MAC & Partial Pressure

Anesthetic Pearls: Anesthetic Implications of MAC and Partial Pressure

Minimum Alveolar Concentration

"**MAC**" is defined as the minimum alveolar concentration that is required to prevent movement in 50% of patients receiving noxious stimuli (surgical incision).

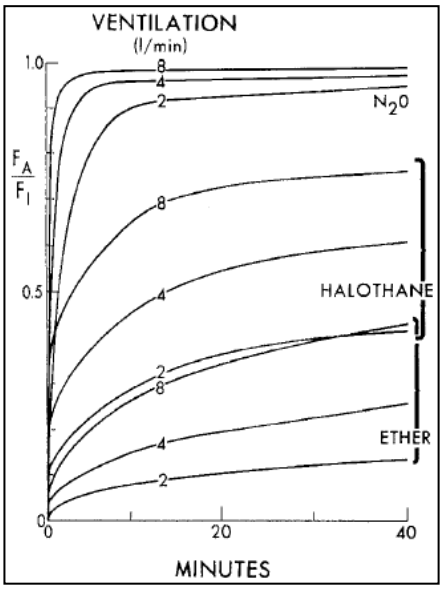
Agent	Structure	MAC%	Vapor Pressure (mm Hg @ 20°C)
Nitrous oxide	$N{=}N{-}O$	105	—
Halothane (Fluothane)	$F_3C{-}CHClBr$	0.75	243
Methoxyflurane (Penthrane)	$CH_3{-}O{-}CF_2{-}CHCl_2$	0.16	22.5
Enflurane (Ethrane)	$CHF_2{-}O{-}CF_2{-}CHFCl$	1.7	175
Isoflurane (Forane)	$CHF_2{-}O{-}CHCl{-}CF_3$	1.2	240
Desflurane (Suprane)	$CHF_2{-}O{-}CHF{-}CF_3$	6.0	681
Sevoflurane (Ultane)	$(CF_3)_2CH{-}O{-}CH_2F$	2.0	160

Clinical importance: MAC provides one of the best indicators of the potency of an inhaled anesthetic. MAC is useful since it mirrors brain partial pressure of an anesthetic. The MAC values of different inhaled anesthetics are also roughly additive. Also, any inhaled anesthetic which is at 1.3 MAC has been found to prevent movement in 95% of individuals. While being an indicator of potency, MAC remains a statistical average and can differ in individual patients.

A. Factors <u>increasing</u> MAC: chronic alcohol use, amphetamines and cocaine, hyperthermia, and young age. The highest MAC occurs at age 6 months and then declines thereafter.

B. Factors <u>decreasing</u> MAC: acute alcohol use, old age, hypothermia, benzodiazapines, narcotics, Ketamine, local anesthetics.

PARTIAL PRESSURE



Partial pressure is a term indicating the relative concentration of one gas with respect to another gas. Partial pressure is relevant in that it helps to indicate how much of an anesthetic gas is required to achieve MAC or induce an anesthetic state. Partial pressure of a gas in the alveolus is associated with the concentration of the gas in the alveoli (F_A). The alveolar partial pressure is important since it helps determine alveolar concentration, which helps determine blood partial pressure, brain partial pressure, and brain tissue concentration. This ultimately determines clinical effect of a particular gas. Practically and clinically it is affecting the anesthetic state and is affected by blood solubility, alveolar blood flow, and differences between alveolar and venous blood gas levels. The higher the blood / gas coefficient, the greater amount of gas is dissolved in the blood and the lower the alveolar partial pressure of the gas. Nitrous is much less soluble than Halothane and achieves a much quicker higher partial pressure in the alveoli, thereby rendering a patient unconscious more rapidly. There is also the clinical efficacy of the second gas effect; this concept uses the absorption of one gas to increases the partial pressure of a second gas in the remaining alveolus thereby increasing the uptake of the other gas. As alveolar blood flow increases, alveolar gas partial pressure decreases and induction is slowed. The difference between alveolar and venous gas levels are essentially an expression of how much gas the tissue absorbs and is affected by tissue solubility, tissue blood flow, and partial pressure differences in arterial and tissue gas levels.