Original Research Article

A comparitive study of cisatracurium and normal saline pre-treatment with tourniquet for reduction of propofol injection pain

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Abstract

Introduction: Pain is a common adverse event associated with propofol injection and pharmacological and nonpharmacological interventions to reduce propofol injection pain have been attempted with varying success. **Aims**: The present study was a randomized control study which aimed to assess the efficacy of pre-treatment with cisatracurium with venous occlusion for prevention of pain associated with propofol injection. **Materials and methods**: The total sample size was 60 patients who were randomly allotted into two groups; Group A: Cisatracurium (N=30) and Group B: Control(normal saline) (N=30). Pretreatment drug in each group was administered in tourniquet occluded veins followed by release of tourniquet after 30s and delivery of propofol. Pain scores were evaluated and expressed using a four-point scale. Each patient's highest pain score were documented. Adverse effects were noted. Adverse effects at the injection site (pain, oedema, wheal, inflammation) were assessed for 24h after surgery. **Results**: The patients in both groups were comparable with regards to age ,gender weight and ASA status. The incidence of pain associated with propofol injection was found to be significantly less in patients in cisatracurium group as compared to the control group. The severity of pain associated with propofol injection was found to be significantly less in patients in cisatracurium group as compared to the control group. Changes in hemodynamic parameters were transient all the patients and no significant variations in hemodynamic parameters were observed in both groups under study. No adverse effects (immediate, after 24 h) were observed in any of the patients in both groups under study. **Conclusion**: Pretreatment with cisatracurium in the dose of 0.15 mg/kg in veins occluded by tourniquet was found to be effective in significantly reducing both the incidence and severity of pain induced by propofol injection (POPI) without any significant complications in patients with propofol induced general anaesthesia.

Keywords: Cisatracurium , Propofol, General anaesthesia.

Introduction

Propofol (2, 6-diisopropylphenol) is a potent intravenous hypnotic agent which is widely used for the induction and maintenance of anesthesia and for sedation in the intensive care unit. Its advantages include rapid onset, short duration of action (allowing prompt emergence), easy titration and low incidence of postoperative nausea and vomiting[1,2].

Propofol is almost an ideal IV anesthetic agent, but pain on its injection is an untoward effect and this condition can reduce patient satisfaction. Three out of five patients experience pain most most patients remember it as one of the unpleasant encounters with anesthetists. In one survey, pain on propofol injection (POPI) stands seventh most important problem in the current practice of clinical anesthesia[3,4].

Various interventions both pharmacological and non pharmacological have been tried to reduce pain on injection of Propofol. These include co-injection with lidocaine, pretreatment with lidocaine, injection of propofol into a large vein, ketamine, thiopental, ondansetron, dexamethasone, opioids, non-steriodal anti-inflammatory drugs ,paracetamol or dexmedetomidine (with or without tourniquet).

Most efficacious interventions to reduce the incidence and severity of propofol injection pain are injection in the antecubital vein or pretreatment with lignocaine in conjunction with venous occlusion when hand veins are used.

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However, a failure rate of 13–48% for the above procedure, elucidates the need for studies about other pharmacological and non pharmacological methods to reduce propofol injection pain[5].

Analgesia produced by intravenous injection of local anaesthetic and application of a tourniquet is intravenous regional anaesthesia (IVRA). IVRA is suitable for operations of the distal extremities, in situations where it is safe and easy to apply an occlusive tourniquet.

Addition of cisatracurium to lidocaine in intravenous regional anesthesia has improved the quality of anesthesia, and decreased analgesic requirements without causing clinical side effects. Also, tourniquet-controlled pretreatment with cisatracurium can thus reduce propofol injection pain.

There are very limited studies worldwide and no studies in India that assess the effect of cisatracurium pretreatment to reduce propofol injection pain (PIP)[6]. Thus, the present study aimed to assess the efficacy of pre-treatment with cisatracurium with venous occlusion for prevention of pain associated with propofol injection.

Materials & methods

The present study was a randomized controlled study done in Department of Anaesthesia, Mamata Medical College for a period of 02 years; (from November 2017- May 2019) in all elective non-cardiac surgeries under general anaesthesia in Mamata general hospital

Sample size

The total sample size was 60 patients who were randomly allotted into two groups.

Each group comprised of 30 patients.

1. Group A : Cisatracurium (N=30)
2. Group B:Control(normal saline) (N=30)

Approval was taken from the institutional ethics committee prior to commencement of the study. Written informed consent was obtained from the patients prior to enrolment in the study.

Inclusion Criteria

Patients belonging to American Society of Anaesthesiologists Grade I & II of either sex, aged between 15-60 years in all elective non-cardiac surgeries under general anaesthesia.

