International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

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

Dr. M. Raghu Praveen Kumar[1], Dr. T. Swathi Priyadarshini[2]

[1]M.D (Anaesthesia, Associate Professor, Department of Anaesthesia, Great Eastern Medical School, Ragole, Srikakulam, India
Email: *mrpk2002[at]gmaik.com*

[2]Assistant Professor, Department of Anaesthesia, Kurnool Medical College, Kurnool. Andhra Pradesh, India
Email: *swathi.talikota[at]gmail.com*

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, responseto 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 difference 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 respectivelyand 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

anaesthesia.

Type of study: A randomized clinical study planned.

Inclusion criteria:
1) Patients aged between 20-70 years of both sexes.
2) Patients Belonging to ASA grade I, andII.
3) Patients who gave informed written consent.

Exclusion criteria: -
1) Patients belonging to ASA grade III &IV.
2) Patient refusal.
3) Those with clinically significant cardiovascular, respiratory, hepatic, renal, neurologic, psychiatric or metabolic disease.
4) Patients of less than 20 years and more than 70 years of age.

Groups: Patients were randomly allocated into two groups using computer generated randomization chart.

- Group D- Receiving Desflurane 4%in 30 patients
- Group S- Receiving Sevoflurane 2% in 30 patients

3. Methods

Pre-Anaesthetic Assessment:
Patients demographic data like age, height, weight, history, and findings of the examination of the airway, cardiovascular and other systems were recorded. Routine investigations like Hemoglobin, Blood Urea, Creatinine, Chest X-ray, ECG were done in all patients. All the patients were kept nil by mouth 6-8 hours pre-induction. Written and informed consent was taken.

Premedication:
Intravenous(i.v). access secured. All patients were premedicated with Inj. Glycopyrrolate 0.004mg/kg IV, and Inj. Ondansetron 0.1mg/kg IV, Inj. Midazolam 0.02mg/kg IV, Inj. Fentanyl 2-3 µg/kg IV given before induction. On arrival of patients in the operating room, antibiotic inj. Ceftriaxone 1 gm iv administered. The patients were connected to monitor which records pulse rate (PR), non-invasive measurements of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP), and oxygen saturation (SPO_2), end-tidal carbon dioxide ($ETCO_2$). The baseline blood pressure and pulse rate were recorded.

Induction and Maintenance
General anaesthesia was induced with IV thiopentone sodium 5 mg/kg. After the loss of consciousness (confirmed by loss of eyelash reflex) and after assessing jaw relaxation, patient intubated with vecuronium 0.1 mg/kg. Anaesthesia was maintained initially with either desflurane 4% or (group 1), sevoflurane 2% (group 2) in combination with N_2O 70% and 30% O_2. The concentration of maintenance anaesthetic varied to maintain hemodynamic variables within 20% of pre-induction values. Haemodynamic parameters heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, end-tidal carbon dioxide were all measured every 15 mins until the procedure was completed. All patients were mechanically ventilated to maintain end-tidal CO_2 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 for30 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 toappropriately.

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 (0.69and 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/bloodsolubility.

There was no difference in hemodynamic parameters using LMA.

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

Type of Tissue	Desflurane	Sevoflurane
Blood	0.45	0.65
Bone	0.6	1.1
Muscle	0.6	1.1
Fat	15	41

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

Age	MAC in 100% oxygen	MAC in 60% nitrous oxide
0–1 year	8.95–10.65	5.75–7.75
1–12 years	7.2–9.4	5.75–7.0
18–30 years	6.35–7.25	3.75–4.25
30–65 years	5.75–6.25	1.75–3.25
Over 65 years	5.17+/-0.6	1.67+/-0.4

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 potentthan 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)	Sevofluranein O_2	Sevofluranein 65% N_2O/35% O_2*
<3	3.3-2.6%	2.0%
3-<5	2.5%	Not available
5 – 12	2.4%	Not available
25	2.5%	1.4%
35	2.2%	1.2%
40	2.05%	1.1%
50	1.8%	0.98%
60	1.6%	0.87%
80	1.4%	0.70%

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 ether 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 reversingbronchospasm.

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 withsevoflurane.

Sevoflurane is not associated with a convulsive or epilepticactivity.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 CO_2) 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 renaldysfunction.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 ofanaesthesia.

Sevofluraneand desfluraneproduces 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 receivingdesflurane.

5. Conclusion

1) We conclude from the present study; desfluraneanaesthesia produces faster emergence and early recovery compared to sevofluraneanaesthesia.
2) Intraoperative haemodynamic parameters were similar in both thegroups.
3) Late recovery features of both desflurane and sevoflurane are the same, and there is not a muchdifference.
4) Both are ideal agents for outpatient anaesthesia; sevoflurane is more pleasant than desflurane in view of its acceptablesmell.
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.

References

[1] Michael H. Nathanson, MRCP, FRCA, Brian Fredman, MB, Bch, Ian Smith, FRCA, and Paul F. White, PhD, MD, FANZCA. Sevoflurane versus desflurane for outpatient anaesthesia: A comparison of maintenance and recovery profiles. Anesth Analg 1995; 81:1186-90.

