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ORIGINAL RESEARCH

The Effects of Prophylactic Intravenous Lignocaine vs Vecuronium on Succinylcholine-Induced Fasciculation and Postoperative Myalgia in Patients Undergoing Elective Surgery at Debre Markos Comprehensive Specialized Hospital, Ethiopia, 2022: Prospective Cohort Study

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Background: The incidence and severity of succinylcholine-induced fasciculation and postoperative myalgia have been shown to decrease when vecuronium bromide or preservative-free 2% plain lignocaine hydrochloride is administered before induction. The aim of this study is to examine the effectiveness of defasciculation dosages of vecuronium bromide and 2% preservative-free plain lignocaine hydrochloride in decreasing succinylcholine-induced fasciculation and postoperative myalgia in patients undergoing elective surgery.

Methods: A total of 110 participants were included in a prospective observational cohort study that was located in an institution. Patients were randomly assigned to (Group L) and (Group V) based on the prophylactic measures they received from the responsible anesthetist utilizing preservative-free 2% plain lignocaine and defasciculation dose of vecuronium bromide, respectively. We recorded, socio-demographic variables, fasciculation, postoperative myalgia, total number of analgesics administered following surgery in 48hrs, and kind of procedure. The descriptive data were compiled using descriptive statistics. Categorical and continuous data were evaluated, respectively, using chi-square statistics and the independent sample *t*-test. To compare the prevalence of fasciculation and myalgia across the various groups, the Fischer exact test was performed. A 0.05 p-value was deemed statistically significant.

Results: This study found that the incidence of fasciculation in the groups receiving the defasciculation doses of vecuronium bromide and preservative-free 2% plain lignocaine hydrochloride was 14.6% and 20% (p-value 0.007), respectively. The rate of mild-to-moderate postoperative myalgia in the vecuronium bromide group was 23.7%, 30.9%, and 16.4% in the first, 24th, and 48th hours, respectively (p-value 0.001), as opposed to 0%, 37.3%, and 9.1%, respectively (p-value 0.008) in the group receiving preservative-free 2% plain lignocaine hydrochloride.

Conclusion: Pretreatment with 2% plain lignocaine that is preservative-free is more efficient than vecuronium bromide at reducing the frequency and intensity of postoperative succinylcholine-induced myalgia, whereas defasciculation dose of vecuronium was more effective prevention of succinylcholine-induced fasciculation.

Keywords: fasciculation, muscle pain, postoperative myalgia, succinylcholine, vecuronium

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Background

For ambulatory anesthesia, quick surgical procedures, and rapid sequence induction, succinylcholine is frequently used as a muscle relaxant.[1,2] An incidence of 5–89%[1–4] of muscular fasciculation and postoperative myalgia are linked to succinylcholine usage.

Fasciculation, which is characterized by an uncontrollable, strong twitching of the muscle that happens right after succinylcholine has been administered and leads to postoperative myalgia (muscle pain), is caused by biochemical damage to the muscle cells and tissue,[5] which lasts for about two to three days. The patient is experiencing shoulder, neck, and abdominal pain on the first postoperative day. Although it is self-limiting, it can upset patients and lengthen hospital stays, which raises the cost of care for patients undergoing ambulatory surgery.[4,6,7]

A meta-analysis concluded that myalgia can be prevented with small doses of non-depolarizing muscle relaxants, lidocaine, or non-steroidal anti-inflammatory drugs.[4]

Numerous preventative strategies have been used to lessen fasciculation and myalgia brought on by succinylcholine. Before administering succinylcholine, the most frequently employed preventative treatments are a short dosage of non-depolarizing muscle relaxants or preservative-free 2% plain lidocaine.[7–9]

In addition to reducing perioperative opioid use and being administered as pretreatment in a patient with an emergency and anticipated difficult intubation, lidocaine is a simple, practical, and effective medication for avoiding succinylcholine-induced postoperative myalgia.[10,11]

Numerous studies demonstrate that succinylcholine-induced fasciculation and postoperative myalgia can be reduced with lidocaine and vecuronium, but no comparison research has been done to establish which preventative methods are more efficient in the study setting.

