-administered questionnaire containing ten questions distributed amongst 100 Allied Health science students. The students were randomly selected across various disciplines of Allied Health Sciences. The study setting was designated in the university campus. The survey instrument was a questionnaire pre tested and evaluated for validity and reliability concerns. The questionnaire included ten questions eliciting the demographic data through open ended responses and multiple choice questions for the other responses. The study was approved by the Institutional Ethical Committee and informed consent was obtained from the participants. The questionnaire was posted in an online platform and the identity of the respondents were kept confidential. The questionnaire assessed the awareness about methoxyflurane structure, mechanism of action of methoxyflurane, adverse effects of methoxyflurane, adult dosage and complications of methoxyflurane, uses of methoxyflurane, responses were recorded and analysed. There were no incomplete responses and no dropouts from the study. The final data obtained was organised, tabulated and subjected to

statistical analysis. Results: 55% of the respondents are aware of the structure of methoxyflurane, 45% were aware of uses of methoxyflurane, 65% were aware of adverse effects, 84% were aware of mechanism of action of nitrous oxide, 95% were aware of normal adult dosage of methoxyflurane, 84% were aware of overdose & complications of methoxyflurane. Conclusion: There is moderate awareness amongst AHS students about use of methoxyflurane. However, enhanced awareness initiatives and educational programmes together with increased importance for curriculum improvements that further promote knowledge and awareness of nitrous oxide should be initiated for further understanding and benefits.

Keywords: Awareness, methoxyflurane mechanism of action, uses, students, adverse effects.

1. Introduction

Methoxyflurane is a volatile, fluorinated anaesthetic agent with analgesic properties. Although no longer used as an anaesthetic due to concerns regarding renal toxicity in high doses, it has enjoyed a resurgence as an inhaled analgesic in prehospital care and in the emergency department. The agent is nonflammable and leads to rapid, titratable analgesia without intravenous access. The Pentrox inhaler device is light, robust, and straightforward to administer. Consequently, it has been proposed as an ideal analgesic for the remote high altitude setting. methoxyflurane provided rapid, effective analgesia for our patient's visceral and procedural pain. The inhaler was easy to administer, and the patient remained responsive to voice, with satisfactory oxygen saturation and respiratory rate throughout.(1)

Concern about its nephrotoxic metabolites at general anaesthetic concentrations and the concomitant emerging popularity of epidural analgesia during this period caused the decline of the methoxyflurane analgesia for the labour pain. However, many studies have shown that the nephrotoxic effect of methoxyflurane is relevant only at higher anaesthetic concentrations when used for many hours. Whereas, for a relatively short period, it is thought to be safe and has been recently released for short term pain treatment. Methoxyflurane is self-administered under observation using the hand-held Pentrox™ Inhaler. Effective methoxyflurane analgesia has been used for various painful procedures, such as during minor surgery, burn dressings, bone fracture, dental procedures, and for management of acute pain in the prehospital, military, emergency search and rescue and industrial setting.(2)

Methoxyflurane nephrotoxicity is mediated by cytochrome P450-catalyzed metabolism to toxic metabolites. It is historically accepted that one of the metabolites, fluoride, is the nephrotoxin, and that methoxyflurane nephrotoxicity is caused by plasma fluoride concentrations in excess of 50 microM.(3)

2. Materials and Method:

This cross-sectional research was conducted with a self-administered questionnaire containing ten questions distributed amongst 100 Allied Health science students. The students were randomly selected across various disciplines of Allied Health Sciences. The study setting was designated in the university campus. The survey instrument was a questionnaire pre tested and evaluated for validity and reliability concerns.

The questionnaire included ten questions eliciting the demographic data through open ended responses and multiple choice questions for the other responses. The study was approved by the Institutional Ethical Committee and informed consent was obtained from the participants. The questionnaire was posted in an online platform and the identity of the respondents were kept confidential.

The questionnaire assessed the awareness about methoxyflurane structure, mechanism of action of methoxyflurane, adverse effects of methoxyflurane, adult dosage and complications of methoxyflurane, uses of nitrous oxide, responses were recorded and analysed. There were no incomplete responses and no dropouts from the study. The final data obtained was organized, tabulated and subjected to statistical analysis.

The salient questions in the study are

1. NAME
2. AGE
3. SEX
4. YEAR OF STUDY
5. STRUCTURE OF methoxyflurane
6. USES OF methoxyflurane
7. MECHANISM OF ACTION OF methoxyflurane
8. ADVERSE EFFECTS OF methoxyflurane
9. NORMAL ADULT DOSAGE of methoxyflurane
10. OVERDOSE COMPLICATIONS OF methoxyflurane

3. Results:

(Fig.1) 55% of the respondents are aware of the structure of methoxyflurane, (Fig.2) 45% were aware of uses of methoxyflurane, (Fig.3) 65% were aware of adverse effects, (Fig.4) 84% were aware of mechanism of action of nitrous oxide, (Fig.5) 95% were aware of normal adult dosage of methoxyflurane, (Fig.6) 84% were aware of overdose & complications of methoxyflurane.

