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Intravenous Lidocaine Efficacy in Preventing Succinylcholine-Induced Postoperative Myalgia in Surgical Adult Patients at Tikur Anbessa Specialized Hospital

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A B S T R A C T

Introduction: Medical professionals exclusively utilize succinylcholine as a depolarizing muscle relaxant. Some of the negative symptoms include fasciculation, myalgia, muscle spasms, and hyperkalemia. The study aimed to evaluate the efficacy of intravenous lidocaine in preventing succinylcholine-induced postoperative myalgia. **Methods:** A prospective cohort study was undertaken on 80 elective surgery patients. Participants were categorized into two groups: one group received intravenous lidocaine (the exposed group), and the other did not receive lidocaine (the control group). The study participant was chosen using a rigorous random sampling procedure. Data collectors monitored patients for post-operative myalgia at 12, 24, and 48 hours following the procedure. We analyzed the data using SPSS version 26. A P-value below 0.05 indicated statistical significance. **Results:** Demographic and clinical data in both groups are similar, with a p-value greater than 0.05. The total incidence rate of succinylcholine-induced postoperative myalgia was 39.3%. 22.5% of the group that received lidocaine experienced postoperative myalgia, compared to 60% of the group that did not receive lidocaine. The group that received lidocaine had lower postoperative myalgia severity generated by succinylcholine compared to the group that did not receive lidocaine, with percentages of 42.9% against 53.3% for mild myalgia, and 15.8% versus 84.3% for moderate myalgia, respectively, with a p-value of 0.001. **Conclusion:** Administering lidocaine intravenously prior to surgery effectively reduced the occurrence and intensity of succinylcholine-induced muscle pain after the operation.

1. Introduction

Since the late 1950s, healthcare professionals have been using succinylcholine, a depolarizing muscle relaxant introduced to the United States market in 1952. It has a distinctive characteristic of quick onset and brief duration of effect, but it also comes with drawbacks like muscular twitching, muscle pain, masseter muscle spasms, high levels of potassium in the blood, muscle breakdown, increased pressure inside the skull, and elevated creatine kinase levels.[1,2] Although succinylcholine has side effects, it remains widely used in developing nations due to its affordability, rapid start of action, shorter duration of action, and more reliable and severe skeletal muscle paralysis compared to other neuromuscular blockers.

Succinylcholine is the cause of myalgia, but the precise mechanism remains uncertain. Sustained muscular contractions are believed to elevate calcium ion levels in muscle cell cytoplasm, leading to the degradation of cell membrane phospholipids. This process results in an elevated release of free fatty acids and free radicals. Free fatty acids and free radicals

promote muscle damage, leading to postoperative myalgia. Phosphokinase elevation is likely involved in the development of postoperative myalgia. Another proposed mechanism is typically associated with increased levels of serum potassium and myoglobin, leading to enhanced creatine kinase and immediate postoperative muscle pain.[3-5]

Postoperative myalgia is a prevalent adverse effect of succinylcholine, occurring in 41% to 92% of cases. The condition typically manifests in the initial days post-surgery, impacting the muscles in the neck, shoulder, and upper abdomen. This led to higher opiate usage and prolonged hospitalizations for outpatient surgeries. Another reported case of succinylcholine-induced postoperative myalgia ranged from 1.5% to 89%. The discomfort had varying durations. It usually lasts for two to three days, but occasionally it persists for a week. Researchers have examined a variety of pretreatments to address the adverse effects of succinylcholine, including non-depolarizing muscle relaxants, lidocaine, remifentanil, dexmedetomidine, diclofenac, magnesium sulfate, gabapentin, and calcium gluconate.[6-8]

Lidocaine, also known as lignocaine, is a Class I antiarrhythmic and amide local anesthetic medication. According to the World Health Organization, it is an essential medicine that is effective, safe, and cost-efficient in any healthcare system.[7] Healthcare providers commonly use it in low doses to treat neuropathic pain, postoperative pain, centrally mediated pain, headaches, and neurological disorders. Doctors also use lidocaine to prevent succinylcholine-induced post-operative muscle pain. Prior administration of lidocaine may prevent succinylcholine-induced elevations in serum potassium and calcium. Lignocaine's ability to stabilize the cell membrane likely hindered the movement of ions across it. Within this research field, there are multiple reasons for using succinylcholine, and there is now no safe substitute for this chemical. The study aimed to compare the occurrence and intensity of succinylcholine-induced postoperative myalgia between patients administered IV lidocaine and those who were not.

