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Review Article

Appraisal of Isoflurane and Sevoflurane

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Abstract

Isoflurane and Sevoflurane are inhalational anesthetics that belong to the halogenated ether group. They are used to induce and maintain general anesthesia. Isoflurane is currently approved for use in dogs, cats, horses, ornamental birds, reptiles, and small mammals such as rabbits in the United Kingdom, but sevoflurane is exclusively approved for use in dogs. Both have similar adverse effects, such as central nervous system depression, respiratory depression, myocardial depression, depression of body temperature regulating centers, hypotension, vasodilatation, and muscle relaxation. Both drugs can lower cerebral metabolic rate and produce vasodilatation leading to a rise in cerebral pressure. In patients with head trauma and/or cerebral pathology, this should be continuously monitored, and it may be required to ventilate them to keep carbon dioxide levels at an adequate level to prevent a further rise in cerebral pressure. When given equal amounts of sevoflurane and isoflurane, a group of dogs experienced less respiratory depression. In terms of total side effects, both are the same and therefore one agent is better than the other.

Keywords: Hypotension; Central Nervous System Depression; Respiratory Depression; Depression of Body Temperature; Muscle Relaxation; Cerebral Pressure

Introduction

Isoflurane

A general inhalation anesthetic medication is a nonflammable liquid that is vaporized and given. Its structural formula is (Figure 1): 1-chloro-2, 2, 2-trifluoroethyl difluoromethyl ether.

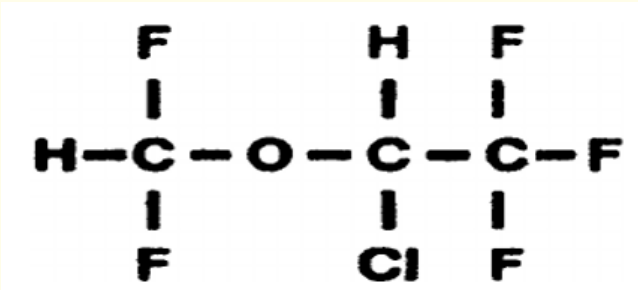

Figure 1: Chemical Structure of Isoflurane.

Isoflurane is a colorless, clear, and stable liquid with no added ingredients or chemical stabilizers. The odor of isoflurane is somewhat unpleasant, musty, and ethereal. Gas chromatography revealed that samples maintained in indirect sunlight in clear, colorless glass for five years, as well as samples directly exposed for 30 hours to a 2 amp, 115 volt, 60 cycles long wave UV light, had the same composition. For nearly six months, isoflurane in a typical sodium methoxide-methanol solution, a strong base, used almost no alkali, indicating strong base stability [1]. At typical working temperatures, isoflurane does not disintegrate in the presence of soda lime and does not react with aluminum, tin, brass, iron, or copper.

Isoflurane anaesthesia is easily induced and recovered from. Isoflurane has a moderate pungency that slows induction, yet it does not appear to cause excessive salivation or tracheobronchial

secretions [2]. The reflexes of the pharyngeal and laryngeal cavities are easily obtunded.

Ananethesial mechanism of isoflurane

Isoflurane reduces junctional conductance by slowing gap junction channel opening and speeding up gap junction channel shutting times. By increasing the fluidity of the lipid membrane, isoflurane also activates calcium dependent ATPase in the sarcoplasmic reticulum [3]. The D subunit of ATP synthase and NADH dehydrogenase appear to be bound as well. Isoflurane binds to the GABA receptor, the Ca^{2+} triggered potassium channel with a large conductance, the glutamate receptor, and the glycine receptor (Figure 2).

Figure 2. Ananethesial mechanism of isoflurane.

The induction and maintenance of general anaesthesia is accomplished by a variety of mechanisms. Inhibition of neurotransmitter-gated ion channels such as GABA, glycine, and N-methyl-d-aspartate (NMDA) receptors in the central nervous system is the most likely of these sites (CNS). Inhibition of these receptors aids in the production of amnesia and sedation required for safe surgical procedures [4]. Volatile anaesthetics in general have sites of action inside the spinal cord that inhibit NMDA-type glutamate and glycine receptors, resulting in skeletal muscle relaxation [5].

Sevoflurane

Sevoflurane is a sweet-smelling, nonflammable, highly fluorinated methyl isopropyl ether that is used as an inhalational anesthetic for general anaesthesia induction and maintenance. It is the fastest-acting volatile anesthetic after desflurane. 1,1,1,3,3,3-Hexafluoro-2-(fluoromethoxy)propane is the IUPAC name for sevoflurane [6] (Figure 3).

