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Research Paper

Lidocaine pre-treatment for Succinylcholine induced postoperative myalgia and associated factors: Longitudinal study

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ABSTRACT

Introduction: Postoperative myalgia in surgical patients is mainly caused by the routinely administered depolarizing muscle relaxant, Succinylcholine. There are many proposed strategies but no one were indicated as ideal preventive mechanisms for Succinylcholine induced post-operative myalgia. Even if data were sparse, Lidocaine pretreatment can reduce postoperative myalgia which requires further supportive evidences urging the initiation of this study.

Methods: Prospective longitudinal cohort study was conducted from March to May 2021 at Dessie Comprehensive Specialized Hospital on 208 adult surgical patients. Patients pretreated with Lidocaine preoperatively were grouped as exposed and others as unexposed. Patients meeting the inclusion criteria during the study period were selected sequentially from the daily operation schedule list. Postoperative myalgia level was measured using post-operative myalgia survey repeatedly. The result was analyzed by Cochran's Q test and generalized estimating equation (GEE). Adjusted odds ratio with 95 % confidence interval and p value < 0.05 was used to show the difference, direction and strength of association.

Result: Exposure specific incidence rate showed that 22 %, 22 % and 29.8 % of patients exposed to Lidocaine and 40.6 %, 42.7 % and 34 % not exposed to Lidocaine developed myalgia at 12, 24, and 48 h respectively. There is no significant difference in the incidence of myalgia over time between the repeated measurements in Lidocaine exposed patients ($p = 0.513$) but in non-exposed patients ($p = 0.003$). Also, there is no difference in the distribution of other predictors between Lidocaine exposed and non-exposed groups ($p > 0.05$). Exposure to Lidocaine reduces postoperative myalgia significantly [AOR = 0.33, 95 % CI = (0.17,0.66)]. Multimodal analgesia [AOR = 0.32, 95 % CI = (0.18,0.55)], non-steroidal anti-inflammatory drugs alone [AOR = 0.47, 95 % CI = (0.29,0.76)], postoperative immobility [AOR = 0.61, 95 % CI = (0.47,0.8)], and being male [AOR = 0.48, 95 % CI = (0.26,0.87)] were other determinants in reducing Succinylcholine induced postoperative myalgia.

Conclusion: Lidocaine pretreatment can significantly reduce the occurrence of Succinylcholine induced postoperative myalgia. Additionally, usage of multimodal analgesia with non-steroidal anti-inflammatory drugs or even only non-steroidal anti-inflammatory drugs in the intraoperative and postoperative period can reduce Succinylcholine induced postoperative myalgia.

Introduction

Myalgia is described as a deep, achy, and cramping sensation or discomfort of muscle often compared to the feeling one obtains after aggressively working the muscles [1–4]. Postoperative myalgia is a muscle pain perceived postoperatively other than the operation site in the neck, shoulder, abdominal and leg muscles [5–7]. It is commonly caused by one of the muscle relaxants, Succinylcholine, which was introduced by Thesleff [8] and Foldes [9] in 1952. It is the only depolarizing, short acting and with fastest onset of action muscle relaxant in

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clinical use today [10,11]. The mechanism by which Succinylcholine produces post-operative muscle pain is still not fully understood. Myalgia is assumed to be due to damage produced in muscle by the unsynchronized contractions of adjacent muscle fibers just before the onset of paralysis during Succinylcholine administration [12–14].

The drug's rapid onset and ultra-short duration of action allowed for both rapid endotracheal intubation and rapid recovery of neuromuscular strength [15]. This results Succinylcholine to be used routinely in spite of its many adverse effects in many parts of the world including Ethiopia [16,17]. "No drugs in anesthesia are more problematic than Succinylcholine. Yet, no drugs have survived as Succinylcholine does in spite of crisis after crisis" said Lee [6,18]. Postoperative myalgia is the most frequent adverse effect of Succinylcholine among others [19–22]. Myalgia incidence ranges from 2 % to 90 % with the frequent figure of around 60 % [5,23]. The duration of myalgia is commonly 2 to 3 days postoperatively but may extend to a week in some patients. Myalgia is a very distressing experience that leads the patient to stay post operatively in the bed especially in out-patients because of the pain worsens with movement [7,24,25]. Some scholars prefer to avoid it from use while others argue the advantage of Succinylcholine overweight its side effect [18,26]. In the other hand; there is no drug which can substitute Succinylcholine's advantage in the market. The arrival of Rocuronium, an intermediate acting non-depolarizing muscle relaxant, with Sugammadex reversal will be expected to replace Succinylcholine. However, the reversal Sugammadex is not available even for many high-income countries due to its cost and uncertainty about its reversal effect [6,18].

