

Via the lungs or the veins?

Volatile agents have been used in anaesthesia since the 1840s and intravenous anaesthetic agents were developed in the 1930s. The technique of using intravenous agents for induction and maintenance (total intravenous anaesthesia) has now gained popularity. This article explores some advantages and disadvantages of volatile (inhalational) based and total intravenous anaesthesia techniques.

Inhalational agents for induction and anaesthesia maintenance

Advantages

Inhalational induction of anaesthesia can be achieved before intravenous access when awake cannulation is difficult, important in children, those with behavioural disorders and needle phobics. Inhalational induction can be used in those with airway compromise or when concerned about difficulty of intubation. Patients can be anaesthetized and the airway instrumented while spontaneously ventilating (Kandasamy and Sivalingam, 2000), and woken while self-ventilating if there is a problem.

Measurement systems monitor 'actual' alveolar concentration of agent and measure minimum alveolar concentration – a guide to anaesthesia depth. Metabolism of volatile agents is >95% pulmonary, so offset is mainly independent of renal and liver function.

Disadvantages

Inhalational induction needs patient cooperation and relies on respiratory function. Some agents are strong smelling and may cause airway irritation, breath holding and laryngospasm. Patients go through the 'excitatory' stage of anaesthesia which may cause uncontrolled movement, vomiting and respiratory or cardiovascular irregularities. There is risk of awareness during intubation and transfer from the anaesthetic room.

Agents cause cerebral vasodilation, increasing intracranial pressure, and in excess cause myocardial depression. Volatile agents are flammable and increase environmental pollution. They are associated with more postoperative nausea and vomiting (Smith et al, 1999). Specific disadvantages include increased arrhythmias and hepatitis risk (halothane), coronary steal (isoflurane), altered methionine metabolism and expansion of air-filled cavities (nitrous oxide), (Yentis et al, 2009) and renal toxicity from compound A (sevoflurane). Volatile agents may trigger malignant hyperthermia.

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Intravenous induction and anaesthesia maintenance

Advantages

Induction is smooth, rapid and avoids potential distress and airway irritation. Agents are delivered directly into the circulation, not reliant on respiration. The excitatory stage is often bypassed. Patients can be intubated and anaesthesia maintained without neuromuscular blockade (Erhan et al, 2003), which is important in those with neuromuscular disease. Maintenance is generally delivered by infusion.

Programmable infusion pumps allow rapid titration. Anaesthesia is uninterrupted when disconnected from the anaesthetic machine, i.e. during airway instrumentation or transfer from the anaesthetic room. There is reduced postoperative nausea and vomiting with total intravenous anaesthesia, and propofol is an antiemetic. Intracranial pressure is not increased with propofol and remifentanyl, which is important in neurosurgery. There is a 'clean' recovery profile making total intravenous anaesthesia useful in day case surgery. If suxamethonium is avoided, total intravenous anaesthesia is safe in those susceptible to malignant hyperthermia, and pollution is reduced.

Disadvantages

Intravenous induction requires awake intravenous access, often difficult in some groups. Intravenous induction in cases of

stridor is not ideal if trying to maintain spontaneous ventilation during induction, as apnoea may occur quickly. In the haemodynamically unstable intravenous induction can cause cardiovascular collapse if not titrated carefully. Those new to the technique need training. Equipment and intravenous agents can be expensive. Total intravenous anaesthesia relies on patient intravenous access throughout surgery.

Actual plasma concentration of agent cannot be measured, and total intravenous anaesthesia relies on calculation of estimated plasma concentration based on pharmacokinetic models, so anaesthetic depth is difficult and expensive to measure. With the exception of remifentanyl, agents accumulate if infused over prolonged periods and may delay wake up (Campbell et al, 2001).

Conclusions

Both volatile anaesthesia and total intravenous anaesthesia have advantages and disadvantages. The choice will depend on anaesthetic expertise, the patient, available equipment and the procedure. There are total intravenous anaesthesia enthusiasts and those who combine techniques, although most would change from routine practice if the situation warranted. Advances in anaesthetic equipment and pharmacological agents mean that anaesthetists have resources available to optimize patient safety in any situation. **BJHM**

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