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Decreasing post-succinylcholine myalgia in outpatients

The effectiveness of four pretreatment regimens in decreasing succinylcholine-induced myalgias was studied in healthy outpatients undergoing general anaesthesia for ambulatory surgery. Four hundred and forty adult females were randomly assigned to one of four pretreatment groups. Three hundred and ninety-five patients completed the study. One of the following pretreatments was given prior to injection of 1.5 mg·kg⁻¹ of succinylcholine: (1) normal saline IV three minutes and again immediately prior to succinylcholine; (2) 0.06 mg·kg⁻¹ d-tubocurarine (dTc) IV three minutes prior and normal saline IV immediately prior; (3) normal saline IV three minutes prior and 1.5 mg·kg⁻¹ lidocaine IV immediately prior; (4) 0.06 mg·kg⁻¹ dTc IV three minutes prior and 1.5 mg·kg⁻¹ lidocaine IV immediately prior. Fasciculations after injection of succinylcholine were observed and recorded. Patients were contacted by telephone 40–48 hours postoperatively and questioned about the presence of muscle pains. These pains, if present, were graded either mild or moderate to severe. The patients in the two dTc-containing groups exhibited less fasciculations than patients in the other two experimental groups. The dTc-lidocaine group had a lower incidence of moderate to severe fasciculations than in any of the other three groups. Patients in the dTc, lidocaine, and dTc-lidocaine experimental groups reported a higher incidence of absence of muscle pain and a lower incidence of moderate-severe pain than did patients in the saline group. The dTc-lidocaine group had more patients without myalgia and less patients with moderate to severe myalgias than any of the other groups. Only 8.3 per cent of the patients in the dTc-lidocaine group reported muscle pains. We conclude that a pretreatment regimen consisting of 0.06 mg·kg⁻¹ dTc IV three minutes prior to injection of succinylcholine, along with 1.5 mg·kg⁻¹ lidocaine IV immediately prior to succinylcholine is very effective in decreasing succinylcholine induced fasciculations and myalgia in outpatients.

Key words

NEUROMUSCULAR RELAXANTS: succinylcholine, tubocurarine; ANAESTHETICS, LOCAL: lidocaine; COMPLICATIONS: myalgia.

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As ambulatory surgery continues to grow in importance, it becomes increasingly important to address the anaesthetic problems this presents. Postoperative succinylcholine myalgias are a considerable problem in outpatients. This incidence is reported to be as high as 72 per cent.¹ Various pretreatment regimens have been tried in an effort to reduce myalgias.^{2–7} Non-depolarizing muscle relaxants can decrease the incidence to the 20–40 per cent range. Diazepam may be even better, but only in high doses (15–20 mg IV). Dantrolene and "self-taming" with succinylcholine appear to be ineffective. A recent report has suggested lidocaine pretreatment may be of great value.⁸ It was the purpose of this study to compare pretreatment regimens consisting of normal saline, d-tubocurarine (dTc), lidocaine, and a combination of dTc and lidocaine on the incidence and severity of succinylcholine-induced myalgias in outpatients.

Four hundred and forty adult female outpatients undergoing elective surgical procedures were studied. Procedures involved were tubal and diagnostic laparoscopy, breast biopsy, conization of cervix, wisdom teeth extraction and dilatation and curettage. All patients involved were electively intubated because of type of procedure or a physical characteristic of the patient (hiatus hernia, anticipated difficult airway). All were ASA physical status I or II. The study was approved by the Hospital Committee on Human Research and informed consent was obtained.

