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Research Article

# EFFECT OF INTRAVENOUS LIGNOCAINE ON HEMODYNAMIC VARIABLES DURING INTRAOPERATIVE AND POST-OPERATIVE PERIOD

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**ABSTRACT**

**Objectives:** The objective of this study was to assess the efficacy of intravenous lignocaine on hemodynamic variables during intraoperative and post-operative periods and in relieving post-operative pain in major abdominal surgery.

**Methods:** To investigate the effects of lidocaine, we designed a double-blind study. We enrolled 100 patients of ASA Grade I or II slated for major abdominal procedures. Each participant received either lidocaine or a saline placebo intravenously. After surgery, we monitored their pain levels, vital signs, and any potential side effects.

**Results:** Our study revealed clear differences in heart rate, blood pressure (both systolic and diastolic), and overall arterial pressure between the lidocaine and placebo groups. Notably, the lidocaine group experienced fewer side effects, such as nausea, vomiting, headache, and shivering, compared to the control group.

**Conclusion:** Intravenous lidocaine reduces intraoperative and post-operative pulse rate and blood pressure in major abdominal surgery. It delays analgesic needs and lowers the incidence of nausea, vomiting, chills, and headache compared to controls.

**Keywords:** Hemodynamic response, Post-operative analgesia, Lidocaine.

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## INTRODUCTION

Lidocaine/lignocaine is a local anesthetic used commonly to numb particular areas of the body during surgical procedures or to relieve pain and discomfort caused by various conditions such as sore throat, dental procedures, or skin irritation. It works by blocking nerve signals in the body and is often administered topically or through injection. In addition, lidocaine is sometimes used intravenously to manage certain types of irregular heart rhythms or to reduce pain during medical procedures [1]. Recent studies have suggested important analgesic effects: Antinociceptive, immunomodulatory, and anti-inflammatory properties. Because of its analgesic, antihyperalgesic, and anti-inflammatory effects, intravenous lignocaine is administered in abdominal surgery [2-4]. Studies suggest that giving lidocaine intravenously around the time of surgery (perioperatively) can lead to several benefits. These include reduced chronic pain after surgery, faster recovery from bowel issues (ileus), less nausea and vomiting, lower need for opioid painkillers, and potentially shorter hospital stays. These effects were predominantly observed in patients undergoing abdominal surgery [5]. More encouraging outcomes were observed in different types of operations such as the spine or the brain [6,7]. A useful parameter of lidocaine is the attenuation of hemodynamic changes resulting from intubation/extubation or post-operative analgesic efficacy. Recent research has indicated that perioperative infusion of lidocaine is also beneficial for alleviating post-operative pain [8-11].

Limited prior research has investigated the combined impact of lignocaine infusion on mitigating the hemodynamic response to tracheal intubation and extubation, along with providing post-operative analgesia [12-14]. In our contemporary study, our objective is to investigate whether intravenous lidocaine therapy, involving perioperative bolus doses followed by perioperative infusion, can mitigate hemodynamic fluctuations during tracheal intubation and extubation and alleviate post-operative pain.

## METHODS

To ensure the research was conducted ethically, we obtained approval from the Institutional Ethics Committee (IEC) before proceeding. We then implemented a rigorous double-blind, randomized controlled trial involving 100 patients. To ensure objectivity, neither the surgeon nor the anesthesiologist knew which solution (lidocaine or placebo) each patient received. The study included patients aged 20–50, classified as ASA I or II, who were slated for major abdominal surgery under general anesthesia. To ensure accurate pain assessment, we excluded individuals with pre-existing health conditions that could affect their ability to understand and report pain levels using the Visual Analog Scale (VAS). In addition, we excluded patients with severe obesity, bleeding disorders, those taking blood thinners, allergies to local anesthetics, a history of drug allergies, or long-term steroid treatment.

To ensure unbiased allocation, we randomly divided the 100 patients into two equal groups of 50 using a computer-generated randomization table. One group, designated Group C, received an intravenous infusion of a placebo saline solution (0.9% normal saline). The other group, Group L, received an intravenous lidocaine infusion which was stopped 15 min before the anesthesia reversal process began. Following successful surgery, all patients were transferred to the post-anesthesia care unit (PACU) for monitoring and recovery.

