Original Research Article

Recovery from desflurane and sevoflurane anaesthesia after prolonged surgery - A comparative study using Index of Consciousness (IoC) monitoring

Raj Kumar Choubey¹, Kirti Bhushan², Geetanjali Singh³, Sachin Narayan Kulkarni⁴, Manish Honwad⁵, Rahul Yadav⁶,*

¹Dept. of Anaesthesiology & Critical Care, Heritage Institute of Medical Science, Varanasi, Uttar Pradesh, India
²Dept. of Anaesthesiology & Critical Care, Tata Main Hospital, Jamshedpur, Jharkhand, India
³Dept. of Ophthalmology, Manav Welfare Trust & Eye Hospital, Mumbai, Maharashtra, India
⁴Dept. of Anaesthesiology & Critical Care, INHS Asvini, Mumbai, Maharashtra, India
⁵INHS Sanjivani, Kochi, Kerala, India
⁶Dept. of Anaesthesiology and Neuroanaesthesiology, INHS Asvini, Mumbai, Maharashtra, India

A B S T R A C T

Background: The present study compared the recovery from desflurane and sevoflurane anaesthesia in patients after prolonged surgery using Index of Consciousness (IoC) monitoring scale.

Materials and Methods: A total of 50 patients between 18 to 60 years of age, scheduled to undergo prolonged surgeries (lasting for more than 120 minutes) were included in this study and randomly divided in two groups (Group A: Desflurane; Group B: Sevoflurane) of 25 patients each.

Results: The patients who received Desflurane had better recovery characteristics than Sevoflurane. Results showed that for attaining value of IoC- 95, mean time required by patients of group A was 1.82 (± 0.50) minutes as compared to 5.36 (± 0.95) minutes by group B. Similarly for attaining value of IoC-99 (i.e. state of complete consciousness), mean time required by patients of group A was 11.04 (± 1.62) minutes as compared to 22.84 (± 4.85) minutes by group B. The results were significantly different (p< 0.05) for both the values of IoC.

Conclusion: The present study concludes that inhalation based desflurane anaesthesia has a faster recovery than sevoflurane anaesthesia in prolonged surgeries, when both are guided by IoC monitoring.

© This is an open access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/) which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

1. Introduction

There is an ongoing quest to know which agent is most suitable for induction as well as maintenance of anaesthesia. Agents which show excellent induction and maintenance characteristics may not necessarily provide ideal recovery profile.

Achieving adequate depth of anaesthesia during surgical procedure is desirable. Assessment of depth of anaesthesia is fundamental to anaesthesia practice. While deep level of anaesthesia, resulting in cardiovascular depression and prolonged awakening is of clinical significance, light anaesthesia is more frightening for the patient. Awareness during anaesthesia can lead to long-term effects such as anxiety, nightmares, flashbacks, clinical depression and post-traumatic stress disorder. There are various subjective and objective methods of assessing depth of anaesthesia. Subjective methods rely on the movement and autonomic response to stimuli and depend on the opinion and experience of an anesthetist. The objective methods rely on the sensitivity of the monitor. The Index of Consciousness (IoC) monitor is one such device. The main parameter of the IoC is the symbolic dynamics method, which detects the complex non-linear properties of the EEG that can be correlated to the depth of anaesthesia.¹

*Corresponding author.
E-mail address: docrahulyadav@gmail.com (R. Yadav).
Desflurane is known to have a rapid onset and offset of action, thereby making it possible for the anaesthesiologist to control the depth of anaesthesia rapidly. It also provides haemodynamic stability with preservation of tissue perfusion even in face of hypotension; however it is irritating to the airway and therefore is not routinely utilised for inhalational induction. \(^2\)\(^3\) However, studies have shown that controlled desflurane induction along with opioid premedication can be rapid and well tolerated.\(^4\)\(^5\) Sevoflurane administration has been associated with a smooth, rapid loss of consciousness during inhalation induction and a rapid recovery following discontinuation of anaesthesia. The present study was carried out to assess the recovery from Desflurane and Sevoflurane anaesthesia after prolonged surgery using Index of Consciousness (IoC) monitoring scale.

