Succinylcholine: burn physiology

Succinylcholine, by activating the nicotinic acetylcholine receptor on muscle allowing potassium efflux from the cell, typically causes an increase in potassium concentration of 0.5-1.0 mEq/L. However this increase can be much greater in states of denervation, immobilization, critical illness, and severe inflammation. These disease states can result in the proliferation of acetylcholine receptors throughout the muscle cell in addition to their usual location of the neuromuscular junction. The exact reason why burn patients express these extrajunctional receptors is unknown, but is thought to be due to a combination of direct denervation from thermal trauma and systemic inflammation.

The presence of extrajunctional acetylcholine receptors significantly increases the number of receptors accessible to succinylcholine resulting in the potential for significant hyperkalemia. Patients with extrajunctional receptors do not experience hyperkalemia with physiologic acetylcholine release during muscle contraction because the acetylcholine is so rapidly metabolized that it can not diffuse from the neuromuscular junction, this is contrast to succinylcholine which is metabolized over 10-20 minutes. There are two types of extrajunctional receptors, one is called “fetal” or “immature” and consist of two α1 subunits and one each of the β1, δ, and γ subunits, which differs from the mature receptor in that a γ subunit has taken the place of the usual ε subunit. This fetal receptor stays open longer when activated contributing further to hyperkalemia. The other extrajunctional receptor consists of 5 α7 subunits meaning the channel can be activated even if 3 of the subunits are blocked with antagonists. α7 subunits also respond to even low concentrations of choline, one of the metabolites of succinylcholine.

Extrajunctional receptors are noted to be present within hours of the inciting event, although the exact timeline of when a patient becomes at risk to a hyperkalemic response is unknown. Most references believe it is safe to give a burn patient succinylcholine in the first 48-72 hours. My personal practice is to avoid it starting 24 hours after a burn. There is also debate about how long to avoid succinylcholine for in burn patients: at a minimum one should avoid it until all wounds are healed, protein catabolism has ended, and the patient is mobile. Avoidance of succinylcholine for 1-2 unless there is evidence of continued myopathy is likely prudent.

Further reading:

Martyn JA, Richtsfeld M. Succinylcholine-induced hyperkalemia in acquired pathologic states: etiologic factors and molecular mechanisms. Anesthesiology. 2006 Jan;104(1):158-69. doi: 10.1097/00000542-200601000-00022. PMID: 16394702.