The effects of different preventive mechanisms of post-operative myalgia were studied. However, any one of these preventive strategies were not described as ideal. Even though sparse, there are studies supporting the effectiveness of Lidocaine pretreatment on the reduction of Succinylcholine induced postoperative myalgia [27–30]. Many of these studies were conducted within 12 h postoperatively and didn't indicate Lidocaine's effect beyond this hour. Other studies which were conducted beyond 12 h didn't consider the repeated nature of the data during analysis to show the effect of variations due to dependency of repeated measurements. The aim of this study was to determine the effect of Lidocaine pretreatment and other predictors on Succinylcholine induced post-operative myalgia over time.

Methods

Study area and period

This Study was conducted in Dessie Comprehensive Specialized Hospital from March 2021 to May 2021 after getting Institutional Review Board approval. Dessie Comprehensive Specialized Hospital is one of the referral Hospitals, found in Amhara Regional State of Ethiopia. The surgical procedures performed in Dessie Comprehensive Specialized Hospital are: General Surgery, Obstetrics and Gynecological Surgery, ENT (Ear, Nose and Throat) Surgery, Maxillofacial Surgery, Orthopedic Surgery, Neurologic Surgery, Pediatric Surgery, Plastic Surgery and Urologic Surgery. According to the Operation Theater Logbook Record, 15 to 30 emergency and elective operations were performed per day in this Hospital.

Study design

Institutional based prospective longitudinal cohort study was conducted. Patients entered in the cohort at different time in the study period based on their operation schedule date and each patient was followed for 2 days postoperatively.

Population

All patients who undergo surgery under General Anesthesia with Succinylcholine in Dessie Comprehensive Specialized Hospital were the target population. Patients who undergo elective Surgery with General Anesthesia using Succinylcholine as a muscle relaxant and pretreated with intravenous (IV) Lidocaine before Succinylcholine administration in the study period were grouped in the exposed population. Patients who undergo elective Surgery with General Anesthesia using Succinylcholine as a muscle relaxant and not pretreated with IV Lidocaine before Succinylcholine administration in the study period were grouped in the non-exposed population.

Study variables

Post-operative myalgia is the dependent variable. Lidocaine exposure statuses, sex, extent of surgery, ambulation status, type of analgesia given preoperatively, intraoperatively and postoperatively, duration of surgery, and type of surgery were independent variables found in many literatures. Other important independent variables such as; age (extreme), magnesium pretreatment, Benzodiazepine pretreatment, None-Depolarizing Neuromuscular Blockers (NDNMB) pretreatment, and being pregnant, were not included in this study. The effect of these variables on postoperative myalgia is well known in many studies [14,31–36]. These variables were restricted in the design to avoid random error of small sample size.

Inclusion criteria

Patients with American Societies of Anesthesiologists (ASA) physical status class of I and II, age 18–60 years, patient who took Succinylcholine in both exposed and non-exposed groups with a dose of 2 mg/kg, patients who took IV plain Lidocaine bolus 0.5 to 1.5 mg/kg IV before Succinylcholine administration in Lidocaine exposed group, patients taking induction dose of IV hypnotic agents (for patients induced by Ketofol, patients taking 1:2 ratio of Ketamine to Propofol) were included in the study.

Exclusion criteria

Pregnant patients, patients with preexisting neuromuscular disorders, or myofascial pain syndromes, patients with dementia and cognitive impairment, patients pretreated with NDNMB, Benzodiazepine and Magnesium and patients who becomes critical postoperatively were excluded from the study.

Sample size calculation

The sample size for this study was calculated by epi info 3.1 software using single population proportion assumption for the first objective and double population proportion assumption for the second objective [37]. Population size, frequency of outcome, and 5 % margin of error at 95 % confidence level were considered for the first objective. The desired power Z1-β (80 %), Z1-α/2 confidence level (95 %), percent of event in unexposed and exposed, and ratio of unexposed subjects to exposed were considered to the second objective. Percent of events were taken from different studies which have similarity in scope with this study objective [16,27,29,38,39]. The total number of desired study subjects becomes 198 by taking the largest of the calculated sample sizes. After adding 10 % non-response rate, the total sample size become 218 by taking the largest from the rest.

