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Amity University achieves faster healing of diabetic wound

JANUARY 12, 2019

The hydrogel nanotube can be used as a medicament, says Monalisa Mukherjee (fourth from left).

Hydrogel nanotubes containing ice in a helical structure developed by Amity University researchers has been found to quicken diabetic wound healing. Complete healing of wounds in Wistar rats was seen on day 16. No scarring was seen and fur growth at the wound site was observed.

Hydrogel nanotubes containing ice in a helical structure developed by a multi-institutional team led by researchers from Amity University, Noida have been found to accelerate diabetic wound healing and achieve complete healing in 16 days in Wistar rats. No drug was used. In comparison, wound healing was only 80% in the control group at the end of the same period. The researchers did not observe any scarring at the wound site in rats belonging to the treatment group. As a result, reappearance of fur was seen at the wound site in these rats.

While diabetes leads to compromised blood flow leaving the cells at the wound site poorly nourished, the use of hydrogel nanotubes developed by the team led by Prof. Monalisa Mukherjee from Amity Institute of Click Chemistry Research and Studies led to early appearance of new blood vessels.

“Besides biocompatibility, the hydrogel nanotubes were found to facilitate quicker proliferation and migration of epithelial cells, fibroblasts and keratinocytes to the wound bed. This led to faster wound healing,” says Rohan Bhattacharya from Amity University and one of the authors of a **paper published** in the journal *Materials Horizons*. “The moist environment provided for a prolonger period by the hydrogel nanotubes also hastened the wound healing process.”

"The hydrogel nanotube can be used as a medicament which can control wound moisture, absorb inflammatory cytokines and dead cells from the wound and form a barrier to microbes," says Prof. Mukherjee.

Synthesis of hydrogel

The researchers synthesised the hydrogel nanotubes through a facile, cost-effective, template-free method to polymerise two monomers at 40 degree C using water as solvent and an initiator. During polymerisation, water gets trapped inside the mesh matrix and gets nanoconfined. "Initially we observed 2D polymer nanosheets where water locked within the polymer mesh became hexagonal ice due to nanoconfinement," says Prof. Mukherjee. "Water to ice conversion takes place at 40 degree C due to pressure caused by nanoconfinement."

As polymerisation proceeds, the polymer nanosheets get stacked one above the other. When many sheets get stacked, pressure is exerted on the bottom sheets by the sheets above leading to buckling and folding of the sheets into 1D nanotubes.

While bulk water present between the sheets gets squeezed out due to pressure, some water gets trapped within the hollow tubes as nanodroplets. Due to nanoconfinement inside the hollow tubes, the water gets converted into ice. The ice that is formed is octagonal in shape. "The ice closer to the wall binds to it while ice that is away from the tube remains free and unbound. To attain a stable architecture in a nanoconfined space, the ice arranges itself into a helix resembling a DNA-like structure," says Aarti Singh from Amity University and first author of the paper. "The hydrogel nanotubes exhibit robust mechanical properties."

"This is the first report which mentions the existence of ice helix within hydrogel nanotubes," claims Prof. Mukherjee.

Sustained drug release

The researchers tested the hydrogel nanotubes for sustained drug release. A drug loaded inside the hydrogel nanotubes will have sustained release at the target site as the helical architecture inside the nanotubes impede burst release due to frictional drag. Nearly 90% of a drug (benzalkonium chloride) loaded in the hydrogel nanotubes was released over a period of 22 hours.

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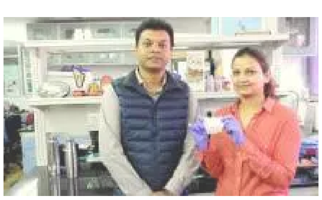

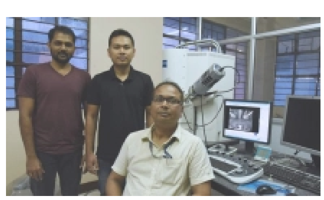

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