

Does Perioperative Lidocaine Infusion Decrease the Minimum Alveolar Concentration of Isoflurane viz-a-viz Depth of Anaesthesia using Processed Electroencephalogram (Bispectral Index)

Khairat Mohd¹, Aatif Sha², Samiksha Khanooja³

ABSTRACT

Introduction: Minimal alveolar concentration (MAC) of volatile anaesthetics is that which prevent movement in 50% of subjects in response to a noxious stimulus. MAC is influenced by several drugs like fentanyl, midazolam, propofol, clonidine. Various successful studies have been done to demonstrate the effect of IV anaesthetics and opioids on MAC of various inhaled anaesthetics in balanced anaesthesia settings. To assess the effect of a perioperative lidocaine infusion on the MAC of isoflurane in a balanced anaesthesia technique by correlating it with the depth of anaesthesia as assessed by the Bispectral Index (BIS).

Material and methods: It is a prospective randomized study consisting of 100 patients. The patients were categorized into group L and group S, Group L received a bolus of 1.5mg/kg of lidocaine five minutes before the induction of general anaesthesia followed by 1.5mg/kg/hr of lidocaine infusion till the end of the surgical procedure or upto a maximum of three hours (whichever was earlier). Group S received saline similarly. BIS was maintained between 40 to 60 and MAC of isoflurane was measured in both group.

Result: Significant difference with regard to MAC of isoflurane used to maintain anaesthesia was noted between the two groups. It was found overall average MAC of isoflurane in Group L was (0.761±0.011) and control group was (0.885±0.020).

Conclusion: Our study found that lidocaine loading dose followed by infusion significantly reduces volatile anaesthetic requirement as measured by MAC of isoflurane

Keywords: Depth of Anaesthesia, Bispectral Index, Isoflurane, Lidocaine

The effect of intravenous anaesthetics and opioids on the MAC of various inhaled anaesthetics in a balanced anaesthesia setting have been studied.^{6,7} In this study we aimed to study the effect of perioperative lidocaine infusion on the MAC of isoflurane in a balanced anaesthesia technique by correlating it with the depth of anaesthesia as assessed by the Bispectral Index (BIS).

MATERIAL AND METHODS

The study was a prospective, randomized double blinded, placebo controlled trial and included 100 patients. Permission from the Institutional ethical committee was taken and due written informed consent from the participants of the study was taken.

Inclusion criteria

1. Patients of both genders above the age of 18 years undergoing general anaesthesia and surgery.
2. ASA physical status I and II.
3. Duration of surgery less than or equal to 3 hours.

Exclusion criteria

1. Refusal to participate in the study.
2. Allergic to lidocaine.
3. Pre-existing Respiratory, renal, cardiovascular or hepatic disease.
4. Body weight greater than or equal to 90 kilograms.
5. Pregnant. A thorough menstrual history of every woman in the reproductive age group was taken.
6. History of drug abuse, poor comprehension and a psychiatric disturbance which limited proper patient cooperation.

The patients were categorized into group L (Lidocaine) and

INTRODUCTION

The induction of immobility in response to surgical stimulation is an essential feature of general anaesthesia. The capability of volatile anaesthetics to immobilize patients who are exposed to noxious stimulation is measured using the MAC which is defined as “the minimum alveolar concentration of anaesthetic that prevents movement in 50% of subjects in response to a noxious stimulus.”¹ The MAC is influenced by several drugs including fentanyl², midazolam³, propofol⁴, and clonidine.⁵ Several brain-function monitors based on the processed electroencephalogram or evoked potentials have been developed to assess anaesthetic depth. BIS value range from 100 to 0, reflecting the awake state and the absence of brain activity, respectively. BIS values between 40 and 60 indicate adequate general anaesthesia for surgery, and value below 40 indicate a deep hypnotic state.