Sampling techniques

The daily operation schedule list of each department was used as a frame to recruit the study individuals. After the patients were scheduled, their chart was reviewed and their primary physicians were communicated for initial eligibility checkup. Patients who fulfill the exclusion criteria such as pregnant mothers and patients with cognitive impairment were excluded early. Then, other consecutive patient from the

daily operation list opted for General Anesthesia were followed until Anesthesia was administered. After the Anesthesia administered by the responsible Anesthesia Provider, patients who undergone Surgery with General Anesthesia by using Succinylcholine as a muscle relaxant and pretreated with Lidocaine prior to Succinylcholine administration was selected to be grouped in the exposed group and those who doesn't pretreated with Lidocaine but still took Succinylcholine were grouped as non-exposed.

In this stage, patients who were fulfilling the exclusion criteria such as patients pretreated with Benzodiazepine and NDNMBs by the responsible Anesthesia Provider were excluded again. Since exposure to Lidocaine is relatively rare; we took the ratio of exposed to none exposed to be nearly 1:4. We had stopped collecting data after getting the required sample size in May 25/2021. The total numbers of participants in the exposed group were 60 and in that of non-exposed group were 158.The selected participants were followed for 2 days postoperatively. Two participants were lost to follow up in the exposed group and 8 participants from the non- exposed group. The final sample included 208 participants, of which 58 were pretreated with Lidocaine and 150 were not (Fig. 1). The comparability of other independent variables in each group was not determined in the design phase since the Anesthesia Providers administer each drug randomly based on their preference. However, the comparability was seen in the analysis phase.

Data collection method and ascertainment of exposure

Two trained Anesthetists were assigned for data collection. Preoperative, intraoperative and postoperative exposure status and other information were collected by the first trained data collector by using questionnaire. The questionnaire was prepared by considering all important variables listed in literature. Preoperative and intraoperative exposure status to Lidocaine, Succinylcholine and other variables were ascertained by seeing the Anesthesia Record Sheet, by observing the procedure, and by asking the Anesthesia Providers directly. Postoperative exposure status to different variables mainly type of analgesia given, mobility status of patients and others were ascertained by seeing the Nursing Record and physicians order, by directly asking the professionals, and by observing and asking the patients. The postoperative exposure ascertainment was done at different time within the 2-day postoperative follow up period at least once within each 12 h and the total consumption of each group of analgesia was recorded.

Outcome measurement

The outcome data, intensity of post-operative myalgia, was collected by the second trained data collector by using postoperative myalgia survey which is adapted from two previous studies [2,28] to differentiate myalgia from surgical pain (Annex 1). For each patient, the survey incorporates the presence or absence of myalgia (muscle pain and/or stiffness), myalgia location, and myalgia severity in 11 muscle groups. The 11 muscle groups were localized to one of the three areas, i.e., head/neck (neck and/or jaw stiffness), Trunk, or extremities (including buttocks). For ease of analyses, the myalgia severity was categorized as follow as used in other researches [16]. If muscle stiffness or pain was at one of the three areas i.e., in the neck/shoulder/chest, in the limb or in the trunk and that doesn't limit activity and not require analgesia, it is mild myalgia. Muscle stiffness and pain spontaneously complained of by the patient that requires analgesics or pain perceived at two or more areas i.e., in the neck/shoulder/chest, in the limb or in the trunk that doesn't limit activity is moderate myalgia. If the pain was incapacitating generalized muscle stiffness or pain limiting activity, it is severe myalgia. Each of the selected participants was followed for two days; postoperative outcome data (myalgia severity) was measured at 12-h, 24-h, and 48-h from each patient by the second data collector repeatedly using the postoperative myalgia survey tool.