2. Materials and Methods

This was a prospective randomized comparative study. After approval from institutional ethics committee and obtaining written informed consent, fifty adults of either sex between the age group of 18 and 60 years, belonging to the American Society of Anaesthesiologists physical status I and II, scheduled to undergo prolonged surgeries (lasting for more than 120 minutes; primarily Gastrointestinal, Oncologic, Maxillofacial, Otolaryngeal and Neurological surgeries) were enrolled in the study. Patients with significant co-morbidities (coronary artery disease, chronic pulmonary disease, renal failure, hepatic dysfunction, severe anemia), obese patients (BMI >35kg/m2), and those with exposure to general anesthetic agents within previous seven days were excluded from the study. The patients were randomly divided into two groups of 25 each, to receive either Desflurane/Nitrous oxide (Group A) or Sevoflurane/Nitrous oxide anaesthesia (Group B).

Patients were administered 2mcg kg-1 fentanyl and anaesthesia was induced with Propofol 1.5-2.5 mg kg-1 intravenous. The neuromuscular blockade was provided with vecuronium 0.1mg/kg. Anaesthesia was maintained with either Desflurane 2-6% or Sevoflurane 0.6-1.75% with Nitrous oxide 65% in Oxygen and intermittent doses of Vecuronium. Inspired anaesthetic concentrations were adjusted to obtain adequate surgical anaesthesia (IoC value between 40-50) and fentanyl was repeated as per requirement at the discretion of the attending anaesthesiologist to maintain mean arterial pressure within 20% of baseline values. Mechanical ventilation was adjusted to keep the end tidal CO\(_2\) concentration between 35 to 38 mm Hg. Lactated Ringers solution was used for correction of fluid deficit and for maintenance requirements during surgery.

The volatile anaesthetic agents were cut-off at the time of last skin suture and time taken for attainment of the Index of Consciousness index to 95 and 99 during recovery period using the Morpheus Medicals IoC view monitor was noted. The individual value of IoC scores thus obtained was tabulated for Desflurane and Sevoflurane separately.

Monitoring during anaesthesia consisted of continuous ECG, heart rate, pulse oximetry, side stream capnometry, non-invasive blood pressure, nasopharyngeal temperature and Index of consciousness (IoC). All parameters were recorded at 15 min. intervals. Neuromuscular block was antagonized with Glycopyrrolate (6-8mcg kg-1 IV) and Neostigmine (40-80 mcg kg-1 IV). Ventilation of lungs was continued with oxygen 100% at a fresh gas flow rate of 6 litre min-1 until the patient was extubated.

2.1. IoC-view scale

The IoC-view is a continuous processed EEG parameter that correlates to the patient's level of hypnosis where decreasing IoC-view values correspond to gradually loss of consciousness and a deepening of the level of anaesthesia. In a scale from 99 to 0, an index of 99 indicates an awake patient and an index of 0 indicates a flat EEG.

2.2. Statistical analysis

Data were statistically described in terms of mean (±SD), frequencies (number of cases) and percentages when appropriate. Data was tested first for normal distribution by Klongorov– Smirnov test. Comparison of quantitative variables between the study groups was done using student t test for independent samples, when variables were found to be normally distributed. For comparing categorical data, Chi square test was performed. Exact test was used instead when the expected frequency is less than 5. A probability value (p value) less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs Microsoft Excel 2007 (Microsoft Corporation, NY, USA) and SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15.

3. Results

A total of fifty patients enrolled and completed the study. The demographic characteristics such as mean age and sex were comparable in the two groups. The mean age of group A patients was 46.4 (± 12.2) years while mean age of Group B patients was 43.6 (± 12.4) years (Table 1). The mean age difference was statistically not significant (p>0.05). Group A consisted of 72% female patients while 52% of patients in group B were females (Table 2). There was no significant difference in the two groups regarding sex distribution (p> 0.05).

3.1. Intraoperative hemodynamics

Heart rate (HR) and non-invasive blood pressure (NIBP) of the patients were recorded at 15 min. intervals during the
surgery. In our study mean HR from 0 min to 180 min was higher with desflurane in comparison to sevoflurane group (Table 3), though the difference was significant in few readings only (at 75, 105 and 135 min.). No significant difference was noted in mean NIBP (systolic and diastolic) from 0 min to 180 min in both the study groups (Table 4 and Table 5).

