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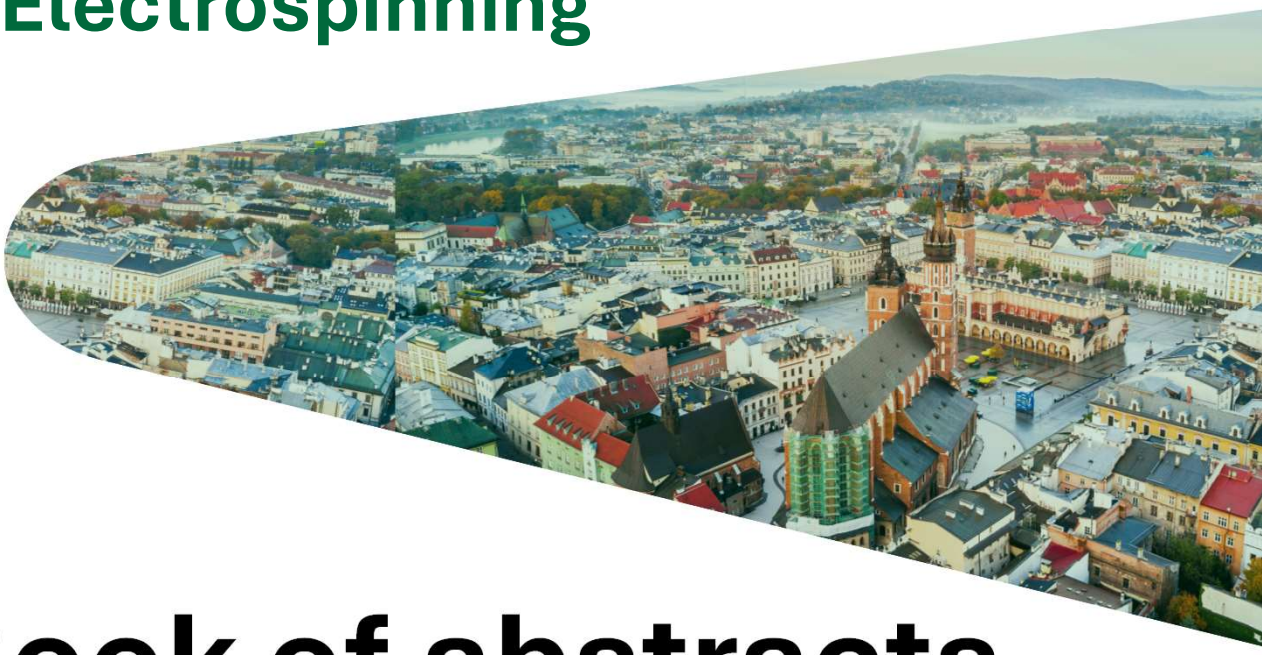

Book of abstracts

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Swift Battlefield First Aid: Rapid-Dissolving Fibers for Acute Wound Care

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Keywords: tranexamic acid, injuries, drug delivery

In the context of any domestic, military, pediatric, sports, or industrial injury, providing immediate medical solutions is critical. This research aims to create fibers comprising a mixture of tranexamic acid (TXA) and polyvinylpyrrolidone (PVP) through an electrospinning (ES) process, with the aim of achieving rapid blood clotting (Morrison, 2012). TXA is critically important in wound treatment, especially for severe trauma, due to its ability to significantly reduce bleeding and improve survival rates. TXA has become a key component in massive transfusion protocols for treating severe hemorrhage in military combat trauma (Johnston, 2018). Interest in using TXA for trauma care grew significantly after the CRASH-2 trial, a randomized placebo-controlled study, demonstrated that TXA reduced overall mortality in trauma patients. The importance of TXA in military trauma was further highlighted by the MATTERs study, which confirmed the CRASH-2 findings. This study showed that TXA administration was independently linked to improved survival rates, particularly in patients requiring a massive transfusion, defined as receiving 10 or more units of packed red blood cells within 24 hours.

The optimal process conditions for the preparation of TXA fibers were first determined. The solution concentration was 4.3% (w/v) of TXA (10% (w/v) of PVP). Electrospinning was performed at 1.0 ml/h flow rate, a distance of 15 cm from syringe tip to collector distance, and a 7.08 kV applied voltage. The collected fiber mats were peeled off the Al plate collector using tweezer and stored in a desiccator until further usage. The fibers were characterized by scanning electron microscopy (SEM), X-ray diffraction(XRD), Fourier transform infrared (spectroscopy, diffraction scanning calorimetry, and thermogravimetric analysis. Functional performance assessments comprised a disintegration test, drug release study and blood coagulation assay.

SEM results demonstrated that the fibers were uniformly cylindrical and without beads. The average diameter of the fresh fibers was 1.37 ± 0.06 µm, which remained unchanged at 1.38 ± 0.20 µm after aging. Morphology is also not markedly affected by aging for 3 weeks.

XRD and DSC results suggested that TXA was present in the fibers in an amorphous state thanks to the rapid drying in ES. The disintegration test data show that both aged and fresh TXA-loaded fibers disintegrate rapidly upon contact with the saline, indicating their potential for quick drug release in a biological setting. An in vitro coagulation assay confirmed the pronounced clotting effect of the fibers, which thus could have potential for treating traumatic injuries

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