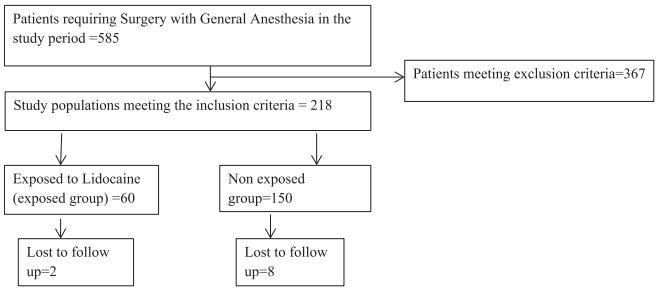

Fig. 1. Sampling technique used to select study participants from the daily schedule.

Data quality control

To have appropriate data, the data collectors were trained and pretest was done before the actual data collection period for the questionnaire. The questionnaire was translated by expert to Amharic and then to English again to maintain consistency. Similar questions were asked for both Lidocaine exposed and non-exposed groups. Ascertainment of the outcome, occurrence and severity of myalgia, was ensured by other data collector who doesn't know the exposure status of the patients to avoid observer bias. Cronbach's alpha was used to measure the internal consistency of the postoperative myalgia survey items of the questionnaire and it is 0.82 showing good consistency. Face and content validity of the questionnaire was done by experts in the field.

Data processing and analysis

The data was entered into EpiData 3.1 and exported to Stata/MP14 in wide form for analysis. For ease of analysis the outcome was dichotomized in to binary i.e., if the patients have either mild, moderate or severe pain it is "yes" and if they have no myalgia at all it is "No". The result of this study was described and interpreted based on this binary outcome. After cleaning and coding, the data was transformed to long form for longitudinal data analysis. To handle the correlation due to the repeated measurement of the same individual using a working correlation structure, the Generalized Estimating Equation (GEE) technique was employed so that the marginal effects of variables on post-operative myalgia were determined. Consequently; we used an autoregressive working correlation structure after seeing the nature of the correlation structure. Cochran's Q test was used to determine the difference in the incidence of myalgia between the repeated measurements in each group (exposed and non-exposed). In addition, Chi-square test was done to compare the difference in the proportion of different independent variables in exposed and none-exposed groups.

Variables with a p value of >0.2 in the bi-variable analysis was avoided from the multivariable analysis. Multicollinearity was checked by using correlation analysis of the independent variables showing there is no significant correlation between independent variables with correlation coefficients ($r < 0.2$) in all measurements. An adjusted odds ratio with a 95 % confidence interval and p value of <0.05 was used to show the effect of determinant factors on the outcome variable.

Result

Participant characteristics

Participants of this study were 208 surgical patients aged between eighteen and sixty. Sixty percent (126) were females and 39 % (82) were males. Most patients were induced by Propofol (38 %) and followed by Ketofol with 1:2 ratio of Ketamine to Propofol (22.6 %) (Table 1). There is no missing data from each time repeated measurement except those whom lose to follow up.

Table 1
Characteristics of patients undergoing surgery with general anesthesia at Dessie Comprehensive Specialized Hospital, May 2021–March 2021.

Category	Frequency	Percentage
Sex		
Male	82	39.42
Female	126	60.58
Exposure status to Lidocaine		
Exposed	58	27.88
Non-exposed	150	72.12
Type of anesthesia induction drug used		
Thiopentone	43	20.67
Ketamine	39	18.75
Ketofol	47	22.60
Propofol	79	37.98
Extent of surgery		
Major	163	78.37
Minor or moderate	45	21.63
Type of surgery		
General surgery	144	69.23
Gynecological surgery	31	14.90
Other surgeries	33	15.87

To see the comparability of each independent variables distribution in the Lidocaine exposed and non-exposed groups, Chi-square tests was performed. As shown in Table 2. There is no significant difference between the exposed and non-exposed groups by the distribution of other exposure variables.

Incidence of Succinylcholine induced postoperative myalgia

The crude incidence rate of postoperative myalgia was 36 %, 37 % and 29 % at 12, 24 and 48 h respectively. The incidence of severe myalgia was 6 %, 1.4 %, and 0 % at 12, 24 and 48 h respectively. Exposure specific incidence rate showed that 22 %, 22 % and 29.8 % of patients exposed to Lidocaine developed myalgia at 12, 24, and 48 h respectively (Table 3). Cochran's Q test shows that there is no significant difference in the incidence of myalgia over time between the repeated measurements in Lidocaine exposed patients ($p = 0.513$). In the other hand, 40.6 %, 42.7 % and 34 % of patients not exposed to Lidocaine developed postoperative myalgia at 12, 24 and 48 h respectively. Cochran's Q test shows that there is a significant difference of postoperative myalgia over time in unexposed groups ($p = 0.003$).