Methods and Materials

Study Design, Setting, and Population

At Debre Markos Comprehensive Specialized Hospital, prospective institutional cohort research was carried out between April 1 and June 30, 2022. The study included all surgical patients ASA I and II, male or female, between the ages of 18 and 50, under general anesthesia with endotracheal intubation. Exclusion criteria for the study were included patients with an allergy to the study medicines, pregnant or nursing women, prior neurologic and nonspecific symptoms, a history of difficult intubation, prospective airway issues, and patients discharged before 48 hours.

Sample Size and Sampling Technique

The sample size was calculated using a double population proportion based on an earlier article with myalgia proportions of 36% and 18.3% in vecuronium and lidocaine, respectively, at a power (1-B) of 0.80, a threshold of significance of 5%, and a 95% confidence interval.[12]

$$n = \frac{p1(1-p1)+p2(1-p2)}{(P2-p1)^2} \times f(\alpha,\beta)$$

n=52

Assuming a 10% none response rate = 58 in each group

where

α = level of significant (5%)

β = power of the study (90%)

f (α, β) = 10.85

p1 = 0.36 (incidence of postoperative myalgia in vecuronium group)

p2 = 0.183 (incidence of postoperative myalgia in lidocaine group).

Study Variables

Post-operative myalgia and succinylcholine-induced fasciculation were outcome factors.

Premedication, surgical type, induction agents, analgesic consumptions, demographic information (age, sex, BMI, ASA physical status), and preoperative medication were independent variables.

Data Collection Procedure

Based on institutional local protocols all elective surgical patients have followed at least with minimum ASA standard of monitoring, 4mg dexamethasone intravenously was used as premedication immediately before induction, pre-oxygenation was applied 3 to 5 minutes and 0.01mg/kg of defasciculation dose of vecuronium bromide or 1mg/kg of preservative free 2% lidocaine before 3 minutes, and ketamine with propofol in (2:3 ratio based on per body weight calculation) as induction before succinylcholine administration.

All anesthetists were made aware of the study's existence, but they were not told when or how it would be carried out. Following ethical permission from the Debre Markos University School of Medicine Ethical Review Board with an approval number of *S/C/R 19/03/2022*, two trained anesthetist data collectors were involved with dividing tasks for data collection using a self-administered questionnaire. The first data collectors take written informed consent and demographic variables in the preoperative period before the day of surgery, then on the day of surgery in the operating room categorized patients into the two groups based on whether a responsible anesthetist had given them vecuronium or lidocaine and graded fasciculation immediately after the administration of succinylcholine, then the first data collector gives a code for both groups before the questioners transfered to the second data collectors who assessed all patients on the first, 24th, and 48th hours following surgery in the post-anesthesia care unit and their respective wards to determine whether or not myalgia was present and how severe it was, and post-operative analgesic consumption. So the researchers are totally blinded and the code for both vecronium and preservative free plain lidocaine group was given by the first data collector to the researchers after they have completed the results section. In addition, the second data collector was blinded from the pretreatment drugs with vecuronium or lidocaine. Patients were categorized as follows: group "V" who received a defasciculation dose of vecuronium bromide and group "L" who received preservative-free 2% plain lignocaine hydrochloride and took "V" as a control group. The occurrence and severity of succinylcholine-induced fasciculation and postoperative myalgia were assessed using a numeric rating scale in both groups.[13]

All patients received standardized postoperative treatment, based on WHO analgesic ladder was used to control post-operative pain.

Data Analysis and Interpretation

Data were entered and analyzed using SPSS version 22. Both descriptive and inferential statistics were used, and the results were presented using tables, graphs and texts. The Shapiro–Wilk normality test was used to determine whether the data were normal, and the Student's independent *t*-test was used to examine the results before the mean and SD (standard deviation) were given. The Mann–Whitney *U*-test was used to assess non-normally distributed variables, and the results were shown as the median and interquartile range.[14] The needed chi-square and Fisher's exact tests were used to assess categorical parameter comparisons in order to determine the associated components, which were then reported as numbers and percentages. Finally, statistical significance was defined as a P-value of 0.05 or lower.

Operational Definitions

Before inducing anesthesia, 0.01 mg/kg of vecuronium is administered as a de-fasciculation dose (2).

