Nitrous oxide: friend or foe?

THE DILEMMA

Nitrous oxide has been used for anaesthesia for a long time, but is it safe?

FRIEND

Nitrous oxide (N_2O) has been widely used in anaesthetic practice for over 150 years. It is a potent analgesic but a weak anaesthetic and so is mainly used as a carrier gas for more potent volatile anaesthetic agents. Many of its potential benefits result from the reduction in the amount of other agents used.

When a volatile anaesthetic is mixed with N_2O rather than an O_2/air mixture, induction is faster. This is the result of its low blood/gas partition coefficient, the second gas effect and concentrating effect. For similar reasons emergence from anaesthesia is also faster when N_2O is used. Time to resume spontaneous breathing is reduced and minute ventilation and carbon dioxide elimination are improved. During maintenance of anaesthesia, supplementation of isoflurane with N_2O reduces cardiovascular (McKinney and Fee, 1998) and respiratory depression. There is also evidence that when N_2O is omitted from an anaesthetic, there is an increased risk of intraoperative awareness (Tramer et al, 1996).

The rapidly reversible analgesic properties of N_2O are exploited as part of a balanced anaesthetic and widely outside the operating theatre. It is used in obstetric practice, dental surgeries and in casualty for minor procedures.

Use of any drug should be guided by a detailed knowledge of its beneficial and adverse effects. N_2O still has a lot to offer in terms of its rapid action, cardiorespiratory stability and relative low cost compared to alternatives (e.g. remifentanil or xenon) and so it is likely it will remain as part of our armoury for the foreseeable future.

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FOE

N_2O is used for its anaesthetic and analgesic action as part of 'balanced' anaesthesia. However, it has a number of negative effects: nausea and vomiting, environmental pollution (for health-care workers and the atmosphere), cardiovascular depression, altered B_{12} and folate metabolism, and volume expansion.

Nausea and vomiting are among the outcomes most frequently disliked by surgical patients (Macario et al, 1999). N_2O induces vomiting in volunteers, when given as the sole anaesthetic agent under hyperbaric conditions. While it is not the only factor, clinical studies have found N_2O to be emetogenic. A meta-analysis of 26 trials with distinct N_2O and non-N_2O groups concluded that omitting N_2O reduced the risk for postoperative nausea and vomiting from 37% to 18% (Divatia et al, 1996).

N_2O irreversibly inactivates cobalamin, the active form of vitamin B_{12} essential for methionine-synthase activity in the brain, potentially leading to demyelination, subacute combined degeneration of the cord and encephalopathy. There are case reports of severe permanent neurological injury in association with B_{12} deficiency after conventional anaesthesia involving N_2O, especially in people with previous restricted consumption or absorption of vitamin B_{12}.

Modern scavenging reduces occupational exposure to all anaesthetic gases: female dental assistants exposed to high levels of N_2O without scavenging had more spontaneous abortions compared to those working in places where the excess gas was scavenged.

How and when could we reduce the use of N_2O? Changing any anaesthetic technique in a way that could negatively affect patients should be done with caution. Moving from N_2O to air may increase the likelihood of awareness if the level of volatile or analgesic agent is not altered. Any change of practice should start with spontaneously breathing patients (less at risk from unpleasant awareness) and include monitoring of exhaled gases along with greater vigilance for awareness.

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