Table 2
Distribution of patient characteristics and other variables in Lidocaine exposed and non-exposed groups with Chi-square test.

Category, N = 218	Exposure to Lidocaine		*p* value
	Yes (n = 58)	No (n = 150)	
Sex			
Male	20	62	0.116
Female	38	88	
Type of anesthesia induction drug used			
Thiopentone	11	32	0.433
Ketamine	12	27	
Ketofol	15	32	
Propofol	20	59	
Extent of surgery			
Major	46	117	0.721
Minor or moderate	12	33	
Type of surgery			
General surgery	39	105	0.177
Gynecological	11	20	
Other surgeries	8	25	
Analgesia given within the first 12 h			
Others (single analgesics other than NSAID)	38	86	0.556
NSAID	6	20	
Multimodal (both others and NSAID)	14	44	
Analgesia given within the next 12 h			
Others (single analgesics other than NSAID)	40	84	0.203
NSAID	5	23	
Multimodal (both others and NSAID)	13	43	
Analgesia given within the last 24 h			
Others (single analgesics other than NSAID)	41	89	0.314
NSAID	5	19	
Multimodal (both others and NSAID)	12	42	

Predictors of Succinylcholine induced postoperative myalgia

After the univariable analysis, duration and type of surgery were excluded from the multivariable analysis as their effect on postoperative myalgia were not significant at 0.2 level of significant. After adjusting for other variables, the odds of developing postoperative myalgia was reduced 0.33 times in Lidocaine exposed patients than that of not exposed to Lidocaine (AOR = 0.33; CI: 0.17–0.66). Multimodal analgesia with non-steroidal anti-inflammatory drug usage reduces the odds of postoperative myalgia 0.32 times than being treated with other analgesic agents (AOR = 0.32; CI: 0.18–0.55, and also only NSAD use reduces the odds of postoperative myalgia 0.47 times than other analgesic agents (AOR = 0.47; CI: 0.29–0.76). Being male reduce the odds of myalgia 0.48 times than being female (AOR = 0.48; CI: 0.26–0.87). Postoperative movement significantly increases the odds of myalgia. Being without movement in the postoperative time reduce the odds of postoperative myalgia 0.61 times than those with movement (AOR = 0.61; CI: 0.47–0 0.81) (Table 4).

Discussion

The crude incidence of postoperative myalgia was 36 %, 37 % and 29 % at 12, 24 and 48 h respectively in this study. This is lower than the frequent figure of postoperative myalgia which is nearly 60 % in many other studies [5,6,14,26,40,41]. Also, 22 %, 22 % and 29.8 % of patients exposed to Lidocaine developed myalgia at 12, 24, and 48 respectively. This is significantly lower when compared to those patients who were not pretreated with Lidocaine in this study. Most studies which have similarity with this study indicate that Lidocaine pretreatment reduces postoperative myalgia [12,27,29,36,38,42–45]. However, many are randomized control trials, and almost all doesn't consider the dependency during the repeated measurement of similar patients at different time to compare with this study. In this study, the incidence of myalgia over the repeated measurements in Lidocaine exposed patients have no significant difference but there is a difference in non-exposed groups. This implies, once the patient is pretreated with Lidocaine initially frequent Lidocaine administration may not be required.

Lidocaine is used for many purposes in the routine anesthesia activity recently in addition to its antiarrhythmic and regional anesthesia activity. It is used to postoperative pain management [12,46–48], reduce Propofol [49] and Rocuronium [27] injection pain, and to attenuate the hemodynamic responses to laryngoscopy. Lidocaine plain is easily accessible with low cost and highest safety margin when administered below 1.5 mg/kg intravenously [25]. Other drugs used for prevention of Succinylcholine induced postoperative myalgia such as; Magnesium and Benzodiazepine pretreatment are not used routinely as Lidocaine unless indicated in the preoperative setting. Also, relatively higher cost, lower safety margin and difficulty of easily availability as a practitioner living in lower income country results these drugs to be less preferable.