Fasciculation, which is an involuntary fast muscular twitching that cannot move limbs or trunks but occurs shortly after succinylcholine administration and grade of succinylcholine-induced fasciculation and postoperative myalgia in patients undergoing elective surgery, was assessed as shown in Table 1.[15]

Results

Socio-Demographic and Clinical Characteristics of Participants

In this study, a total of 116 study participants were enrolled, but only 110 patients with an involvement rate of 94.8%, since three patients from both groups were leaving the hospital before 48 hours. The mean age (years) of study subjects

Table 1 Grade of Succinylcholine-Induced Fasciculation and Postoperative Myalgia in Patients Undergoing Elective Surgery

Grading of	Fasciculation	Postoperative Myalgia
0 = Absent	No fasciculation	Absence of pain other than surgical pain
1 = Mild	Fasciculation of eyes, face, neck, or fingers only	Muscle stiffness or pains, on deep breathing
2 = Moderate	Fasciculation involving limbs and/or trunk	Muscle pains spontaneously complained by the patient
3 = severe	Movement of limbs and/or trunk requiring forceful retention	Severe incapacitating, generalized muscle pain

with standard deviation was 27.3 ± 13.5 and 29.5 ±10.3 in lidocaine and vecuronium group, respectively. Male/female ratio, ASA I:ASA II ratio, BMI (kg/m^2) and duration of surgery (hr.) were comparable distribution in both groups as shown in Table 2. Participants' age, BMI, sex, ASA classification, length of surgery, or overall tramadol, diclofenac, and pethidine usage did not exhibit any discernible statistically significant differences, as seen in Table 2.

Even though the proportion of all surgical procedures performed in the study were equivalent, majority of surgical procedures performed in both groups were thyroidectomy, gynecological procedures, and cholecystectomy, respectively, as shown in Figure 1.

The Comparison of Incidence and Severity of Fasciculation

In individuals receiving pretreatment with preservative-free 2% plain lignocaine as opposed to groups receiving the defasciculation dose of vecuronium bromide, the incidence and severity of fasciculation were both noticeably higher. Even though the majority of patients nil to develop fasciculation following induction with succinylcholine in both groups, the vecuronium "V" group, only 14.6% of patients develop mild fasciculation but nil to develop moderate fasciculation, whereas in group "L" reported mild-to-moderate fasciculation with an incidence of 20% (p = 0.007), as demonstrated in (Table 3).

The Comparison of Incidence and Severity of Myalgia

Within the two therapy groups, there is an overall significant decrease in pain. Preservative-free 2% plain lignocaine groups experienced considerably less postoperative myalgia in 1 hour compared to the vecuronium group, but both groups' myalgia (postoperative muscle pain) rose significantly from 1 to 24 hours. Finally, in all therapy groups, the duration of postoperative myalgia was decreased from 24 to 48 hours as shown in Table 3. In the first hours of post-operative period,

Table 2 Demographics and Study Variables of the Respondents

Socio-Demographics	Lidocaine Group (n = 55)	Vecuronium Group (n = 55)	*P*-value
Age, years, mean ±SD	27.3 ± 13.5	29.5 ±10.3	0.43
Male/female ratio	26:29	30:25	0.13
ASA I:ASA II ratio	35:20	31:24	0.07
BMI (kg/m2)	20.93±2.9	21.8±3.2	0.20
Duration of surgery (hr.)	1.83± 0.30	1.90±0.25	0.09
Tramadol in 48hr postoperatively (mean ±SD)	165±57(72–205)	180±78(97–250)	0.06
Diclofenac in 48hr postoperatively (mean ±SD)	100±37(52–115)	120±48(67–156)	0.08
Pethidine in 48hr postoperatively (mean ±SD)	50±35(43–130)	80±55(60–140)	0.30
Morphine in 48hr postoperatively (mean ±SD)	30±15(23–60)	67±35(56–113)	0.34

Note: (mean ±SD) = in range.
Abbreviations: ASA, American Society of Anesthesiologists; BMI, body mass index; hr, hour; SD, standard deviation.

