

Pretreatment Before Succinylcholine for Outpatient Anesthesia?

Thomas Mencke, MD, Jan-Uwe Schreiber, MD, Christine Becker, MD, Marion Bolte, MD, and Thomas Fuchs-Buder, MD

Department of Anesthesia and Critical Care Medicine, University of the Saarland, Saar, Germany

Succinylcholine is a popular muscle relaxant for ambulatory anesthesia (1). Unfortunately, postoperative myalgia (POM) may frequently occur after the use of succinylcholine (2–7) and this myalgia may be particularly troublesome in outpatients (3,5,6). Although pretreatment with succinylcholine with nondepolarizing myorelaxants seems to be effective in decreasing muscle fasciculation, its effectiveness in reducing POM is controversial (5,6). Moreover, pretreatment may produce muscle weakness preceding loss of consciousness (8). Interestingly, increasing evidence suggests that POM is multifactorial in its origin, with succinylcholine being only one contributing factor (3,5,9,10). Therefore, it is of clinical relevance in the context of ambulatory anesthesia to quantify the specific contribution of succinylcholine on POM, thus allowing clinicians to decide whether strategies to prevent succinylcholine-induced myalgia pretreatment are worth their side effects. To this end, this study was designed to compare the incidence and severity of POM after succinylcholine—with and without pretreatment—with those observed in a control group not receiving succinylcholine but using a nondepolarizing myorelaxant. Moreover, the side effects of pretreatment were also systematically assessed.

Methods

After obtaining approval from the Institutional Ethics Committee and written informed consent, we studied

120 adult, ASA physical status I or II patients, undergoing ambulatory knee arthroscopy under general anesthesia. Pregnant patients, patients with neuromuscular disease or medications known to interact with neuromuscular function were excluded.

Patients were randomly assigned to one of three groups ($n = 40$ for each) by random number: Group A: rocuronium 0.06 mg/kg and 4 min later succinylcholine 1.5 mg/kg; Group B: saline 4 min before succinylcholine 1.5 mg/kg; and Group C (control): saline 4 min before rocuronium 0.6 mg/kg. Pretreatment was administered in a double-blinded manner, and syringes were adjusted to a 3-mL volume. One hour before arrival in the operating room, patients were premedicated with midazolam 7.5 mg orally. The induction regimen was standardized for all groups as follows. At time 0, injection of fentanyl 1–2 $\mu\text{g}/\text{kg}$ and the pretreatment regimen according to the patient's group; 4 min later, anesthesia was induced with thiopentone 4–7 mg/kg IV and succinylcholine 1.5 mg/kg (Group A and B) or rocuronium 0.6 mg/kg (Group C); 60 s later, the patient's trachea was intubated. Afterward, patients received a diclofenac suppository 100 mg. Anesthesia was maintained with remifentanyl 0.25 $\mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ and desflurane 2%–3% in O_2/air ; 15 min before the end of surgery, patients received 1.0 g metamizol as a short infusion and a bolus of piritramid 3.0 mg IV. For the first postoperative hour, patients received piritramid 3.0 mg IV, if requested.

An investigator blinded to the patient's group assignment assessed the following variables:

Fasciculation: recorded according to a 4-point rating scale (6): 0 = absent (no fasciculation), 1 = mild (fine fasciculation of the eyes, face, neck, or fingers but without limb movement), 2 = moderate (fasciculation involving limbs and/or trunk), 3 = severe (fasciculation with movement of one or more limbs and/or movements requiring forceful retention).

Muscle weakness: patients were asked 3 min after injection of the pretreatment whether they had one or more of the following symptoms: diplopia, heavy eyelids, misarticulation (i.e., "voice disorder"), difficulty

Results were presented in part as an abstract at the annual meeting of the European Society of Anaesthesiologists in Gothenburg, Sweden, April 2001, and at the 7th International Neuromuscular Meeting in Belfast, Northern Ireland, June, 2001.

Accepted for publication November 6, 2001.

Address correspondence and reprint requests to Thomas Fuchs-Buder, MD, Department of Anesthesia and Critical Care Medicine, University of the Saarland, D-66421 HOMBURG/Saar, Germany. Address e-mail to aifuc@med-rz.uni-sb.de.

Table 1. Patient Characteristics and Duration of Surgery

Pretreatment Muscle Relaxant	Group A (n = 40) Rocuronium 0.06 mg/kg, Succinylcholine 1.5 mg/kg	Group B (n = 40) Saline 0.9%, Succinylcholine 1.5 mg/kg	Group C (n = 40) Saline 0.9%, Rocuronium 0.6 mg/kg
Age (yr)	38.8 ± 13.7	40.3 ± 13.1	41.7 ± 9.7
Weight (kg)	76.6 ± 12.2	71.6 ± 13.1	73.9 ± 8.3
Gender ratio (m/f)	28:12	26:14	24:16
Duration of surgery (min)	56.6 ± 12.4	55.4 ± 10.9	53.2 ± 11.2

Values are mean ± SD or numbers (gender ratio).

in swallowing, or dyspnea. The severity of muscle weakness was defined as the number of these symptoms (0–5) mentioned by the patients.