After surgery, we assessed patients' pain using a 10-point VAS to measure both sharp (parietal) and dull (visceral) pain at six specific time points: 30, 60, 90, 120, and 240 min after surgery. We also monitored vital signs at these intervals. In addition, the time until the first rescue analgesia was administered, along with monitoring for side-effects, for example,

nausea, dizziness, vomiting, hypotension, hypertension, bradycardia, and tachycardia were conducted.

Visual Analogue Scale (VAS) [15] at the first pain medication:

- 0: No pain
- 1–3: Mild pain
- 4–6: Moderate pain
- 7–10: Severe pain.

Any adverse reactions or complications related to drug administration were documented, including instances of hypotension, hypertension, bradycardia, tachycardia, nausea and vomiting (PONV), chills, headache, etc.

**Statistical analysis**

Once we gathered all the data, we ran it through statistical analysis software called SPSS version 20.0. We presented the results in two ways: First, by showing how often things happened, that is, the data were presented as frequency distribution (percentage), for example, how many people in each group experienced nausea. Moreover secondly, we used mean±standard deviation (SD) to summarize things such as pain scores and blood pressure readings.

## RESULTS AND DISCUSSION

Table 1 shows statistical analysis of demographic data regarding the comparison of mean±SD of age in years. No statistically significant difference was observed in weight (in kilograms) among the study groups.

Table 2 indicates that changes in pulse rate at various time intervals within each group exhibited a high level of significance ($p<0.001$), apart from the instances at 0 min and 30 min, where significance was not observed ($p>0.05$). Change in systolic blood pressure at various time intervals within each group demonstrated high significance, except at 0 min. Similarly, fluctuations in mean diastolic blood pressure at different time points within each group exhibited high significance ($p<0.001$). Furthermore, variations in mean arterial pressure at various time intervals within each group showed high significance ($p<0.001$), with significance also evident at 0 min. In addition, the table reveals that changes in pulse rate at various time intervals within each group were not significant ($p>0.05$), except at 0 min and 30 min. Fluctuations in diastolic blood pressure at different time intervals within each group were notably significant ($p<0.001$), as were variations in mean arterial pressure at different time intervals within each group ($p<0.001$).

Table 3 data indicate that there were statistically significant differences among the study groups in various aspects. Specifically, there were significant disparities in the duration of surgery, the time until the administration of the first rescue analgesic, the total number of patients requiring rescue analgesia, the mean duration of post-operative analgesia, and the VAS scores.

Table 4 shows the side effects or complication observed in both groups during the study period whereas in L group has less complications then control group.

**Table 1: Statistical analysis of demographic profile of the study groups**

| Demographic variables | Group L (mean±SD) | Group C (mean±SD) | p |
|---|---|---|---|
| Age (years) | 50±9.6 | 49.1±9.9 | 0.624 |
| Weight (kg) | 58.6±7.2 | 56.3±6.7 | 0.113 |

SD: Standard deviation

Laryngoscopy, tracheal intubation, and subsequent extubation frequently result in heightened blood pressure (BP), arrhythmias, elevated heart rate, and increased intraocular and intracranial pressure. The factors underlying these changes differ between the intubation and extubation procedures. To manage these hemodynamic events, various medications are commonly prescribed, including lignocaine, beta-blockers, calcium channel blockers, opioids, and inhaled agents [12]. The administration of opioids during surgery may heighten the risk of post-operative complications. These complications can encompass post-operative nausea and vomiting, respiratory depression, sedation as well as ileus (lack of bowel movements), and urinary retention [16]. Esmolol, an intravenously administered cardioselective beta-1 adrenergic antagonist, acts swiftly and has a brief duration of action. It effectively inhibits cardiovascular stress responses triggered by noxious stimulation. However, it lacks analgesic properties and tends to reduce heart rate more significantly than blood pressure [17]. Use of calcium channel blockers has been associated with reflex tachycardia [18]. Hence, there was a requirement for a medication capable of mitigating both heart rate and blood pressure responses while ensuring sufficient analgesia without inducing adverse effects. Lignocaine fits this need. It has recently been utilized as an intravenous infusion to maintain intraoperative hemodynamic stability, provide post-operative analgesia, and facilitate early surgical recovery.