Many research findings support that NSAIDs can reduce postoperative myalgia over other group of analgesic agents [14,39,50] which is in line with this study. Multimodal analgesia has higher benefit than using only NSAIDs in this study which requires other large-scale studies to be acceptable for myalgia prevention. Actually, multimodal analgesia is recommended in managing perioperative surgical pain by reducing the side effect of each drug to attain maximal analgesia. So,

Table 3
Incidence of Succinylcholine induced postoperative myalgia at 12, 24 and 48 h in surgical patients at Dessie Comprehensives Specialized Hospital, May 2021 to March 2021.

Categories	12 h	95 % CI	24 h	95 % CI	48 h	95 % CI
Incidence of myalgia	0.36 (36 %)	0.29, 0.42	0.37 (37 %)	0.3, 0.43	0.29 (29 %)	0.23, 0.36
Incidence categorized by severity of myalgia						
Mild	24.5 %		25 %		25.9 %	
Moderate	4.8 %		11 %		4.3 %	
Severe	6.2 %		1.4 %		0.96 %	
Lidocaine exposure specific incidence of myalgia						
Exposed	22.4 %	0.13–0.35	22.41 %	0.13–0.35	29.81 %	0.1–0.31
Non-exposed	40.67 %	0.33–0.48	42.67 %	0.34–0.5	34 %	0.26–0.42

Table 4
Predictors of Succinylcholine induced postoperative myalgia in surgical patients at Dessie Comprehensive Specialized Hospital, Ethiopia, May 2021 to March 2021.

Variables	COR (95 % CI)	*p* value	AOR (95 % CI)	*p* value
Exposed to Lidocaine				
No	1.0		1.0	
Yes	0.43(0.22, 0.83)	0.013	0.33(0.17, 0.66)	0.002***
Type of anesthesia induction drug				
Thiopentone	1.0		1.0	
Ketamine	0.59(0.25, 1.37)	0.224	0.67(0.27, 1.65)	0.395
Ketofol	0.62(0.28, 1.39)	0.252	0.62(0.26, 1.46)	0.282
Propofol	0.67(0.33, 1.37)	0.277	0.52(0.24,1.13)	0.100
Sex				
Female	1.0		1.0	
Male	0.51(0.29, 0.91)	0.016	0.48(0.26, 0.87)	0.017
Type of analgesia				
Others (single analgesics other than NSAID)	1.0		1.0	
NSAID	0.56(0.35, 0.88)	0.013	0.47(0.29,0.76)	0.003
Multimodal (both others and NSAID)	0.42(0.27 0.66)	0.000	0.32(0.18,0.55)	0.000
Movement				
Yes	1.0		1.0	
No	0.68(0.53, 0.86)	0.002	0.61(0.47,0.81)	0.000
Extent of surgery				
Major	1.0		1.0	
Minor or moderate	0.59(0.29, 1.19)	0.144	0.57(0.28, 1.17)	0.132

using multimodal analgesia in the routine perioperative setting has a double-edged sword effect by reducing both postoperative surgical pain and postoperative myalgia simultaneously. Type of induction agents has no significant effect on postoperative myalgia in this study. Some studies even if not adequate show that Propofol and Ketamine can reduce postoperative myalgia [14,17,51]. In the other direction, there were some other studies that support this finding [52].

Being male has shown to be a protective factor for postoperative myalgia when compared to being female. Researches also show as myalgia is higher in females [53]. Movement as described in other studies [28] is highly associated with postoperative myalgia incidence in this study. Many studies conclude that myalgia is common in ambulatory patients who are discharged home in the day of surgery after undergoing minor surgery. These studies highlighted that minor surgical procedures have highest incidence of myalgia than major surgical procedures [34]. However, in this study postoperative myalgia doesn't have association with extent of surgery. This may be due to that of patients undergoing minor surgery are more movable than patients undergoing major surgery. Based on this study, postoperative movement significantly increases myalgia than extent of surgery. However, as early ambulation is highly advocated in the early postoperative period, it is difficult to recommended bed rest as a preventive mechanism of postoperative myalgia.

The result of this study mainly Lidocaine's preventive effect for Succinylcholine induced postoperative myalgia can be implemented in other similar settings. Delivering health care in lower income countries should balance the cost of health intervention with the minimum required quality of care and safety. Succinylcholine is undeniably very important muscle relaxant not only for lower income countries because of its fast onset and fast recovery. However, safety measures should be taken to preventing its side effects. Lidocaine pretreatment can be other best alternative for postoperative myalgia prevention as it is affordable and feasible drug used in the routine anesthesia practice for different purposes.