3.2. IoC value

The inspired anaesthetic concentration was adjusted to obtain adequate surgical anaesthesia. IoC value throughout surgery ranged from 40-50 in patients of both groups (Table 6). The time taken for attainment of the Index of Consciousness index to 95 and 99 during recovery period using the IoC view monitor was noted. It was observed that for attaining value of IoC- 95, mean time required by patients of group A was 1.82 (± 0.5) minutes as compared to 5.36 (± 0.95) minutes by group B. Similarly for attaining value of IoC-99, mean time required by patients of group A was 11.04 (± 1.62) minutes as compared to 22.84 (± 4.85) minutes by group B. There was a significant difference among both groups as per time required for recovery, with patients of group A demonstrating significantly faster recovery (p< 0.05) than patients of group B (Table 7).

4. Discussion

Sevoflurane and desflurane have pharmacokinetic properties that favour rapid emergence from anaesthesia. More rapid recovery from prolonged anaesthesia may be an advantage in the elderly in whom cognitive impairment (e.g. delirium, confusion) is a problem during recovery.6 Desflurane produces greater sympathetic stimulation. Thus, at concentration above 1 MAC, steady state concentration of desflurane produces a dose-related increase in heart rate.7 The heart rate in our study was higher in desflurane group across majority of the time intervals.

Sevoflurane is a dose-related cardiac depressant. Increasing concentrations of sevoflurane progressively decrease blood pressure in a manner similar to the other volatile anaesthetics, and in unstimulated volunteers this decrease may be slightly less than with isoflurane at a higher MAC. Sevoflurane decreases myocardial contractility in a manner similar to equianesthetic concentrations of isoflurane and desflurane, and does not potentiate epinephrine-induced cardiac arrhythmias.8 No significant difference for NIBP was observed in the two groups of our study.

The availability of less soluble inhalation anesthetics such as sevoflurane and desflurane has led to a reassessment of the use of volatile anesthetics for rapid recovery after surgery. Given the low blood-gas partition coefficients of sevoflurane (0.69) and desflurane (0.42), a more rapid emergence from anaesthesia is expected compared with traditional inhalation anesthetics. Not surprisingly, both drugs have shorter emergence times compared to isoflurane based techniques. The recovery from anaesthesia in patients of both groups was compared using IoC monitoring scale, which has been validated in various studies.9–11 There was a significant difference among both groups of our study as per time required for recovery, with patients of desflurane group demonstrating significantly faster recovery than sevoflurane group. Our results correlated well with those of Heavner et al., who compared emergence from desflurane vs sevoflurane in elderly patients undergoing two or more hours of anaesthesia. They observed that times required to extubation, eye opening and orientation were significantly less for desflurane.12 In a similar study in paediatric population, Welborn et al compared the emergence and recovery characteristics of sevoflurane, desflurane, and halothane in children undergoing adenoidectomy with bilateral myringotomy and the insertion of tubes. The authors concluded that emergence and recovery from anaesthesia was significantly faster in the desflurane group compared with the sevoflurane and halothane groups.13 Chen et al. evaluated the cognitive recovery profiles in elderly patients after general anaesthesia with desflurane or sevoflurane, and inferred that the use of desflurane was associated with a more rapid emergence from anaesthesia and a shorter length of stay in the postanaesthesia care unit.14 A meta-analysis of trials comparing postoperative recovery after anaesthesia with sevoflurane or desflurane done by
### Table 3: Comparison among study groups as per Heart rate

