Declarations of interest

The authors declare that they have no conflicts of interest.

References

1. Bonnet MP, Mercier FJ, Vicaut E, et al. Incidence and risk factors for maternal hypoxaemia during induction of general anaesthesia for non-elective Caesarean section: a prospective multicentre study. *Br J Anaesth* 2020; **25**: e81–7
2. Quinn AC, Milne D, Columb M, Gorton H, Knight M. Failed tracheal intubation in obstetric anaesthesia: 2 yr national case-control study in the UK. *Br J Anaesth* 2013; **110**: 74–80
3. Baraka AS, Hanna MT, Jabbour SI, et al. Preoxygenation of pregnant and nonpregnant women in the head-up versus supine position. *Anesth Analg* 1992; **75**: 757–9
4. Hignett R, Fernando R, McGlennan A, et al. A randomized crossover study to determine the effect of a 30° head-up versus a supine position on the functional residual capacity of term parturients. *Anesth Analg* 2011; **113**: 1098–102
5. Lee BJ, Kang JM, Kim DO. Laryngeal exposure during laryngoscopy is better in the 25 degrees back-up position than in the supine position. *Br J Anaesth* 2007; **99**: 581–6
6. Desai N, Wicker J, Sajayan A, Mendonca C. A survey of practice of rapid sequence induction for caesarean section in England. *Int J Obstet Anesth* 2018; **36**: 3–10

doi: 10.1016/j.bja.2020.05.034
Advance Access Publication Date: 28 June 2020

Not another requiem for succinylcholine. Comment on *Br J Anaesth* 2020; 125: 423–5

Aaron F. Kopman[1] and Sorin J. Brull[2,*]

[1]Boca Raton, FL, USA and [2]Department of Anesthesiology and Perioperative Medicine, Mayo Clinic College of Medicine and Science, Jacksonville, FL, USA

*Corresponding author. E-mail: SJBrull@me.com

Keywords: monitoring; neuromuscular blocking agents; postoperative pulmonary complications; succinylcholine; tracheal intubation

Editor—We read the recent editorial in *British Journal of Anaesthesia*[1] entitled 'Another nail in the coffin of succinylcholine' with considerable interest. The authors' analysis of the observations of Schäfer and colleagues[2] on the association between succinylcholine administration and postoperative pulmonary complications (POPC)[2] was scholarly, as expected from these well-regarded experts. But despite their cogent arguments, we are not yet ready to accept their conclusion that there is no role for succinylcholine in modern anaesthesia practice.

We concur that succinylcholine is not the ideal neuromuscular blocker, as the list of its potential side-effects is lengthy. However, we cannot agree that its pharmacodynamic profile is less than unique. After a 1.0 mg kg^{-1} dose (~3–4 times its effective dose for 95% depression of baseline twitch, ED_{95}), complete twitch suppression at the adductor pollicis muscle usually occurs in slightly more than 60 s. Of greater importance is that spontaneous recovery to 90% of control twitch height typically requires 10 min.[3] A reduced initial dose of 0.6 mg kg^{-1} will speed recovery by 1.5–2 min while still achieving 100% block in <2 min.[3] This lower dose (0.5–0.6 mg kg^{-1}) is as effective in producing good intubating conditions as a 1.0 mg kg^{-1} dose.[4] A small defasciculating dose (10% of ED_{95}) of a non-depolarising neuromuscular blocking agent preceding administration of succinylcholine 1.0 mg kg^{-1} will also reduce offset times.[5] Thus, although no antagonist to the neuromuscular blocking effects of succinylcholine is readily available,[6] one is rarely indicated.

Before the introduction of short and medium duration neuromuscular blocking agents, succinylcholine was widely used to facilitate tracheal intubation, followed by maintenance of neuromuscular block with non-depolarising drugs. This combination is rarely used clinically today; if it is used, we agree the practice may be suboptimal. However, some uniquely evanescent effects of succinylcholine still make it the drug of choice in several clinical situations: (1) when an episode of laryngospasm develops under sedation or mask anaesthesia, a small dose of succinylcholine ($\leq$0.4 mg kg^{-1}) can quickly abort laryngospasm leading to full recovery in <10 min[3]; (2) a patient undergoing a 30–40 min ambulatory procedure (e.g. sinus surgery) who needs tracheal intubation to protect the airway, but does not require further muscle relaxation; and (3) electroconvulsive therapy, when succinylcholine can mitigate tonic–clonic motor activity and potential injuries.

DOIs of original article: 10.1016/j.bja.2020.06.025, 10.1016/j.bja.2020.05.059.

Underlying the study by Shäfer and colleagues[2] and the accompanying editorial[1] is the assumption that POPCs are a direct result of residual neuromuscular block. Shäfer and colleagues[2] define POPCs as postextubation desaturation (haemoglobin oxygen saturation <90%) in the operating room within 10 min after extubation, or tracheal re-intubation requiring unplanned ICU admission within 7 days after surgery. Certainly, there are multiple other causes for arterial desaturation in the immediate postoperative period or for reintubation 7 days later, aside from postoperative residual neuromuscular block. In fact, the recent STRONGER study[7] defined postoperative pulmonary complications as ' … pneumonia, respiratory failure, or other pulmonary complications (including pneumonitis; pulmonary congestion; iatrogenic pulmonary embolism, infarction, or pneumothorax).' The similarity in the incidence of POPC between patients who received succinylcholine and those who received non-depolarising neuromuscular blocking agents could therefore be attributable to the definition of POPC used by Schäfer and colleagues.[2] This observation does not strike us as 'another nail in the coffin of succinylcholine.'