Fig.1. Awareness about the structure of methoxyflurane

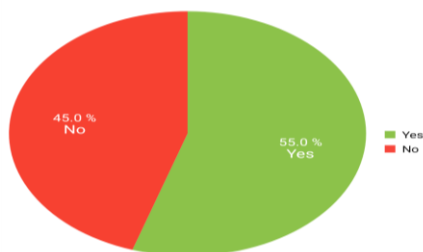


Fig.2.Awareness about the uses of methoxyflurane

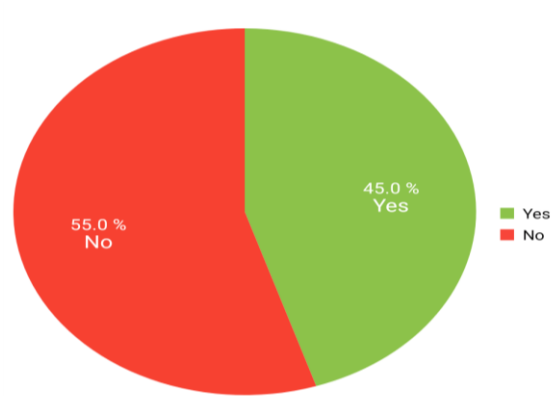


Fig.3.Awareness about adverse effects of methoxyflurane

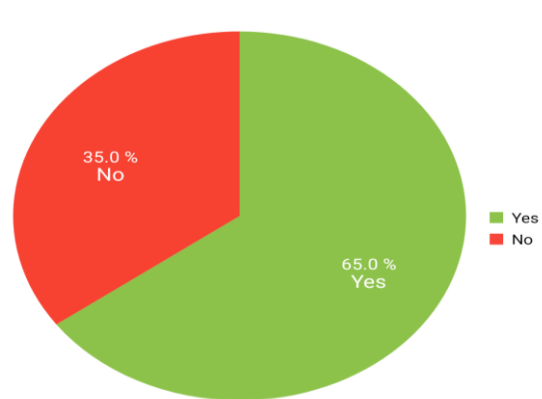


Fig.4. Awareness about mechanism of action of methoxyflurane

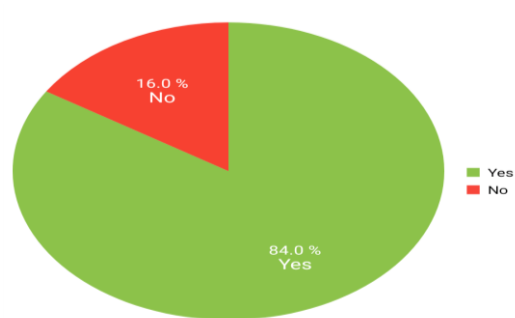


Fig.5.Awareness about normal adult dose of methoxyflurane

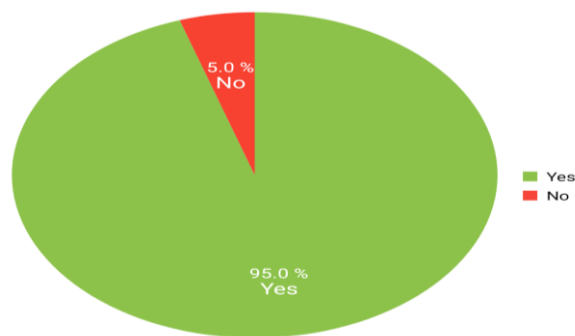
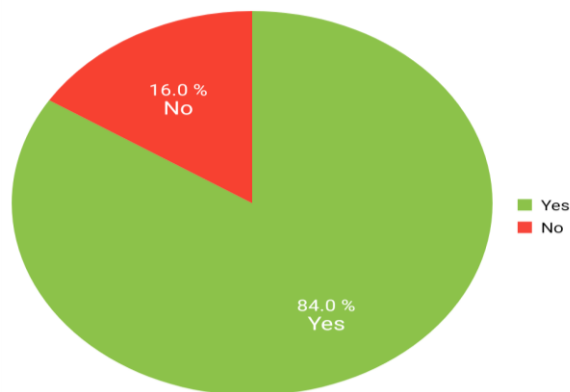


Fig.6.Awareness about over dose complications of methoxyflurane



4. Discussion

Methoxyflurane is an ether in which the two groups attached to the central oxygen atom are methyl and 2,2-dichloro-1,1-difluoroethyl. It has a role as an inhalation anaesthetic, a non-narcotic analgesic, a hepatotoxic agent and a nephrotoxic agent. It is an organofluorine compound, an organochlorine compound and an ether.(4) There is moderate awareness amongst AHS students about structure of methoxyflurane

Pentrox (methoxyflurane) is an inhaled analgesic. It is a non-invasive, lightweight, portable handheld inhaler indicated for the emergency relief of moderate-to-severe pain in conscious adult patients with trauma. It is becoming very popular in the pre-hospital setting and in the emergency department and has been proven to reduce acute pain within 6–10 inhalations. One 3 ml bottle will provide effective analgesic relief for up to 30 minutes (continuous use) or 1

hour (intermittent use). With very few drug interactions and a short half-life, it is the ideal analgesic for conscious patients. However, it is not recommended to use regularly and should not replace a good analgesic approach.(5) There is moderate awareness amongst AHS students about use of methoxyflurane this study shows that students need to develop.