[2] Welborn, Leila G. MD; Hannallah, Raafat S. MD; Norden, Janet ML.MSN; Ruttimann, Urs E. PhD; Callan, Clair M. MD; Comparison of Emergence and Recovery Characteristics of Sevoflurane, Desflurane, and Halothane in Pediatric Ambulatory Patients ; Anesthesia & Analgesia: November 1996 - Volume 83 - Issue 5 - pp917-920

[3] J.Dupont B Tavernier Y Ghosez L Durinck A Thevenot N Moktadir-ChalonsLRuyffelaere-Moises N Declerck P Scherpereel; Recovery after anaesthesia for pulmonary surgery: desflurane, sevoflurane and isoflurane. ; BJA: British Journal of Anaesthesia, Volume 82, Issue 3, 1 March 1999, Pages 355–359

[4] Xiaoguang Chen, MD, Manxu Zhao, MD, Paul F. White, PhD, MD, FANZCA, Shitong Li, MD,Jun Tang, MD, Ronald H. Wender, MD, Alexander Sloninsky, MD, Robert Naruse, MDRobertKariger, MD, Tom Webb, MD, and Eve Norel, MD. The recovery of cognitive function after general anaesthesia in elderly patients: A comparison of desflurane and sevoflurane. AnesthAnalg 2001; 93:1489–94.

[5] Earl M. Strum, MD, Janos Szenohradszki, MD, PhD, Wayne A. Kaufman, MD, Gary J. Anthone, MD, MS, BA, Ingrid L. Manz, CRNA, MSN, and Philip D. Lumb, MB, BS, FCCM Emergence and Recovery Characteristics of Desflurane Versus Sevoflurane in Morbidly Obese Adult Surgical Patients: A Prospective, Randomized Study - AnesthAnalg2004;99:1848–53

[6] S Gergin, B Cevik, G Yildirim, E Ciplakligil, S Colakoglu ; Sevoflurane Vs Desflurane: Haemodynamic Parameters And Recovery Characteristics ; The Internet Journal of Anesthesiology, 2004 vol9 number1

[7] G.B. Saros, A. Doolke, R. E. Anderson, J.G. JakobssonDesflurane vs sevoflurane as the main inhaled anaesthetic for spontaneous breathing via a laryngeal mask for varicose vein day surgery: a prospective randomized study ActaAnaesthesiologicaScandinavica Volume 50, Issue 5 May 2006 Pages549–552

[8] GulcanErk, Gulay Erdogan, FaziletSahin, VildanTaspinar, BayazitDikmen: Which One Is Better Anesthetic For Laparoscopic Cholecystectomy: Desflurane, Sevoflurane or Propofol?. The Internet Journal of Anesthesiology. 2006. Volume 10 Number2

[9] Faster wash-out and recovery for desflurane vs sevoflurane in morbidly obese patients when no premedication is used L. La Colla1., A. Albertin, G. La Colla and A. Mangano - British Journal of Anaesthesia 99 (3): 353–8(2007)

[10] White P, Tang J, Wender R, Yumul R, Stokes O, Sloninsky A, Naruse R, Kariger R, Norel E, Mandel S, Webb T. Desflurane Versus Sevoflurane for Maintenance of Outpatient Anesthesia: The Effect on Early Versus Late Recovery and Perioperative Coughing. Anesthesia & Analgesia. 2009 Aug1;109(2):387-93.

[11] R.E.McKay, A.Malhotra1, O. S. Cakmakkaya, K.T.Hall, W.R.McKay and C.

[12] C. Apfel. Effect of increased body mass index and anaesthetic duration on recovery of protective airway reflexes after sevoflurane vs desflurane. Br J Anaesth 2010; 104: 175– 82.

[13] D. Rortgen, J. Kloos, M. Fries, O. Grottke, S. Rex, R. Rossaint and M. Coburn.Comparison of early cognitive function and recovery after desflurane or sevofluraneanaesthesia in the elderly: a double-blinded randomized controlled trial. Br J Anaesth 2010; 104:167–74

[14] Ravi Jindal, Ved Prakash Kumra, Krishan Kumar Narani, and JayashreeSood; Comparison of maintenance and emergence characteristics after desflurane or sevoflurane in outpatient anaesthesia; Indian J Anaesth. 2011 Jan-Feb; 55(1):36–42

[15] Marana E , Russo A, Colicci S , Polidori L , Bevilacqua F, Viviani D , Di Stasio E ; Desflurane versus sevoflurane: a comparison on stress response ; Minerva Anestesiologica [22 Oct 2012, 79(1):7-14]

[16] JalanErgönenç, TolgaErgönenç, KadirİdinUğurUzun, Ali Dirik, GökhanGedikli, and GülşenBican ; The recovery time of sevoflurane and desflurane and the effects of anesthesia on mental and psychomotor functions and pain ; Anesthesia Essays and Research. 2014 Sep-Dec; 8(3):367–371

[17] Patel M, Parmar N. Comparison of hemodynamic parameters and recovery characteristics between sevoflurane and desflurane in patients undergoing day care gynaecological laparoscopic surgery. Int J Med Sci Public Health2016;5:1412-1416

[18] Airway Reflexes Return More Rapidly After DesfluraneAnaesthesia Than After SevofluraneAnaesthesia Rachel EshimaMckay, MD., Mary Jane C. Large, RN, BSN, Michel C. Balea, MS., and Warren R. Mckay, MD - (AnesthAnalg 2005;100:697– 700)

[19] Dalal KS, Choudhary MV, Palsania AJ, Toal PV. Desflurane for ambulatory anaesthesia: A comparison with sevoflurane for recovery profile and airway responses. Indian J Anaesth2017; 61:315-20.

[20] KurhekarP, Vinod K, Krishna JS, RaghuramanMS. Randomized comparison of isoflurane versus sevoflurane and desflurane for maintenance of ambulatory anaesthesia.AnesthEssaysRes2017;11:875-80

[21] Chudasama PA, Mehta MV. Comparison of hemodynamic parameters and recovery characteristics between sevoflurane and desflurane in patients undergoing day-care surgical procedure. Adv Hum Biol 2018; 8:140-4.