

DESCRIPTION FOR THE GENERAL PUBLIC

Blood loss on the battlefield is one of the most common causes of death among soldiers involved in military operations in Iraq and Afghanistan. It should be noted that these deaths could be avoided if timely rescued and supplied with effective dressings. Equally often, the inability to stop bleeding leads to death of patients in operating rooms. Right after cardiac issues, massive bleeding represent approximately 22% of deaths in hospitals.

The most commonly used dressings are bandages pressed at the site of bleeding, these include cellulose bandages, and materials supporting active hemostasis, such as chitosan and collagen. Dressings with chitosan not only accelerate the inhibition of bleeding, but thanks to its anti-bacterial properties can help in case of microorganisms infected wounds.

The scientists in their laboratories, are working on finding appropriate hemostatic dressings. They created many of them, one of interesting examples are hydrogel dressings. Researchers from the Department of Biomedical Engineering in Brigham and Women's Hospital have developed a protein hydrogel with unique properties that make it possible to stop bleeding as well as assists in the processes of tissue regeneration and creation of a network of blood vessels. The proposed hydrogel comprising a polypeptide chains is crosslinked in contact with the light, so that it changes the mechanical properties of the dressing. As with all new dressings, it must go through a series of laboratory tests on animals, to be approved for the applications in humans.

Another example of dressing, which has already found application in the military is the invention of a group of scientists from the Massachusetts Institute of Technology, which is in the form of foam. The foam has an active ingredient - thrombin natural substance needed for blood clotting. In combination with a substance which prevents the premature degradation of the thrombin it is placed deep in the wound through the syringe applicator. With this material, scientists managed to stop the bleeding in a minute, while other dressings needed even twelve minutes.

Scientists in Poland also have numerous successes in the production of biomaterials for the applications in biomedical engineering. The project on the prevention of post-traumatic changes in the brain tissue was done at the Institute of Fundamental Technological Research. Nanofiber dressing was releasing the drugs at the site of damage, especially antioxidants and cell growth factors supportive damaged cells. This material caused inhibition of the degeneration of brain tissue, that was shown in animal studies. The same material was also used as an insulating material in the spinal surgery. Physicians operating with this material have found that the nanofibers in contact with blood are causing fast clotting what gave motivation to extend the research on our nanofibrous material.

The idea proposed in this project, concerns preparation of hemostatic dressing made of nanofibers. This material will be designed in a way to obtain the appropriate characteristics of the fibers. Important parameters that affect the coagulation of blood in the contact with the nanofibers are their size, orientation in the material and surface modification. It is planned to modify it in such a way that blood cell, particularly platelets adhere to the surface of the nanofibers, and activate clot formation. Proper surface modification with selected functional groups provide attraction place on the surface for thrombocytes, and will accelerate the blood coagulation cascade. Coagulation cascade is a series of chemical reactions leading to the activation of fibrinogen, protein forming a fibrin which is a clot forming fiber. The acceleration of these reactions can also be done due to the release of drugs especially vitamin K and tranexamic acid, which participate actively in the process of blood clotting. These materials will be subjected to numerous tests in contact with human blood in order to determine their effectiveness and their potential for the use in operating rooms.