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Use of Lidocaine to Reduce the Propofol Induced Pain during Induction of General Anesthesia in Adult

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ABSTRACT

Introduction: Propofol is a commonly used intravenous anesthetic agent characterized by a short induction and recovery time. However, its injection is often characterized by moderate to severe pain, thus making it uncomfortable for patients. Lidocaine has been investigated as one of the agents that can be useful in the reduction of this pain. **Objective**: To evaluate the efficacy of intravenous lidocaine in reducing propofol-induced pain during induction of general anesthesia in adult patients. **Materials and Method**: This comparative study was conducted on 110 adult patients selected from elective lower limb surgeries at Liaquat University of Medical & Health Sciences, Hyderabad, Pakistan from January 2024, to June 2024. There were two groups the first group was given 40 mg lidocaine and the second group was given saline. Pain was calculated with the help of a tool known as the Verbal Numerical Rating Score (VNRS). **Results**: Lidocaine significantly decreased the prevalence and intensity of propofol injection pain, 89.1% of patients in Group L reported mild pain compared to 49.1 % of patients in Group C ($p < 0.001$). **Conclusion**: The use of lidocaine can minimize propofol injection pain, and it should be used routinely during induction.

INTRODUCTION

Propofol is one of the most widely employed intravenous anesthetic agents for both induction and maintenance of general anesthesia, and it is characterized by its rapid onset of action and short awakening effect. However, while it has been established to have some pharmacological advantages, there is a disadvantage linked to this substance: pain during administration via an injection. Several researches undertaken clinically for propofol reported varying levels of pain or discomfort in the range of 28-90% of the patients (1). This also poses a disadvantage to the patient because it hurts the process of anesthesia, bringing anxiety and concern for future operations (2). Pretreatment with lidocaine, an established local anesthetic, has bagged the potential of reducing the pain attributed to propofol use. Lidocaine has the property of stabilizing neuronal membranes by preventing the movement of ions that are essential for the generation of action potentials (3).

Various authors have also reported that the use of lidocaine in patients acts as a preventative measure, which helps in reducing both the occurrence and severity of propofol pain (4). In elderly patients who had gastrointestinal endoscopy, lidocaine can decrease propofol dosage and/or injection pain to improve the safety and comfort of the patients (2). In a randomized controlled study carried out independently for this study, it was found that lidocaine reduced the effective dose (ED50) of propofol for the absence of movement during gastroscope, indicating that lidocaine has an added advantage of lowering dosage and pain (3). The proposed means through which propofol induces pain is by directly stimulating the endothelium of the blood veins and activating the kallikrein-kinin system, which in turn causes the release of bradykinin and other inflammatory substances. These substances increase the permeability of blood vessels and stimulate nerve endings to cause the sensation of pain (4). The pain is usually immediate but can be delayed and depends on the injection site, the vein size, and the type of propofol used (5). Attempts have been made to reduce this pain by altering the site of injection, using more prominent

veins, altering the temperature of the drug, and using pharmacologic agents such as ketamine, magnesium sulfate, and lidocaine, in particular (6).

An observational cross over dose finding study showed the median effective lidocaine dose in the prevention of propofol induced pain with demonstrating dose response and effectiveness of lidocaine when calculated per lean body weight (6) Some hospital-based assessments that have argued positively towards regular application of lidocaine in clinical practice show that the advantages in terms of patient satisfaction as well as general outcome of anesthetic agents warrants for lidocaine to be integrated into practice (7). In addition, the use of lidocaine mixed with other drugs such as ketamine has also been studied and found to be effective in decreasing the instances of painful injection of propofol (8). Research conducted in literatures found lidocaine and ketamine to be effective thus, lidocaine is preferred for reasons of safety and cost (9). For instance, lidocaine has been used in laparoscopic cholecystectomy and has been compared to ondansetron to reduce pain and has been noted to yield better results, which means that it can be used for all kinds of surgeries (10).

More recently, comparative studies with other agents like ciprofol also indicate that while there is continuing innovation in this area, lidocaine can still be depended on as a mainstay of most anesthesia departments (11). Lidocaine, in addition to an anesthesia regimen, has also been argued to help prevent episodes of fluctuations in the patient's hemodynamic state during extubation, in addition to alleviating the pain of injection (14). Also, a comparison has been made between lidocaine and other adjuvants such as sufentanil, and according to the studies, lidocaine is as effective as the different substances with fewer side effects (12). It was also assessed against remimazolam to reduce discomfort during anesthetic induction, and the result was positive (13). Cross-sectional and meta-analysis studies have shown clear evidence for the effectiveness of lidocaine in reducing the pain associated with propofol administration, and this has become a standard practice in most health organizations globally (15).

Since limited studies have been done locally in Pakistan, there is much need to investigate this issue in our clinical context. This research benefits most especially underprivileged health systems as it suggests a way to increase patients' comfort with a non-costly effort such as lidocaine instead of a more costly measure. The purpose of the present study is to address this issue and present empirical evidence that can be used to include lidocaine in everyday anesthetic use in Pakistan.