Patients were assigned to one of four groups via random number draw. There was no attempt to divide patients according to specific surgical procedure. All patients had an 18-gauge intravenous catheter and were monitored by precordial or oesophageal stethoscope, continuous electrocardiogram with print-out and automated blood pressure cuff (Ohio 2105). Induction of anaesthesia for each group consisted of thiopentone 5–7 mg·kg⁻¹ IV. Relaxation for tracheal intubation was obtained with 1.5 mg·kg⁻¹ of succinylcholine IV. After intubation anaesthesia was maintained with 60 per cent nitrous oxide and oxygen (3:2 L·min⁻¹) and isoflurane 0.5–3.0 per cent. No intravenous analgesics were used. Group I patients (control) received normal saline IV three minutes prior to injection of succinylcholine and again just prior to injection of succinylcholine. Group II (dTc) patients received 0.06 mg·kg⁻¹ dTc IV three minutes prior and normal saline

IV immediately prior to succinylcholine. Group III (lidocaine) patients received normal saline IV three minutes prior and $1.5 \text{ mg} \cdot \text{kg}^{-1}$ lidocaine IV just prior to succinylcholine. Group IV (dTc-lidocaine) patients received $0.06 \text{ mg} \cdot \text{kg}^{-1}$ dTc IV three minutes prior and $1.5 \text{ mg} \cdot \text{kg}^{-1}$ lidocaine IV just prior to injection of succinylcholine. A fasciculation evaluation was done by a nurse anaesthetist observer who was unaware of the medications used. The assignments were as follows: none – no fasciculations, mild – fasciculations around eyes and forehead only, moderate – fasciculations involving entire face and neck, severe – fasciculations involving trunk or extremities. Tracheal intubation was performed by a second anaesthetist one minute after injection of the succinylcholine. This anaesthetist recorded if it was felt the intubation was difficult because of inadequate relaxation.

Patients were contacted by telephone 40–48 hours postoperatively by a research assistant and questioned as to the occurrence of muscle pains. They were asked if they had any muscle pain, soreness, or stiffness. No objective criteria concerning pain reporting were suggested to the patients. Any patient reporting myalgia was asked to describe the severity of the pain as either mild or moderate to severe. The person questioning the patients was unaware of the experimental group the patient was in or what pretreatment regimen she received. Any patient who could not be reached by telephone or who had to be admitted to the hospital overnight was not included in the results.

Data were analyzed in the following way. Characteristics of patients (height, weight, and age) were compared using one-way analyses of variance (ANOVA). Postoperative pain was analyzed as dTc vs saline; lidocaine vs saline; dTc-lidocaine vs curare; dTc-lidocaine vs lidocaine; dTc-lidocaine vs saline; and dTc vs saline using Armitage's test for trend in proportions.⁹ In addition, a logistic regression analysis was applied to these data.¹⁰ Fasciculation data were analyzed in the same manner. A value of $p < 0.05$ was chosen to indicate statistical significance.

Results

Of the 440 patients originally included in the study, 45 are not included in the results. They were either admitted to our hospital overnight (36) or could not be reached by

TABLE I Height, weight and age of patients

Group	Number	Ht (cm)	Wt (kg)	Age
Saline	104	163.5 ± 2.6	63.4 ± 3.7	29.6 ± 3.1
dTc	95	164.1 ± 1.5	61.4 ± 3.7	28.1 ± 2.7
lidocaine	100	163.1 ± 1.9	62.1 ± 4.1	31.0 ± 2.6
dTc-lidocaine	96	165.7 ± 1.8	65.1 ± 3.6	31.1 ± 3.5

ANOVA, $p = \text{NS}$.

TABLE II Fasciculation results

Group	Number	Fasciculations (number of patients)		
		Mild	Moderate-severe	Total number fasciculating
Saline	104	7	39–55	102
dTc	95	7	9–1	17*
lidocaine	100	6	27–58	91
dTc-lidocaine	96	12	1–0	13*

Armitage's test for trend.

* $p < 0.001$ compared to saline.

† $p < 0.05$ compared to dTc.

telephone.⁹ A Chi-square analysis of the remaining patients indicated that this loss to follow-up did not create a disproportionate number of subjects in any of the experimental groups. The study is therefore considered to be of 395 patients, well distributed among all groups. There was no difference between the groups with regard to height, weight, and age (Table I). No patient was felt to be difficult to intubate secondary to inadequate relaxation.

Patients in the dTc groups had a lower incidence of fasciculations than those in the saline or lidocaine groups ($p < 0.001$ Tables II and III). Lidocaine did not decrease fasciculations as compared to the saline group. The dTc-lidocaine group was superior to the dTc alone group in that there was a lower incidence of moderate to severe fasciculations as shown by logistic regression analysis ($p < 0.05$) Table III).