The incidence of bradycardia (decrease of heart rate of at least 20% or heart rate <60/min) and irregular rhythm were assessed after the intubating dose of the myorelaxant.

Severity and intensity of POM: an investigator unaware whether patients fasciculated asked them specific questions 1 h and 24 h after surgery (11); see Appendix.

Comparisons among groups were performed by using Fisher's exact test, or the Kruskal-Wallis analysis of variance test, followed by the Duncan's post test (versus Control group) or Dunn's post test (pairwise comparison) as appropriate. Demographic data were analyzed by using the Mann-Whitney *U*-test. Results were presented as mean (SD or percentage) or as median (25th and 75th percentiles). Results were considered statistically significant at $P < 0.05$. Sample-size estimation was based on the results of a meta-analysis (4).

Results

Patient characteristics and surgical duration did not differ among groups (Table 1). Six patients in Group A, 3 in Group B, and 4 in Group C received a bolus of 3 mg of piritramid IV in the postanesthesia care unit (not significant).

The incidence and the severity of myalgias did not differ among groups (Table 2).

The incidence and severity of muscle fasciculation were significantly reduced by pretreatment with succinylcholine with rocuronium instead of saline (2.5% versus 80% Group A versus B; $P < 0.001$). Fasciculations were not observed when succinylcholine was avoided (Group C). In the 120 patients studied, there was no correlation between the fasciculation score and POM.

Pretreatment with rocuronium (Group A) was associated with a significantly more frequent incidence of signs of muscle weakness compared with both groups pretreated with saline, i.e., Group B and C (90% versus 22.5% versus 15%, respectively; $P < 0.001$). In Group

A, the severity of muscle weakness was also significantly increased (Table 3).

After succinylcholine administration, bradycardia requiring atropine IV occurred in six patients (three in each group, A and B).

Discussion

Increasing evidence suggests that eliminating succinylcholine may not eliminate POM in outpatients. Pretreatment with different nondepolarizing myorelaxants did not affect the incidence of succinylcholine-induced myalgia (6). Substituting vecuronium for succinylcholine failed to decrease the incidence of POM after outpatient laparoscopy and similar findings were reported for atracurium (3,5,10). To assess the specific contribution of succinylcholine on POM in outpatients, we standardized the perioperative management, and the type of surgery was uniform (all patients underwent ambulatory knee arthroscopy). Thus, anesthesia- and surgery-related factors contributing to POM were controlled; demographic data were also comparable among groups (Table 1). In this clinical setting, the incidence and the severity of POM did not differ whether $2 \times ED_{95}$ rocuronium or succinylcholine—with or without pretreatment—was used to facilitate intubation (Table 2). These observations further support the claim that there may be a baseline incidence of POM in outpatients that is unrelated to the choice of muscle relaxant (3,5,9,10). Pretreatment of succinylcholine, however, led to muscle weakness in most patients (Table 3). Whereas Martin et al. (8) reported a similarly frequent rate of muscle weakness after pretreatment, some other studies observed those symptoms only rarely (6,9). This discrepancy may be explained by the manner in which side effects were assessed. Similarly to Martin et al., we asked all patients systematically for the occurrence of weakness symptoms. Most studies reporting an infrequent incidence assessed weakness by observation. However, diplopia or heavy eyelids may be difficult to quantify by observation, thus leading to an underestimation of their incidence. Surprisingly, some patients being pretreated with saline (Groups B and C) also complained of signs of muscle weakness. This may be related to

Table 2. Incidence, Severity, and Localization of Myalgia

Pretreatment Muscle Relaxant	Group A (n = 40) Rocuronium 0.06 mg/kg, Succinylcholine 1.5 mg/kg	Group B (n = 40) Saline 0.9%, Succinylcholine 1.5 mg/kg	Group C (n = 40) Saline 0.9%, Rocuronium 0.6 mg/kg
Myalgia in PACU			
Incidence	4 (10)	2 (5)	2 (5)
Severity	0 (0-1)	0 (0-1)	0 (0-1)
Myalgia at 24 h			
Incidence	7 (17.5)	11 (27.5)	7 (17.5)
Severity	0 (0-2)	0 (0-3)	0 (0-3)
Overall myalgia			
Incidence	10 (25)	12 (30)	7 (17.5)
Localization			
Neck	5	6	4
Shoulder	2	6	5
Throat	4	3	3
Other	4	6	4

Incidence of myalgia = number (percentage) of patients.
Severity of myalgia = median (range) according to a 4-point rating scale (11): 0 = none, 1 = slight, 2 = moderate, 3 = severe.
PACU = Postanesthesia Care Unit.

