Trace and Waste Anesthetic Gases

Anesthetic waste gases can include any gas from the anesthesia machine which passes the patient without being inhaled, as well as any gases the patient exhales. Trace gas can occur due to leaking equipment, method of filling vaporizers, spillage, etc. It is assumed that prolonged and repetitive exposure to anesthetic gases can be toxic to procedure area personnel. Consequently, NIOSH has recommended Permissible Exposure Limits (PEL's) for anesthetic agents. The PEL established for halogenated anesthetics is 2 parts per million (PPM). When NIOSH made the recommendation in 1978, newer anesthetic agents such as Isoflurane, Sevoflurane and Desflurane were not a part of the original study. However, the recommendation should be applied to these agents until updated recommendations are made.

Containing Anesthetic Gas

With respect to specific methods or products, OSHA makes no recommendations on how to comply with these limits. All anesthetic gases must be contained as they travel to and from the patient. Since gas is constantly being delivered to the patient, there is always an excess that needs to either be evacuated from the area or filtered such that all anesthetic agent is removed.

Evacuating Gases

Evacuation of waste gas from the area without filtering means that the gas must continue to be contained until it can be released to the outside atmosphere. Channeling to the outside requires oversight to ensure that all connections are leak free. Testing must be done to assure that the number of bends in the evacuation line, as well as the overall length, does not cause resistance to the flow of gas from the anesthesia machine. Evacuation lines must be checked periodically to assure they are clear of obstructions.

Filtering Gases

Filtering means the gas is run through an adsorbent material such as activated charcoal, which collects and holds onto the anesthetic molecules while allowing the oxygen and CO_2 to pass through. Activated charcoal, when used as a filter medium, has oversight requirements as well.

Once the charcoal is saturated, anesthetic gases which pass through will NOT be adsorbed - this is referred to as break-through. Activated charcoal can adsorb roughly 25% of its own weight by volume. Small charcoal canisters should have their saturation levels monitored by weight on a daily basis. Protocols should include weighing the canister prior to use, recording the initial weight on the canister and then reweighing the canister after each use. Once saturated, the filter should be discarded.

Passive vs. Active Evacuation

Passive evacuation occurs when the gas flow from the anesthesia machine pushes the waste gases, via the path of least resistance, to the outlet (atmosphere) or filtering canister. Active evacuation involves applying negative pressure (suction) to the evacuation circuit. These methods have caveats that must be considered. In the passive system, a leak in the evacuation circuit could cause the waste gases to leak "outward" into the procedure area. Diligence in checking the system for leaks is required. In the active system, if negative pressure reaches the patient's nosecone, it may pull the anesthetic gases past the nosecone, depriving the patient of the delivered concentration of gas. If operating with a loose fitting mask, a dilution of the delivered concentration may occur, thus giving the appearance that there is something wrong with the anesthesia machine. Precautions must always be taken to ensure the negative pressure never reaches the anesthesia machine or the patient's breathing circuit.

In-facility Vacuum / Fume Hoods & Down Draft Tables

There are two common ways to use active evacuation. The first utilizes an in-facility suction system and a scavenging interface device. Tubing from the in-house vacuum (evacuation) system, as well as the exhaust tubing from the breathing circuit, are connected directly to the interface. This device should constantly attenuate pressure such that negative pressure is never applied directly to the anesthesia machine or patient. It should also have a provision to avoid accidental positive pressure build-up in the breathing circuit. This is the standard method in human hospital surgery suites. The second method is to apply the negative pressure to the procedure area (e.g. fume hoods and down draft tables) in a manner that allows any waste gas to be pulled into the stream of moving air, but does not apply negative pressure to the patient or anesthesia system. This method is very popular in rodent surgery as it lends itself to the use of less obtrusive breathing circuits.