Exclusion Criteria

Patients with psychiatric history, Allergy to propofol or egg**,** Mallampati class III–IV and history of difficult intubation, history of cardiovascular, respiratory, neurological, neuromuscular.

Patients were randomly assigned to one of two groups, control group pre-treatment with normal saline group and Cisatracurium 0.15mg/kg group. All pre-treatment drugs were stored at room temperature (20–23C), an anaesthetist who is involved in the study prepared all pre-treatment drugs. Patients were taken into the operating room and electrocardiogram, pulse oximetry, non-invasive arterial pressure was secured. An 18-G cannula was inserted into the largest visible vein on the radial side of the non dominant forearm. A venous tourniquet was applied just above the elbow and the pre-treatment drug was administered. The tourniquet was released after 30s, then 0.5mg/kg propofol were delivered via intravenous cannula.

In order to evaluate pain and determine the possibility of muscle paralysis, patients were asked ‘‘does it hurt?’’ by the anaesthetist at 10s after the initial propofol dose, and at 20s intervals thereafter until unresponsive. Any spontaneous movement of the wrist, elbow or shoulder were noted.

Pain scores were evaluated and expressed using a four-point scale

- 0 : No Pain
- 1: Mild Pain (pain reported only in response to questioning and without behavioural signs)
- 2: Moderate Pain (pain reported in response to questioning and with behavioural signs, or pain reported without questioning);
- 3: severe pain (strong vocal or behavioural response).

Each patient’s highest pain score were documented. Adverse effects (including airway obstruction and diplopia) were noted. Induction of anaesthesia was completed with the remaining 1.5mg/kg propofol.

Tracheal intubation was facilitated with Cisatracurium to a total dose of 0.15mg/kg. Anaesthesia was maintained with inhalational agent with 50% nitrous oxide–oxygen. Adverse effects at the injection site (pain, oedema, wheal, inflammation) were assessed by the study investigator for 24h after surgery, using spontaneous reporting and patient interview.

Statistical Analysis

Data analysis was done using MS Excel and SPSS 23.0. Unpaired Students paired t-test was used to compare significance of difference in the mean (+-SD) pain scores between the two study groups. Chi square test / Fischer’s test (as applicable) was used to test the significance of difference in proportions between the two study groups. A P-value of <0.05 was considered to be significant and <0.001 was considered to be highly significant.

Results

The present study was finally conducted in 60 patients, who were randomly allocated into two groups, comprising of 30 participants each.

Table 1: Comparison of Demographic & Clinical Characteristics between the Study Groups

Characteristic	Group A (Cisatracurium) (N=30)	Group B (normal saline) (N=30)	P value
Age (yrs)(Mean+-SD)	33.07(+-10.60)	36.40(+-9.67)	> 0.05
Gender (M/F)	14/16	12/18	> 0.05
Weight (kg) (Mean+-SD)	64.37(+-11.80)	63.07(+-10.55)	>0.05
ASA status (I/II)	28/2	27/3	>0.05

SD: standard deviation; ASA status: American society of Anesthesiologist-physical status

The difference in demographic details between the two groups was not found to be statistically significant. (P>0.05) and the two study groups were thus observed to be comparable.

Table 2: Incidence and grade of pain on Propofol Injection in both study groups

Incidence Of Pain	Group A (Cisatracurium)	Group B (Normal saline)	P value
	N (%)	**N (%)**	
Incidence of propofol induced pain	12(40)	26 (86.67)	<0.05*
No pain	28(60)	4(13.33)	
Grade of pain			
0, No Pain	18(60%)	4(13.3%)	**<0.05***
1, Mild Pain	10(33.3%)	4(13.3%)	
2, Moderate Pain	2(6.7%)	12(40%)	
3, Severe Pain	0	10(33.3%)	

P<0.05 *: Significant

This difference between the study groups in incidence of pain and difference in the grade of pain on propofol Injection was found to be highly significant statistically. (P<0.05)