| Heart Rate (per min.) | Group       | N  | Mean   | SD    | SEM   | t-value | P-value |
|-----------------------|-------------|----|--------|-------|-------|---------|---------|
|                       | Desflurane  | 25 | 72.40  | 7.94  | 1.59  | 0.36    | 0.72    |
| 15 Min.               | Sevoflurane | 25 | 71.60  | 7.51  | 1.50  |          |         |
|                       | Desflurane  | 25 | 70.08  | 7.80  | 1.56  | 0.16    | 0.87    |
| 30 Min.               | Sevoflurane | 25 | 70.48  | 9.10  | 1.82  |          |         |
|                       | Desflurane  | 25 | 70.20  | 6.87  | 1.37  | 0.78    | 0.44    |
| 45 Min.               | Sevoflurane | 25 | 68.40  | 9.24  | 1.85  |          |         |
|                       | Desflurane  | 25 | 70.08  | 7.34  | 1.47  | 0.12    |         |
| 60 Min.               | Sevoflurane | 25 | 66.32  | 9.28  | 1.86  | 1.59    | 0.19    |
| 75 Min.               | Desflurane  | 25 | 71.76  | 7.47  | 1.49  | 2.32    | 0.03    |
|                       | Sevoflurane | 25 | 71.27  | 9.27  | 1.85  |          |         |
| 90 Min.               | Desflurane  | 25 | 69.40  | 7.25  | 1.45  | 1.19    | 0.24    |
|                       | Sevoflurane | 25 | 66.52  | 9.75  | 1.95  |          |         |
| 105 Min.              | Desflurane  | 25 | 69.88  | 8.35  | 1.67  | 2.10    | 0.04    |
|                       | Sevoflurane | 25 | 68.40  | 8.85  | 1.77  |          |         |
| 120 Min.              | Desflurane  | 25 | 68.56  | 8.44  | 1.69  | 0.99    | 0.32    |
|                       | Sevoflurane | 25 | 66.00  | 9.70  | 1.94  |          |         |
| 135 Min.              | Desflurane  | 23 | 69.74  | 8.07  | 1.68  | 2.24    | 0.03    |
|                       | Sevoflurane | 22 | 64.27  | 8.42  | 1.80  |          |         |
| 150 Min.              | Desflurane  | 18 | 66.33  | 4.81  | 1.13  | 1.78    | 0.09    |
|                       | Sevoflurane | 17 | 62.29  | 8.29  | 2.01  |          |         |
| 165 Min.              | Desflurane  | 8  | 67.50  | 1.41  | 0.50  | 0.59    | 0.56    |
|                       | Sevoflurane | 9  | 65.22  | 10.77 | 3.59  |          |         |
| 180 Min.              | Desflurane  | 6  | 65.67  | 4.97  | 2.03  | 0.79    | 0.45    |
|                       | Sevoflurane | 3  | 68.67  | 6.11  | 3.53  |          |         |

### Table 4: Comparison among study groups as per NIBP (Systolic)

| Systolic B.P (mm Hg) | Group       | N  | Mean   | SD    | SEM   | t-value | P-value |
|----------------------|-------------|----|--------|-------|-------|---------|---------|
|                      | Desflurane  | 25 | 125.12 | 7.42  | 1.48  | 0.48    | 0.63    |
| 15 Min.              | Sevoflurane | 25 | 126.08 | 6.74  | 1.35  |         |         |
|                      | Desflurane  | 25 | 119.68 | 8.14  | 1.63  | 0.03    | 0.97    |
| 30 Min.              | Sevoflurane | 25 | 119.76 | 8.31  | 1.66  |         |         |
|                      | Desflurane  | 25 | 114.56 | 8.50  | 1.70  | 0.28    | 0.78    |
| 45 Min.              | Sevoflurane | 25 | 113.92 | 7.67  | 1.53  |         |         |
|                      | Desflurane  | 25 | 115.52 | 6.36  | 1.27  | 0.04    | 0.96    |
| 60 Min.              | Sevoflurane | 25 | 115.44 | 6.23  | 1.25  |         |         |
|                      | Desflurane  | 25 | 116.08 | 9.30  | 1.86  | 0.98    | 0.32    |
| 75 Min.              | Sevoflurane | 25 | 118.32 | 6.47  | 1.29  |         |         |
|                      | Desflurane  | 25 | 114.45 | 6.41  | 1.28  | 0.91    | 0.31    |
| 90 Min.              | Sevoflurane | 25 | 116.67 | 6.94  | 1.38  |         |         |
|                      | Desflurane  | 25 | 113.78 | 7.14  | 1.46  | 0.34    | 0.81    |
| 105 Min.             | Sevoflurane | 25 | 114.48 | 6.31  | 1.26  |         |         |
|                      | Desflurane  | 25 | 115.61 | 7.50  | 1.52  | 0.03    | 0.97    |
| 120 Min.             | Sevoflurane | 25 | 115.81 | 6.48  | 1.29  |         |         |
|                      | Desflurane  | 23 | 114.56 | 7.96  | 1.58  | 0.02    | 0.98    |
| 135 Min.             | Sevoflurane | 22 | 114.45 | 8.23  | 1.65  |         |         |
|                      | Desflurane  | 18 | 115.9  | 8.98  | 1.81  | 0.38    | 0.75    |
| 150 Min.             | Sevoflurane | 17 | 113.92 | 7.42  | 1.54  |         |         |
|                      | Desflurane  | 8  | 115.12 | 7.36  | 1.53  | 0.31    | 0.76    |
| 165 Min.             | Sevoflurane | 9  | 114.42 | 6.83  | 1.31  |         |         |
|                      | Desflurane  | 6  | 114.98 | 8.35  | 1.66  | 0.08    | 0.94    |
| 180 Min.             | Sevoflurane | 3  | 115.18 | 7.45  | 1.54  |         |         |
### Table 5: Comparison among study groups as per NIBP (Diastolic)