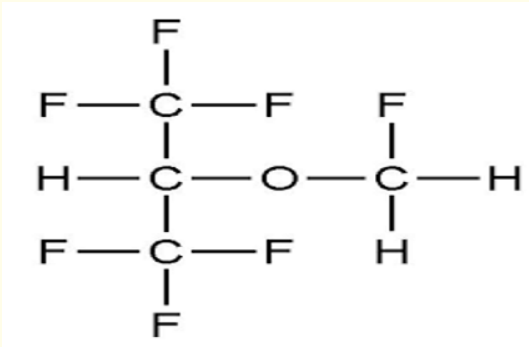

Figure 3: Chemical Structure of Sevoflurane.

Sevoflurane's specific mechanism for inducing and maintaining general anaesthesia, like that of other halogenated inhalational anaesthetics, remains unknown. Multiple attempts have been made to find a single unitary hypothesis [7]. However, no one mechanism of action has been proposed that completely explains their clinical effects. Inhaled anaesthetics increase inhibitory postsynaptic channel activity (gamma-amino butyric acid (GABA) and glycine) while inhibiting excitatory synaptic channel activity (NMDA, nicotinic acetylcholine, serotonin, and glutamate) in the central nervous system, according to a current working hypothesis [8]. Sevoflurane is a halogenated anaesthetic that is inhaled through a calibrated sevoflurane vaporizer coupled to an anaesthesia machine (Figure 4).

Figure 4: Ananethesial mechanism of Sevoflurane.

Sevoflurane is administered as a volume percent of inspired gas through the lungs. Sevoflurane must be transferred from the inspired gas into the blood of the pulmonary capillaries, and then circulated into the central nervous system to have an effect. The commencement of effect of sevoflurane is determined by the agent's inspired concentration, partition coefficients, minute ventilation, and pulmonary blood flow of the patient. These four parameters are in charge of the speed with which the concentration gradient of sevoflurane between the alveoli, pulmonary blood flow, and the central nervous system equilibrates, and thus the speed with which anesthetic induction occurs [9].

Sevoflurane is currently more expensive than isoflurane; however, if demand from the veterinary market grows, especially following the phase-out of halothane, the price may drop, making it more inexpensive and equivalent to the less expensive agent isoflurane. It should be noted that utilizing a low-flow anaesthetic approach can reduce the expense of sevoflurane; however, this needs more careful monitoring and monitoring equipment [10]. This is also true of isoflurane; therefore sevoflurane is still significantly more expensive when compared to isoflurane. It's worth noting that low-flow anaesthesia slows the rate at which the vaporiser setting influences anaesthetic gas levels in the lungs, eliminating some of sevoflurane's advantages over isoflurane.

When sevoflurane combines with soda lime, it produces 1, 1, 3, 3, 3-pentafluoro-2-(fluoromethoxy)propene, also known as component A. Compound A has been shown to cause nephrotoxicity in rats; however, the mechanism is unknown, and no evidence of this has been found in dogs. Because the concentration of compound A rises in a circular system as sevoflurane levels rise and fresh gas flow rates fall, the manufacturer's data sheet warns against using sevoflurane for long-term, low-flow anaesthesia [11].

Conclusion

While the development and licensing of sevoflurane for the veterinary market clearly has some advantages in the anaesthesia of critical patients, isoflurane is still the licenced drug for many species and should be considered under the VMD regulations and the prescribing cascade due to the more rapid change in anaesthetic depth. Savoflurane could be a significant addition to veterinary anaesthesia as it becomes more inexpensive and perhaps licenced for a wider range of animals. It currently allows for anaesthesia induction in dogs, resulting in a quick onset of anaesthesia.

Sevoflurane will, without a doubt, result in a tiny percentage increase in recovery times and faster variations in anaesthetic depth than isoflurane, although the therapeutic significance of this is unclear. Speedy recovery is obviously beneficial, but does not always imply smooth recovery, which is often just as important; other factors besides the inhalant agent, especially sedative premedicants and analgesia, will influence this. It's worth noting that a balanced anaesthesia isn't just about the inhalant and induction agents at this point.

Despite the benefits of sevoflurane, isoflurane should not be overlooked as a significant resource in small animal anaesthesia; despite the pungent odour and irritation of the airways when used for masked induction, it poses no concerns in this area when used for anaesthesia maintenance. In healthy individuals undergoing routine surgery, the variation in blood-gas solubility is not significant enough to make a difference. However, sevoflurane may be beneficial in critical canine situations if the anaesthetist is familiar with its administration.

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