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Use of an antimicrobial cationic biopolymer for UTI and sepsis prevention in kidney stone surgery

Stanford scientists have discovered that treating colonized kidney stones with a cationic biopolymer effectively disrupts bacterial biofilms and reduces bacterial burden while remaining biocompatible with kidney tissue. Irrigating the kidney with this cationic biopolymer during surgery could serve as a novel method to prevent urinary tract infections (UTIs) and sepsis in kidney stone procedures.

Kidney stones are an increasingly prevalent urological disorder, often causing significant pain and requiring surgical intervention. Pathogenic bacteria are present in up to 40% of stones and can form biofilms which protect them from antibiotic treatments. As a result, stone surgeries can inadvertently disperse bacterial biofilms across the urinary tract and cause up to 30% of patients to develop a UTI and 15% to develop sepsis. Despite these known complications, little effort has been made to address this clinical issue. The standard clinical practice involves urine tests for infection followed by antibiotic treatment if the culture is positive. However, urine culture positivity rates are low compared to pelvic and stone culture positivity rates and intravenous antimicrobial therapies do not lower the risk of postoperative UTIs. Therefore, a new method of UTI and sepsis prevention during kidney stone procedures is needed.

A cationic biopolymer has been demonstrated to interact with negatively charged bacterial surfaces, disrupting their membranes and inducing cell death through the leakage of intracellular components. Furthermore, the biopolymer disrupts bacterial biofilms, thereby reducing their resilience to antibiotic treatments. And, in the urinary tract, the biopolymer interacts with the urothelium, inducing exfoliation that expels and facilitates the eradication of highly resistant intracellular bacterial reservoirs. Treatment of colonized patient kidney stones with the biopolymer

resulted in a greater than 90% bacterial viability decrease after 90 minutes. Importantly, histological analysis of human urothelium did not show any abnormalities or cytotoxic effects after treatment with the biopolymer. Therefore, the inclusion of this cationic biopolymer in saline irrigation methods during kidney surgeries can be an impactful preventative measure to decrease UTIs and sepsis in kidney stone patients.

Stage of Development:
Preclinical – in-vivo
Continued research – Large animal studies

Applications

- Antimicrobial irrigation during kidney stone surgery
- Antimicrobial irrigation during endourological procedures
- Prevention of UTI and sepsis

Advantages

- Currently, there are no known intravesical therapies that have broad range antimicrobial and exfoliative effects.
- Improves antimicrobial treatment independently of bacterial strain, biofilm biomass intensity and antibiotic resistance pattern.
- Biocompatible with human urinary tract tissue

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