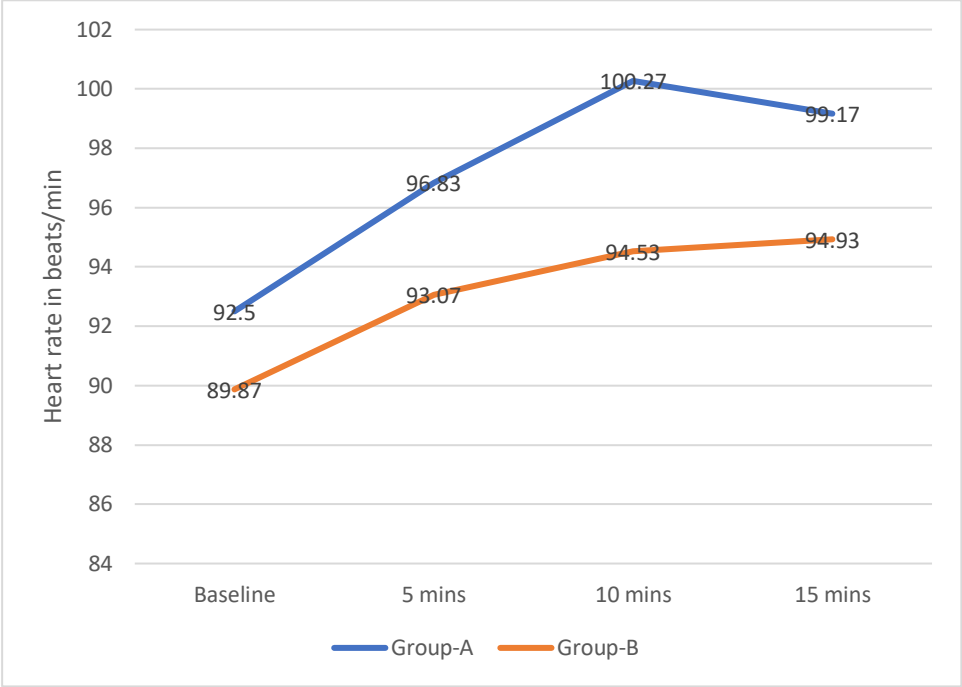

Fig. 1: Mean heart rate variability in groups

A slight increase in the mean heart rate at 5,10 and 15 minutes from the baseline mean heart rate was observed but the mean heart rate variability was not found to be statistically significant. (p>0.05)

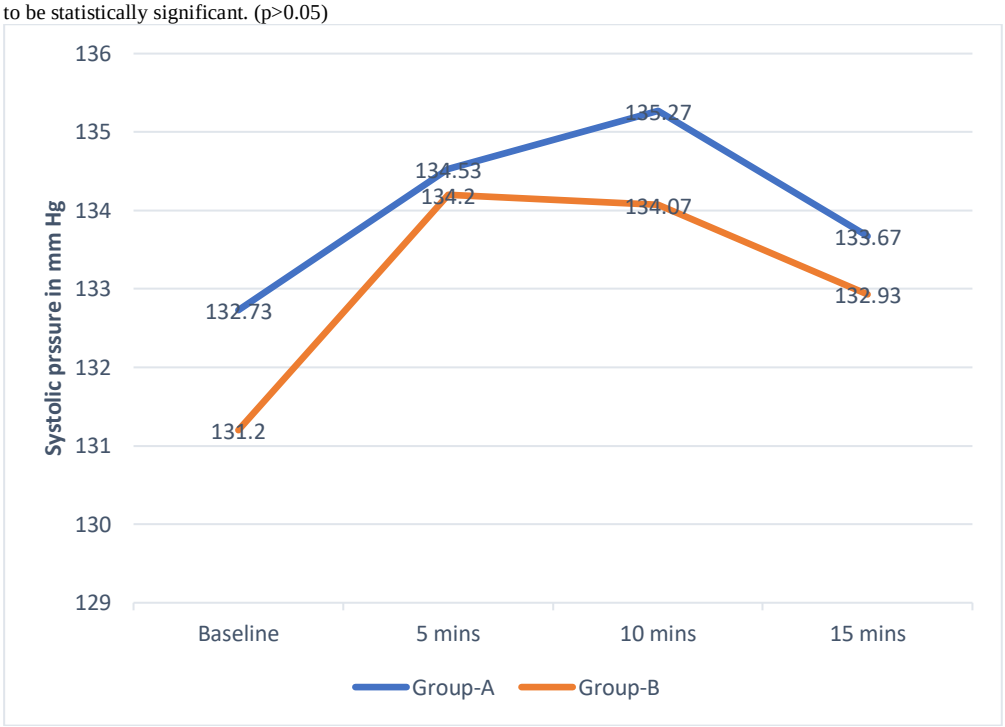

Fig. 2: Mean Systolic Blood Pressure Variability in Groups

A slight increase followed by decrease in the mean systolic blood pressure at 5,10 and 15 minutes from the baseline mean systolic blood pressure was observed but the mean systolic blood pressure variability was not found to be statistically significant. (p>0.05).

