Medical Xpress

Toward a portable emergency treatment for stopping life-threatening internal bleeding

August 20 2012

Progress toward a new emergency treatment for internal bleeding — counterpart to the tourniquets, pressure bandages and Quick Clot products that keep people from bleeding to death from external wounds — was reported here today at the 244th National Meeting & Exposition of the American Chemical Society.

Erin Lavik, Sc.D., who described the advance toward developing synthetic platelets, said it is among the efforts underway world-wide to treat bleeding from "blunt-force" injuries — in car accidents like the crash that killed Princess Diana, for instance, and the battlefield blast waves from bombs and other weapons that are the leading cause of battlefield deaths. Sports injuries, falls and other problems likewise can cause internal bleeding.

"Emergency treatments for stopping the flow of blood from cuts and other external injuries save thousands of lives each year," Lavik pointed out. "But we have nothing that emergency responders or military medics can use to stop internal bleeding permanently or at least long enough to get a patient to a hospital. There's a tremendous need in the military, where almost 80 percent of battlefield traumas are blast injuries. In civilian life, there are many accidents, violence-related injuries and other incidents that result in internal bleeding."

Lavik's team, which is at Case Western Reserve University, was inspired by studies showing there are few options to treat soldiers in Afghanistan and Iraq who suffer internal injuries from the roadside bombs known as improvised explosive devices and other blasts. They wanted to develop a treatment military medics could use in the field to stabilize wounded soldiers en route to definitive care in a hospital.

"The military has been phenomenal at developing technology to halt bleeding, but the technology has been effective only on external or compressible injuries," Lavik said. "An emergency treatment for internal bleeding could provide a broader ability to stop life-threatening hemorrhage."

Currently, no effective treatments exist that are portable and can stop internal bleeding at the scene, Lavik explained. At the hospital, however, patients typically undergo surgery and receive donated platelets or something called factor VIIa, which helps with clotting, but both can cause immune problems. Factor VIIa also can potentially cause blood clots elsewhere in the body, not just at the site of bleeding, increasing stroke risk. Other alternatives have been developed in the laboratory, but they've had similar side effects and are not currently used in hospitals.

Lavik and colleagues are developing synthetic platelets. These are artificial versions of the disc-shaped particles in blood that collect on the jagged edges of cut blood vessels and launch the chain of biochemical events that result in formation of a clot that stops the flow of blood. The synthetic platelets are special nanoparticles, so small that 10 would fit across the width of a single human hair. Their role is to stick to natural platelets and leverage quicker and more efficient clotting at the site of an internal wound.

The nanoparticles are spheres that are made of the same polyester material used in dissolvable sutures, and they disappear from the body after doing their work. The particles have an outer coating of polyethylene glycol (PEG), the same thick, sticky substance used as a thickening agent in skin creams, toothpastes and other consumer products. Researchers then attach a peptide, or small piece of protein, that sticks to platelets. The end product is a white powder that has a shelf-life without refrigeration of at least two weeks — almost twice as long as the donated natural platelets now administered to control bleeding. Unlike donated platelets or factor VIIa, the synthetic platelets do not require refrigeration.

In tests on laboratory rats, stand-ins for humans in such experiments, the artificial platelets worked better than factor VIIa in stopping internal bleeding and increased survival, explained Lavik. Emergency medical technicians or battlefield medics could carry the powder out into the field to treat patients immediately, which could mean the difference between life and death, Lavik noted.

Lavik explained that the development process is ongoing, and it will take several years for the treatment to reach first-responders. So far, the nanoparticles appear safe, and all of the materials used to make them are already approved for medical use.

Provided by American Chemical Society