Military Health System Research Symposium

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Breakout Session: Old Antibiotics, New Strategies: Repurposing and Combining FDA-Approved Therapies for Combat Wound Infections

Abstract MHSRS-25-16553

Title: Combination of Vancomycin with QuickGel* Click Hydrogel for Improved Activity against Combat Wound Infections.

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Introduction

Surgical site infections (SSIs) are a major post-operative complication, leading to increased morbidity, mortality, and healthcare costs for both military and civilian patients. Current systemic antibiotic therapies, including vancomycin for *Staphylococcus aureus* (MSSA and MRSA), exhibit rapid clearance from circulation and poor penetration into deep musculoskeletal tissues. While vancomycin powder is often applied intraoperatively, there are no FDA-approved biodegradable materials providing localized, sustained antibiotic release directly to the surgical site. To address this, we have developed QuickGel, an injectable, biodegradable polyethylene glycol (PEG)-based Cu++-free click chemistry hydrogel that rapidly polymerizes in situ for sustained antibiotic delivery. This study evaluates the effectiveness of QuickGel for targeted SSI prevention.

Materials and Methods

In Vitro Studies: QuickGel's antibiotic release profile was assessed using a Kirby-Bauer disc inhibition assay against MSSA and MRSA. Release kinetics were quantified via spectrofluorometric measurement of vancomycin concentration over time. **In Vivo Studies:** A rat muscle pouch model was used to simulate SSIs. QuickGel containing vancomycin was injected into the infected site, with bacterial burden and infection progression evaluated over 14 days.

Results

Preliminary *in vitro* studies demonstrated complete vancomycin release within 24 hours, achieving significant inhibition zones against *S. aureus*. QuickGel provided sustained local antibiotic availability, potentially overcoming systemic clearance limitations. *In vivo* rat studies were performed and demonstrate significant infection rate reductions in treated subjects compared to controls.

Conclusions

QuickGel effectively delivers and sustains antibiotic levels at surgical sites, offering a novel solution to SSI prevention. Its injectable, space-filling properties allow for seamless integration into complex wound environments. This technology aligns with the DoD mission to enhance military medical readiness by reducing infection severity and recovery times in injured personnel.

Future Directions

Further optimization of QuickGel formulations will enable broader surgical applications, incorporation of alternative antibiotics, and translational studies toward clinical implementation.

*ClickGel™

Learning Objectives

1. **Understand the limitations of current systemic antibiotic treatments** for surgical site infections (SSIs) and the need for localized, sustained antibiotic delivery in post-surgical wound management.

2. **Explain the mechanism and advantages of QuickGel Click Hydrogel** as a biodegradable, space-filling, and tunable drug delivery system for targeted antibiotic release at surgical sites.

3. **Evaluate the preliminary in vitro and in vivo data** demonstrating QuickGel's effectiveness in antibiotic delivery and its potential impact on reducing SSIs in both military and civilian surgical settings.

Conflicts of Interest

BDB, ZS, and DJC are faculty in the Department of Biomedical Engineering, Virginia Commonwealth University. MVH is a faculty member of the Center for Infectious Disease Research at George Mason University. We thank the van Hoek lab for assistance with this study. BDB is the Co-Founder and CEO of Pascal Medical Corporation (PMC, Richmond, VA). DJC is a consultant of PMC. PMC provided ClickGel for the study. This research was supported by a grant from VBHRC Virginia Catalyst #1302 PascalMed-VCU-GMU. "Orthopedic Surgical Site Infection Prevention via Controlled, Sustained, Targeted, and Localized Antibiotic-Releasing Click Hydrogel".