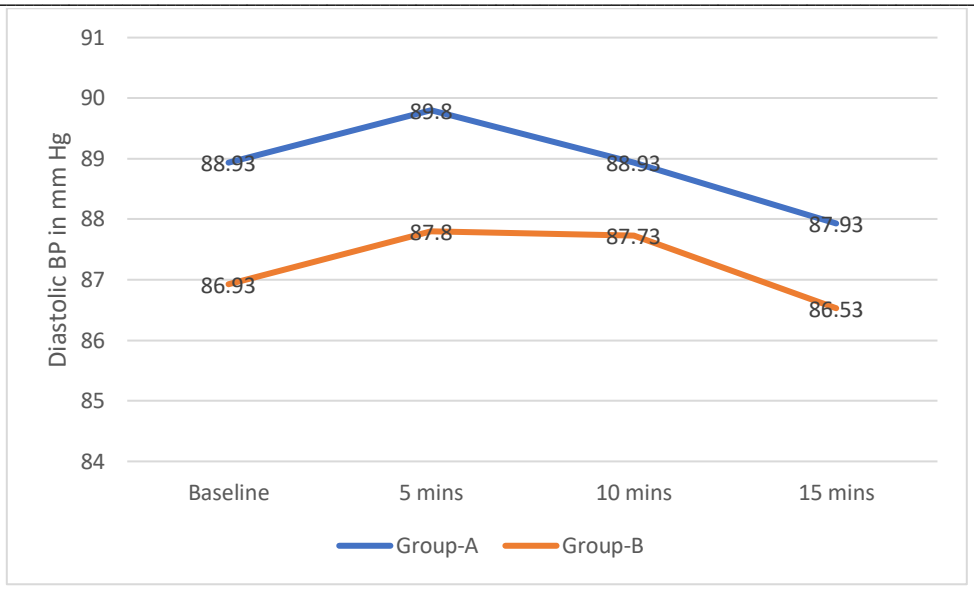

Fig. 3: Mean Diastolic Blood Pressure Variability in Groups

A slight increase followed by decrease in the mean diastolic blood pressure at 5,10 and 15 minutes from the baseline mean diastolic blood pressure was observed but the mean diastolic blood pressure variability was not found to be statistically significant. (p>0.05)

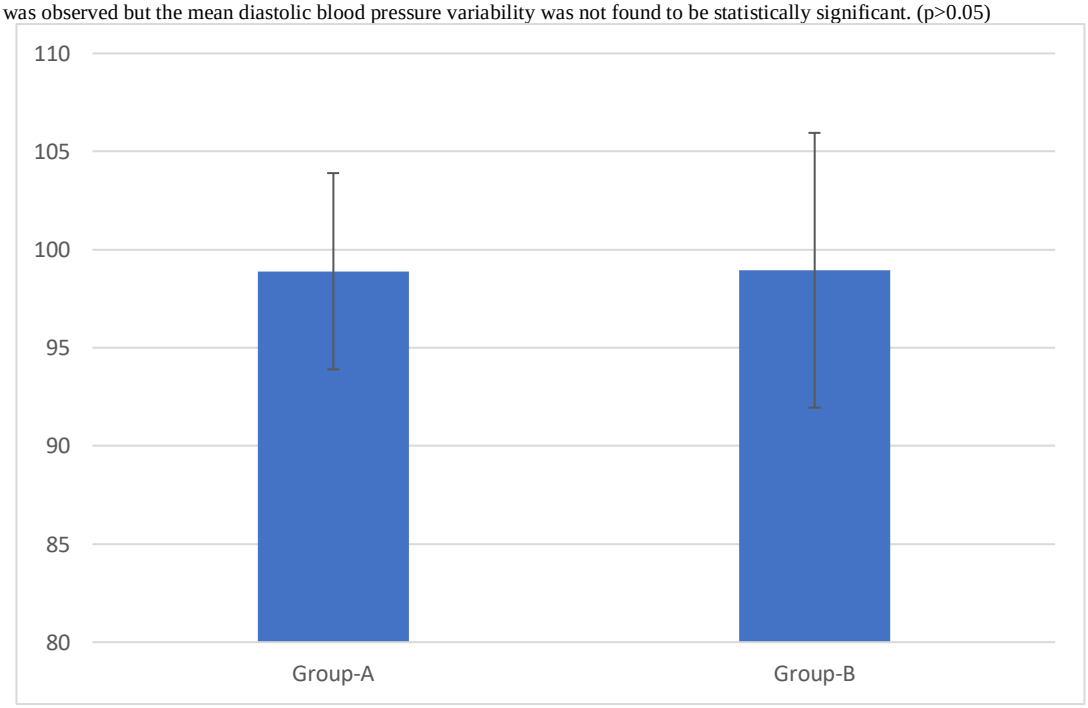

Fig. 4: Mean Baseline Body Temperature in Both Study Groups:

In group A (Cisatracurium) patients; the mean (+-SD) baseline body temperature was observed to be 98.99(+-0.05) deg Fahrenheit (F) and was 98.95(+-0.17) deg Fahrenheit (F) in Group B (Normal saline) patients. The mean baseline body temperature in both study groups was found to be comparable. i.e. the difference in the mean baseline body temperature between the two study groups was not found to be significant statistically.(P>0.05) Thereafter, in both the study groups the mean body temperature was observed to be the same at 5, 10 and 15 minutes respectively.