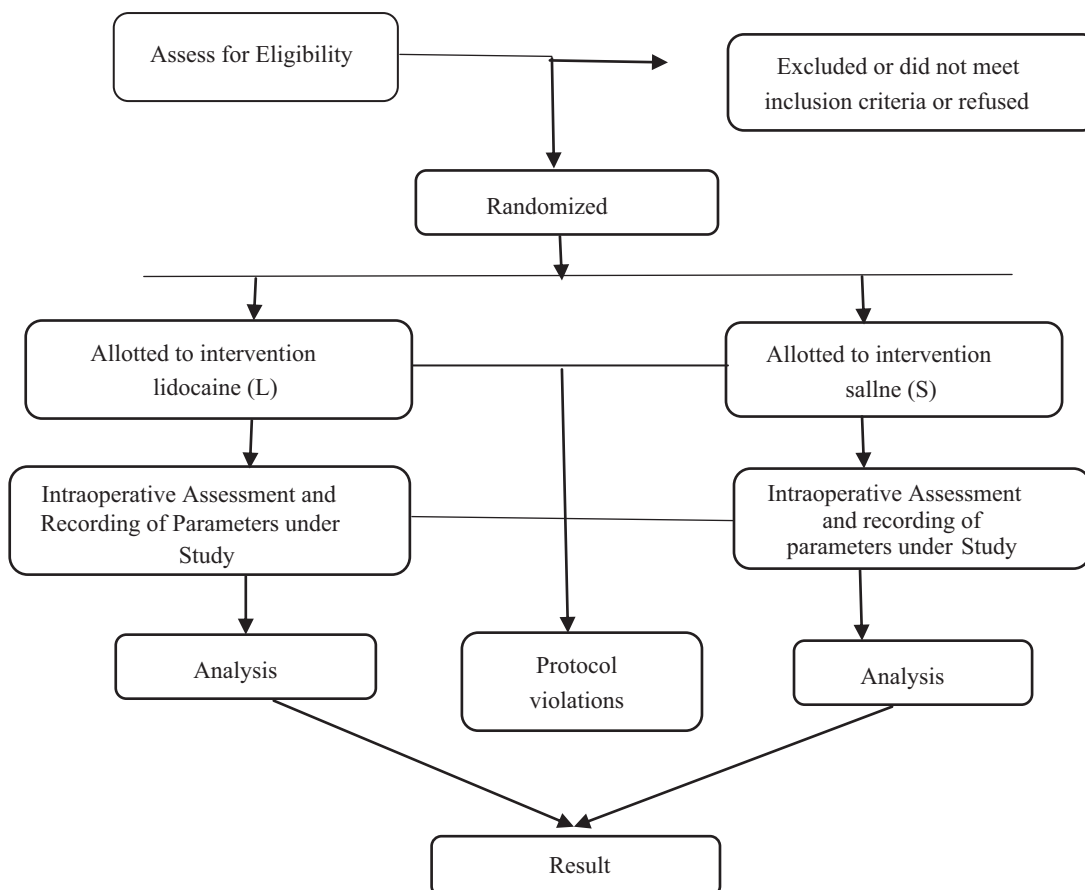
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Flow study diagram



group S (Saline), each containing fifty patients. A reliable intravenous access was secured on the non-dominant hand. Group L received a bolus of 1.5mg/kg of lidocaine five minutes before the induction of general anaesthesia followed by 1.5mg/kg/hr of lidocaine infusion till the end of the surgical procedure or upto a maximum of three hours (whichever was earlier). Low dose lidocaine well below the maximum recommended dose of 3 mg/kg was used to ensure no toxic effects are seen.²⁰ Group S was given the same volume of normal saline. Group allotments were done at random and by research personnel not directly involved with patient care. The same research personnel prepared syringes labelled with the study drug to blind subjects enrolled in the study, anaesthesia providers, and investigators collecting the data. All the subjects were premedicated with 0.25 mg Alprazolam tablet and 40mg of pantoprazole tablet.

The patients were shifted to the operating room on a trolley with oxygen facility and SpO₂ monitor. BIS electrodes were attached and a baseline reading of BIS was taken. Anaesthesia was induced with 2mg/kg body weight of propofol. Fentanyl 1.5 mcg/kg was used for analgesia on induction and atracurium 0.5mg/kg was used to induce a neuromuscular block. Bag and mask ventilation was done for 3 minutes. Tracheal intubation was performed by a qualified anaesthetist. Anaesthesia maintenance was achieved using oxygen, nitrous, isoflurane and atracurium

titrated to maintain a blood pressure within 20% of the baseline and a BIS (bispectral index) between 40 and 60. Gas flows were kept constant between the two groups. During the intraoperative period measurements of MAC of isoflurane used to maintain anaesthesia within the prefixed limits were taken at regular intervals. Intraoperative standard doses of opioid analgesics were given to both Group L and Group S. Neuromuscular blockade was reversed at the end of the surgical procedure using 60 mcg/kg of Neostigmine and 10 mcg/kg of Glycopyrrolate. Ondansteron 0.1 mg/ kg was used as an anti-emetic in both the groups. At the end of the procedure the subjects were given 30mg of IV ketorolac and 1 gm IV paracetamol.