| Diastolic B.P (mm Hg) | Group      | N  | Mean   | SD   | SEM   | t-value | P-value |
|-----------------------|------------|----|--------|------|-------|---------|---------|
| 15 Min.               | Desflurane | 25 | 71.52  | 6.64 | 1.33  | 0.04    | 0.97    |
|                       | Sevoflurane| 25 | 71.60  | 8.64 | 1.73  | 0.41    | 0.68    |
| 30 Min.               | Desflurane | 25 | 66.72  | 6.43 | 1.29  | 0.00    | 1.00    |
|                       | Sevoflurane| 25 | 67.60  | 8.52 | 1.70  | 0.68    | 0.29    |
| 45 Min.               | Desflurane | 25 | 63.60  | 7.33 | 1.47  | 0.92    | 0.37    |
|                       | Sevoflurane| 25 | 63.60  | 7.19 | 1.44  | 1.00    | 1.00    |
| 60 Min.               | Desflurane | 25 | 62.40  | 7.68 | 1.54  | 0.32    | 0.72    |
|                       | Sevoflurane| 25 | 60.32  | 8.30 | 1.66  | 0.86    | 0.44    |
| 75 Min.               | Desflurane | 25 | 64.24  | 8.70 | 1.74  | 0.56    | 0.58    |
|                       | Sevoflurane| 25 | 65.04  | 8.53 | 1.71  | 0.11    | 0.87    |
| 90 Min.               | Desflurane | 25 | 70.42  | 6.69 | 1.33  | 0.03    | 0.97    |
|                       | Sevoflurane| 25 | 65.12  | 7.78 | 1.69  | 2.14    | 0.03    |
| 105 Min.              | Desflurane | 25 | 64.89  | 7.32 | 1.68  | 0.33    | 0.71    |
|                       | Sevoflurane| 25 | 62.78  | 7.56 | 1.46  | 0.01    | 0.91    |
| 120 Min.              | Desflurane | 23 | 61.98  | 7.58 | 1.55  | 0.02    | 0.90    |
|                       | Sevoflurane| 22 | 62.78  | 7.56 | 1.54  | 0.02    | 0.90    |
| 135 Min.              | Desflurane | 18 | 64.78  | 8.79 | 1.72  | 0.02    | 0.90    |
|                       | Sevoflurane| 17 | 65.14  | 8.12 | 1.68  | 0.02    | 0.90    |
| 150 Min.              | Desflurane | 8  | 62.67  | 7.78 | 1.55  | 0.02    | 0.90    |
|                       | Sevoflurane| 9  | 61.37  | 8.45 | 1.74  | 0.02    | 0.90    |
| 165 Min.              | Desflurane | 6  | 64.94  | 7.76 | 1.70  | 0.02    | 0.90    |
|                       | Sevoflurane| 3  | 64.23  | 7.58 | 1.52  | 0.02    | 0.90    |