Table 3: Mean Spo2 Variability in Group A (Cisatracurium)

SpO2	Baseline	5 mins	10 mins	15 mins	P value
Group-A	99.47 (+-0.73)	99.50 (+-0.73)	99.63 (+-0.61)	99.83 (+-0.38)	>0.05
Group-B	99.67 (+-0.61)	99.53 (+-0.73),	99.53 (+-0.73)	99.77 (+-0.43)	>0.05

A slight decrease followed by increase in the mean SpO2 was observed at 5, 10 and 15 minutes from the baseline mean SpO2 but the mean SpO2 variability was not found

Adverse Effects

None of the patients (N=60) in group (cisatracurium) and control group experienced any immediate signs of anaphylactic reactions (flushing, hypotension, tachycardia, and bronchospasm) or diplopia, airway obstruction. None of the patients developed pain, oedema, weal or inflammation at the injection site within the first 12 hours and 24 hours after surgery.

Discussion

Propofol is the most widely used intravenous (IV) anesthetic agent for induction and maintenance of anesthesia as well as for sedation. In spite of its advantages like rapid onset, short duration of action, easy titration and favourable profile for side effects; which account for its wide spread use; pain on its injection still remains a problem with three out of five patients experiencing pain on injection of propofol, with one of these patients reporting severe or excruciating pain[1].

The pain may not be a serious complication, but most patients remember it as one of the unpleasant encounters with anesthetists. and some patients recall the induction of anaesthesia as the most painful part of the perioperative period. In one survey, pain on propofol injection (POPI) stood as seventh most important problem in the current practice of clinical anesthesia[3].

In the present study, the mean age of patients in group A (Cisatracurium) was observed to be 33.07(+-10.60) years and the mean age of patients in control Group i.e. B (normal saline) was 36.40(+-9.67) years. In their study Kaya S et al[7]. Compared the effectiveness of various venous occlusion times for lidocaine analgesia to prevent pain during propofol injection. The (mean [SD] age was 30.9 [7.5] years and mean weight was 63.9 [10.6] kg). In the study by Sumalatha GB et al.[8] the mean age of patients in the study groups O,R and L were 36.8+-9.7, 36.4+-9.3 and 37.5+-8.2 yrs respectively. The groups did not differ significantly in age.In the study by El-Radaideh KM[9] assessed the efficacy of the pretreatment with lidocaine and lidocaine mixed with fentanyl and IV paracetamol on diminishing pain associated with the injection of propofol after temporary venous occlusion using an increased volume to 4 mL instead of the commonly used 2 mL. The mean age in the groups was 47.9+-13.8, 48.7+-13.7,46.0+-14.2 and 44.5+-13.4 yrs respectively which is higher than the present study . The groups did not differ in age. In a similar study Kim YH et al.[6] assessed the efficacy of pre-treatment with cisatracurium for prevention of pain associated with propofol injection and compared it with that of lidocaine. The mean age of patients in Cisatracurium group and control group was was 45.5 (+-10.1) years 43.3(+-10.9) years respectively.

In their study Ray S et al[10] determined the efficacy of pretreatment with lignocaine, fentanyl and placebo for prevention of pain on propofol injection. No statistically significant difference between the groups with respect to age, height, weight, sex and ASA physical status was observed.

Singh D et al.[11] determined efficacy of pre-treatment with IV ramosetron in reducing propofol-induced pain as an equivalent to lidocaine. The mean age was 34.2(+-15.4)yrs, 32.6(+-15.2)yrs and 32.6(+-15.8)yrs in ramosetron,lidocaine and control group respectively and the difference in the mean age was not found to be statistically significant. The mean age of patients in the present study and other Indian studies are observed to be lower than studies in different countries.

In the present study, Group A (Cisatracurium) was observed to comprise of 14(46.67 %) males and 16 (53.33%) females. Group B (normal saline) was observed to comprise of 12 (40%) males and 18(60 %) females. Both study groups were observed to be comparable in terms of gender. The study by Kaya S et al.[7] comprised 100 women and no men and study groups were comparable. In the study by Ray S et al.[10] no statistically significant difference between the groups with respect to height, weight, sex and ASA physical status was observed.

In the present study; thus all demographic and clinical characteristics studied including age gender, weight, ASA status were comparable in both the study (cisatracurium) and control groups. In other similar studies assessing effects of various modalities on reducing the incidence of propofol induced pain; the groups under study were comparable with respect to demographic and clinical characteristics like age of patients, gender, weight and ASA status[7,8,9].