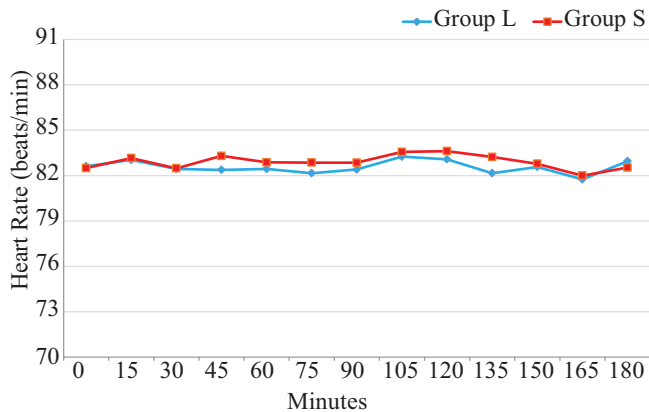
STATISTICAL ANALYSIS

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were summarized in the form of means and standard deviations and categorical variables were summarized as percentages. Student's independent t-test was employed for parametric data. Chi-square test or Fisher's exact test, whichever appropriate, was used for comparison of categorical variables. A P-value of less than 0.05 was considered statistically significant. All P-values were two tailed.

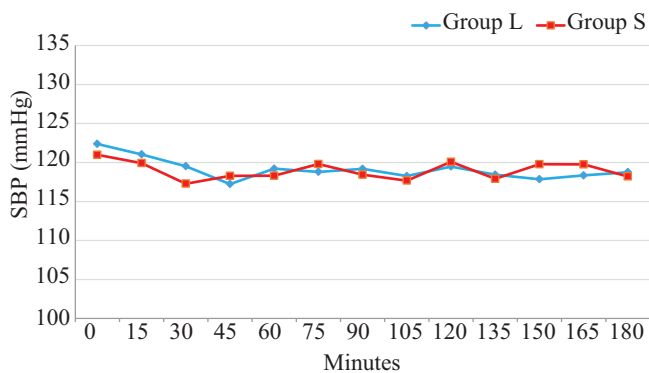
RESULTS

The two groups were comparable with reference to age (Table-1), sex (Table-2), body weight (Table-3), and duration of surgery (Table-4). They were found to be insignificant.

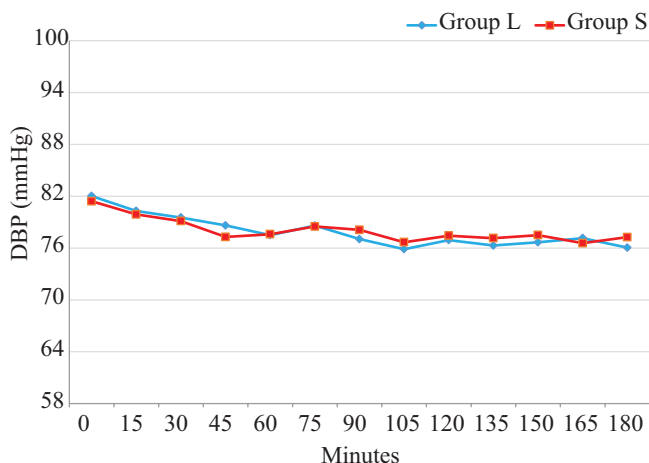
The groups when compared with reference to mean heart rate (graph 1), mean systolic blood pressure (graph 2), and mean diastolic blood pressure (graph 3) at various intervals, the difference was found to be statistically insignificant (p value > 0.05). No patient in either group developed significant change in hemodynamic parameters that demanded intervention.