Objective

To evaluate the efficacy of intravenous lidocaine in reducing pain associated with propofol injection during induction of general anesthesia in adult patients undergoing elective surgical procedures.

MATERIALS AND METHODS

Settings

Randomized controlled trial.

Study

The study was carried out at The Department of Anesthesiology of Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, Pakistan.

Duration

The study period was from January 2024, to June 2024.

Inclusion Criteria

This study enrolled patients between the ages of 18 - 60 years of either gender, scheduled for elective lower limb surgery under general anesthesia. Inclusion criteria was comprised only those patients with the American Society of Anesthesiologists (ASA) physical status from I to III.

Exclusion Criteria

Exclusion criteria include allergies to lidocaine and propofol, use of apomorphine and dronedarone, MAO and serotonergic drugs, patients with cardiac arrhythmias such as prolonged QT syndrome or third-degree AV block, history of chronic pain was excluded.

Methods

In this case, after consultative approval from the institutional review board and CPSP, patients meeting the inclusion criteria was included in the study. It was ensured that all subjects give written consent in the study. The participants was randomly recruited and assigned to two groups with an allocation ratio of 1: 1 using the SNOSE technique Lidocaine (Group L) and control (Group C). Group L was administered with 40 mg lidocaine intravenously, and Group C was administered with 0.9% saline. For the anesthetic procedure, an IV catheter of size 20G was inserted into the dorsum of the hand, and propofol 50mg was administered over 30 seconds using a syringe pump. The pain intensity was measured at the end of the procedure using the Verbal Numerical Rating Score (VNRS). The induction agents was given following the general anesthesia procedure. Demographic data, including age, gender, co-existing medical conditions, if any, and the initial pain score was captured on a formatted form.

RESULTS

One hundred ten patients were selected for the study, with 55 patients in the Lidocaine group (L) and 55 in the Control group (C). Both groups recorded similar details about the demographic factors at the respective study sites. Nevertheless, there were no significant differences between the mean ages of the subjects in Group L, 39.6 ± 10.4, and Group C, 40.2 ± 11.1. Regarding gender distribution, there were 29 males and 26 females in Group L, while there were 30 males and 25 females in Group C. There were no significant differences in other baseline parameters such as smoking status, T2DM history, and hypertension.

Table 1
Demographic and Clinical Characteristics of Patients

Variable	Group L (n=55)	Group C (n=55)	p-value
Mean Age (years)	39.6 ± 10.4	40.2 ± 11.1	0.76
Gender (M/F)	29 / 26	30 / 25	0.85
Smoking Status	18 (32.7%)	20 (36.3%)	0.70
History of T2DM	11 (20.0%)	13 (23.6%)	0.64
History of Hypertension	10 (18.1%)	12 (21.8%)	0.62

After propofol injection, patients' pain was evaluated using the Verbal Numerical Rating Score (VNRS). It was observed that the number of patients who experienced pain after the procedure was comparatively less in the lidocaine group. In Group L, 36 patients (65.5%) did not complain of any pain, 13 (23.6%) expressed painful discomfort to some extent, 5 patients (9.1%) complained of moderate pain, and only one patient (1.8%) described the degree of pain as severe. In contrast, in Group C, 9 of the participants (16.3%) stated that they did not have any pain, 18 of the participants (32.7%) reported that they had mild pain, 21 of the participants (38.1%) stated that they had moderate pain while only 7 of the participants (12.7%) reported that they had severe pain.

Table 2
Severity of Pain after Propofol Injection

Pain Severity	Group L (n=55)	Group C (n=55)	p-value
No Pain	36 (65.5%)	9 (16.3%)	<0.001
Mild Pain	13 (23.6%)	18 (32.7%)	
Moderate Pain	5 (9.1%)	21 (38.1%)	
Severe Pain	1 (1.8%)	7 (12.7%)	

The efficacy in terms of the VNRS score ranging between 0 to 3 (no or mild pain) was higher only in Group L. The number of patients with adequate pain control within the lidocaine group was 49 (89.1%), while in the control group was 27 (49.1%). The difference was statistically significant ($p < 0.001$).

Table 3
Comparison of Efficacy between Groups

Efficacy Outcome	Group L (n=55)	Group C (n=55)	p-value
Effective (0–3 score)	49 (89.1%)	27 (49.1%)	<0.001
Not Effective (≥4 score)	6 (10.9%)	28 (50.9%)	

These findings clearly show that when propofol was used for intravenous induction of anesthesia, lidocaine premedication was effective in reducing pain sensation during injection.