2. Methods

A prospective cohort study was done at Tikur Anbessa Specialized Hospital for patients scheduled for elective surgery under general anesthesia in 2021/2022 after receiving approval from the institutional ethics council (Ref. number 130/2021) and obtaining signed informed consent. Patients aged 18 to 50 with American Society of Anesthesiologists (ASA) classifications I and II, body mass index (BMI) between 18.5 kg/m^2 and 30 kg/m^2, and scheduled elective surgery were eligible for inclusion. The patient had difficulty understanding information presented verbally or in written form. With a history of musculoskeletal issues, an expectant mother, and a duration of surgery exceeding 4 hours, A patient who was taking calcium channel blockers, diclofenac sodium, a non-depolarizing muscle relaxant, magnesium sulfate, and diazepam prior to succinylcholine administration was not included in the study. The sample size for the study was determined using a two-fold population proportion for comparison, assuming a significance level of 5% and a power of 80%. According to a previous study in India, the incidence of myalgia in the lidocaine group was 45%, and in the group that did not get lidocaine, it was 77.5%. The ultimate sample size consisted of 40 patients in each category. We selected the study participants via systematic random sampling. We drew a sample from the daily operation schedule list. Eighty participants enrolled in this trial, and all remained present during follow-ups.

All study participants received standard preoperative and intraoperative monitoring upon entering the operating room, in accordance with the hospital's routine monitoring practice. Researchers used a structured questionnaire during the perioperative period to collect and record demographic information, ASA class, type of diagnosis, induction drug administered, dose of muscle relaxant, dose and timing of lidocaine administration before succinylcholine, and duration of surgery data. The trial included patients who received 1.5 mg/kg of lidocaine at least three minutes before succinylcholine administration, as well as those who did not receive lidocaine. Each subject received propofol at a dose of

2-3 mg/kg for general anesthesia, morphine at a dose of 0.1–0.2 mg/kg for pain relief, and succinylcholine at a dose of 2 mg/kg for tracheal intubation. Patients received mechanical ventilation and anesthesia maintenance with an inhalation anesthetic medication. At the end of the surgery, the medical team administered neostigmine and atropine to reverse muscle relaxation. After achieving the desired spontaneous ventilation, we extubated the patients and then transferred them to the recovery room before taking them to the ward.

We utilized a standardized English version of the questionnaire to gather data and modified the Amharic version to assess the frequency and intensity of succinylcholine-induced postoperative myalgia. Trained data collectors monitored the patients for postoperative muscle pain at 12 hours, 24 hours, and 48 hours after surgery. Four grades were used to categorize the assessment of myalgia: grade 0 (nil) indicating no muscle pain or stiffness; grade I (mild) indicating muscle pain or stiffness at one site without limiting activities; grade II (moderate), indicating muscle pain or stiffness that may require analgesic medication but does not restrict normal activity; and grade III (severe myalgia) refers to muscle discomfort or stiffness at one or more locations that result in impairment or restrict activity. Statistical analysis SPSS 26 was utilized to conduct a chi-square test for categorical variables and an independent sample t-test for continuous variables. A p-value less than 0.05 was deemed statistically significant.

3. Results

The study involved 80 volunteers split into two groups: one group received IV lidocaine (the exposed group) and the other did not receive lidocaine (the control group). There was no significant difference between the groups in terms of age, body mass index, sex, ASA status, or duration of operation (p-value > 0.05). Females accounted for 62.5% of the total participants, with 71.3% classified as ASA I (Table 1).