Graph-1: Showing heart rate (beats/min) among two groups at different time intervals



Graph-2: Showing SBP (mmHg) among two groups at different time intervals

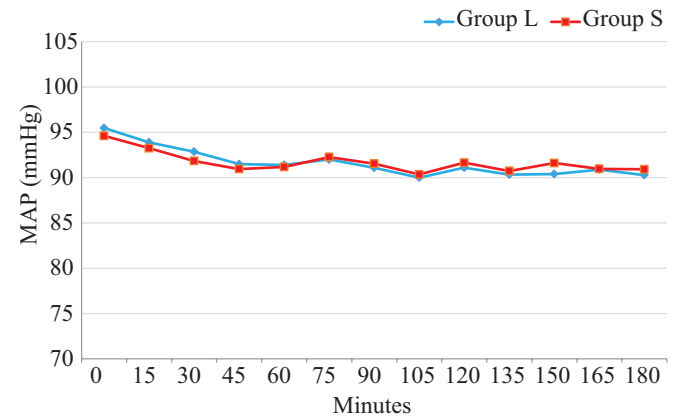


Graph-3: Showing DBP (mmHg) among two groups at different time intervals

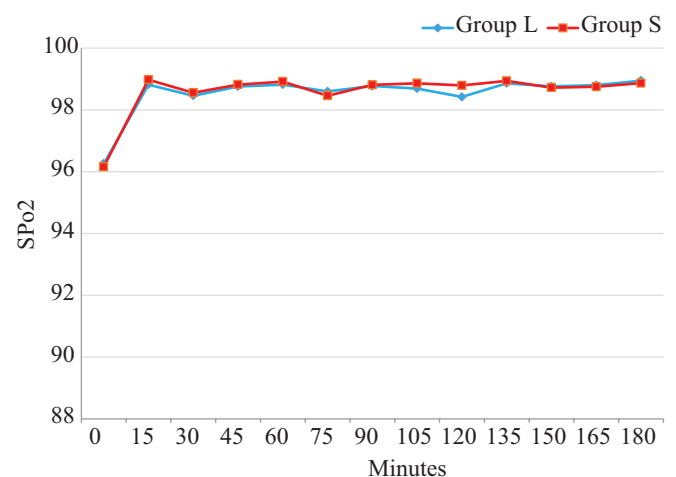
No significant respiratory depression was reported in any patient in this study and none of the patients had a SpO_2 value of $< 95\%$ on pulse oximetry. (graph 5)

No statistically significant difference was seen with respect to Bispectral Index (BIS) between the two groups ($p > 0.05$). (Graph 6)

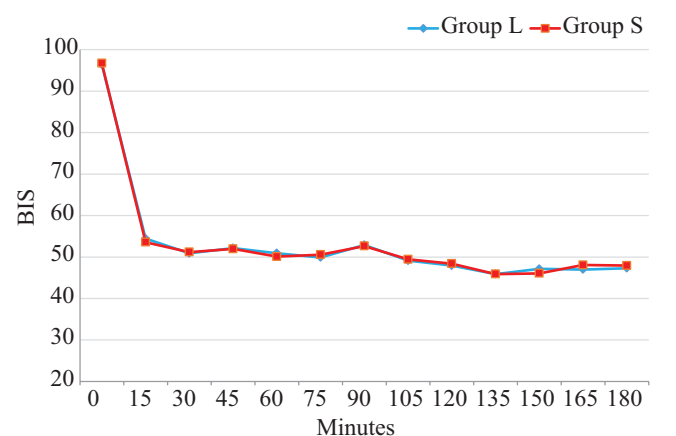
However significant difference with regard to MAC of isoflurane used to maintain anaesthesia was noted between the two groups. It was found overall average MAC of



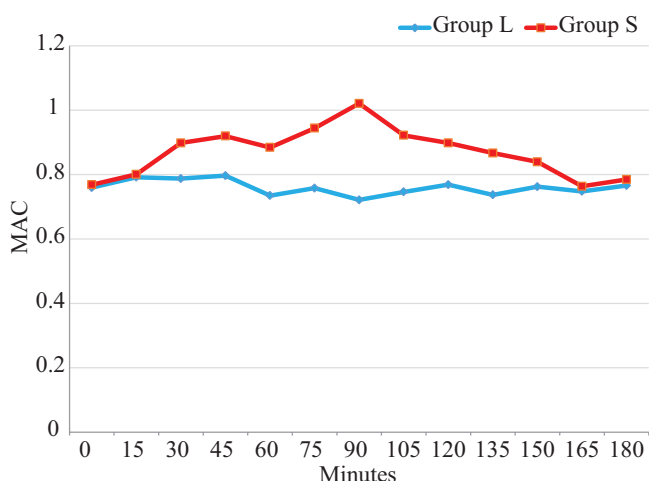
Graph-4: Showing MAP(mmHg) among two groups at different time intervals