In the present study, the incidence of pain on propofol Injection (PIP/POPI) observed among Group A (Cisatracurium) patients was 12/30 (40%) and 28 (60%) patients did not suffer any pain. Among control group; Group B (normal saline) patients the incidence of pain on propofol Injection (PIP) was observed to be 26/30 (86.67%) Cisatracurium was found to be significantly more effective than normal saline (control) in reducing propofol induced pain (PIP) in patients under study. (P<0.05) Varied findings on incidence of pain on propofol injection are reported by other studies.

In the study by Kaya S et al[7] the incidence of pain due to propofol injection in was highest 18 (90%) in control group compared with the other treatment groups which included lidocaine; without (group 1, 9 [45%] patients; and with venous occlusion for 15,30,60 seconds i.e. group 2, 6 [30%]; group 3, 7 [35%]; group 4, 2 [10%]). The incidence of pain was significantly less in the lidocaine groups with and without venous occlusion compared with the control group. Significantly more patients in group 5 (18 [90%]; $P < 0.05$) reported pain compared with the other treatment groups. The incidence of reported pain was significantly greater in group 1 (lidocaine without venous occlusion) than in group 4 ($P < 0.05$); however, the incidence of pain was similar in group 1 compared with groups 2 and 3.

Tariq MA et al[12] studied the frequency of pain due to propofol injection and to assess the efficacy of addition of lignocaine to propofol, selecting big vein in antecubital fossa or both combined in reducing pain. Incidence of pain was 58% with plain propofol injected in small vein, 10% when lignocaine was added prior to injection, 8% when injected in large vein and 6% when lignocaine was added before injecting propofol in large vein. Addition of lignocaine to propofol before injection into a small vein and administration of plain propofol into a large vein were equally and significantly effective (P value<0.001) Addition of lignocaine to propofol into a large vein further reduced the incidence as compared to plain propofol but this was not statistically significant (P value >0.05).

In the study by Agarwal A et al[13] twenty-four patients (77%) complained of pain in the group pretreated with normal saline as compared with 12 (39%), 10 (32%), and 1 (3%) in the groups pretreated with lidocaine 40 mg, thiopental 0.25 mg/kg, and thiopental 0.5 mg/kg, respectively ($P < 0.05$). Pain associated with IV injection of propofol is seen in 28%-90% patients. Pretreatment with thiopental 0.25 mg/kg and 0.5 mg/kg after manual venous occlusion for 1 min effectively attenuated pain associated with propofol injection

In the study by Sumalatha GB et al[8] conducted to compare the efficacy of ondansetron, ramosetron and lignocaine in terms of attenuation of propofol-induced pain during induction of anaesthesia. The overall incidence and intensity of pain were significantly less in Groups L and R compared to Group O ($P \leq 0.001$). The incidence of mild to moderate pain in Groups O, R and L was 56%, 26% and 20%, respectively. The incidence of score '0' (no pain) was significantly higher in Group L (76%) and Group R (72%) than Group O (34%) ($P < 0.001$). Pre-treatment with IV ramosetron 0.3 mg and lignocaine 0.5 mg/kg significantly reduced the propofol-induced pain when compared to ondansetron 4 mg

In the study by Ahmad N et al[14] the incidence of pain was 32% and 13% (an absolute risk reduction of 19% (95% confidence interval 6.6 %-31.0%)) in the placebo and fentanyl groups, respectively. A statistically significant reduction in incidence of pain in the fentanyl group when compared with the placebo group was found. (p<0.003).

El-Radaideh KM[9] assessed the efficacy of intravenous (IV) pretreatment with lidocaine, IV paracetamol (Perfalgan) or lidocaine

mixed with fentanyl in reducing propofol injection pain. Lidocaine-fentanyl (70% pain free), and lidocaine (68% pain free) significantly reduced propofol injection pain more than paracetamol (54% pain free) and more than placebo (36% pain free) ($p < 0.05$). Compared with the placebo group, there was significantly less pain noted by the patients of Group L (36% pain free versus 68%; $p < 0.05$), the patients of Group LF (36% pain free versus 70%; $p< 0.05$) and patients of Group R (36% pain free versus 54%; $p < 0.05$).

In the study by Lee JH et al[15] the incidence of injection pain diminished significantly in group 3 (52.5%) dexmedetomidine 0.5 µg/kg and group 4 (50%) dexmedetomidine 0.75 µg/kg compared with group 1 (control)(75%) and group 2 dexmedetomidine 0.25 µg/kg (75%), while there was no significant difference between groups 3 and 4.