Methoxyflurane decreases the gap junction channel opening times and increases gap junction channel closing time which induces reduction in junctional conductance. The drug also increases the fluidity of the lipid membrane and thus, activates calcium dependent ATPase in the sarcoplasmic reticulum. Methoxyflurane also binds with D subunit of ATP synthase, GABA receptors, glutamate receptors, glycine receptors, the large conductance Calcium ion activated potassium channel and NADH dehydrogenase.(6)

Major side-effects in anaesthetic doses Methoxyflurane causes dose-dependent renal toxicity. Rare cases of hepatic dysfunction have been reported after methoxyflurane anaesthesia.³ The aetiology of hepatotoxicity is unclear; Major side-effects in analgesic doses : renal dysfunction, hypoxia, jaundice and vomiting. Minor side-effects of sedation, hallucinations, vomiting, confusion, dizziness, cough and headache, restless, drowsy.(7)

The Pentrox inhaler is a green whistle-shaped single-use device that delivers methoxyflurane in analgesic doses, with a maximum recommended dose in 24 h of two 3 mL vials. Laboratory evidence also shows a large safety margin for analgesic use of methoxyflurane in the Pentrox inhaler [a dose of 6 mL/day and 15 mL/week results in exposure of 0.59 methoxyflurane minimum alveolar concentration (MAC)-hours, which is well below the reported level of risk of nephrotoxicity of 2.0 MAC-hours. Due to the physicochemical characteristics of methoxyflurane, absorption is rapid, providing fast onset of analgesic action (usually within 6–10 inhalations) to treat acute pain rapidly.(8-9)

There were no reported complications associated with methoxyflurane use. methoxyflurane alone provided sufficient analgesia during the pre-hospital phase of patient management and no additional pain control was required.(10)

5. Conclusion

There is moderate awareness amongst AHS students about use of methoxyflurane. However, enhanced awareness initiatives and educational programmes together with increased importance for curriculum improvements that further promote knowledge and awareness of methoxyflurane should be initiated for further understanding and benefits.

References

1. Wilkes M, Heath EC, Mason NP. Methoxyflurane for procedural analgesia at 4470 m altitude. *Wilderness & Environmental Medicine*. 2018 Sep 1;29(3):388-91.
2. Anwari JS, Khalil L, Terkawi AS. Efficacy of the methoxyflurane as bridging analgesia during epidural placement in laboring parturient. *Saudi Journal of Anaesthesia*. 2015 Oct;9(4):370.
3. Kharasch ED, Hankins DC, Thummel K, Anderson T. Human kidney methoxyflurane and sevoflurane metabolism: intrarenal fluoride production as a possible mechanism of

- methoxyflurane nephrotoxicity. ANESTHESIOLOGY-PHILADELPHIA THEN HAGERSTOWN-. 1994 Sep 1;81:A434-.
4. National Center for Biotechnology Information (NCBI)[Internet]. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information.
 5. Sevillano-Barbero M, Ruddy C. The use of Pentrox (methoxyflurane) in trauma patients. *Journal of Prescribing Practice*. 2019 Sep 2;1(9):454-7.
 6. Poznak AV. Methoxyflurane and teflurane. In *Modern Inhalation Anesthetics 1972* (pp. 77-92). Springer, Berlin, Heidelberg.
 7. Grindlay J, Babl FE. Efficacy and safety of methoxyflurane analgesia in the emergency department and prehospital setting. *Emergency Medicine Australasia*. 2009 Feb;21(1):4-11.
 8. Coffey F, Dissmann P, Mirza K, Lomax M. Methoxyflurane analgesia in adult patients in the emergency department: a subgroup analysis of a randomized, double-blind, placebo-controlled study (STOP!). *Advances in therapy*. 2016 Nov;33(11):2012-31.
 9. Forrest M, Porter K, van der Velde J. Methoxyflurane (Pentrox®)—a case series of use in the prehospital setting. *Journal of Paramedic Practice*. 2019 Feb 2;11(2):54-60.
 10. Jephcott C, Grummet J, Nguyen N, Spruyt O. A review of the safety and efficacy of inhaled methoxyflurane as an analgesic for outpatient procedures. *British Journal of Anaesthesia*. 2018 May 1;120(5):1040-8.