The saline group had less patients reporting no postoperative pain and more patients reporting moderate-severe pain than any of the other three treatment groups (dTc $p < 0.05$; lidocaine $p < 0.01$; dTc-lidocaine $p < 0.001$) Table IV). Logistic regression analysis confirmed these trends (Table V).

The dTc-lidocaine group also had more patients reporting no pain and less patients reporting moderate-severe pain than either the dTc or the lidocaine group ($p < 0.01$). Mild pain was comparable in all four groups.

TABLE III Predicted logistic regression proportions and 95% confidence intervals for fasciculation

Group	Number	Proportion of patients fasciculating	
		None-mild	Moderate-severe
Saline	104	0.068 (0.011–0.125)	0.932 (0.875–0.989)
dTc	95	0.916 (0.880–0.952)	0.084 (0.048–0.120)
Lidocaine	100	0.170 (0.119–0.211)	0.830 (0.779–0.881)
dTc-lidocaine	96	0.969 (0.953–0.985)	0.031 (0.015–0.047)

Saline vs lidocaine N.S. (nonsignificant).

dTc or dTc-lidocaine vs saline or lidocaine $p < 0.001$.

dTc-lidocaine vs dTc $p < 0.05$.

TABLE IV Pain comparison between groups

Group	Number	Number of patients with pain (%)		
		Mild	Moderate-severe	Total
Saline	104	12 (11.5)	31 (29.8)	43 (41.3)
dTc	95	6 (6.3)	18 (18.9)*	24 (25.3)*
Lidocaine	100	8 (8)	14 (14)‡	22 (22)‡
dTc-lidocaine	96	4 (4.1)	4* (4.1)†§	8* (8.3)†§

Armitage's test for trend.

* $p < 0.05$ compared to saline.

‡ $p < 0.01$ compared to saline.

† $p < 0.001$ compared to saline.

§ $p < 0.01$ compared to dTc and lidocaine.

Discussion

Succinylcholine-induced muscle pain is a common problem in ambulatory surgical patients. It has recently been reported to occur in 63 per cent of non-pretreated outpatients.³ Outpatients appear to be at much greater risk than inpatients.^{1,11} The reasons for this are not completely known but may be due to more vigorous use of muscles in early ambulation, lesser amounts of surgical pain present in outpatients making muscle pain more apparent, or use of lower potency analgesics for outpatients. Whatever the reasons, it is important to determine the most effective way of decreasing these muscle pains.

Various methods have been used in an attempt to decrease this pain.^{4,5,7,8} The most commonly used method is pretreatment with a small dose of non-depolarizing muscle relaxant. The incidence of muscle pains with this method is in the 20–40 per cent range.^{2,3} Better success has been reported using diazepam^{5,6} as pretreatment but the dose needed to decrease muscle pains to less than 20 per cent (15–20 mg IV) is probably too high for outpatients who must be fully ambulatory within a few hours. Recently, lidocaine pretreatment (2.0 mg·kg⁻¹) has been reported to decrease the incidence of myalgias to 8 per cent.⁸

TABLE V Predicted logistic regression proportions and 95% confidence intervals for pain

Group	Number	Proportion of patients with pain	
		None-mild	Moderate-severe
Saline	104	0.685 (0.616–0.754)	0.315 (0.246–0.384)
dTc	95	0.829 (0.782–0.876)	0.171 (0.124–0.218)
Lidocaine	100	0.877 (0.842–0.912)	0.123 (0.088–0.158)
dTc-lidocaine	96	0.941 (0.920–0.962)	0.059 (0.038–0.080)

dTc vs lidocaine NS.

dTc-lidocaine vs dTc or lidocaine $p < 0.05$.

Lidocaine or curare vs saline $p < 0.05$.

