Evaluation of Hemodynamic Changes and Recovery Time in Patients under Going Laparoscopic Cholecystectomy - A Clinical Comparison between Desflurane and Sevoflurane

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Abstract: **Objectives:** To compare the following factors in two groups. The study population was randomly divided into two groups with 30 patients in each group denoted as group ‘D’ and group ‘S’ between 20-70 years of age, undergoing laparoscopic cholecystectomy under general anaesthesia. 1) Group D- Receiving Desflurane 4%in 30 patients 2) Group S- Receiving Sevoflurane 2% in 30 patients. **Parameters observed:** Demographic parameters includes Age, Sex, Height, Weight. Hemodynamic parameters: HR, BP – SBP, DBP, MAP, SPO2, End Tidal CO2 concentration. Recovery time: Time for spontaneous breathing, Eye-opening, Obeying commands, Handgrip, Recall of name. Assessments included will be recovery time to eye-opening, response to commands, spontaneous breathing, recall of name, hand grip etc. Methods: In the present study 60 ASA grade I-II patients divided into two groups – each group denoted as group ‘D’ and group ‘S’ between 20-70 years of age, undergoing laparoscopic cholecystectomy under general anaesthesia. a) Group D-Receiving Desflurane 4%in 30 patients b) Group S- Receiving Sevoflurane 2% in 30 patients. Results: Age, sex, weight and the duration of surgery were comparable in both the groups. Both desflurane and sevoflurane-maintained intraoperative hemodynamics and the differences were statistically insignificant. The time to, extubation, recall of name, and handgrip were shorter in the desflurane group than the sevoflurane group. The difference was statistically significant. Mean response time to pain stimulus in sevoflurane was 5.3 min, and desflurane group was 4.6 min. The mean time for recall of name was 8.7 min in sevoflurane and desflurane group was 7 min. The time to recall of name was significantly more in sevoflurane. The mean time for handgrip was 8.2 min in the sevoflurane group and 6.9 min in the desflurane group. In our present study, the recovery characteristics are similar. The mean response to spontaneous movements in the sevoflurane group was 4.6 min, and desflurane group was 3.9 min though patients in the desflurane group had earlier spontaneous movements but not significant statistically. The mean duration for PARS >10 (post-anaesthesia recovery score of Aldrete and Kroulik) was 9.3 minutes and 11.1 minutes in Desflurane and Sevoflurane group respectively and it was statistically significant. The incidence of nausea and vomiting was 40% in the sevoflurane group and 50% in the desflurane group, the desflurane group had a higher incidence of nausea and vomiting in spite of using ondansetron as premedication.

**Keywords:** Desflurane, sevoflurane, induction, recovery, recall time, spontaneous respiration

1. Introduction

The procedures done laparoscopically have rapidly increased in the past 15 years. For day case anaesthesia applications, the use of anaesthetics that provide fast and smooth induction allows quick changes in depth while maintaining anaesthesia, minimum Haemodynamic changes, early recovery and less postoperative nausea and vomiting are recommended. Volatile anaesthetics are the most widely used drugs for maintenance of general anaesthesia because of their predictable intraoperative and recovery characteristics. Management of haemodynamic stability and early recovery is the essential part of a standardised balanced technique. Rapid induction and recovery may lead to faster operating room turnover times; shorter recovery room stays and earlier discharges to home.

Inhaled anaesthetics allow rapid emergence from anaesthesia because of easy titratability, with inherent neuromuscular blocker potentiating effects. The availability of less soluble inhalation anaesthetics such as sevoflurane and desflurane made us rethink about the selection of volatile anaesthetics for surgical procedures. Given the low solubility and low blood: gas partition coefficient of sevoflurane and desflurane, faster induction and emergence from anaesthesia is expected compared to traditional inhalation anesthetics.

Given the low blood-gas partition coefficient of sevoflurane (0.69) and desflurane (0.42) a more rapid emergence from anaesthesia is expected compared with traditional inhalational agents like isoflurane because of fast induction and early recovery based on low blood/gas partition coefficients, desflurane is better when compared to sevoflurane in day-care anaesthetic applications.

