

COMMENTARY

# Rapid sequence induction with rocuronium – a challenge to the gold standard

Gerard F Curley\*<sup>1,2</sup>

See related research by Marsch *et al.*, <http://ccforum.com/content/15/4/R199>

## Abstract

Succinylcholine has been indicted on account of the diverse risks associated with its administration, which include hyperkalemia, vagal arrest, and malignant hyperthermia. However, it provides excellent intubating conditions reliably and quickly, characteristics that sustain its appeal for use in the intensive care unit, where airway management is challenging. There is an increasing body of evidence, outlined here, that rocuronium is an acceptable alternative to succinylcholine.

In the previous issue of *Critical Care*, Marsch and colleagues [1] report the results of a trial that compares the use of rocuronium and succinylcholine for rapid sequence induction (RSI) in the intensive care unit (ICU). Given the importance of high-quality airway management in the critically ill, for whom time is of the essence and the consequences of failed intubation are at their most serious [2], this challenge to the gold standard is contentious.

RSI is an anesthesia induction technique designed to facilitate rapid tracheal intubation in patients at high risk for pulmonary aspiration. Succinylcholine has been a mainstay of RSI for more than 50 years, primarily because of the drug's rapid onset time. This property facilitates that fundamental axiom of RSI, which is that the time from induction of anesthesia to endotracheal intubation with a cuffed endotracheal tube, the airway's period of vulnerability to aspiration risk, should be as short as possible.

The concept of RSI evolved after the introduction of succinylcholine in 1951 and the description of cricoid pressure in 1961 [3]. The traditional components of the technique as outlined in the original description [4] include oxygen administration, injection of a predetermined dose of thiopental immediately followed by succinylcholine, application of cricoid pressure, and avoidance of positive pressure ventilation before tracheal intubation with a cuffed endotracheal tube [4]. Currently, RSI is the standard of care for anesthesia induction in patients with an increased risk for gastric aspiration. However, in practice, there is considerable variation and not a little controversy regarding some elements of the technique [5].

For more than 30 years, questions over succinylcholine use in RSI have been raised [6]. Succinylcholine possesses the fastest onset (45 seconds) and produces the shortest period of muscle relaxation (6 to 10 minutes) compared with all other agents. However, it is a 'pharmacologically dirty and dangerous drug' with the potential to result in acute lethal hyperkalemia [6]. Several commonly encountered conditions in the ICU predispose patients to dangerous elevations in serum potassium with succinylcholine, including upper or lower motor neuron defects (for example, spinal cord injury and critical illness polyneuropathy), prolonged chemical denervation (for example, muscle relaxants), direct muscle trauma or inflammation, thermal trauma, disuse atrophy, and severe infection. In each, there is an upregulation of muscle nicotinic acetylcholine receptors, which when depolarized with succinylcholine lead to efflux of intracellular potassium into the plasma, leading to acute hyperkalemia [7]. These issues have increased the interest in the use of rocuronium, an aminosteroid non-depolarizing neuromuscular blocking drug, in place of succinylcholine for RSI in surgical [8], obstetric [9], and, now, critically ill [1] populations.

The prospective randomized controlled trial by Marsch and colleagues [1] evaluates the use of succinylcholine versus rocuronium to facilitate RSI in intensive care. A prior study in patients undergoing surgery [8] and a Cochrane meta-analysis review [10] reveal the superior intubating conditions with succinylcholine versus

\*Correspondence: [gerard.curley@nuigalway.ie](mailto:gerard.curley@nuigalway.ie)

<sup>1</sup>Department of Anaesthesia and Intensive Care Medicine, Galway University Hospitals, Newcastle Road, Galway, Ireland

<sup>2</sup>Department of Anaesthesia, School of Medicine, Clinical Sciences Institute, National University of Ireland, Galway, Newcastle Road, Galway, Ireland

rocuronium. However, the significance of these findings in critically ill patients, the very population most at risk for succinylcholine-related side effects, was, until now, unknown. Marsch and colleagues [1] report that the incidence of failed intubation attempts and qualitative scores of intubation conditions did not differ between the groups. Furthermore, the widely reported difference in onset times between the two drugs was not clinically relevant in this population. Whereas time to completion of intubation was faster in the succinylcholine group, this was not accompanied by a decrement in oxygen saturation in the rocuronium group.

So, what does this mean for the clinician? What this study shows is that rocuronium and succinylcholine are equally effective at facilitating laryngoscopy in this ICU population. The unpredictability of the hyperkalemic response to succinylcholine in ICU patients [11] and the fact that the population at risk is diverse and difficult to identify [7] mandate, at the very least, extreme caution regarding its use. On the other hand, tracheal intubation in the ICU is difficult and is associated with a high incidence of complications [2,12]. Intubations in this study were performed by physicians with dual training in anesthesia and intensive care. It is worth considering whether these findings can be extrapolated to ICUs where this level of expertise in airway management is not the norm.

Second, when succinylcholine is replaced by rocuronium for RSI, the optimal dose of rocuronium may be higher than that used in this study. A large dose of rocuronium (1.2 mg/kg) has been shown to have a mean onset time of 55 seconds, which was similar to the mean onset time of succinylcholine (50 seconds) in the same population [13]. At this high dose, the mean duration of action of rocuronium is 60 to 73 minutes. However, sugammadex, a specifically designed g-cyclo-dextrin, can be used to rapidly and predictably reverse even profound levels of rocuronium-induced neuromuscular blockade [14].

Third, this study result holds true for the neuromuscular blocking agents used; however, the induction agents (propofol or etomidate) and fentanyl premedication play an important role in achieving good intubating conditions [15]. Effective premedication and anesthesia may mask a difference between the neuromuscular blockers which without their use may become evident.

Finally, in a population of obese patients, in whom apnea for even less than 1 minute may lead to hypoxemia, a 14-second difference in time to intubation may be more significant than was the case in this relatively lean population.

In conclusion, rocuronium was as safe and effective as succinylcholine in facilitating laryngoscopy and intubation during RSI in this study [1]. Careful consideration

should go into the use of a drug such as succinylcholine in the ICU, and rocuronium is a very attractive alternative. However, succinylcholine carries a weight of evidence for fast, profound, and reliable neuromuscular blockade which cannot yet be discounted.

#### Abbreviations

ICU, intensive care unit; RSI, rapid sequence induction.

#### Competing interests

The author declares that he has no competing interests.

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