Biomedical Innovation Competitor #4

RIC Technologies

Presented by Brittney Herrington and Kyle Guild

Video: https://w21cinnovationacademy.com/competitors/#Competitor8

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Acute ischemic stroke causes rapid neuronal death due to a loss of blood flow in the brain. No prehospital treatments currently exist that can help mitigate these losses during transport time to a stroke centre. Our innovation uses remote ischemic conditioning (RIC), a tissue-protective strategy that promotes cell survival and repair, while inhibiting cellular death and inflammatory pathways. Our device is comprised of four centrally-controlled blood pressure cuffs that will cycle between occlusion of blood flow and reperfusion for specified time intervals. Perfusion-reperfusion induces RIC, and is a non-invasive treatment modality that can be delivered with ease in an ambulance.

During acute ischemic stroke, a loss of blood flow in the brain results in the loss of around 2 million neurons per minute. Emergent treatment is required to restore blood flow, which can only be performed at comprehensive stroke centres - in eligible patients who still have salvageable brain tissue on arrival. In most cases, there is an unavoidable transport delay from the location of stroke-onset to a treatment facility, making many patients ineligible for treatment upon arrival. Therefore, there is an urgent need for treatments that can be safely administered in an ambulance, to maximize salvageable brain tissue.

Remote ischemic conditioning (RIC) is a non-invasive intervention that activates protective pathways in our body. RIC works by occluding blood flow at a remote site (such as the arm) and inducing an ischemic environment downstream for a period of time. During this time, the hypoxic environment will activate endogenous pathways where neuroprotective elements such as nitric oxide, bradykinin, adenosine, and heat shock proteins are produced (England et al., 2017). Upon reperfusion, these factors are able to travel through the bloodstream to exert a protective effect at a proximal location, such as the brain. While the exact mechanism is still unknown, it is believed that both neural and humoral factors are activated during this time of occlusion and can provide protection against future bouts of ischemia. Initial potential for this therapy was first shown in preclinical studies within various animal models with protection of both myocardial and neuronal tissue occurring by application of RIC (Hess et al., 2015). In humans, previous research has evaluated the use of remote ischemic postconditioning, such as the RECAST clinical trial (England et al, 2017) which applied this therapy in patients who had an ischemic stroke within 24hrs and saw that the postconditioning was safe and tolerable among patients, and found that patients with treatment showed improved National Institutes of Health Stroke Scale (NIHSS) scores. Additionally, in treating ischemic stroke in the acute pre-hospital setting, a clinical trial in Denmark utilized RIC in stroke patients during transit to the hospital, and found through tissue survival analysis, that the group with the RIC treatment had decreased tissue risk of infarct (Hougaard et al., 2013). Importantly, there was no evidence of any significant harm including in patients with hemorrhagic stroke who were initially enrolled (since hemorrhage can only be ruled out by imaging, unavailable in most ambulances). However, while these results have been promising, they have only

ever utilized one or two arm cuffs, thus applying a sub-maximal dose. We wish to fully harness the potential protective effects of RIC by applying a maximal four-limb dose, adapted for the acute pre-hospital setting i.e. transit time for stroke patients.

Unlike other devices currently on the market, our prototype allows health-care providers to control the duration and dose of RIC. It is also the first device of its kind that serves a secondary function as a blood pressure monitor, and the only one that can be used on multiple limbs at once to apply a maximal dose. It is completely wireless, compact, and user-friendly in a critical setting such as an ambulance. Finally, while other commercial devices in Canada cost upwards of $2500, our device is projected to have half the cost.