

Comparison of Awareness using BIS Monitoring and Recovery Profile in Laparoscopic Cholecystectomy Surgery: A Comparison between Desflurane and Isoflurane

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Abstract:

Background and Aim: General anesthesia using agents like Desflurane or Sevoflurane are beneficial for early recovery especially for ambulatory procedures. The aim of this study was to compare the hemodynamic, emergence & recovery characteristics of isoflurane & desflurane in GA for patients undergoing laparoscopic Cholecystectomy operations.

Material and Methods: A Prospective Randomized and comparative study was conducted in 50 patients posted for elective Laparoscopic cholecystectomy. 50 patients were randomly allocated in 2 groups (n=25) Group I: Anaesthesia maintained with 60% N₂O in O₂ and Isoflurane Group D: Anaesthesia maintained with 60% N₂O in O₂ and desflurane. Following parameters were observed –bis value for awareness (depth of anesthesia), recovery profile (specifically time to eye opening, time to obeying commands, time to tracheal extubation, and time to achieving discharge criteria, hemodynamic parameters including HR and MAP and complications

Results: Systolic blood pressure difference was statistically significant between the two groups at 5 minutes and 90 minutes after induction. Desflurane cause statistically significant increase in HR and in some observation increase in SBP also. There was significant difference in Post- operative cognitive functions recovery among both the groups. In group D 3 cases develop nausea and vomiting while in group 2 and 1pt develop nausea & vomiting respectively.

Conclusion: Recovery profile of desflurane is faster than isoflurane. Though total cost of desflurane is higher as compared to isoflurane, but use of desflurane can be justified with faster emergence from anaesthesia, faster shifting from PACU as recovery of cognitive function is also early discharge, lesser complication, which will cause lesser hospital stay, lower chance of nosocomial infection and over all lower cost of hospital stay.

Keywords: Desflurane, Isoflurane, Laparoscopic Cholecystectomy, Systolic blood pressure.

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Introduction

One of the major factors that determine speed of recovery from anaesthesia is the choice of anaesthetic technique. [1] An ideal General anaesthesia should provide smooth & rapid induction, optimal operating conditions and rapid recovery with minimal side effects such as nausea, vomiting, bleeding & post op pain. Inhaled volatile anesthetics remain the most widely used drugs for maintenance of GA because of their ease of administration & predictable intraoperative & recovery characteristics, rapid onset & offset and low solubility in blood. [1] Among all the inhaled anesthetics available with those having low blood

gas coefficients like isoflurane and desflurane, a more rapid emergence from anaesthesia is expected. [2] Isoflurane is an inhalational anesthetic whose low solubility enables a rapid induction & recovery from anaesthesia. The insignificant pungency of isoflurane may border the rate of induction, although extreme salivation or tracheobronchial secretions do not seem to be stimulated. [3] Desflurane is a fluorinated methyl ethyl ether. It has a pungent odour, is irritable to the respiratory tract, and is non-inflammable. Low solubility of desflurane in blood and body tissues leads to rapid induction and recovery. It does not

predispose to ventricular arrhythmias. [4,5] Maintenance characteristics can be assessed by various monitoring techniques, which include electrocardiogram, oxygen saturation, noninvasive mean arterial pressure (MAP), heart rate, and ET_{CO2} along with assessment of intraoperative awareness by BIS monitoring. [6]

Awareness during general anaesthesia is undesired, unanticipated patient wakefulness during surgery or recall afterward. The incidence of awareness under anaesthesia is probably underestimated because very often conscious recall is taken, as evidence. The incidence of intraoperative awareness has been reported to be 0.2% to as high as 40% in high risk situations like trauma, caesarean sections and during cardiac surgery. [7,8] Out of all the monitoring systems that have been designed to estimate the depth of anaesthesia BIS offers advantage over several technologies. [9,10]

The purpose of this prospective randomized controlled study was to compare the intraoperative awareness at MAC of desflurane or isoflurane by using BIS, in patients undergoing laparoscopic cholecystectomy under general anaesthesia. The aim of this study was to compare the hemodynamic, emergence & recovery characteristics of isoflurane & desflurane in GA for patients undergoing laparoscopic Cholecystectomy operations.