The total incidence rate of succinylcholine-induced postoperative myalgia was 39.3%. 9 out of 40 patients (22.5%) who received intravenous lidocaine and 24 out of 40 patients (60%) in the control group developed succinylcholine-induced postoperative myalgia. Grade II myalgia had a reduced occurrence in the group that received lidocaine compared to the group that did not get lidocaine (15.8% versus 84.3%). In terms of grade I myalgia, the group that received lidocaine had fewer patients compared to the group that did not get lidocaine. Neither group experienced severe myalgia. The groups who received lidocaine experienced a significant reduction in both the occurrence and intensity of symptoms compared to the control group (p = 0.001), with no reported adverse effects (Table 2).

Table 1. Comparison of participants' socio-demographic and clinical features of patients.

Parameter	Lidocaine group (N=40)	Control group (N=40)	p-value
Age in years (mean ± SD)	35.33±7.21	33.35±8.58	0.26
Gender (M/F)	13/27	17/23	0.35
BMI (mean ± SD)	23.56 ±2.02	23.14±2.12	0.36
ASA status(I/II)	28/12	29/11	0.80
Duration of surgery in minutes (mean ± SD)	147.88±25.48	138.98±25.03	0.19

Notes: ASA= American society of anesthesiologists, BMI=Body mass index, F=Female, M=Male, SD= Standard deviation. Independent t-test and chi-square test were used, with a p-value of <0.05 considered as statistically significant.

Table 2. Incidence and severity of succinylcholine-induced postoperative myalgia.

Postoperative myalgia	Lidocaine group	Control group	p-value
Incidence of myalgia	22.5%	60%	0.001
Severity of myalgia			
Nil	31 (77.5%)	16(40%)	
Mild	6(42.9%)	8(53.3%)	0.001
Moderate	3(15.8%)	16(84.3%)	
Severe	0	0	

Chi-square test were used, with p –value <0.05 considered as statically significant.

4. Discussion

Succinylcholine is a depolarizing muscle relaxant utilized for brief surgical procedures and quick sequence induction. Nevertheless, it has the disadvantage of postoperative myalgia, a common side effect with an incidence rate ranging from 1.5% to 89%. Various factors contribute to the increased incidence of succinylcholine-induced myalgia, and researchers have conducted numerous experiments. Current research suggests that non-depolarizing muscle relaxants, lidocaine, and non-steroidal anti-inflammatory drugs (NSAIDs) are the most effective methods for preventing succinylcholine-induced myalgia.[9] Non-depolarizing medicine can somewhat reduce myalgia but may also have significant negative effects. The goal of this prospective cohort study was to find out how often and how bad succinylcholine-induced muscle pain was after surgery in adult patients who were given lidocaine and those who were not in order to lessen the bad effects of non-depolarizing muscle relaxants before surgery.[10,11]

Groups that received intravenous lidocaine showed significant differences in the occurrence and intensity of succinylcholine-induced postoperative muscle pain compared to those that did not (p = 0.001). The group that received lidocaine experienced a reduction in both the frequency and severity of myalgia. Neither group experienced severe post-operative myalgia (POM). Previous studies stated that pre-treatment with lidocaine was more effective than diclofenac in preventing POM.[13-15]

Another study found that lidocaine does not significantly impact the occurrence of adverse effects of succinylcholine.[16] Patients who were administered intravenous lidocaine experienced a notable reduction in the occurrence of sore throats. There was no substantial variation in succinylcholine-induced POM.[17-20] Variations in population genetic composition or variances in the age groups of the study participants may explain this. The study's limitation is that most of the research evaluated was randomized control trials, and various surgical methods were utilized, potentially introducing confounding variables.

5. Conclusion

The study demonstrated that administering 1.5 mg/kg of intravenous lidocaine before succinylcholine effectively reduced the occurrence and intensity of postoperative myalgia without causing any negative effects.

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