In our study dTc or lidocaine pretreatment had equal and favourable effects on postoperative myalgias. These were superior to saline (control) in both increasing the number of patients without muscle pain and decreasing the frequency of moderate-severe myalgias. The incidence of myalgia in the dTc group is similar to that reported by other authors pretreating with non-depolarizers.^{2,3,12} The effects on fasciculations of these groups were strikingly different. Almost all the patients in the lidocaine or saline groups fasciculated while few in the dTc group did. This seems to support the impression of other authors that there is no correlation between fasciculations and postoperative muscle pain.^{2,12} If one wishes to decrease fasciculations then dTc is a good pretreatment. Our dTc-lidocaine pretreatment proved superior to dTc alone. Although the number of patients fasciculating were equal in both groups, those in the dTc-lidocaine group had a lower incidence of the moderate to severe fasciculations. Our lidocaine results differed considerably from those previously reported⁸ in that we had a much higher incidence of myalgia. This may be explained by our lower dosage of lidocaine or our much larger sample size.

By far the most effective way of decreasing myalgia was the dTc-lidocaine combination. Few patients reported muscle pain, as the incidence of pain in this group was only 8.3 per cent. Also important was the fact that moderate to severe pain was reported in only 4.1 per cent of the patients in this group. This is less than 30 per cent of the incidence of any of the other groups. One may question why we classified moderate and severe pain in the same group. Follow-up was done over the phone and no objective observations of pain could be made. We felt it would be difficult to accurately separate moderate from severe pain. What we really determined was how many patients had no pain, how many had mild pain and how many had pain they considered to be worse than mild.

The mechanism of action of dTc and lidocaine in decreasing myalgias is only speculative. It was not the purpose of this study to investigate it. It has been reported that pretreatment with non-depolarizing muscle relaxants decreases resting muscle tension and the frequency of motor unit discharge in patients receiving succinylcholine.¹³ If the frequency is reduced below 48 Hz, pain is decreased. It has been suggested that lidocaine's protective effect is due to its membrane stabilizing ability which prevents the rise in serum potassium and decrease in calcium often seen with succinylcholine injection.⁸ Exactly why this would decrease myalgias is not clear. Whatever the mechanisms, the two working together apparently have an additive effect.

With any pretreatment regimen, it is important to know if there are any adverse effects. One important problem is possible antagonism of succinylcholine-induced relax-

ation, making intubation more difficult. This could not be studied blindly because the severity of fasciculations often made it apparent which patients did not receive dTc. However, at no time was intubation felt to be difficult due to incomplete relaxation. Other problems due to bolus injection of lidocaine such as central nervous system toxicity or alterations in heart rate or rhythm or blood pressure were not clinically noticed.

In summary we compared the effects of different pretreatment regimens on succinylcholine-induced fasciculations and myalgias in outpatients. Lidocaine was effective in decreasing myalgias; dTc in decreasing myalgias and fasciculation. A dTc-lidocaine combination was the most effective in decreasing myalgias and fasciculations.

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Résumé

L'efficacité de quatre méthodes de prétraitement afin de diminuer les myalgies induites par la succinylcholine ont été étudiées chez les patients sains devant subir une chirurgie ambulatoire. Quatre-cent-quarante patients ont été assignés au hasard afin de recevoir un des quatre mode de prétraitement: 1) solution physiologique, 2) d-tubocurarine (dTc), 3) lidocaine, 4) combinaison de dTc-lidocaine. Les fasciculations après l'administration intraveineuse de succinylcholine étaient observées et enregistrées. Les malades furent consultés entre 40 et 48 heures postopératoires et ont été interrogés sur la présence de douleur et de myalgies qu'on a classifié comme légère, modeste ou sévère. Les groupes de patients ayant reçu la d-tubocurarine ont montré moins de myalgie que les autres. Les patients du groupe dTc-lidocaine ont eu une incidence totale de myalgie plus basse que les autres groupes et ont accusé moins de myalgie modeste ou sévère. On n'a pas démontré aucune corrélation entre les fasciculations et les myalgies. En conclusion ces résultats suggèrent que le prétraitement avec du dTc-lidocaine est plus efficace pour prévenir les myalgies post succinylcholine chez les patients ambulants.