Advancing Surgical Sutures: The Promise of Cellulose-Based Materials

A Comprehensive Review of Cellulose-Based Sutures: Innovation and Future Outlook

NANJING, CHINA, March 14, 2025 /EINPresswire.com/ -- A recent review published in the Journal of Bioresources and Bioproducts examines the state of cellulose-based sutures, focusing on materials, fabrication methods, and application performance. The study underscores the potential of these sutures as eco-friendly alternatives to traditional synthetic sutures, with significant advancements in biocompatibility and biodegradability.

Surgical sutures are critical in wound closure and healing, with traditional materials like cotton and synthetic polymers dominating the market. However, the rise of sustainable and biocompatible materials has led researchers to explore cellulose-based sutures as a viable alternative. A comprehensive review published in the Journal of Bioresources and Bioproducts provides an in-depth look at the current state of cellulose-based sutures, their fabrication methods, and potential applications.

Cellulose, the most abundant natural polymer on Earth, offers several advantages for surgical sutures, including non-toxicity, biocompatibility, and mechanical strength. The review covers various types of cellulose-based sutures, including natural cellulose, nanocellulose, and regenerated cellulose. Each type offers unique properties, with nanocellulose showing particular promise due to its high strength and flexibility. For instance, cellulose nanofibrils (CNF) have been used to create sutures with tensile strengths comparable to traditional materials, while maintaining excellent biocompatibility.

The review also highlights innovative fabrication methods such as wet spinning and interfacial polyelectrolyte complexation (IPC) spinning. Wet spinning is a traditional method used to create strong and flexible fibers, while IPC spinning allows for the creation of composite fibers with enhanced properties. These methods enable the production of sutures with tailored mechanical properties, biodegradability, and antibacterial characteristics.

One of the key challenges identified in the review is the need for consistent quality and improved biocompatibility in cellulose-based sutures. While natural cellulose fibers like cotton have been used historically, their quality can vary, leading to inconsistent performance. In contrast, nanocellulose and oxidized regenerated cellulose (ORC) offer more uniform properties and can be engineered for specific applications. For example, ORC sutures have demonstrated significant biodegradability, losing over 50% of their strength within 14 days, making them suitable for absorbable sutures.

The review also emphasizes the importance of multifunctional sutures that integrate antibacterial properties and growth factors to enhance wound healing. For instance, CNF/chitosan composite sutures have shown excellent antibacterial activity against common pathogens like Escherichia coli and Staphylococcus aureus, while maintaining high cell viability in vitro and in vivo.

Looking ahead, the review suggests that cellulose-based sutures could become the next generation of high-end medical sutures, driven by advancements in materials science and a growing focus on sustainability. Future research should focus on optimizing fabrication processes, enhancing mechanical properties, and conducting clinical trials to validate their performance.

See the article:

DOI
https://doi.org/10.1016/j.jobab.2024.11.006

Original Source URL
https://www.sciencedirect.com/science/article/pii/S2369969824000811

Huicong Cao
Nanjing Forestry University
02585426289
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