Material and Methods

Present prospective, randomized, and comparative one conducted during the years 2016-2018 with permission of INSTITUTE ETHICS COMMITTEE (IEC) IEC No. PDU/MCR/IEC/19062/2016 for guided research after informed written consent of 50 patients of age 18-65 years and above posted for elective Laparoscopic cholecystectomy.

Inclusion Criteria

Patients undergoing LC above 18 -65 years of age of either gender of ASA grade 1 & 2

Exclusion Criteria

- Known Allergy isoflurane or desflurane
- Patients with history of neuro-psychiatric disorder
- Known case of bronchial asthma
- Patients with hepato-renal dysfunction
- Patients with history of alcohol consumption

All patients were examined pre - operatively and noted. Detail personal history regarding drug allergy, surgical, medical as well as detailed history related to anaesthesia was Obtained and noted. 50 patients were randomly allocated in 2 groups (n=25)

Group I: Anaesthesia maintained with 60% N₂O in O₂ and Isoflurane

Group D: Anaesthesia maintained with 60% N₂O in O₂ and desflurane.

All patients underwent a pre-anaesthetic check-up before surgery and all the routine and specific investigations were documented. The patients were kept nil per oral for 6 hours before surgery. Prior to operation patients were explained about the procedure and written informed consent was taken. Standard monitors like ECG, NIBP, and pulse oximeter were applied to patients and patients' baseline parameters like pulse, blood pressure, respiratory rate, spO₂ were recorded.

All patients were preoxygenated prior to induction of anaesthesia. Anaesthesia was induced with propofol 2.5mg/kg iv and succinylcholine 1.5mg/kg. After loss of consciousness, ventilation of lungs was manually assisted and then put on ventilator. The patients subsequently received either isoflurane 1-2% or desflurane 3- 6% with 50% nitrous oxide in oxygen. The inspired concentration of the volatile anaesthetic was adjusted to maintain MAP within 20% of baseline values. Rescue bolus doses of metoprolol 0.1mg/kg was administered to control acute haemodynamic changes not responding to a 50% increase in inspired concentration of the volatile anesthetic agent.

Muscle relaxation was maintained using intermittent doses of vecuronium bromide at appropriate intervals, on the bases of TOF scoring by PNS. Intraoperative monitoring of pulse, SBP, DBP, SpO₂, Dial flow with monitoring of end tidal volume was done at every 5 minutes till 20 minutes then at 30min and after that at every 15 minutes till surgery got over. Change of dial setting was done according to patient's hemodynamic changes. Reversal was done with inj. glycopyrrolate dose 0.008mg/kg and inj. neostigmine dose 0.05mg/kg. Extubation was done after proper criteria for extubation were met. After closure, inhalational recovery parameters was assessed as time to eye opening, time to respond to verbal command, to extubation, modified Aldrete's score at time of shifting to recovery.

Statistical analysis: The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were described as means and standard deviations or median and interquartile range based on their distribution. Qualitative variables were presented as count and percentages. For all tests, confidence level and level of significance were set at 95% and 5% respectively.

Results

Table 1: Demographic characteristics (mean \pm SD)

Variable	Group D	Group I	P Value	Significance
Age(yrs)	38.28 \pm 15.0	32.96 \pm 15.49	0.2248	NS
Weight (kgs)	58.68 \pm 11.07	60.76 \pm 9.47	0.4789	NS
Duration of surgery (min)	111.6 \pm 7.32	114.28 \pm 6.36	0.1736	NS

The groups were comparable with respect to age, weight, and duration of surgery.