The strength of this study was that of the analytical model used which is stronger than previous to handle the dependency of repeated measurements. Also, the restriction of independent variables whose effect were studied and well known to avoid the biases associated with mall sample size. However, even if this study is conducted with good analytical model, it is a cohort study with short follow up period with wide outcome measurement hour interval and relatively small sample size as a limitation. It is recommended to have additional research outputs using randomized control trials with similar analysis modality and meta analyses to make the evidence stronger.

Conclusion

Lidocaine pretreatment, perioperative multimodal analgesia and NSAIDs have significant effect on reduction of postoperative myalgia. Since Lidocaine and these analgesic agents are easily accessible and with minimal side effects, it is important to use for prevention of Succinylcholine induced postoperative myalgia in the routine anesthesia activity. Reducing movement can be effective to reduce postoperative myalgia. However, movement is important in the postoperative period for other purposes to be advised than these drugs.

Abbreviations

AOR	Adjusted Odds Ratio
ASA	American Society of Anesthesiologists
CI	Confidence Interval
COR	Crude Odds Ratio
ENT	Ear, Nose and Throat
IV	Intravenous
GEE	Generalized Estimating Equation
NAChR	Nicotinic Acetylcholine Receptor
NDNMB	None depolarizing Neuromuscular Blockers
NSAID	None steroidal anti-inflammatory drugs
PMS	Postoperative Myalgia Survey

Ethical approval and consent to participate

The protocol of this study was approved by Wollo University Institutional Review Board with a protocol number of 'SPH/ERC078/21'. Dessie Comprehensive Specialized Hospital was also consulted after ethical approval and permission was given before proceeding the data collection process. The study was conducted after a written consent was

taken from participants.

Consent for publication

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CRediT authorship contribution statement

Fassil Mihretu: Writing – original draft, Visualization, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Telake Azale:** Writing – review & editing, Visualization, Supervision, Project administration, Data curation. **Foziya Mohammed:** Writing – review & editing, Visualization, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Amare Agumas:** Writing – review & editing, Supervision, Data curation, Conceptualization. **Sara Timerga:** Writing – review & editing, Visualization, Supervision, Conceptualization. **Aynalem Befikadu:** Writing – review & editing, Supervision, Data curation, Conceptualization.

Declaration of competing interest

None.

Data availability

Data will be accessed upon request to the corresponding author.

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Appendix 1. Postoperative Myalgia Survey (PMS) [2,28]

1 Do you have any soreness or stiffness in your muscle besides headache or surgical gas pains? 1. Yes 2. No
2 Have you been up and about (ambulatory)? 1. Yes 2. No
3 Is there pain and stiffness in the muscles during movement? 1. Yes 2. No
4 In which sites do you have muscle pain/stiffness? Jaw ___ Throat ___ Neck ___ Shoulder ___ Arms ___ Chest ___ Abdomen back ___ Buttocks ___ Thighs ___ Calves ___ Generalized ___
5 When did you first notice the pain?
6 Rate the muscle stiffness/pain on a score 0–10 (0 being no pain, and 10 the worst pain ever) only on the sites reported to be painful by the patient. Jaw ___ Throat ___ Neck ___ Shoulders ___ Arms ___ Chest ___ Abdomen ___ Back ___ Buttocks ___ Thighs ___ Calves ___ Generalized ___
7 What makes the muscle stiffness/pain worse? 1. Movement 2. Rest
8 Describe the muscle pain/stiffness in your own words _____
9 Do you think the muscle pain is restricting your normal routine activity? 1. Yes 2. No ___
10 Is the muscle pain preventing you from getting out of bed? 1. Yes 2. No ___
11 How would you rate this limitation of activity on a scale of 0-1 0? (0 being no limitation in activity, 10 being muscle pain limiting the patient to bed all the time except for essential activity)
12 Do you think the muscle pain is severe enough for you to take extra pain medication? 1. Yes 2. No
13 Are you taking your prescribed pain medication to help your surgical pain or muscle pain? 1. Yes 2. No
14 Postoperative Analgesia taken 1. Paracetamol or opioids 2. NSAID 3. Multimodal with NSAI

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