We agree that intermittent succinylcholine administration or succinylcholine infusions are outmoded and potentially dangerous practices. Nevertheless, there are situations in which a clinician should not be criticised for choosing succinylcholine as a first choice. The recent guidelines on the use of neuromuscular blocking agents by the French Society of Anaesthesia and Intensive Care[8] regarding electroconvulsive therapy suggest that 'suxamethonium remains the gold standard as a muscle relaxant in the vast majority of cases'.

Finally, we are not sure what the authors advocate when they suggest that, ' … fade of the twitch response following succinylcholine requires *specific* neuromuscular monitoring practice.' We surmise they refer to the recommendation[2] that quantitative monitoring be used even when succinylcholine is administered, despite the fact that train-of-four (TOF) ratio measurement may not be helpful, because depolarising neuromuscular blockers do not induce significant TOF fade. We agree that monitoring of responses is essential. Quantitative monitoring in this setting would necessitate measuring and establishing a control single twitch response before succinylcholine administration and assurance that the first twitch of the TOF (or the single twitch) has returned to baseline to indicate return of normal neuromuscular function after depolarising block. The ability to do this comparison to a baseline twitch already exists in most modern objective monitors. If such a monitor is not available, then subjective evaluation of the twitch response using a peripheral nerve stimulator is still required. A 'specific' monitoring algorithm for use after depolarising block is, however, not needed.

More than a decade ago, Lee[9] prophesised that succinylcholine would soon disappear from the anaesthesiologist's armamentarium. He reasoned, ' … sugammadex … promises not only to revolutionize the reversal of neuromuscular block but also to retire the cholinesterase inhibitors as well as suxamethonium.' This has not yet come to pass. Certainly, the halcyon days of succinylcholine are over. We posit that while succinylcholine ultimately may be viewed as a 'niche' drug, it will likely continue to occupy a secure place in the top drawer of our anaesthesia machines. The 'requiem for suxamethonium' predicted almost three decades ago[10] and reforecast today[1] is still premature.

Declarations of interest

AFK has nothing to disclose. SJB has intellectual property assigned to Mayo Clinic (Rochester, MN, USA); has received research funding from Merck & Co., Inc. (funds to Mayo Clinic) and is a consultant for Merck & Co., Inc. (Kenilworth, NJ, USA); is a principal and shareholder in Senzime AB (publ) (Uppsala, Sweden); and is a member of the Scientific Advisory Boards for The Doctors Company (Napa, CA, USA) and NMD Pharma (Aarhus, Denmark).

References

1. Blobner M, Hunter JM. Another nail in the coffin of succinylcholine? *Br J Anaesth* 2020; **125**: 423–5
2. Schäfer MS, Hammer M, Santer P, et al. Succinylcholine and postoperative pulmonary complications: a retrospective cohort study utilizing registry data from two hospital networks. *Br J Anaesth* 2020; **125**: 629–36
3. Kopman AF, Zhaku B, Lai KS. The "intubating dose" of succinylcholine: the effect of decreasing doses on recovery time. *Anesthesiology* 2003; **99**: 1050–4
4. El-Orbany MI, Joseph NJ, Salem MR, Klowden AJ. The neuromuscular effects and tracheal intubation conditions after small doses of succinylcholine. *Anesth Analg* 2004; **98**: 1680–5
5. Eisenkraft JB, Mingus ML, Herlich A, Book WJ, Kopman AF. A defasciculating dose of d-tubocurarine causes resistance to succinylcholine. *Can J Anaesth* 1990; **37**: 538–42
6. Geyer BC, Larrimore KE, Kilbourne J, Kannan L, Mor TS. Reversal of succinylcholine induced apnea with an organophosphate scavenging recombinant butyrylcholinesterase. *PLoS One* 2013; **8**, e59159
7. Kheterpal S, Vaughn MT, Dubovoy TZ, et al. Sugammadex versus neostigmine for reversal of neuromuscular blockade and postoperative pulmonary complications (STRONGER): a multicenter matched cohort analysis. *Anesthesiology* 2020; **132**: 1371–81
8. Plaud B, Baillard C, Bourgain JL, et al. Guidelines on muscle relaxants and reversal in anaesthesia. *Anaesth Crit Care Pain Med* 2020; **39**: 125–42
9. Lee C. Goodbye suxamethonium! *Anaesthesia* 2009; **64**(Suppl 1): 73–81
10. Durant NN, Katz RL. Suxamethonium. *Br J Anaesth* 1982; **54**: 195–208

doi: 10.1016/j.bja.2020.07.007
Advance Access Publication Date: 1 August 2020