Conference Proceeding

Desflurane in neurosurgery: Pros

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Abstract

Neurosurgery and neuroanaesthesia are making rapid progress, and with this progress, there is the search for excellence and ideal results. The practice of neuroanaesthesia is fairly standardised today, and any debate can only be on the fine-tuning aspects of the techniques. The aim of all research in anaesthesia is to provide the best possible and safest operating conditions and to have a complete recovery at the end of the surgery. The maintenance of anaesthesia for neurosurgery is with balanced general anaesthesia which combines intravenous and inhalational agents. A review of literature shows that desflurane has definite advantages, and hence, it is an integral part of modern neuroanaesthesia.

Key words: Cerebral vasodilatation, desflurane, neurosurgery, post-operative recovery

INTRODUCTION

Neurosurgery is usually a long-duration surgery, and hence, the choice of the drugs used for maintenance of anaesthesia, along with good monitoring is of vital importance. The characteristics of an ideal anaesthetic agent used for the maintenance of anaesthesia in neurosurgical patients are tabulated in Table 1. The common drugs used in the maintenance of neuroanaesthesia in India include fentanyl, midazolam, propofol, dexmedetomidine, isoflurane, sevoflurane and desflurane.

DESFLURANE IN NEUROANAESTHESIA

Desflurane is a very attractive option available to anaesthetists for the maintenance of general anaesthesia. The obvious advantages urged researchers to study this drug in brain surgery. A review of literature shows that desflurane is a safe drug with respect to cerebral haemodynamics.[1] Various advantages and disadvantages of desflurane are mentioned in Table 2.

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PRECISE CONTROL OVER THE DEPTH OF ANAESTHESIA

Desflurane has the lowest blood/gas solubility of 0.42 as compared to the solubility of other the common anaesthetic agents. This allows anaesthetic alveolar concentration to remain near inspired concentration and hence a predictable and precise control over the depth of anaesthesia. In neurosurgery, the anaesthetic requirement changes rapidly as surgical stimulus is keeps varying. Desflurane offers this distinct advantage.

HAEMODYNAMIC STABILITY

Desflurane causes fewer episodes of intraoperative hypotension, without the occurrence of more hypertensive episodes than sevoflurane when studied using an experimental inhalation bolus technique in morbidly obese patients.[2] Furthermore, when desflurane was used for hypotensive anaesthesia, the heart rate was unchanged from baseline throughout surgery, with a significantly faster return to baseline arterial blood

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Table 1: Characteristics of ideal anaesthetic agent

Smooth maintenance of anaesthesia
Haemodynamic stability
Minimal effects on cerebral haemodynamics
Early and complete recovery at the end of the operation
No significant delay in recovery in high-risk patients and obese patients

Table 2: Advantages and disadvantages of desflurane

Advantages
Precise control over the depth of anaesthesia
Haemodynamic stability
Rapid recovery and early neurological assessment
Distinct advantages in obese and elderly
Renal advantage
Disadvantages
Cerebral vasodilatation and Increase in ICP
Atmospheric pollution
Can trigger malignant hyperpyrexia

ICP=Intracranial pressure

pressure (BP) at the end of anaesthesia, as compared to sevoflurane and propofol.[3] For both brain and more so spine surgery, some periods of good control of BP are required by the surgeon and this can be safely given with desflurane. In patients undergoing spinal surgery requiring moderate arterial hypotension, desflurane was found to maintain tighter arterial BP control than isoflurane.

RAPID RECOVERY

This is the most important advantage of desflurane and many studies have proved it. The two dreaded complications, cerebral oedema and development of haematoma, need to be picked up at the earliest. A study by Bilotta *et al*. was conducted to evaluate the recovery after both sevoflurane and desflurane anaesthesia.[4] They studied the cognitive function using short orientation memory concentration test and the Rancho Los Amigos scale. In addition, the gas exchange patterns (pH, PaO_2 and $PaCO_2$) were recorded. These parameters were recorded at 15, 30, 45 and 60 min. In the desflurane group, cognitive values returned to baseline within 30 min, whereas in patients receiving sevoflurane, cognitive function recovered in 45 min. The authors also found a higher $PaCO_2$ at 15 and 30 min and lower pH up to 45 min post-extubation in patients receiving sevoflurane-based anaesthesia. The desflurane group had earlier reversal to normocapnia and normal pH. The differences in cognitive recovery and post-operative gas exchange patterns are clinically advantageous in patients undergoing neurosurgery because they minimise the cerebral hyperaemia related to hypercarbia and allow earlier diagnosis should a postoperative complication develop.[5] Several studies have shown that the recovery with desflurane is 15 min earlier than that with sevoflurane and this can influence the decision of the surgeon to ask for a computed tomography scan if he is not satisfied with the neuro-assessment.

