A Summary of Inhalation Anesthetics

Inhalation anesthetics (also known as volatile anesthetics) are those that are introduced into the body via inhalation through the lungs. Following inhalation the anesthetic is distributed throughout the body's tissues via the bloodstream. In most cases, the brain is the principle target when inhalation anesthetics are administered.

History of Inhalation Anesthetics

The first inhalation anesthetics were used in the Islamic Empire, and were comprised of sponges soaked in a narcotic preparation. The sponge was held over the face of the individual who was undergoing surgery.

The use of inhalant anesthetics and the success of surgery in the modern world hinges on two discoveries: the development by Joseph Lister of sterile surgical techniques, and the discovery of the anesthetic properties of nitrous oxide.

The first modern inhalant anesthetics were carbon dioxide and nitrous oxide. While carbon dioxide never really came into regular use as an inhalant anesthetic, nitrous oxide became very widely used, and in fact is still in use today.

The efficacy of nitrous oxide as an inhalant anesthetic was first publicly noted by British chemist Humphrey Davy, who published a paper on the subject in 1800. However, it was several decades before the use of nitrous oxide became widespread. One of the first successful uses of the gas-a painless tooth extraction was carried out by William Thomas Green Morton, an American Dentist-was not recorded until 1846.

Also during the 1840s, another inhalation anesthetic known as diethyl ether was publicly demonstrated for use for the first time, during a tooth extraction procedure. Chloroform had also been developed a decade earlier, and despite the well-documented dangers of both chloroform and ether, both saw reasonably widespread use in Britain for a time.

During the 1930s and 1940s, inhalation anesthetics such as cyclopropane, trichloroethylene, and isopropenyl vinyl ether were developed. However, the development of halothane in 1951 and the introduction of this anesthetic into clinical practice five years later made most of the earlier inhalation anesthetics obsolete.

During the 1960s and 1970s, a small number of new inhalation anesthetics were synthesized. Among them were enflurane, isoflurane, sevoflurane, desflurane, and methoxyflurane. With the exception of methoxyflurane, which was taken off the market due to nephrotoxicity, many of the inhalation anesthetics developed during this period are still in use today.

Inhalation Anesthetics Currently Used

Most of the currently used inhalation anesthetics are halogen-containing volatile anesthetics that were developed in the 1960s and 1970s. Among these are isoflurane, sevoflurane, enflurane, and desflurane. Halothane, developed in the 1950s, is also still in use.

Nitrous oxide, developed over a century ago, is also in regular use as an inhalation anesthetic. Colloquially known as "laughing gas", its most well-known medical use is in dentistry.

Another type of non-volatile inhalation anesthetic that may eventually come into more regular use is xenon. Currently, xenon is more expensive to use than other inhalation anesthetics, and this has limited its use somewhat. However, xenon is an attractive prospect, as it is around 50% more potent than nitrous oxide, and as it is not a greenhouse gas, is also more environmentally-friendly.

Mode of Action

Inhalation anesthetics are administered via an anesthetic machine that uses a vaporizer to generate an inhalable gas from a liquid version of the anesthetic. Once inhaled, the gas is distributed throughout the body via the bloodstream at a rate that is dependent on the dose administered, the type of anesthetic used, and on more specific factors that depend on the patient who is receiving the anesthetic.

Inhalation anesthetics generally operate via one of two methods: increase of inhibitory function, or decrease of excitatory transmission, at brain nerve endings. In ideal situations, inhalation anesthetics induce anesthesia quickly, and emergence from the anesthetized state is rapid once the anesthetic stimulus is removed.

The body deals with inhalation anesthetics in two ways: via metabolism, and via exhalation. The ideal inhalation anesthetics are those which are metabolized only at low levels. Metabolism rates vary widely between different anesthetics: halothane, for example, is metabolized at a rate of 10% to 20%, while enflurane has a metabolism rate of around 2.5%, and nitrous oxide has a rate of 0%, and is not metabolized at all.

During a surgical procedure, inhalation anesthetics tend to accumulate in fatty tissue, meaning that patients with higher percentages of body fat will awaken from the anesthetized state slower than patients with less body fat.

Possible Side Effects and Toxic Effects

Most inhalation anesthetics produce a variety of different side effects. Some side effects occur only in one or two different anesthetics, while other side effects are common to almost all. Some of the most common side effects include the following:

Cardiovascular effects include decreased blood pressure (in all inhalation anesthetics except for nitrous oxide, and increased heart rate (isoflurane and halothane).

Pulmonary effects include an increase in respiratory rate. This increase is dose-dependent and is common to all inhalation anesthetics.

Renal and hepatic function is decreased following administration of all inhalation anesthetics. In extremely rare cases (between one in 6,000 and one in 35,000), necrosis of the liver may result from administration of halothane. Kidney toxicity, once a relatively common result of the use methoxyflurane, is occasionally seen following the administration of high doses of sevoflurane.

About the Author

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