In the study by Esmaoglu, A. et al.[16] determined the onset and regression time of motor and sensory block, and the quality of anesthesia and postoperative analgesia by the addition of cisatracurium to local anesthetic solution in small doses in intravenous regional anesthesia. The onset time of sensory and motor block in the cisatracurium group was shorter than in the control group, and the difference was statistically significant. The quality of anesthesia was better in the cisatracurium group than in the control group, and the difference was statistically significant. There was no difference between the two groups with respect to sensory block regression time. Motor block regression time was statistically longer in the cisatracurium group than in the control group. Analgesic requirement was greater in the control group than in the cisatracurium group. Cisatracurium as an adjuvant tolidocaine in intravenous regional anesthesia shortened the sensory and motor block onset times, improved the quality of anesthesia, and decreased analgesic requirements without causing clinical side effects.

In the study by Kim YH et al[6] the incidence of pain was significantly lower in the lidocaine and 0.15 mg/kg cisatracurium groups than the control and 0.03 mg/kg cisatracurium groups ($P < 0.05$ for each comparison). There were no significant differences in the incidence of pain between the control and 0.03 mg/kg cisatracurium groups, or between the lidocaine and 0.15 mg/kg cisatracurium groups. There were no significant between-group differences in the incidence of mild pain. Significantly fewer patients reported moderate or severe pain in the lidocaine and 0.15 mg/kg cisatracurium groups than in the control and 0.03 mg/kg cisatracurium groups ($P < 0.05$ for each comparison). The incidence of severe pain was significantly lower in the 0.03 mg/kg cisatracurium group than the control group ($P < 0.05$). There were no significant between-group differences in the incidence of mild pain. Pretreatment with 0.15 mg/kg cisatracurium was as effective as 0.5 mg/kg lidocaine in attenuating pain during intravenous injection of propofol. Pretreatment with 0.03 mg/ kg cisatracurium decreased the intensity but not the frequency of pain. These findings indicate that cisatracurium has a primary analgesic effect.

In the study by Ray S et al[10] the incidence of pain on pretreatment drug injection was higher in the fentanyl group (33.3%) compared with lignocaine and normal saline ($P<0.05$). The lowest incidence of pain on propofol injection was observed in the lignocaine pretreatment group (14.3%) compared with fentanyl (42.9%) and normal saline. (71.4%) ($P<0.05$) Analysis of the incidences of severe pain (score 4) on the propofol injection revealed that in group C (normal saline pretreatment group), 38.1% (eight of 21) participants experienced severe pain, 9.5% (two of 21) of the group A participants (fentanyl pretreatment group) experienced severe pain and none of the group B participants (lignocaine pretreatment group) experienced severe pain. The differences between the three groups (group A vs. group B, group B vs. group C and group C vs. group A) were statistically significant ($P<0.05$). Similar significant differences were observed between the groups in moderate pain also; both lignocaine and fentanyl pretreatment reduced pain on propofol injection, with lignocaine pretreatment being more efficacious.

In their study Polat R et al[17] compared effect of various drugs with saline, lidocaine and together at the same time in reducing pain on propofol injection. Incidence of propofol induced pain was 38%, 76%, 76%, and 58% respectively in pretreatment with remifentanil 0.02 mg, % 2 lidocaine 40 mg, metoclopramide 10 mg, and ketamine 100 microg/kg respectively. Pretreatment with lidocaine or metoclopramide equally and significantly reduced the incidence and severity of propofol induced pain (76%).

In the study by Kim E et al[6] determined the efficacy of nitrous oxide (N(2)O) in alleviating the pain that followed sequential injection of propofol and rocuronium. Incidence and severity of pain from the propofol injection in groups (0.5 mg/kg lidocaine and 100 % O(2)) L, (NaCl and a mixture of 67 % N(2)O/O(2)) N, and (0.5 mg/kg lidocaine and a mixture of 67 % N(2)O/O(2)) LN were significantly lower than those in group C (NaCl and 100 % O(2)) ($P < 0.001$). Pretreatment with inhaled N(2)O reduced the pain associated with propofol and rocuronium injection. Moreover, N(2)O (with or without lidocaine) was more effective than lidocaine alone in reducing rocuronium-related withdrawal reactions associated with sequential injection of propofol and rocuronium.

DeSousa K et al[18] conducted a randomized single-blinded study in which 100 patients were randomly allocated equally into five groups: sevoflurane-lidocaine-tourniquet (SLT), sevoflurane-lidocaine (SL), lidocaine-tourniquet (LT), lidocaine (L), and sevoflurane (S). In the SLT group, all patients (100%) were pain free and had no hand movements. There was no significant difference in pain grade or in hand movements between the L and the S groups, or between the SLT and the SL groups. However, significant differences were observed in pain grade between the SLT and the L groups as well as between the SLT and the S groups. In addition, a significant difference in hand movement was observed only between the SLT and the S groups. The addition of 3% sevoflurane at the time of preoxygenation for 1 min along with routine use of lidocaine-tourniquet completely (100%) prevented pain upon propofol injection whereas sevoflurane by itself provided similar analgesia to premixed lidocaine with propofol.