Systolic blood pressure difference was statistically significant between the two groups at 5 minutes (group D 127.6 \pm 9.03 and group I 121.2 \pm 7.48) and 90 minutes (group D 115.4 \pm 8.55 and group I 121.2 \pm 6.94) after induction. Diastolic blood pressure difference was statistically significant between 30, 45, 90 minutes after induction. Mean blood pressure difference was statistically significant between 30 minutes after induction in group D MBP (93.76 \pm 4.03) and group I (89.54 \pm 5.88). Heart rate increased in group D with maximum increase in heart rate 110.16 \pm 6.97 was seen 10 min after induction and group I maximum heart rate was 83.2 \pm 5.74 at 60 min after induction. Regarding Post op SBP measurement There was statistically significant difference between two group just after

extubation (group D 112.56 \pm 9.13 and group I 120.08 \pm 8.05), 1 hr (GROUP D 121.84 \pm 7.72 AND GROUP I 114.24 \pm 9.36) and 6 hrs (121.52 \pm 7.00 and GROUP I 125.28 \pm 6.42). Regarding Post op DBP there was statistically significant difference between two groups just after extubation to 24 hrs post op period. Regarding post op mean BP there was statistically significant difference in both groups up to 24hour postoperatively except at 30 min (group D 85.95 \pm 4.26 and group I 83.36 \pm 4.98) it was not significant.

Regarding Post op HR There was statistically significant difference in post op HR Between two group just after extubation (group D 84.64 \pm 6.89 and group I 75.8 \pm 7.53), 30 min (group D 88.32 \pm 6.96 and group I 79.88 \pm 5.40), 1 hr (group D 86.32 \pm 6.96 and group I 77 \pm 6.39) and 4 hr (group D 86.8 \pm 5.77 and group I 83.2 \pm 6.87)

Table 2: Post-Operative Cognitive Functions Recovery

Time(Min)	Group D	Group I	P Value	Significance
Eye Opening	6.06 \pm 0.86	9.6 \pm 1.08	0.0001	HS
Verbal Command	7.3 \pm 0.88	11.06 \pm 1.12	0.0001	HS
Extubation	8.58 \pm 0.96	14.3 \pm 1.13	0.0001	HS
Sedation score	2.0 \pm 0	1.8 \pm 0.4	0.01	S
Modified Aldrete's Score at 30 Mins of Extubation	10 \pm 0	9.16 \pm 0.37	0.0001	HS
MMSE Score	30 \pm 0	28.8 \pm 1.58	0.0004	HS

There was significant difference in Post- operative cognitive functions recovery among both the groups. Mean eye opening in Group-I was 9.6 \pm 1.08 minutes and in Group D 6.06 \pm 0.86 minutes. Mean time to follow verbal command in Group-I was 10.7 \pm 1 minutes and in Group D 7.1 \pm 0.9. Minutes The mean time to extubation in Group I was 11.06 \pm 11.2 minutes and Group D was 7.3 \pm 0.88minutes. Recovery was faster and better in Group D. Modified Aldrete's score and MMSE score was higher in Group D.

Table 3: Complications and Drug Used

Complications	Group D	Group I	Drug used
Nausea	3	2	Ondansetron(iv)
Vomiting	3	1	Ondansetron(iv)
Chest pain	-	-	
Convulsion	-	-	
Bradycardia	-	-	
Laryngospasm	-	-	

In group D 3 cases develop nausea and vomiting while in group 2 and 1pt develop nausea & vomiting respectively which was manageable with inj. Ondansetron.

Table 4: BIS Score

Time(Min)	Group D	Group I	P Value	Significance
Before induction	95.4 \pm 2.16	96.32 \pm 1.93	0.11	NS
Just after induction	44.92 \pm 3.66	45.28 \pm 2.77	0.69	NS
5 min	45.6 \pm 3.20	46.12 \pm 4.28	0.62	NS
10 min	48.32 \pm 5.49	46.36 \pm 4.452	0.16	NS
15 min	47.12 \pm 4.78	46.28 \pm 3.71	0.49	NS
30 min	47.4 \pm 5.06	45.88 \pm 3.96	0.20	NS

45 min	45.84+ 2.44	46.64+ 3.55	0.35	NS
60 min	46.36+ 4.9	45.64+3.2	0.54	NS
75 min	50.84+ 5.60	47.48+ 4.13	0.019	NS
90 min	49.12+ 5.93	46.52+ 4.21	0.08	NS
105 min	49.84+ 6.01	46.28+ 3.95	0.016	S
120 min	62.32+ 6.65	49.61+ 5.72	0.0001	HS
Just after extubation	90.32+1.37	87.8+2.08	0.0001	HS