DISCUSSION

This paper contains significant data regarding the effectiveness of intravenous lidocaine for the management of pain on propofol injection during the experience of general anesthesia in adult patients. Pain on propofol injection has been described as one of the most common adverse effects in anesthetic practice. It varies from 28-90% based on the site of injection, rate of administration, and other factors (1). This discomfort has been the subject of numerous studies concerning pharmacological and non-pharmacological treatments, with lidocaine shown to be one of the most effective agents (2). The present study also corroborates the findings of Jinat (1) regarding the decrease in propofol-induced pain due to pretreatment with lidocaine in patients who were undergoing general anesthesia. They also found that 89.1% of the patients on lidocaine possibly experience no pain or pain that is just mild as compared with the control group, which had only 49.1%. This observation aligns with the study by Hu et al. (2), who also reported that lidocaine decreased injection pain and the dose of propofol needed in elderly patients undergoing gastroscopy. These two advantages of lidocaine make this agent cost-effective and a favorite in many clinical practices, especially in developing economies. In addition, a study carried out by Qi et al. (3) revealed that lidocaine reduced the amount of propofol needed to prevent patient movement during procedures. This means that lidocaine works synergistically with propofol and may be used to improve the onset of the drug while reducing side effects. Similarly, in the present work, not only the pain scores but also the level of comfort perceived by the patient during the induction phase was significantly higher in the lidocaine group.

Our results also complement those of Wu et al. Wu et al. (4) assessed the safety and efficacy of different propofol formulations. Though newer agents like propofol have been evaluated for reduced injection-associated pain, lidocaine remains more feasible because of its availability, comfort level for anesthesiologists, and cost-effectiveness. In this context, more specifically, Tang et al. (5) also pointed out another positive effect of intravenous lidocaine, it can reduce the amount of propofol required for necessary induction and would not cause hemodynamic instability in elderly patients. It is postulated that the pain felt at the site of propofol injection is due to the activation of kallikrein-kinin and the subsequent release of bradykinin that increases the vascular permeability and excites the nociceptive channels (6).

Tian et al. (6) determined the median effective dose of lidocaine to reverse this process, and their results described a dose-related effect. Our study was conducted with an administration of 40 mg, which helped the majority of patients, demonstrating that even small doses of lidocaine can be efficient when used appropriately. The discussion on the use of lidocaine has remained contentious, with Ratanshi and Mandour (7) noting that lidocaine should be applied routinely since it is effective and has few side effects. Their perception corroborates our study's conclusion and underscores the significance of lidocaine in regular anesthesia practice. Notably, the

use of a combination of agents like lidocaine with ketamine has also been considered. Chachart (8) supports their findings as they observed a reduced level of pain in patients who were administered with lidocaine together with ketamine. However, because our study did not address combination therapy, this could contribute to the basis for further research in this regard.

Khadka and Sharma (9), in their comparative study of ketamine and lidocaine, concluded that both produce analgesia, but lidocaine was more acceptable. Ashfaq et al. (10) compared their results to other agents like ondansetron and observed that lidocaine still had better effects. These comparisons justify the use of lidocaine in different surgical and procedural requirements, including in our practice in Pakistan. Another research in the literature focuses on the comparison of lidocaine with the newer agents of ciprofol. Hudaib et al. (11) meta-analysis states that ciprofol may have a better pharmacokinetic profile, though lidocaine has relevance where cost factor plays a vital role. Alipour et al. (12) also noted that the use of lidocaine was more effective than sufentanil for pain relief and general safety.

Similarly, the findings by Guan et al. (13) highlight that other evidence-based drugs, such as remimazolam, have the potential to be effective, but more research is needed regarding its use. Until such alternatives are widely available and cost-effective, lidocaine continue to be the most sensible option. Nigussie et al. (14) also showed that lidocaine has other advantages during extubation because it helps reduce hemodynamic changes, so lidocaine is a versatile drug within the anesthetic application. In a systematic review and meta-analysis by Wu et al. (15), the evidence presented supported lidocaine, especially when compared to placebo and other drugs. In this regard, our study receives strong support for integrating lidocaine as a standard pretreatment medication before the onset of propofol-induced general anesthesia.

Therefore, based on this study and the literature review, it can be concluded that lidocaine is a potent and efficient agent in combating propofol-induced injection pain. Since this side effect is frequently reported in patients and notably affects their comfort and satisfaction in the event of voluntary or elective surgeries, the administration of lidocaine would be beneficial to improve the anesthetic process. Additionally, in developing countries such as Pakistan, this makes lidocaine easily accessible, as cost is a significant factor. This investigation aids in building knowledge relevant to the local setting and advocates for the widespread application of lidocaine during induction to improve the overall client experience and outcomes. Further studies will be made on the effects of distancing, or the outcomes of using two agents or different concentrations of lidocaine in adults, children, or elderly patients.

CONCLUSION

From this research, intravenous lidocaine is very effective in decreasing the incidence and the severity of pain experienced during the injection of propofol while administering general anesthesia in adult patients. According to their findings, the analyzed result shows that the patients treated with lidocaine had less or no pain compared to the control group, which was also statistically significant. Thus, due to its low cost, ease of administration, and favorable safety profile, lidocaine remains a valuable component in the management of patients undergoing routine anesthesia delivery in settings such as Pakistan. It not only makes patients feel comfortable and easily satisfied but also helps in the success of anesthetic induction and may decrease the need for other sedatives or analgesics. This work suggests that lidocaine should be integrated into anesthesia induction because it is both safe and beneficial, and calls for further work to refine dosing practices and investigate the utility of lidocaine across various types of surgeries and types of patient populations to improve deliverance of personalized anesthesia care.

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