In the study by Massad IM et al[19]. In group I (control), 35 patient complained of pain, compared to 26 in group II, 23 in group III, and 7 patients in group IV (venous occlusion for 60 seconds with the use of lidocaine 1%), with a significant reduction in the incidence and intensity of pain in group II, III, and IV compared with the control ($p<0.005$). The best reduction of intensity and incidence was achieved in group IV, when compared with groups I, II and III ($p<0.05$).

In the study by Singh D et al[11] the incidence of pain on injection of propofol in the control group was 65% (26/40), as compared to 35% (14/40) in lidocaine group and 30% (12/40) in ramosetron group. Ramosetron pretreatment was as effective as lidocaine to attenuate propofol associated pain when compared to saline group ($P < 0.05$). Two patients each in Groups L and R (5% each) had moderate and severe pain. The difference in pain was statistically not significant with each other, but when compared to Group N (control)(25 and 30%, respectively) it was statistically significant. Significant reduction in the pain for propofol injection was found and both lidocaine and ramosetron were equally effective.

In the present study, In participants receiving Cisatracurium (group A) of the 12 patients in whom incidence of pain on propofol Injection (PIP) was observed; incidence of mild pain was observed in 10 (33.33%) patients; incidence of moderate pain was observed in 2 (6.67%) patient. In the study by Kaya S et al. [8] severity of pain was significantly less in the lidocaine groups with and without venous occlusion compared with the control group.

In the study by Sumalatha GB et al[7] the incidence of mild to moderate pain was 28%, 13% and 11% in Groups Ondansetron, Ramosetron and Lidocaine, respectively , and that of severe pain was 10% (n = 5) in Group O and 2% (n = 1) in both Groups R and L. In the study by Ray S et al[10] In the normal saline pretreatment group, 38.1% of the participants experienced severe pain, compared with 9.5% in the fentanyl ($P<0.05$) group; none with lignocaine.

In the study by Singh D et al[11] two patients each in Groups L and R (5% each) had moderate and severe pain. The difference in pain was statistically not significant with each other, but when compared to Group N (25 and 30%, respectively) it was statistically significant. In

the study by Singh D et al. [55]. Even there was significant decrease in moderate and severe pain (5% in each L and R group) compared with normal saline group (25 and 30%, respectively).

In the present study; the hemodynamic parameters at the baseline: heart rate, systolic and diastolic blood pressure and oxygen saturation (SpO_2) were comparable in both cisatracurium and control group. In the cisatracurium group; a slight increase followed by decrease in the mean heart rate at 5,10 and 15 minutes from the baseline mean heart rate was observed but the mean heart rate variability was not found to be statistically significant. In the control group too, the mean heart rate variability from the baseline was not found to be statistically significant. A slight increase followed by decrease in the mean systolic blood pressure at 5,10 and 15 minutes was observed but the mean systolic blood pressure variability was not found to be statistically significant. In the control group too, the mean systolic blood pressure variability from the baseline was not found to be statistically significant. A slight increase followed by decrease in the mean diastolic blood pressure at 5,10 and 15 minutes from the baseline mean diastolic blood pressure was observed but the mean diastolic blood pressure variability was not found to be statistically significant. In the control group too, the mean diastolic blood pressure variability from the baseline was not found to be statistically significant. Similarly, the mean SPO_2 variability was also observed to be insignificant in both cisatracurium and control group.

Effects of cisatracurium followed by propofol on the monitored hemodynamic parameters were only transient and did not require drug therapy in the present study. Findings of the present study are in accordance with those reported by other similar studies[6].

In the present study none of the patients (N=60) in group (cisatracurium) and control group experienced any immediate signs of anaphylactic reactions (flushing, hypotension, tachycardia, and bronchospasm). This observation could be due to cisatracurium being free of histamine releasing properties.

None of the patients developed pain, oedema, weal or inflammation at the injection site within the first 12 hours and 24 hours after surgery. Similar findings have been reported by other studies studying efficacy of cisatracurium and none of the studies [19,20] have reported serious adverse effects thus reinforcing the safety profile of

Limitations of the Present Study

1. The present study was conducted only on elective surgeries
2. The present study was conducted only on adults

Conclusions

Pretreatment with cisatracurium in the dose of 0.15 mg/kg in veins occluded by tourniquet was found to be effective in reducing both the incidence and severity of pain induced by propofol injection (POPI) without any significant complications in patients with propofol induced general anaesthesia.

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