Succinylcholine Duration and Critical Hemoglobin Desaturation in the Healthy Adult

To the Editor: —I read with interest the article by Benumof et al. examining the development of critical desaturation after paralysis with 1 mg/kg of succinylcholine. I am concerned that some of the authors’ interpretations, as well as the commentary in “This Month in Anesthesiology,” may not be entirely justified and may, in some cases, lead to premature or potentially hazardous intervention. Benumof et al. conclude that “before significant desaturation...a rescue option should be instituted aggressively and early.” The commentary warns that “potentially fatal hypoxia may occur long before recovery.” These conclusions are based largely on a mathematical model of hemoglobin desaturation during apnea, duration of succinylcholine effect culled from other articles,” and an arbitrary assumption of what constitutes functional neuromuscular recovery to ensure adequate ventilation.

I am primarily concerned about the reasonably healthy adult patient, who comprises the majority of most anesthesiologists’ cases. First I am not sure the authors’ determination of the duration of succinylcholine effect is accurate. How the mean time to 50% recovery after succinylcholine was determined is not clear, one of the references cited used 0.8 mg/kg; another used 40 mg/m² BSA, which using their data is > 1.1 mg/kg; and a third reported 10%, 25%, 75%, and 90%, but not 50% twitch height recovery. Further, one reference reports the time to 50% recovery began at the time of injection and that 80 ± 24 s elapsed before paralysis occurred.
CORRESPONDENCE

another reports time to recovery began at the first indication of a reduction in twitch, not at the cessation of ventilation. In the other references it appears, but is not clearly stated, that the beginning time was at the time of injection, not at the time ventilation stopped. Based on my reading of the cited references, the mean time from cessation of ventilation caused by paralysis until recovery of 50% twitch could be shortened by 30-90 s.

Second the requirement of a return to 50% peripheral twitch height may not be necessary for some minimal level of ventilation that would prevent critical hemoglobin desaturation. One of the references states that, during general anesthesia, after paralysis with succinylcholine, "in most cases respiration had begun prior to any demonstrable activity at the thumb." A second study, also during general anesthesia, measured the actual apneic period and found it to be approximately 2 min less than the time required for 50% twitch recovery. A third reference reported diaphragmatic recovery paralleling adductor pollicis recovery but preceding it by 2 min at all degrees of recovery. Finally a study of unanesthetized volunteers receiving succinylcholine by continuous infusion showed that airway patency was maintained, and vital capacity and inspiratory pressure were greater than 65% of control when peripheral strength was 20% of control. Even during general anesthesia, 50% peripheral twitch recovery may not be the absolute lower limit for sufficient ventilation with 100% oxygen to maintain hemoglobin saturation.

Benumof et al. perform their analysis and base their recommendation on the use of a 1 mg/kg dose of succinylcholine. However, at least one of their references and several major textbooks of anesthesia recommend 0.5-1.0 mg/kg for an intubation dose in healthy adults and note that the ED95 for intravenous succinylcholine is 0.20-0.25 mg/kg. Further, although the duration of paralysis is directly related to dose, once recovery begins it proceeds at approximately 25% per min. regardless of dose (within the clinical range of 0.2-4.0 mg/kg). After an intravenous dose of 0.5 mg/kg succinylcholine, the time to 50% twitch height recovery is about 5.4 min, at which time the apneic model predicts an oxyhemoglobin saturation of 97-98% for a healthy adult.

Bearing in mind that no subjects were studied, it seems to me that, in the instance of a healthy adult, Benumof et al. have overstated their case. If, using the information above, the actual duration of apnea is decreased by 45-60 s, then the hemoglobin saturation will only have decreased to between 94 and 92%. Or if the dose of succinylcholine is reduced to 0.6-0.8 mg/kg, then the duration of apnea would be in the 6- to 7-min range, and saturation would have decreased only to 98-96%.

I cannot dispute the data for small children or obese or ill adults, although more definitive data than presented would be preferable. My recommendation would be to minimize the need for aggressive intervention by always ensuring the best possible preoxygenation

and by using the lowest effective dose of succinylcholine. Like any anesthesiologist, I would always be prepared for aggressive intervention, but I prefer prevention to intervention.

Denis L. Bourke, M.D.
Anesthesiology Service
Baltimore VA Medical Center
Department of Anesthesiology
University of Maryland at Baltimore
Baltimore, Maryland

References

1. Benumof JL, Dagg R, Benumof R: Critical hemoglobin desaturation will occur before return to an unparalyzed state following 1 mg/kg intravenous succinylcholine. ANESTHESIOLOGY 1997; 87:979-82
2. Henkel G: Can functional recovery be achieved before life-threatening desaturation occurs? ANESTHESIOLOGY 1997; 87:5A

(Accepted for publication February 5, 1998.)