Graph-5: Showing SpO_2 among two groups at different time intervals



Graph-6: Showing BIS among two groups at different time intervals



Graph-7: Showing MAC among two groups at different time intervals

Age (Years)	Mean	SD	Range	P-value
Group L	37.2	10.23	17-59	0.554
Group S	38.3	9.30	19-58	

Table-1: Age distribution of studied patients

Gender	Group L		Group S		P value
	No.	%age	No.	%age	
Male	28	56.0	31	62.0	0.542
Female	22	44.0	19	38.0	
Total	50	100	50	100	

Table-2: Gender distribution of studied patients

Weight (kg)	Mean	SD	Range	P-value
Group L	62.2	9.16	45-81	0.677
Group S	62.9	7.49	47-82	

Table-3: Distribution of weight (kg) in studied patients

Operative time (minutes)	Mean	SD	Range	P value
Group L	144.3	34.25	85-180	0.577
Group S	140.5	33.66	82-180	

Table-4: Showing duration of surgery (minutes) of studied patients

isoflurane in Group L was (0.761±0.011) and control group was (0.885±0.020). The two groups showed statistically significant difference (p=0.001).(graph 7)

DISCUSSION

Our study found that lidocaine loading dose followed by infusion significantly reduces volatile anaesthetic requirement as measured by MAC of isoflurane required to maintain BIS between 40- 60 without any significant hemodynamic changes

Lidocaine has been used as an intravenous anaesthetic and for pain relief extensively.^{8,9,10} Studies showing a MAC reduction effect of intravenous lidocaine in various anaesthetic settings have been done in humans and animals.¹¹ These studies demonstrate that lidocaine when used as an

infusion decreases the MAC of inhaled anaesthetic agents. There is paucity of literature regarding the effect of lidocaine infusion on MAC of isoflurane in humans. We conducted this study with the aim of evaluating the effect of perioperative lidocaine infusion on MAC of isoflurane and its correlation with bispectral index.

Our results are in concordance with the study by Basil P et al who observed an anaesthetic sparing effect of intravenous lidocaine infusion indicated by lower MAC requirements in patients undergoing major abdominal surgery.¹² Weinberg L et al also observed that i.v. lidocaine reduces volatile requirements as measured by end tidal sevoflurane concentration in patients undergoing open prostatectomy.¹³ Perioperative lidocaine infusion did not have any effect on remifentanyl dosage or on BIS in hypotensive anaesthesia.¹⁴ The mechanism for MAC reduction with lidocaine is not clear. While lidocaine’s analgesic effects may be responsible for the sparing effect on volatile anaesthetic MAC, it may also result from sedative effect of lidocaine as drugs with sedative effect are known to decrease MAC. The analgesic effect of lidocaine has been demonstrated in various studies. Lidocaine decreased the incidence of postoperative pain, hastened the return of intestinal motility and shortened hospital stay in patients undergoing prostatectomy. Postoperative pain decreased by 90% in patients in patients who received i.v. lidocaine intraoperative.

We did not find any significant differences in hemodynamic parameters between the study groups. This contrasts with the study by Weinberg L et al who observed lower values of heart rate and mean arterial pressure in patients receiving lidocaine infusion compared to placebo. This difference can be explained by the fact that end tidal sevoflurane concentrations were measured for calculating volatile agent requirements and MAC was kept constant around 1. Also BIS values were significantly lower in patients receiving lidocaine, reflecting greater depth of anaesthesia which would result in lower heart rate and mean arterial pressure in lidocaine group.

CONCLUSION

Our study found that lidocaine loading dose followed by infusion significantly reduces volatile anaesthetic requirement as measured by MAC of isoflurane required to maintain BIS between 40- 60 without any significant hemodynamic changes.

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