Frozen succinylcholine: the danger of being overzealous with its cold storage

P. Dewachter1,* and C. Mouton-Faivre2

1Paris, France, and 2Nancy, France

*E-mail: pascale.dewachter@yahoo.fr

Editor—We wish to report an unusual problem encountered with the use of succinylcholine. During a rapid sequence induction in an obese patient (BMI=40) after propofol, diluted succinylcholine solution (10 mg ml⁻¹) could not be injected after the seventh ml of the 10 ml syringe despite a substantial pressure on the plunger. On closer inspection, the remaining solution was found to be completely frozen inside the syringe. A second succinylcholine syringe was used without delay. The course of anaesthesia and surgery proceeded uneventfully.

It is usual practice in our hospital to draw up and store emergency anaesthetics such as succinylcholine in a heat insulated box with eutectic gel pack to prevent its warming to operating room temperature. This blue eutectic gel is for use with pharmaceutical products between 2 and 8°C. In the present case, the succinylcholine syringe was in direct contact with the gel for ~15–20 min before its use. This procedure follows a warning letter published by the French National Agency for the Safety of Medicine and Health Products,1 in 2012. This letter reminded that only cold commercial solutions of succinylcholine vials stored at 2–8°C can be used, as inadequate storage conditions of succinylcholine vials might be involved in the onset of a higher case–declaration of succinylcholine-induced anaphylaxis, in France, between 2005 and 2011.

Two cases of frozen succinylcholine have been previously published,2,3 both encountered during emergency Cesarean section, where closer inspection revealed that the contents (100 mg) were completely frozen inside the 2 ml-syringe. The corresponding syringes were stored either close to the icebox4 or on the middle shelf in a drug-fridge for ~6 h.5 The freezing point of succinylcholine was subsequently measured to be at 0.62°C.3

Manufacturers have determined proper temperature storage conditions needed to maintain safety and efficacy until the expiration date.4 In France, only the preservative-free succinylcholine chloride solution (50 mg ml⁻¹) is commercially available and the drug product labels mention that the vials must be stored in refrigerator at 2° to 8°C. In the US, the drug facts state that the succinylcholine chloride solution (100 mg ml⁻¹) must be stored in refrigerator but indicate that multi-dose vials (20 mg ml⁻¹) are stable for up to 14 days at room temperature without significant loss of potency.5

Previous studies demonstrated that the chemical stability of succinylcholine in saline solution at concentrations of either 10 mg ml⁻¹ or 20 mg ml⁻¹, is not altered when stored at room temperature, for up to seven days6 and three months,7 respectively. Besides, if a 10% loss of potency is considered acceptable, the 20 and 50 mg ml⁻¹ succinylcholine solutions vials can be stored without refrigeration for about eight and five months, as the rate of degradation of the 20 mg ml⁻¹ solution appears to be slower than that of the 50 mg ml⁻¹ solution.8 On the other hand, exposure to light only slightly affects the stability of succinylcholine chloride solutions.5 Finally, preservative-free diluted succinylcholine solutions (10 mg ml⁻¹) and those manufactured with preservatives (20 mg ml⁻¹) remained sterile when drawn into sterile syringes and stored at room temperature, respectively for up to 7 days9 and 30 days.10,11

Although freezing of succinylcholine is a rare event, the consequences may be hazardous especially in cases of rapid sequence induction. It belongs to a National Regulatory Authorities to remind storage conditions of health products; however the hypothetical relationship between storage conditions of succinylcholine and the rising incidence of succinylcholine-induced anaphylaxis suggested by the French Agency, has not been supported by any scientific evidence. In addition, it should be highlighted that an overzealous interpretation of guidelines may induce adverse events such as in the present case, whereas clinical recommendations should be based on the literature and not on subjective beliefs.

In conclusion, it should be questioned why succinylcholine be stored in cold conditions before its use as its chemical stability and sterility is not altered by room temperature?6,11

Declaration of interest
None declared.

References
Quality of tracheostomy care is probably as important as timing

B. A. McGrath* and C. Doherty

Manchester, UK
*E-mail: brendan.mcgrath@manchester.ac.uk

Editor—We would agree that the recent meta-analysis by Szakmany & colleagues1 examining the effect of early tracheostomy on resource utilization and clinical outcomes in critically ill patients reached some important conclusions. An early tracheostomy culture (within 10 days of commencing mechanical ventilation) is likely to significantly increase the number of patients undergoing the procedure without any clear outcome benefits. However, the outcomes here, considered in terms of 60 day to two yr mortality, peri-procedural complications and informed by the few studies that report complications, don’t tell the whole story.

The recent NCEPOD study ‘On the right trach’ examined data from over 2500 new tracheostomy episodes and noted complications in 23.6% of ICU patients and 31.3% of ward patients.2 In keeping with previous reports, tube displacement, obstruction, pneumothorax and major hemorrhage were the most common serious complications, with accidental tube displacement more common in ward-based patients (6.3% vs. 4.1%). Nearly 30% of patients experiencing one complication experienced further complications, indicating the vulnerability of this specific cohort of patients. Overall hospital mortality for a patient requiring tracheostomy was 17%, similar to the 20% reported from the USA.3 This figure can increase to 40% in subgroups with co-morbidities.4

Whilst Szakmany notes an ‘excess’ of early tracheostomies is likely to increase these complications, morbidity and mortality are clearly multifactorial and we would argue that that the quality of care offered to patients with tracheostomies is at least as important as the timing - perhaps more so. There is emerging evidence that adopting a hospital-wide quality improvement approach to tracheostomy care, can improve surrogate measures of the quality and safety of care. Improvements in hospital and ICU length of stay, time to first use of speaking valve, time to decannulation, patient satisfaction and outcomes have been reported by a variety of exemplar institutions from around the world.5 These methodologies have been amalgamated and promoted by the Global Tracheostomy Collaborative (www.globaltrach.org) which aims to improve care for all patients using an international collaborative quality improvement model. Whilst the timing of tracheostomy in the critically ill is one piece of the jigsaw, there are likely many other elements of care that need to be addressed, as highlighted by the NCEPOD report.

Declaration of interest
B.A.M. is chair of the UK National Tracheostomy Safety Project and European Lead of the Global Tracheostomy Collaborative. C.D. is NTSP Paediatric Working Party Lead.

References

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