**Intraoperative hemodynamic parameters**

*Pulse rate*

The baseline mean±SD pulse rate (beats/min) was 105.1±14.9 in Group L and 102.6±18.5 in Group C. In Group L, a statistically significant reduction ($p<0.000$) in the average pulse rate observed at the time of induction, intubation, and at 30, 60, 90, 120, and 240 min during the surgical procedure. In contrast, the control group receiving the placebo solution showed no statistically significant changes in blood pressure

**Table 2: Effect of lignocaine on vitals compared with placebo over different time period in intraoperative and post-operative period**

| Time (min) | Pulse rate | | | SBP | | | DBP | | | Mean arterial BP | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Group L, mean±SD | Group C, mean±SD | p | Group L, mean±SD | Group C, mean±SD | p | Group L, mean±SD | Group C, mean±SD | p | Group L, mean±SD | Group C, mean±SD | p |
| IO 0 | 105.1±14.9 | 102.6±18.5 | 0.473 | 138.9±11.5 | 137.74±9.71 | 0.58 | 79.7±8.6 | 87±6.4 | <0.001 | 99.4±8.5 | 103.9±5.5 | 0.002 |
| IO 30 | 97.9±11.3 | 102.7±16 | 0.087 | 133.2±11.9 | 138.78±7.8 | 0.007 | 78.7±8.4 | 87.4±3.8 | <0.001 | 96.9±8.5 | 104.5±3.9 | <0.001 |
| IO 60 | 94±11.4 | 104±14.9 | <0.001 | 127.9±13 | 138.72±6.95 | <0.001 | 78.4±7.2 | 89±4.3 | <0.001 | 94.9±7.7 | 105.6±4.2 | <0.001 |
| IO 90 | 89.5±10.1 | 103.5±11.5 | <0.001 | 127.7±9.6 | 140.48±6.19 | <0.001 | 77.8±6.4 | 89.3±5.4 | <0.001 | 94.4±5.9 | 106.4±4.3 | <0.001 |
| IO 120 | 85.9±9.6 | 102.7±11.6 | <0.001 | 125.2±8.8 | 141.32±6.57 | <0.001 | 77.4±5.9 | 89.6±5.4 | <0.001 | 93.4±5.2 | 106.8±4.9 | <0.001 |
| IO 240 | 82.7±9.2 | 100.5±11 | <0.001 | 121.9±9.8 | 144.36±5.67 | <0.001 | 75.7±5.3 | 91.1±4.3 | <0.001 | 91.1±4.9 | 108.8±3.5 | <0.001 |
| PO 0 | 93.7±5.5 | 98.4±9 | 0.002 | 114.6±7.9 | 135.76±7.45 | <0.001 | 74.5±5.8 | 80.6±4.1 | <0.001 | 87.9±4.5 | 98.7±5.0 | <0.001 |
| PO 30 | 77.1±9.2 | 104.9±10.7 | <0.001 | 111.1±10.1 | 131.9±8.2 | <0.001 | 71.7±4.8 | 82.1±5.7 | <0.001 | 84.8±4.3 | 99.2±4.3 | <0.001 |
| PO 60 | 74.6±8.5 | 72.8±8.9 | 0.297 | 112.2±8.1 | 129.12±9.35 | <0.001 | 74.1±5.3 | 84.3±4.1 | <0.001 | 86.8±4.2 | 104.0±5.0 | <0.001 |
| PO 90 | 76.8±5.9 | 76.5±5.2 | 0.8 | 110.7±8 | 138.9±10.66 | <0.001 | 75.5±4.3 | 86.5±5.2 | <0.001 | 87.2±4.1 | 104.4±4.5 | <0.001 |
| PO 120 | 76.5±5.1 | 75.2±3.8 | 0.149 | 111±5.4 | 139.6±11.04 | <0.001 | 76.9±4.4 | 86.8±4.3 | <0.001 | 88.2±3.5 | 106.0±4.1 | <0.001 |
| PO 240 | 77.4±4.7 | 75.9±2.4 | 0.059 | 111.1±5.2 | 143.26±8.95 | <0.001 | 75.5±5.4 | 87.3±5.4 | <0.001 | 87.3±4.1 | 98.2±5.6 | <0.001 |

SD: Standard deviation, BP: Blood pressure, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

**Table 3: Comparison of duration of surgery, VAS score, time for rescue analgesia, and mean duration of post-operative analgesia after rescue analgesia**

| Variables | Group L (n=50), (mean±SD) | Group C (n=50), (mean±SD) | p |
|---|---|---|---|
| Duration of surgery (h) | 4.04±1.26 | 3.88±0.87 | 0.462 |
| VAS score | 4.4±1.7 | 6.5±1.2 | 0.000 |
| Time for rescue analgesia | 2.86±1.16 | 1.57±0.79 | 0.000 |
| Mean duration of post-operative analgesia after rescue analgesia | 6.54±1.19 | 4.36±1.68 | 0.000 |