In this study, evaluation of the haemodynamic changes and recovery time in patients undergoing laparoscopic cholecystectomy- A clinical comparison between desflurane and sevoflurane was done.

2. Material and Methods

After approval from hospital ethics committee and obtaining written informed consent from patients, 60 ASA grade I-II patients divided into two groups – each group denoted as group ‘D’ and group ‘S’ between 20-70 years of age, undergoing laparoscopic cholecystectomy under general
patients were mechanically ventilated to maintain end tidal CO₂ within 27-32 mm of mercury. Patients were extubated after observing spontaneous breathing, eye- opening, obeying a command, attaining of the handgrip. Patients were observed for 30 minutes after extubation to find out any complications like nausea, vomiting, drowsiness, sore throat etc.

Comparing the following parameters:
Demographic parameters
- Age,
- Sex,
- Height,
- Weight

Hemodynamic parameters
- HR,
- BP – SBP, DBP, MAP
- SPO2,
- End Tidal CO2 concentration.

Recovery time
- Time for spontaneous breathing,
- Eye-opening,
- Obeying commands,
- Handgrip,
- Recall of name.

4. Discussion
Laparoscopy started in the 1950s has revolutionized the way surgery has been done. It is also called minimal access surgery, it is usually done as an outpatient procedure, and is associated with less operative cost, less bleeding, and early discharge. Laparoscopy with carbon dioxide insufflation is associated with a sympathetic surge which may affect the perioperative outcome of patients, if not attended to appropriately.

Introduction of newer volatile anaesthetics sevoflurane and desflurane has made anaesthesia management most comfortable to the anaesthesiologists; continuous research has been done to introduce anaesthesia with low blood gas solubility and tissue gas solubilities. Sevoflurane and desflurane fall into this category.

Sevoflurane and desflurane are inhalational anaesthetics with low blood gas solubility (0.69 and 0.42 respectively) and fat/blood solubility (40 and 27 respectively) making them suitable for an outpatient procedure. Desflurane has lower blood gas and fat/blood solubility.

There was no difference in hemodynamic parameters using LMA.

Table 1: Partition coefficients of inhaled anaesthetic agents in blood and tissues

<table>
<thead>
<tr>
<th>Type of Tissue</th>
<th>Desflurane</th>
<th>Sevoflurane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood</td>
<td>0.45</td>
<td>0.65</td>
</tr>
<tr>
<td>Bone</td>
<td>0.6</td>
<td>1.1</td>
</tr>
<tr>
<td>Muscle</td>
<td>0.6</td>
<td>1.1</td>
</tr>
<tr>
<td>Fat</td>
<td>15</td>
<td>41</td>
</tr>
</tbody>
</table>
Desflurane has lower anaesthetic potency leading to higher MAC values. Several physiological factors decrease MAC: decreased body temperature, decreased central nervous system, sodium concentrations, pregnancy, and increased age.

### Table 2: Desflurane MAC is age-specific and decreases with 60% nitrous oxide

<table>
<thead>
<tr>
<th>Age</th>
<th>MAC in 100% oxygen</th>
<th>MAC in 60% nitrous oxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–1 year</td>
<td>8.95–10.65</td>
<td>5.75–7.75</td>
</tr>
<tr>
<td>1–12 years</td>
<td>7.2–9.4</td>
<td>5.75–7.0</td>
</tr>
<tr>
<td>18–30 years</td>
<td>6.35–7.25</td>
<td>3.75–4.25</td>
</tr>
<tr>
<td>30–65 years</td>
<td>5.75–6.25</td>
<td>1.75–3.25</td>
</tr>
<tr>
<td>Over 65 years</td>
<td>5.17+/−0.6</td>
<td>1.67+/−0.4</td>
</tr>
</tbody>
</table>

The anaesthetic potency of sevoflurane is correlated with its lipid solubility. With an oil gas partition coefficient of 47.2, its MAC has been reported to be 2.05%. Thus, its potency is lower than that of halothane and isoflurane but is about three times more potent than desflurane. The MAC of sevoflurane decreases with age and the addition of Nitrous Oxide, as shown in table below.