Table 3. Incidence, Symptoms, and Severity of Muscle Weakness After Pretreatment

Pretreatment Muscle Relaxant	Group A (n = 40) Rocuronium 0.06 mg/kg, Succinylcholine 1.5 mg/kg	Group B (n = 40) Saline 0.9%, Succinylcholine 1.5 mg/kg	Group C (n = 40) Saline 0.9%, Rocuronium 0.6 mg/kg
Incidence	36 (90)*	9 (22.5)	6 (15)
Symptoms			
Heavy eyelids	31*	7	6
Diplopia	18*	3	2
Voice disorder	6*	0	0
Dyspnea	3	1	0
Swallowing difficulty	8*	1	0
Severity			
Once	13*	6	4
Twice	16*	3	2
Three or more	7*	0	0

Values are numbers (percentage).
Severity = number of paralytic symptoms (0-5) presented.
* P < 0.001 compared with Group B or C.

the prior administration of fentanyl because drowsiness and dizziness were reported after opioids, and some patients may have interpreted these symptoms as weakness (12).

A significant limitation of this study is that POM was assessed only up to 24 h. However, it has been reported that 92% of patients who complained of POM reported it within 24 hours after surgery. Another study reported no difference in the incidence 24 versus 48 hours after surgery (13,14). Therefore, we expect that our methodology would have identified most cases of severe POM.

In conclusion, in the present study, pretreatment with rocuronium failed to decrease the incidence or severity of POM. Pretreatment, however, was regularly associated with muscle weakness before loss of

consciousness. In light of these results, there is no convincing evidence supporting routine pretreatment with succinylcholine for outpatients.

Appendix: Assessment of Postoperative Myalgia

1. Do you have any pains and aches or stiffness in your muscles other than the knee wherein the arthroscopy was performed?

If the answer was no, myalgia was graded 0 = none (no pain); if the answer was yes, the location (i.e., neck, shoulder, arm, throat, abdomen, buttocks), the severity of pain, and the necessity for pain medication were recorded:

A: If the pain was confined to one location, myalgia was graded 1 = slight (pain confirmed to one site but causing no disability).

B: If the pain was affecting more than one location, myalgia was graded 2 = moderate or 3 = severe.

2. Does the muscle pain restrict your normal activity? Restriction of normal activity was assessed as follows: Can you get out of bed? Are you able to turn your head? Can you cough without distress or pain?

A: If the answer was yes, myalgia was graded 2 = moderate (pain affecting more than one site but causing no disability).

B: If one of these questions was answered with no, myalgia was graded 3 = severe (pain affecting more than one site and causing disability).

References

1. Tang J, Joshi GP, White PF. Comparison of rocuronium and mivacurium to succinylcholine during outpatient laparoscopic surgery. *Anesth Analg* 1996;82:994-8.
2. Churchill-Davidson HC. Suxamethonium (succinylcholine) chloride and muscle pains. *BMJ* 1954;1:74-5.
3. Zahl K, Apfelbaum JL. Muscle pain after outpatient laparoscopy despite the substitution of vecuronium for succinylcholine. *Anesthesiology* 1989;70:408-11.
4. Pace N. Prevention of succinylcholine myalgias: a meta-analysis. *Anesth Analg* 1990;70:477-83.
5. Smith I, Ding Y, White PF. Muscle pain after outpatient laparoscopy: influence of propofol versus thiopental and enflurane. *Anesth Analg* 1993;76:1181-4.
6. Joshi GP, Hailey A, Cross S, et al. Effects of pretreatment with cisatracurium, rocuronium, and d-tubocurarine on succinylcholine-induced fasciculations and myalgia: a comparison with placebo. *J Clin Anesth* 1999;11:641-5.
7. Wong SF, Chung F. Succinylcholine-associated postoperative myalgia. *Anaesthesia* 2000;55:144-52.
8. Martin R, Carrier J, Pirlet M, et al. Rocuronium is the best non-depolarizing relaxant to prevent succinylcholine fasciculations and myalgia. *Can J Anaesth* 1998;45:521-5.
9. Mikat-Stevens M, Sukhani R, Pappas AL, et al. Is succinylcholine after pretreatment with d-tubocurarine and lidocaine contraindicated for outpatient anesthesia? *Anesth Analg* 2000;91:312-6.
10. Trepanier CA, Brosseau L, Lacertel L. Myalgia in outpatient surgery: a comparison of atracurium and succinylcholine. *Can Anaesth Soc J* 1988;35:225-9.
11. White DC. Observations on prevention of muscle pain after suxamethonium. *Br J Anaesth* 1962;34:332-5.
12. Smith LA, Carroll D, Edwards JE, et al. Single-dose of ketorolac and pethidine in acute postoperative pain: systematic review with meta-analysis. *Br J Anaesth* 2000;84:48-58.
13. Erkola O. Effects of precurarisation on suxamethonium-induced postoperative myalgia during the first trimester of pregnancy. *Acta Anaesthesiol Scand* 1990;34:63-7.
14. Maddineni R, Mirakhur RK, Copper AR. Myalgia and biochemical changes following suxamethonium after induction of anaesthesia with thiopentone or propofol. *Anaesthesia* 1993;48:626-8.