There is no significant difference in both groups before induction. Highest bis score in group D seen at 120 min 62.32+6.65. There is no significant difference in both groups during intra op period. and at the end of surgery there is significant difference between two group in group D(62.32+6.65 and group I49.61+ 5.72)and just after extubation BIS score between two group (90.32+1.37 in group D and 87.2+2.08 in group I) which was statistically significant.

There was significant difference in cost benefit ratio among both the groups. In Group I, Total mean volume of inhalational agents was 11.71+0.5 ml and means cost was Rs. 120.6±6.72. In Group D, Total means volume of inhalational agents was 42.3±4. ml and mean cost was Rs.1513±139.2 Inhalational agents was used and cost was higher in Group D. There is no difference in both group among patients, anesthesiologist, surgeon satisfaction score.

Discussion

One of the most common procedures to be carried out laparoscopically is laparoscopic cholecystectomy. Since the procedure is associated with very little postoperative morbidity, these patients can potentially recover much earlier and be discharged from hospital care. The pharmacokinetics of desflurane and sevoflurane favor better intraoperative control of anesthesia and a rapid postoperative recovery. They have significantly lower blood/gas partition coefficients than isoflurane (1.4) or halothane (2.4). The lower fat/blood partition coefficient of desflurane, should favor its early elimination from the body resulting in early recovery. [11,12]

BIS has been shown to correlate well with anesthetic depth for a number of agents. Recovery of consciousness during general anaesthesia without any recall has generally been associated with BIS value 60. BIS values in a range of 40-60 have been proposed for producing adequate degree of hypnosis during anaesthesia and thus, BIS can be very useful for reducing the risk of intraoperative awareness. Thus, present study was done to compare the effects of equipotent concentration of desflurane and isoflurane for intraoperative adequacy of depth of anaesthesia by using BIS monitoring and compare the recovery profile in both groups in laparoscopic cholecystectomy surgery.

In our study both groups were demographically comparable and there was no any statistical significant difference between the two groups. SBP difference was statistically significant between the two groups at 5minutes and 90 minutes after induction. Dupont et al [13] studied maintenance and recovery profiles after general anaesthesia with sevoflurane, desflurane and isoflurane in 100 patients undergoing pulmonary surgery. There were no significant differences between isoflurane and desflurane groups as SBP was maintained within 20% of baseline values during maintenance by the two inhalational anesthetics in patients scheduled for elective lobectomy or pneumonectomy.

In our study, there was significant difference in both groups preoperatively. Mean DBP of group I was 76.08 + 6.48, while in group D, it was 70.48 + 4.09, which was highly significant. But after induction, we found that, highest DBP 79.44±5.08 belonged to Group D 30 minutes after induction. Fraga et al [14] observed that there was significant difference between isoflurane and desflurane groups in patients scheduled for craniotomy and removal of brain tumours with no evidence of a midline shift as DBP decreased significantly in all patients of both groups, though slight more reduction of DBP in desflurane group was observed compared with the baseline values.

There was significant difference of MBP in both groups preoperatively. MBP of group I was 89.12 + 5.07, while in group D it was 84.56 + 5.77, which was highly significant. Dupont et al [13] studied maintenance and recovery profiles after GA with sevoflurane, desflurane and isoflurane in 100 patients undergoing pulmonary surgery, 100 patients allocated randomly to one of three groups: sevoflurane, desflurane or isoflurane anaesthesia. there were no significant differences between isoflurane and desflurane groups as MBP was maintained within 20% of baseline values during maintenance by the two inhalational anaesthetics in patients scheduled for elective lobectomy or pneumonectomy.