VAS: Visual Analog Scale, SD: Standard deviation

**Table 4: Various side effects/complication into study group**

| Side effect | Group L (n=50), n (%) | Group C (n=50), n (%) |
|---|---|---|
| Nausea | 7 (14) | 11 (22) |
| Vomiting | 5 (10) | 10 (20) |
| Headache | 1 (2) | 6 (12) |
| Shivering | 3 (6) | 7 (14) |

throughout the surgical procedure. This includes measurements taken at induction, intubation, and follow-up time points at 30, 60, 90, 120, and 240 min. Comparing the two groups revealed a notably significant (p<0.00) reduction in pulse rate in patients in Group L at the time of intubation, which persisted up to 240 min during the operation. The results of our study agreed with Reddy *et al.* [14], Kaba *et al.* [19].

**Systolic blood pressure (SBP)**

In our study (Table 2), the initial values of mean±SD of SBP (mmHg) were 138.9±11.5 and 137.74±9.71 in Group L and C, respectively. In Group L, a highly significant reduction (p<0.000) in SBP was noted following intravenous lidocaine administration, at induction, intubation, and throughout the intraoperative period, including at 30, 60, 90, 120, and 240 min. In Group C, an increase in SBP was observed after induction and at 30, 60, and 90 min, but significant changes in SBP were observed at 120 min and a highly significant change at 240 min. SBP increased from baseline throughout the study period, but there were significant changes at 120 min and 240 min. A comparison between Group L and Group C involved a statistical evaluation of systolic blood pressure. It was found that Group L exhibited a significant decrease ($p < 0.05$) in SBP at induction, as well as at 30, 60, 90, 120, and 240 min.

**Diastolic blood pressure (DBP)**

In our study (Table 2), the initial mean±SD value of DBP (mmHg) was slightly lower in Group L (lidocaine) at 79.7 compared to Group C (placebo) at 87. This difference was statistically significant (p<0.000). Lidocaine seemed to effectively lower DBP throughout the surgery. In the lidocaine group (Group L), DBP readings stayed consistently down at all points measured (30, 90, 120, and 240 min after starting the drug) compared to baseline. On the other hand, the placebo group (Group C) had a bit of a rollercoaster ride. Their DBP initially went down but then rose again at intubation and 30 min after. Overall, their DBP was significantly higher than the lidocaine group at most points measured throughout the surgery (60, 90, 120, and 240 min). Statistically speaking, the difference in DBP was undeniable (p<0.000), showing that lidocaine effectively lowered DBP compared to placebo, both at the beginning of surgery and throughout the entire procedure.

**Mean arterial pressure**

In our study, the baseline mean±SD MAP (mmHg) values were 99.4±8.5 and 103.9±5.5 in Group L and C, respectively. Following intravenous lidocaine administration, Group L exhibited a highly significant reduction (p<0.000) in MAP at induction and throughout the intraoperative period at 30, 60, 90, 120, and 240 min. In contrast, in Group C, a significant difference (p<0.00) in mean arterial pressure at the time of induction and at 30, 60, 90, 120, and 240 min intraoperatively, with a notable increase compared to the lidocaine group was observed. On comparing the two groups, a statistical analysis of mean arterial pressure was conducted. The group receiving lidocaine (Group L) experienced a significant decrease in their mean arterial pressure (MAP) following administration of the study drug and during surgery at 30, 60, 90, 120, and 240 min. This difference was highly statistically significant, with a p<0.00. The results of our study match with the studies conducted by Weinberg *et al.* [1], Reddy *et al.* [14], Jain and Khan [12], Kaba *et al.* [19], Gupta *et al.* [20], Murthy and Kumar [21], and Bhalerao *et al.* [22].

**Post-operative hemodynamic parameters**

*Post-operative pulse rate*

In our study (Table 2), the statistical analysis of the post-operative pulse rate at different time intervals compared to the basal pulse rate, a statistically significant decrease was found at 30, 60, 90, and 120 min after surgery in Group L. This could be related to the use of intravenous lidocaine and anesthesia technique during surgery, which may have clinical implications on the immediate post-operative hemodynamics. In Group C, there was no notable reduction in pulse rate upon transfer to the post-operative room at 0 and 30 min following the operation. However, following emergency analgesia, the pulse rate consistently decreased throughout the duration of the study. When comparing the two groups, a statistically significant lower pulse rate was evident in Group L at 0, 30, and 240 min post-surgery. However, there was no significant difference at 60, 90, and 120 min post-surgery.