ADVANTAGE IN OBESE AND ELDERLY

The study by Bilotta *et al*. was done in obese patients.[4] The advantage of desflurane in obese patients is proved by several authors.[6] By comparison, sevoflurane has a slower washout from adipose tissues. In the elderly too, the recovery from desflurane anaesthesia is faster. This becomes particularly relevant as neurosurgical procedures last for several hours, and with the average life expectancy going up, we can expect a significant number of elder patients for neurosurgery.[7]

RENAL ADVANTAGE

Desflurane produces almost negligible fluoride ions and this is one strong reason to prefer it over sevoflurane.[8] With emphasis on low flow gas technique, this gains more importance particularly in long-duration operations.

NEUROMONITORING

Monitoring of cranial nerve functions, somatosensory-evoked potential and motor-evoked potential (MEP) is becoming very common both in brain and spine surgery. Its use is going to increase with every passing year as more centres will have the equipment and trained personnel. This requires a very fine tuned balanced anaesthesia with a narcotic, propofol or dexmedetomidine and an inhalational agent to provide the ideal conditions. Propofol is the best agent as far as neuromonitoring is concerned, but we need to reduce the total dose with the help of an inhalational agent. The advantages of desflurane are that it is most effective in eliminating patient movement and also causes far less hypotension than propofol.[9] For prolonged operations, we can continuously monitor the minimum alveolar concentration (MAC) and expired concentration of inhalational agents, which is not possible for propofol. A study by Chong *et al*. showed that using 0.3 MAC desflurane with background anaesthesia of propofol and remifentanil causes no statistically significant difference in transcranial-evoked MEP amplitudes from the baseline in both upper limb (UL) and lower limb (LL) stimulation. However, this was not the case

for sevoflurane for which even a low concentration at 0.3 MAC significantly depressed MEP amplitudes of LL (but not UL) from baseline value.[10]

CEREBRAL HAEMODYNAMICS

Desflurane gives the fastest recovery from anaesthesia and would become the automatic choice for neurosurgery; however, for one major consideration, i.e., it causes cerebral vasodilatation and increases intracranial pressure (ICP).[11] This has prompted several researchers to study the effects of desflurane on the brain to ascertain whether this concern is theoretical or does it affect the operating conditions. All studies were done on patients who did not have a significantly raised ICP preoperatively.

Bilotta *et al*. in their study evaluated the neurosurgeon's impression about the brain and concluded that there was no difference between desflurane and sevoflurane.[4] Similar results were found in the study by Magni *et al*.[12] There have been a few Indian studies to find out the effects of desflurane on ICP. One study on supratentorial tumours was done measuring cerebrospinal fluid pressure, and also, taking the surgeon's evaluation showed that there was no difference between desflurane and sevoflurane.[13] The surgeon was blinded to the agent used.

In another study on supratentorial tumours, the researchers did a subjective analysis of intraoperative brain relaxation was by the surgeon at the various steps during surgery. These include at raising of the bone flap, at dural reflection, at tumour excision and after dural closure. The brain relaxation was graded as satisfied, not satisfied but can manage and not satisfied, and intervention is required. The attending anaesthesiologist also assessed the slackness of brain at the time of raising the bone flap and graded it as within the margin of the inner table of the skull, within the margin of the outer table of the skull and outside the margin of the outer table of the skull. The study showed no significant difference between desflurane, sevoflurane and propofol.[14]

In another study on cerebellopontine angle tumour, authors compared propofol with desflurane for maintenance and found that the brain relaxation was similar in both groups, but the emergence time was significantly more in propofol group.[15]

ENVIRONMENTAL EFFECTS AND MALIGNANT HYPERPYREXIA

All halogenated anaesthetic gases are recognised greenhouse gases and are potentially damaging to the earth's ozone layer.[16] Desflurane has the maximum environmental pollution today as halothane is hardly used anymore. There is a definite responsibility on the hospitals and individuals to minimise this.

The most important is awareness. Pollution can be reduced with the use and improved design of scavenging systems, installation of more effective general ventilation systems, low flow techniques and increased attention to equipment maintenance and leak detection. Simple practices such as not using desflurane during mask ventilation will be benefiting our environment.

Desflurane can potentiate malignant hyperpyrexia. Fortunately, it is not common in our country but this consideration should be kept in mind.

CONCLUSION

Desflurane is a very useful inhalational drug for maintenance of anaesthesia in neurosurgery. The most important benefit is that it has the fastest recovery time. In addition, it has distinct advantage in obese, elderly and renal-compromised patients. An emerging benefit today is its usefulness in neuromonitoring. The effects on the brain have been studied and are probably theoretical and do not translate into any adverse operating conditions. To conclude, desflurane has a very definite place in neurosurgery and neuroanaesthesia.

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Conflicts of interest
There are no conflicts of interest.

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