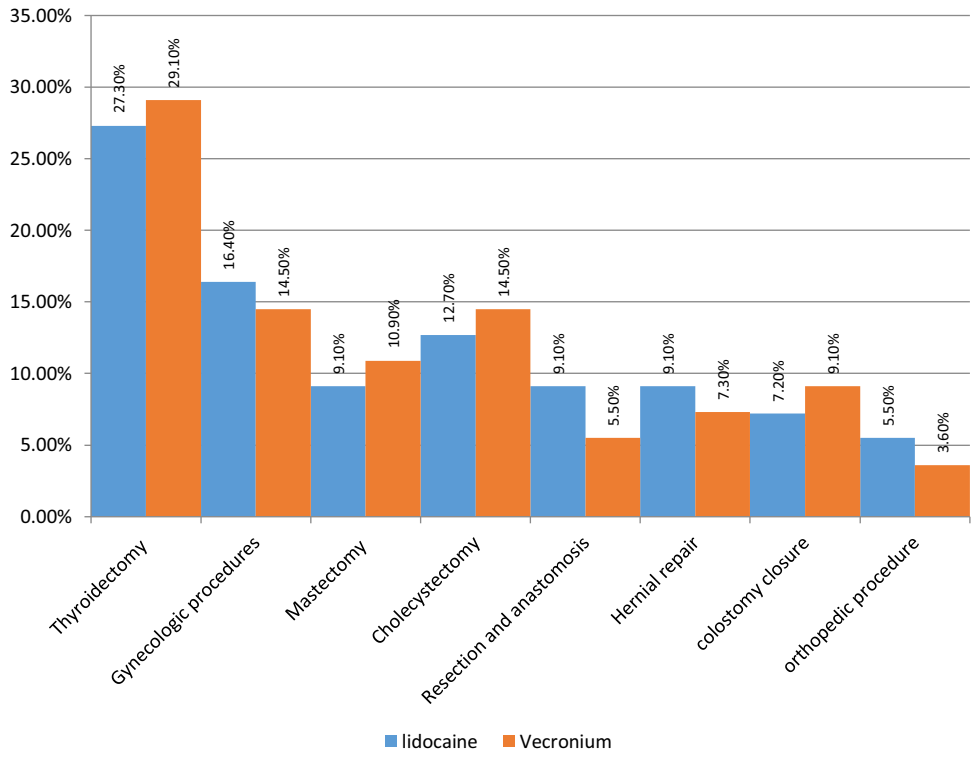

Figure 1 Distribution of the respondents in the two groups for various surgical procedures, 2022 (n = 110).

myalgia was not statically significant (p-value=0.31), as compared to the vecuronium group. Even the incidence of myalgia varies at 24 and 48 hours myalgia was statically significant (p value=<0.001) as shown in Table 4.

Discussion

For quick procedures and rapid sequence induction that call for endotracheal intubation, succinylcholine is the preferred medication.[8,16] Following surgery, patients are distressed by succinylcholine's consequences, which include postoperative myalgia and fasciculation, which are signs of muscular injury.[17] In the current study, both defasciculation dose of vecuronium and preservative-free 2% plain lignocaine significantly reduced succinylcholine-induced fasciculation and post-operative muscle pain. In addition, preservative-free 2% plain lignocaine reduced the need for postoperative analgesics.

Numerous studies have been undertaken to address these issues; these studies revealed the causes of succinylcholine-induced myalgia and developed methods to reduce both the frequency and intensity of the pain.[2,11,15,18,19] When compared to the groups receiving preservative-free 2% plain lignocaine, individuals who received a defasciculation dose of vecuronium bromide experienced less succinylcholine-induced fasciculation. Although fasciculation was better prevented with the de-fasciculation dose of vecuronium bromide, the incidence and severity of myalgia were significantly

Table 3 Comparison of Incidence and Severity of Succinylcholine-Induced Fasciculation During Induction Among Elective Surgical Patients (n = 110)

Fasciculation		Vecuronium Group (n = 55)	Lidocaine Group (n=55)	*P* value
Grading	Nil	47(85.4%)	44(80%)	0.007
	Mild	8(14.6%)	8(14.5%)	
	Moderate	0	3(5.5%)	

Table 4 Comparison of Postoperative Succinylcholine-Induced Myalgia Between the Two Groups in Incidence and Severity Among Elective Surgical Patients Under General Anesthesia Within 48hrs (n = 110)