**Post-operative SBP, DBP, and MAP**

In Group L, a notable reduction in post-operative blood pressure at 30, 60, and 90 min compared to baseline in patients who initially requested emergency analgesia. Following the administration of rescue analgesia, blood pressure began to decrease further. On the other hand, the control group (Group C) receiving the placebo did show a temporary decrease in systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) compared to their levels before surgery. However, this decrease was only significant at 30 and 60 min after surgery. However, the decrease became more pronounced after 120 min until the end of the study period as patients received rescue analgesia. Similar trends were observed when comparing the two groups (Table 2) in terms of SBP, DBP, and MAP. Group L exhibited significantly lower blood pressure at 30, 60, 90, 120, and 240 min during the post-operative period. Similar results were observed in studies conducted by Reddy *et al.* [14], Kaba *et al.* [19].

**VAS score at the time for first rescue analgesia (TRA)**

Our study examined pain levels using a scoring system called the VAS (Table 3). Patients who received lidocaine (Group L) reported significantly lower pain scores (average 4.4) in contrast to those who received the placebo (Group C, average 6.5). We found a statistically significant difference (p=0.00). This means that the observed difference is very unlikely to be due to random chance and suggests a real effect. Interestingly, the lidocaine group also showed a decrease in the production of molecules involved in inflammation (IL-6 and IL-8). This suggests that intravenous lidocaine may not only help manage pain but also reduce inflammation, contributing to overall post-operative pain relief. The observations of our study are also supported by Song *et al.* [23] and De Oliveira *et al.* [24].

**Time for rescue analgesia (TRA)**

In our study (Table 3), we observed total rescue analgesic (TRA) scores (mean±SD) of 2.86±1.16 and 1.57±0.79 in Group L and C, respectively, (p=0.00). Infusion of lidocaine effectively attenuated hemodynamic

responses and provided post-operative analgesia. Our findings indicated that the pain-free interval and analgesic requirements during the initial 6 h of the post-operative period were markedly diminished in the lidocaine cohort. The observations of our study are also supported by Song *et al.* [23] and Koshyari *et al.* [25].

**Mean duration of post-operative analgesia after rescue analgesia**

Looking at Table 3, we found that patients who received lidocaine enjoyed significantly longer pain relief after surgery. On average, lidocaine provided pain relief for 4.36 h (with some variation), whereas the placebo group only experienced relief for an average of 2.19 h). We found a statistically significant difference (p-value = 0.001). This means that the observed difference is very unlikely to be due to random chance and suggests a real effect, suggesting lidocaine is clearly effective in extending pain control after surgery. Comparable findings were reported in a study carried out by Reddy *et al.* [14].

**Various side effects/complication into study group**

In Group L, 12 patients reported experiencing nausea and vomiting (Table 4), whereas in Group C, this was reported by 22 patients. While some patients experienced side effects, they were generally mild. Chills occurred in a few patients (3 in the lidocaine group and 7 in the placebo group). Headaches were also infrequent, with only one patient in the lidocaine group and six in the placebo group reporting them. Nausea and vomiting were managed effectively using an intravenous injection of ondansetron (4 mg) for those who needed it. Comparable findings were reported in a study carried out by Tikuisis *et al.* [26]. Studies have shown that lidocaine can be a valuable tool after surgery. It effectively reduces pain, helps speed up the return of normal bowel function (ileus resolution), and lowers the chances of nausea and vomiting (PONV) after surgery. Furthermore, it has been shown to decrease opioid usage after abdominal surgery [27].

## CONCLUSION

This comparative clinical study suggests that lignocaine effectively attenuates hemodynamic responses to intubation and laryngoscopy. The intravenous administration of a bolus of lidocaine followed by lidocaine infusion decreases both intraoperative and post-operative pulse rate and blood pressure in individuals subjected to major abdominal surgery under general anesthesia. Lidocaine notably prolongs the interval until the initial requirement for analgesics. Furthermore, the occurrence of side effects is reduced with lidocaine.

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## CONFLICTS OF INTERESTS

Nil.

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Nil.

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