How to make Desflurane work for you - Use its low solubility
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Desflurane is the anesthetic with lowest blood/gas solubility
Low solubility causes expired concentration to follow inspired concentration closely
The inhalation route causes expired concentration to change quickly with all inhalants
The closeness of expired to inspired concentration permits dramatic control of depth
Low solubility reduces the diluting effect of expired gas on fresh gas
Low solubility allows low fresh gas flow, low vapor use, and low cost
Desflurane can be easily administered at 1 L/min or less
Desflurane is also chemically inert and unmetabolized
Desflurane is the anesthetic with lowest blood/gas solubility. The solubilities of common anesthetic agents are diethyl-ether 12.0, halothane 2.3, enfurane 1.9, isoflurane 1.3, sevoflurane 0.67, nitrous oxide 0.47, desflurane 0.42. Xenon has a solubility of 0.13 but is not yet available commercially. Nitrogen has a solubility of 0.014 but is not considered an anesthetic.

Low blood/gas solubility causes expired concentration to follow inspired concentration closely with desflurane. This is because low blood/gas solubility allows little anesthetic to be removed from the lungs, and alveolar concentration remains near inspired.¹

Like all drugs administered by inhalation, alveolar concentration or tension changes rapidly in response to changes in inspired concentration. Under most circumstances, the time constant (τ) is approximately one-half minute. This is computed from the ratio of effective volume to effective flow, here functional residual capacity (FRC) divided by alveolar ventilation (VA). Thus τ = FRC / VA = 2 L / (4 L/min) = 0.5 min.

With drugs of higher solubility, the change is still rapid, but it is small. High solubility permits only small changes in anesthetic depth to be achieved quickly. Large changes in depth are not possible unless inspired concentration is changed many multiples of the desired change in expired concentration. This may be possible during induction, but only if the vaporizer has a high maximum setting. This is never possible during emergence, where the lowest possible vaporizer setting is zero. Thus, low blood/gas solubility permits dramatic control of anesthetic depth, including fast awakening.

Low blood/gas solubility also reduces the diluting effect of expired gas on fresh gas. This is because expired concentration is close to inspired concentration so expired gas does not dilute the fresh gas provided by the anesthesia machine. Therefore, inspired concentration is close to vaporizer setting.²

Low blood/gas solubility allows low fresh gas flow, because of the decreased dilution of the high expired concentration. As fresh gas flow is reduced, less vapor is used and cost is lower. Desflurane can be easily administered at 1 L/min or less and is excellent even for closed circuit anesthesia.²

Desflurane can be administered as follows.³ After intravenous induction and tracheal intubation, fresh gas flow (FGF) is set to 1 L/min oxygen-enriched air and the desflurane vaporizer is switched on and set to its maximum, 18%. Inspired desflurane rises slowly because expired gas dominates over fresh gas and expired gas desflurane concentration is zero at the beginning. When the inspired and expired desflurane concentrations reach approximately 8% and 6% respectively, the vaporizer is adjusted to
9% and fresh gas flow is left at 1 L/min. This induction technique results in little hypertension or tachycardia. Some time thereafter, FGF can be lowered further. If this is done, the vaporizer will need to be adjusted above 9% to maintain the desired expired and required inspired concentrations. If desired, FGF can be reduced to a completely closed circuit. Desflurane cost is $6.92 per hour at 1 L/min FGF and $2.65 per hour with a 0.25 L/min closed circuit anesthetic. When using low FGF, sampled gas should be returned to the breathing circuit. A truly closed circuit requires sampled gas return.

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Figure. Gas Man® Simulation of anesthetic tension in gas which is delivered (Del), inspired (I), expired (E), in vessel-rich group including brain (R), in muscle (M), and in fat (F). The dotted line represents MAC.²

References

