

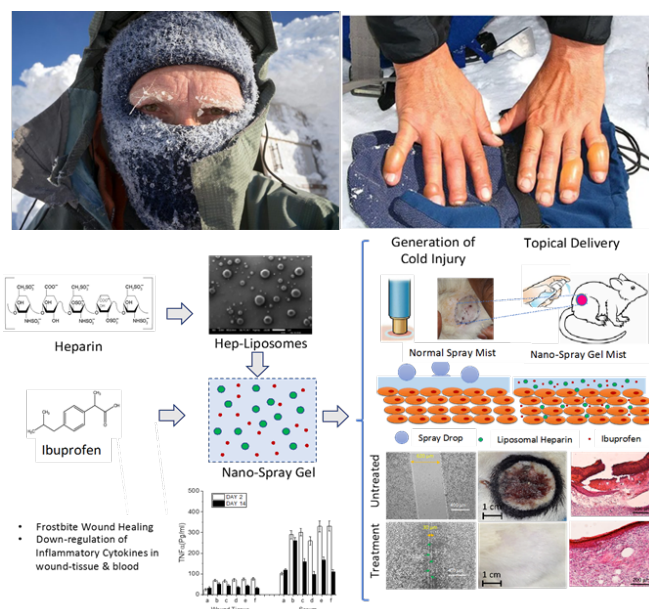
New spray gel developed by INST could help take the bite out of frostbite

Severe winters bring with it cases of frostbite -- a medical condition involving damage to skin and tissues due to extreme cold under extreme conditions.

Scientists at the Institute of Nano Science and Technology (INST) in Mohali, an autonomous institution under the Department of Science & Technology, have developed a cold-stable spray gel that could be administered on-site for the immediate treatment of frostbite injuries and heal the wound. They have titled it 'Nano-Spray Gel.'

Mountaineers and winter sports enthusiasts know the dangers of frostbite — the tissue damage that can occur when extremities, such as the nose, ears, fingers, and toes, are exposed to very cold temperatures often necessitating amputation. Frostbite can occur when the skin is exposed to a temperature of 0 °C (32 °F) or lower, resulting in vasoconstriction. The resultant decrease in blood flow does not deliver sufficient heat to the tissue to prevent the formation of ice crystals. However, it can be difficult to get treated quickly in remote, snowbound areas. This is also a serious medical problem for the Armed Forces operating in snow-bound areas at high altitudes like Siachen, Ladhak and so on.

Rahul Verma and colleagues at INST, Mohali prepared the spray gel using heparin, an anticoagulant that improves blood flow by reducing clotting and aiding in blood vessel repair. They packaged heparin into liposomes -- lipid carriers, thus helping deliver the anticoagulant deep inside the skin.



The nano-Spray gel is a combination of NSAID (pain-killer & anti-inflammatory) and clot-buster drugs (thrombolytic) for rapid relief and effective management of Frost-Bite injury. The few spray puffs of proposed “Nano-gel” can help save extremities of soldiers, pilgrims, and mountaineers having frostbite symptoms.

The scientists embedded the heparin-loaded liposomes in a sprayable hydrogel that also contained ibuprofen (a painkiller and anti-inflammatory drug) and propylene glycol, which helped keep the spray from freezing at very low temperatures. Their innovation has also been published in the peer reviewed journal American Chemical Society *Biomaterials Science & Engineering*.

The researchers tested the spray gel on rats with frostbite, and found that the treatment completely healed the injuries within 14 days. In comparison, untreated injuries were only about 40% healed, while wounds treated with an antibiotic cream were about 80% healed. The spray reduced levels of inflammatory cytokines at the wound site and in the blood circulation, which likely accelerated healing, the researchers say.

Frostbite causes fluids in the skin and underlying tissues to freeze and crystallize, resulting in inflammation, decreased blood flow, and cell death. Extremities are the most affected areas because they are farther away from the body's core and already have reduced blood flow. If frostbite is not treated soon after the injury, it could lead to gangrene and amputation of the affected parts.

Conventional treatments include immersing the body part in warm water, applying topical antibiotic creams or administering vasodilators, and anti-inflammatory drugs, but many of these are unavailable in isolated snowy areas, like mountaintops. Others, such as topical medications, could end up freezing themselves. The new gel can be of great help under such conditions.

The technology is in the pre-clinical phase and the researchers plan to test it on humans in the future as well.