### Table 6: Comparison among study groups as per IoC value during surgery

| IoC Value | Group      | N  | Mean   | SD   | SEM   | t-value | P-value |
|-----------|------------|----|--------|------|-------|---------|---------|
| 15 Min.   | Desflurane | 25 | 44.76  | 3.19 | 0.64  | 1.65    | 0.11    |
|           | Sevoflurane| 25 | 46.20  | 2.99 | 0.60  | 0.66    | 0.51    |
| 30 Min.   | Desflurane | 25 | 47.04  | 3.14 | 0.63  | 0.89    | 0.37    |
|           | Sevoflurane| 25 | 46.36  | 4.10 | 0.82  | 0.03    | 0.97    |
| 45 Min.   | Desflurane | 25 | 46.00  | 5.37 | 1.07  | 0.02    | 0.90    |
|           | Sevoflurane| 25 | 47.40  | 5.69 | 1.14  | 0.02    | 0.90    |
| 60 Min.   | Desflurane | 25 | 45.04  | 4.68 | 0.94  | 0.02    | 0.90    |
|           | Sevoflurane| 25 | 45.08  | 4.10 | 0.82  | 0.02    | 0.90    |
| 75 Min.   | Desflurane | 25 | 45.60  | 2.96 | 0.59  | 0.02    | 0.90    |
|           | Sevoflurane| 25 | 44.76  | 3.60 | 0.72  | 0.02    | 0.90    |
| 90 Min.   | Desflurane | 25 | 44.84  | 3.59 | 0.72  | 0.02    | 0.90    |
|           | Sevoflurane| 25 | 44.96  | 3.76 | 0.75  | 0.02    | 0.90    |
| 105 Min.  | Desflurane | 25 | 45.64  | 3.49 | 0.70  | 0.02    | 0.90    |
|           | Sevoflurane| 25 | 44.52  | 4.62 | 0.92  | 0.02    | 0.90    |
| 120 Min.  | Desflurane | 25 | 46.04  | 3.86 | 0.77  | 0.02    | 0.90    |
|           | Sevoflurane| 25 | 45.60  | 4.56 | 0.91  | 0.02    | 0.90    |
| 135 Min.  | Desflurane | 23 | 47.22  | 4.10 | 0.86  | 2.29    | 0.03    |
|           | Sevoflurane| 22 | 44.55  | 3.67 | 0.78  | 1.36    | 0.08    |
| 150 Min.  | Desflurane | 18 | 46.56  | 3.88 | 0.92  | 1.36    | 0.08    |
|           | Sevoflurane| 17 | 44.69  | 4.14 | 1.04  | 0.36    | 0.18    |
| 165 Min.  | Desflurane | 8  | 44.25  | 4.20 | 1.49  | 0.93    | 0.37    |
|           | Sevoflurane| 9  | 46.10  | 4.23 | 1.34  | 0.02    | 0.90    |
| 180 Min.  | Desflurane | 6  | 47.67  | 1.97 | 0.80  | 1.14    | 0.29    |
|           | Sevoflurane| 3  | 49.33  | 2.31 | 1.33  | 0.02    | 0.90    |
Macario et al showed that patients receiving desflurane recovered 1–2 minutes quicker in the operating room than patients receiving sevoflurane. The limitation of our study is that the study design did not permit a double-blind comparison of the two inhalational anaesthetics. However, similar depth of anaesthesia was maintained with both volatile anaesthetics until the end of surgery to enable assessment of recovery from similar clinical end-points. Furthermore, the observers performing the recovery assessments were blinded.

