Inhaled Anesthetics

Inhaled anesthetics are a highly lipid-soluble drug class used to induce and maintain anesthesia in patients. These drugs work via an unknown mechanism, though they have been used in practice for over 40 years. Commonly used inhaled anesthetics can be remembered by the acronym HEISMN, for halothane, enflurane, isoflurane, sevoflurane, methoxyflurane and nitrous oxide. These drugs are known to cause respiratory depression by decreasing medullary drive to breathe, as well as myocardial depression by decreasing cardiac contractility, depressing the SA node and decreasing blood pressure. Inhaled anesthetics have profound CNS effects which are not entirely understood, but have shown to lower cerebral metabolic demand, but increase cerebral blood flow by mediating vasodilation. Side effects of these drugs include severe hepatotoxicity (seen with halothane) and nephrotoxicity (methoxyflurane), as well as seizure (enflurane), though these risks have been reduced with newer inhalational agents. Malignant hyperthermia, a severe catabolic condition characterized by increased temperature, CO_2 production, O_2 production, respiration, acidosis and rhabdomyolysis, is still a risk with inhaled anesthetic drugs, with exception to nitrous oxide (N2O). Nitrous oxide use can lead to expansion of trapped gas, which becomes a problem when it affects areas which cannot expand, such as sinuses and the middle ear.

PLAY PICMONIC

Mechanism of Action

Unknown Mechanism

Question-mark Mechanism

The neurological mechanism of action for inhaled anesthetics is unknown.

Inhaled Anesthetic Drugs

HEISMN Drug Name Acronym

Heisman-trophy-player

This acronym represents halothane, enflurane, isoflurane, sevoflurane, methoxyflurane, nitrous oxide

Side Effects

Respiratory Depression

Deflated Lungs

Respiratory depression occurs with all inhalational anesthetics due to blunted medullary respiratory drive. Furthermore, these drugs are usually combined with mechanical ventilation, making mechanical respiration necessary.

Myocardial Depression

Deflated Mayo-heart

Inhaled anesthetics lead to myocardial depression by causing reduced cardiac contractility and depression of the SA node. Blood pressure is also reduced.

Lower Metabolic Demand, Increased Cerebral Blood Flow

Dropping Down-arrow Metal-ball and Sending Up-arrow Blood to Brain

These drugs significantly lower cerebral metabolic demand. Inhaled anesthetics also affects cerebral blood vessels by causing cerebral vascular vasodilation, increasing cerebral blood flow.

Hepatotoxicity (Halothane)

Liver with Toxic-green-glow

Halothane, due to oxidative reactions in the liver, can cause severe liver injury, termed "halothane hepatitis." This drug is rarely used in adults or children, as safer drugs have replaced it.

Nephrotoxicity (Methoxyflurane)

Kidneys with Toxic-green-glow

Methoxyflurane is broken down in the liver and kidney, and its metabolites lead to irreversible, dose-dependant nephrotoxicity. It has also been linked to hepatotoxicity. This drug's use has been largely abandoned due to newer inhaled anesthetics.

Seizure (Enflurane)

Caesar

Enflurane is known to lower the seizure threshold and used should cautioned in patients with epilepsy. Enflurane can also cause nephrotoxicity in patients.

Malignant Hyperthermia

Malignant-man Hiker-thermometer

With exception to nitrous oxide (N2O), inhaled anesthetic drugs can trigger malignant hyperthermia, a severe side effect. Malignant hyperthermia is a life-threatening condition with symptoms of increased temperature, CO_2 production, respiration and O_2 consumption, as well as acidosis and rhabdomyolysis.

Expansion of Trapped Gas

Expanded Gas-guy

Nitrous oxide leads to expansion of trapped gas when blood containing NO equilibriates with closed air-containing spaces in the body. This is not a problem with compliant tissues (gut lumen), but may cause increased pressure and trauma if the space cannot expand (sinuses, middle ear).