### Table 3: Effect of age on minimum alveolar concentration (MAC) of sevoflurane

| Age of Patient (years) | Sevoflurane  
|------------------------|-------------|
|                        | Sevofluraneim  
|                        | O2 5%  
|                        | O2 35% O2  
| <3                     | 3.3–2.6%  
| 3–5                    | 2.5%       
| 5–12                   | 2.4%       
| 25                     | 2.5%       
| 35                     | 2.2%       
| 40                     | 2.05%      
| 50                     | 1.8%       
| 60                     | 1.6%       
| 80                     | 1.4%       

Sevoflurane produces dose-dependent ventilatory depression and also reduces respiratory drive in response to hypoxia and increases in carbon dioxide partial pressure, comparable with levels achieved with other anaesthetics. It relaxes bronchial smooth muscle. Sevoflurane had a minimal effect on tidal volume and had no effect on respiratory rate and did not initiate a cough reflex. Sevoflurane is effective in reversing bronchospasm.

Airway irritation occurred when desflurane was given in a concentration above the threshold for respiratory irritation (1–1.5 MAC) to patients. Irritation of the airway, coughing, breath-holding, and laryngospasm do not occur at an end-tidal concentration of 5.4% or less. Concentrations that may have been irritating during the induction of anaesthesia do not necessarily increase the incidence of airway irritation during maintenance. The factors that influence the threshold for irritation are age, opioid administration, and smoking. Increasing age decreases airway responsiveness to irritants. With the use of LMA, on awakening, desflurane provides more rapid recovery of pharyngeal reflexes as compared with sevoflurane.

Sevoflurane is not associated with a convulsive or epileptic activity. Desflurane reduces cerebral vascular resistance and increases intracranial pressure. Cerebrospinal fluid (CSF) production is increased slightly with desflurane. Cerebral autoregulation appeared to be delayed but maintained at least up to 0.5 MAC; at 1.5 MAC autoregulation is abolished. Desflurane produces central respiratory depression (ventilatory response to CO₂) comparable with that seen with enflurane and greater than that seen with isoflurane.

Sevoflurane and desflurane have dose-related myocardial depression and reduction in systemic vascular resistance. Though desflurane has direct yet transient sympathetic nervous system activation, this occurs mostly with a rapid rise in desflurane concentration.

Renal and hepatic blood flow is well preserved with sevoflurane, and organ toxicity has not been observed to date. Potential renal toxicity is of concern because sevoflurane is metabolized to inorganic fluoride. Studies documenting the presence of Compound A in the anaesthesia circuit during sevoflurane anaesthesia in humans have detected no post-anaesthesia renal dysfunction. There is no evidence of hepatic injury secondary to anaesthesia with desflurane. Absence of hepatotoxicity is consistent with the minimal biodegradation of desflurane, the sustained hepatic arterial blood flow, and the rapid elimination of desflurane after the termination of anaesthesia.

Sevoflurane and desflurane produces a clinically useful neuromuscular block and potentiates neuromuscular blockers to a similar degree to other anaesthetics. Both can trigger malignant hyperpyrexia in susceptible individuals. Desflurane produces dose-dependent muscle relaxation.

More rapid recovery from prolonged anaesthesia may be an advantage in the elderly in whom hepatic, and renal functions are decreasing, and cognitive impairment is a problem during recovery. Several studies have demonstrated a faster, clearheaded, and more predictable recovery in elderly patients after desflurane as compared with sevoflurane. Early (as measured by times to extubation, eye-opening, squeezing fingers on command, and orientation) but not intermediate recovery (as measured by the digit symbol substitution test and time to discharge) was significantly better in patients receiving desflurane.

### 5. Conclusion

1. We conclude from the present study: desflurane anesthesia produces faster emergence and early recovery compared to sevoflurane anesthesia.
2. Intraoperative haemodynamic parameters were similar in both the groups.
3. Late recovery features of both desflurane and sevoflurane are the same, and there is not a much difference.
4. Both are ideal agents for outpatient anaesthesia; sevoflurane is more pleasant than desflurane in view of its acceptable smell.
5. Recovery characteristics in healthy patients, like a response to the command, handgrip, eye-opening, name recall etc. They were earlier and faster in the desflurane group than the sevoflurane group.
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