5. Conclusion

The use of desflurane for maintenance of anaesthesia resulted in faster postoperative recovery, as compared to sevoflurane, in patients undergoing prolonged surgeries; while no significant difference was observed in NIBP, oxygen saturation, end tidal CO₂ and nasopharyngeal temperature.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Jensen EW, Jospin M, Gambús PL, Valverdú M, Caminal P. Validation of the Index of Consciousness (IoC) during sedation/analgesia for ultrasonographic endoscopy. In: Proceedings of the 30th annual International Conference of IEEE on Engineering in Medicine and Biology Society, Vancouver, BC, Canada; 2008. p. 20-24.
2. Graham SG. New drug in volatile anesthesia-desflurane. Ann Acad Med. 1994;23:510–8.
3. Rapp SE, Conahan TJ, Pavlin DJ, Levy WJ, Hautman B, Lecky J, et al. Comparison of desflurane with propofol in outpatients undergoing peripheral orthopedic surgery. Anesth Analg. 1992;75:572–9.
4. Graham SG, Atkenhead AR. A comparison between propofol and desflurane anaesthesia for minor gynaecological laparoscopic surgery. Anaesth. 1993;48(6):471–5. doi:10.1111/j.1365-205x.1993.tb06541.x
5. Jones RM, Cashman JN, Mant TGK. Clinical impressions and cardiorespiratory effects of a new fluorinated inhalation anesthetic, desflurane (1-535) in volunteers. Br J Anaesth. 1990;64(1):11–5. doi:10.1093/bja/64.1.11
6. Panikh SS, Chang F. Postoperative delirium in the elderly. Anesth Analg. 1999;89:1223–32.
7. Stoelting RK. Inhaled Anesthetics. In: Stoelting RK, editor. Pharmacology and physiology in anesthesia practice. Philadelphia: Lippincott Williams and Wilkins; 2006. p. 42–82.
8. Ebert TJ, Harkin CP, Muzi M. Cardiovascular Responses to Sevoflurane. Anesth Analg. 1995;81(Supplement):115–22S. doi:10.1213/00000539-199512001-00003
9. Revuelta M, Paniagua P, Campos JM, Fernández JA, Martínez A, Jospin M, et al. Validation of the index of consciousness during sevoflurane and remifentanil anaesthesia: a comparison with the bispectral index and the cerebral state index. Br J Anaesth. 2008;101(5):653–8. doi:10.1093/bja/aen245
10. Chakravarty M, Holla S, Jawali V. Index of consciousness and bispectral index values are interchangeable during normotension and hypotension but not during non pulsatile flow state during cardiac surgical procedures: a prospective study. J Clin Monitoring Comput. 2010;24(2):83–91. doi:10.1007/s10877-009-9214-8
11. Silva A, Ferreira DA, Venâncio C, Souza AP, Antunes LM. Performance of electroencephalogram-derived parameters in prediction of depth of anaesthesia in a rabbit model. Br J Anaesth. 2011;106(4):540. doi:10.1093/bja/aeq407
12. Heavner JE, Kaye AD, Lin BK, King T. Recovery of elderly patients from two or more hours of desflurane or sevoflurane anaesthesia †. Br J Anaesth. 2003;91(4):502–6. doi:10.1093/bja/aeg224
13. Welborn LG, Hannallah RS, Norden JM, Ruttimann UE, Callan CM. Comparison of emergence and recovery characteristics of sevoflurane, desflurane, and halothane in pediatric ambulatory patients. Anesth Analg. 1996;83:917–20.
14. Chen X, Zhao M, White PF, Li S, Tang J, Wender RH, et al. The Recovery of Cognitive Function After General Anesthesia in Elderly Patients: A Comparison of Desflurane and Sevoflurane. Anesth Analg. 2001;93(6):1489–94. doi:10.1093/anae/93.6.1489
15. Macario A, Dexter F, Lubarsky D. Meta-analysis of trials comparing postoperative recovery after anesthesia with sevoflurane or desflurane. Am J Health-Syst Pharm. 2005;62(1):63–8. doi:10.1007/s13677-009-9214-8

Author biography

Raj Kumar Choubey, Assistant Professor
Kirti Bhushan, Specialist
Geetanjali Singh, Consultant
Sachin Narayan Kulkarni, Professor
Manish Honwad, Professor
Rahul Yadav, Professor

Cite this article: Choubey RK, Bhushan K, Singh G, Kulkarni SN, Honwad M, Yadav R. Recovery from desflurane and sevoflurane anaesthesia after prolonged surgery - A comparative study using Index of Consciousness (IoC) monitoring. Indian J Clin Anaesth 2021;8(1):68-73.