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Oxygen-generating compound shows promise for saving tissue after severe injury

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The same compound in a common household clothes detergent shows promise as a treatment to preserve muscle tissue after severe injury. Researchers at the Wake Forest Baptist Medical Center's Institute for Regenerative Medicine hope the oxygen-generating compound could one day aid in saving and repairing limbs and tissue.

The research in rats, published online ahead of print in *PLOS ONE*, found that injections of the compound sodium percarbonate (SPO) can produce enough oxygen to help preserve muscle tissue when blood flow is disrupted.

"Some commercial detergents generate oxygen bubbles to help clean clothes or remove stains," said Benjamin Harrison, Ph.D., co-author and associate professor of regenerative medicine at Wake Forest Baptist. "We modified the material so it can be injected into muscle and provide a boost of oxygen to slow down muscle death until surgery can restore blood flow. Potential applications include treating amputations, crush injuries from car accidents or even blast injuries suffered by those in combat zones."

SPO is a combination of sodium carbonate and hydrogen peroxide molecules. In the presence of water, it decomposes into oxygen and other salts. The current formulation used by the researchers generates oxygen for about three hours.

"Normally, when blood flow to muscle tissue is reduced due to severe

injury, the muscle begins to die," said Harrison. "Providing extra oxygen to oxygen-deprived muscle following injury is currently a major medical challenge. The few treatments that are available are primarily aimed at increasing the oxygen-carrying capacity of blood and require an intact system of blood vessels to carry that fluid, which we don't always have in damaged tissue."

When muscles don't have enough oxygen, they lose the ability to contract and their delicate metabolic balance (homeostasis) is impaired. The current project measured the effects of injecting oxygen-starved muscles with SPO. The first phase of this study, involving laboratory studies of muscle outside the body, compared SPO-treated muscles with non-treated muscles and found that SPO was effective at preserving both function and homeostasis in oxygen-deprived muscles.

"Our surprising finding was that even after exercising isolated leg muscles in the absence of oxygen, the muscles injected with the SPO compound could generate 20 percent more force than untreated muscles," said Harrison. "These studies were conducted using a standard laboratory test to evaluate muscle function outside the body."

Another part of the study involved rats in which the blood flow to a leg was interrupted and muscle function was studied while still in the body. The scientists measured flexion of the foot in response to nerve stimulation, which causes contraction of the tibialis anterior muscle. Even 30 minutes after the start of exercise (muscle stimulation), oxygen-deprived muscles injected with SPO maintained 30 percent of normal force. In muscles not treated with SPO, there was nearly complete cessation of contraction under identical conditions.

"This research, which evaluated muscles both outside and within the body, is the first to demonstrate that an oxygen-generating compound helps preserve muscle function and metabolic balance after oxygen-

deprivation," said Harrison. "It may be a way to get oxygen to muscles when blood flow is severely compromised."

Harrison said additional work is still needed to determine if SPO will be effective in larger muscles and can be dispersed throughout the muscle, as well as if it can be applied to humans.

If successful, Harrison said the treatment could potentially extend the window of time, known as the "golden hour" in emergency medicine, when treatment has the highest chance of preventing death.

"The major implication of these findings is that oxygen-generating compounds can potentially reduce the magnitude of the permanent functional deficits resulting from traumatic injury to muscle, said George Christ, Ph.D., co-author and professor of regenerative medicine at Wake Forest Baptist. "This effect alone would be extremely valuable to both wounded warriors and civilians. However, it is also conceivable that the technology, because it delivers oxygen independent of blood flow, may also have diverse applications to the salvage, repair and regeneration of soft tissue following trauma."

Provided by Wake Forest University Baptist Medical Center