There was significant difference in HR among both groups before induction in I group, while in D group. The HR increased in group D with maximum increase in HR 110.16+6.97 was seen 10 min after induction and group I maximum HR was 83.2±5.74 at 60 min after induction. Loan et al [15], compared the HR changes in patients

scheduled for dental surgeries. They studied 50 patients which divided into two groups and induced with fentanyl 1-2 mcg/kg and propofol 1-3 mg /kg and ventilated with 66% N₂O with O₂ manually. There were changes in HR in both groups that was higher in desflurane group and was statistically significant.

There was statistically significant difference in statistically significant difference between two groups just after extubation, 1 hr and 6 hrs. In DBP, there was statistically significant difference between two groups just after extubation to 24 hrs post op period.

Overall our observations and results regarding hemodynamic changes in this study show that desflurane can produce higher blood pressure and higher heart rate ranges in comparison to isoflurane.

There was significant difference in post-operative cognitive functions recovery among both the groups. Mean time to follow verbal command in Group I was 10.7±1 minutes and in Group D 7.1±0.9. Minutes and mean eye opening was also shorter in desflurane group. Mean time to extubation which was 6 min earlier than isoflurane, which is statistically highly significant. Jakobsson et al [16], who studied 70 pt female patients scheduled for elective gynaecological laparoscopic procedures.

Patients receiving desflurane were extubated earlier than patients receiving isoflurane; group D 5 +/- 1 and Group I 9 +/- 1 min respectively (P < 0.05) and the patients anaesthetized with desflurane were able to tell their name and date on average 5 min earlier than those who had received isoflurane. Findings are similar to our study. Ved Prakash et al [17] did Comparison of maintenance and emergence characteristics after desflurane or sevoflurane in outpatient anaesthesia.

Both sevoflurane and desflurane have shorter emergence times compared to isoflurane based anaesthesia. Because of its pharmacological properties, desflurane appears to yield a rapid early and intermediate recovery compared with sevoflurane. The aim of this study was to assess the maintenance and emergence characteristics after anaesthesia with sevoflurane or desflurane.

Incidence of nausea and vomiting in group D were observed in 6 patients, whereas in group I, there were 3 patients affected with nausea and vomiting. Incidence is higher in desflurane group, but it was not statistically significant. There is no significant difference in both groups before induction. There is no significant difference in both groups during intra op period. In GA required BIS score between 40-60 and in our study both group maintained BIS score 40 - 60 through intra op period, and at the end of

surgery there is significant difference between two groups in group D and just after extubation BIS score between two groups which was statistically significant.

This shows that recovery is faster in desflurane group by achieving higher BIS value earlier than isoflurane. Kreuer et al [18], showed that there were no significant differences in BSI values between isoflurane and desflurane groups in patients scheduled for radical prostatectomies. By use of BIS monitor, we can easily titrate general anesthetic agents during anaesthesia. Furthermore, with this BIS values, we can easily diagnose that causes of high HR &BP is not because of lighter plane of anaesthesia.

There was significant difference in cost benefit ratio among both the groups. Cost of desflurane is quite high in comparison to isoflurane. Furthermore, required MAC for desflurane is also high, so volume consumption will also be high. But, overall recovery of cognitive function is earlier in desflurane group. So, discharge criteria can be met earlier than in isoflurane group. Overall hospital stay can be reduced in desflurane group.

There is no difference in both groups among pt, anesthesiologist, and surgeon satisfaction score. Hong Yu et al [19] Early postoperative recovery in operating room after desflurane anaesthesia combined with BIS monitoring and warming in lengthy abdominal surgery: a randomized controlled study found that Anaesthetist satisfaction in group DES 4.71±0.67 &group control 4.54±0.82 p value 0.21 surgeon satisfaction in group DES 4.86±0.43.

Conclusion

Recovery profile of desflurane is faster than isoflurane. Though total cost of desflurane is higher as compared to isoflurane, but use of desflurane can be justified with faster emergence from anaesthesia, faster shifting from PACU as recovery of cognitive function is also early discharge, lesser complication, which will cause lesser hospital stay, lower chance of nosocomial infection and over all lower cost of hospital stay.

Desflurane group patient achieve higher BIS value earlier in comparison to isoflurane.

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