Groups	Myalgia	1 Hours	*P*-value	24 Hours	*P*-value	48 Hours	*P*-value
Vecuronium	Nil	42(763%)	0.04	38(69.1%)	<0.001	46(83.6%)	0.012
	Mild	9(16.3%)		12(21.8%)		6(10.9%)	
	Moderate	4(7.4%)		5(9.1%)		3(5.5%)	
Lidocaine	Nil	49(89.1%)	0.31	35(63.7%)	<0.001	50(90.9%)	0.08
	Mild	6(10.9%)		13(23.6%)		5(9.1%)	
	Moderate	0%		7(12.7%)		0%	

reduced in the preservative-free 2% plain lignocaine prophylaxis groups ($p < 0.001$), so we concluded that there is no correlation between the occurrence of fasciculation and the severity of postoperative myalgia, which is consistent with prior studies.[4,20,21]

The results of the current study are in line with those of several investigations by Senapati et al and Bekele Buli et al have demonstrated a general decrease in the incidence and severity of postoperative myalgia with pretreatment of preservative-free 2% plain lignocaine and de-fasciculation dose of vecuronium bromide.[8,12]

According to a meta-analysis, pretreatment with non-depolarizing muscle relaxants or local anesthetic medications reduces the incidence of fasciculation and postoperative myalgia by 20–30% on induction and the first postoperative day, respectively.[17] Concerning myalgia following succinylcholine, rocuronium, and lidocaine pretreatment were compared in this meta-analysis. Another study by Spence et al found that lidocaine considerably reduced the severity of postoperative myalgia more effectively than rocuronium, proving that lidocaine is superior.

According to a study conducted in India by Shital Hardik et al, only 10%, 2.5%, and 5% and 0% of patients, respectively, had moderate or severe postoperative myalgia after 1 hour and 24 hours, indicating a considerable reduction in the condition. They concluded that both groups experienced a considerable decrease in post-operative myalgia over time, with lidocaine pretreatment being the most effective at preventing succinylcholine-induced myalgia after surgery.[22]

Findlay et al did not discover a statistically significant difference in myalgia between the groups, in contrast to this study. Their study revealed that there was no discernible difference in the severity of myalgia between the two groups on the first and second postoperative days when they assessed it on the second postoperative day.[23] Similar investigations by Pandey et al[24] and Lee et al[25] indicated that 12.8% to 30% of patients suffered postoperative myalgia on the first and second postoperative days, respectively. These studies used lignocaine as a pretreatment medication for the prevention of this condition. According to this study, the post-operative myalgia in the ordinary lignocaine group was 10.9% mild, 36.3% mild to moderate, and 9.1% mild at 1 hour, 24 hours, and 48 hours, respectively ($P = 0.008$).

It was superior to use 2% plain lignocaine without preservatives to reduce the frequency and intensity of succinylcholine-induced myalgia. However, the incidence of fasciculation and myalgia was reduced when vecuronium bromide was used as a de-fasciculation dose before succinylcholine delivery.

Strength and Limitation

As a strength, representative sample size was involved with sufficient follow-up to address the problem and postoperative myalgia is preventable with available drugs in the resource-limited setting.

As a limitation, the local pain management modality was not controlled.

Conclusion

Pretreatment with 2% plain lignocaine that is preservative-free is more efficient than vecuronium bromide at reducing the frequency and intensity of postoperative succinylcholine-induced myalgia, whereas defasciculation dose of vecuronium was more effective prevention of succinylcholine-induced fasciculation.

Ethics Approval and Consent to Participate

Ethical approval was obtained from Debre Markos University, School of Medicine Ethical Review Board with the reference number *S/C/R 19/03/2022* and written informed consent was obtained from each study subject after a clear explanation about the objective of the study and their right to refuse to participate in the study at any time and was carried out per the Helsinki declarations.

Data Sharing Statement

Data are available on the corresponding author and can be presented upon request.

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Author Contributions

- All authors have made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas.
- All authors have drafted, written, substantially revised or critically reviewed the article.
- All authors have agreed on the journal to which the article will be submitted.
- All authors reviewed and agreed on all versions of the article before submission, during revision, the final version accepted for publication, and any significant changes introduced at the proofing stage.
- All authors agree to take responsibility and be accountable for the contents of the article.

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Disclosure

The authors declare that there is no conflict of interest.

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