The Toxicity of Chlorhexidine and Povidone-Iodine to Rotator Cuff Tendon

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INTRODUCTION: Antimicrobial wound lavages containing chlorhexidine gluconate (CHG) or povidone-iodine (PI) are commonly used to prevent infection in orthopaedic surgery. For instance, these solutions are frequently used to prevent periprosthetic infection during shoulder arthroplasty. However, the potential toxicity of these solutions to native rotator cuff tendon is not well understood. In anatomic total shoulder arthroplasty, the rotator cuff tendon is often concomitantly repaired, and any toxic effects of antimicrobial wound lavage may affect rotator cuff tendon healing. The purpose of this study was to determine the *in vitro* effects of a 1-minute CHG exposure and a 3-minute 0.35% PI exposure on the viability and biochemical content of rotator cuff tendon.

METHODS: Infraspinatus tendons (n=6 per group) were isolated from shoulders of Nubian goats (n=3; 2 female and 1 male). Tendons were submerged in Irrisept (0.05% CHG in sterile water) for 1 minute or 0.35% Betadine (PI) for 3 minutes per manufacturer guidelines, followed by phosphate-buffered saline wash and culture in tissue culture medium. Control tendon specimens were similarly exposed to tissue culture medium, followed by phosphate-buffered saline wash and culture in tissue culture medium. After seven days of culture, isolates from both the tendon and enthesis portions were analyzed for viability, collagen content (hydroxyproline assay), and glycosaminoglycan (GAG) content (dimethylmethylene blue assay). Statistical analyses were performed via one-way ANOVA with *post hoc* Tukey's test.

RESULTS SECTION: Within the tendon, CHG-treated specimens demonstrated a decrease in mean tenocyte viability compared to controls (p=0.045) (Fig.1). While PI-treated specimens exhibited lower mean viability compared to controls, this difference was not statistically significant. Within the enthesis, tenocyte viability decreased in both CHG- and PI-treated groups; however, these decreases were not statistically significant (Fig. 2). There were no significant differences in mean collagen content/wet weight or GAG/wet weight among groups within the tendon and enthesis (Fig. 3).

DISCUSSION: Brief 0.05% CHG and 0.35% PI exposures to rotator cuff tendon resulted in lower tenocyte viability 7 days after treatment. These results are consistent with the toxicity reported with exposure of CHG and PI to other musculoskeletal tissues, including articular cartilage. Both collagen and GAG content remained unchanged 7 days after treatment, suggesting that any decrease in tenocyte viability does not affect the extracellular matrix of the tendon tissue at the examined timescale.

SIGNIFICANCE/CLINICAL RELEVANCE: Due to the potential catastrophic consequences associated with periprosthetic infection, CHG and PI antimicrobial lavages are commonly used to reduce the risk of periprosthetic infection during arthroplasty surgery. However, the toxic effects of these antimicrobial lavages on the surrounding tendon tissue are unknown. These results suggest that CHG irrigation can cause decreased tenocyte viability in rotator cuff tendon, potentially affecting rotator cuff tendon function and healing of concomitant rotator cuff repair in the setting of shoulder arthroplasty.

IMAGES AND TABLES:

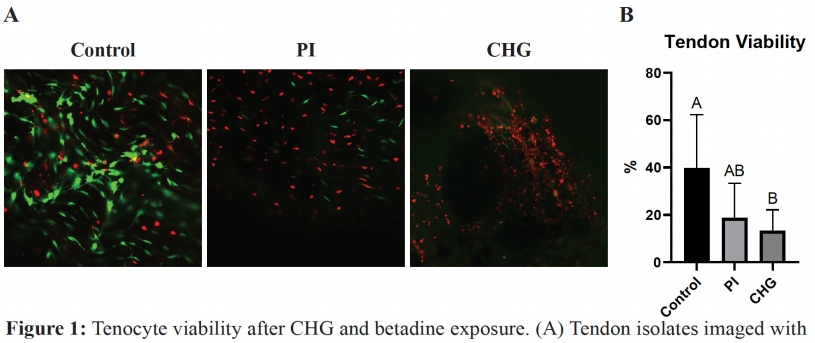

Figure 1: Tenocyte viability after CHG and betadine exposure. (A) Tendon isolates imaged with live/dead assay (20x) show live (green) and dead (red) cells. (B) Quantitative analysis of tenocyte viability. Statistical significance ($p<0.05$) among groups is indicated by groups marked with different letters.

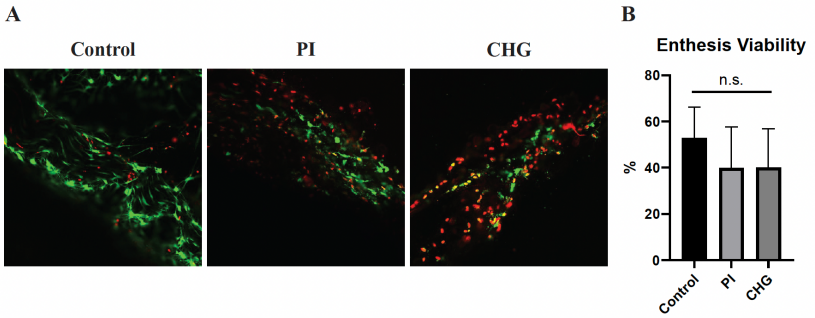

Figure 2: Enthesis viability after CHG and betadine exposure. (A) Enthesis isolates imaged with live/dead assay (20x) show live (green) and dead (red) cells. (B) Quantitative analysis of enthesis viability. Statistical significance ($p<0.05$) among groups is indicated by groups marked with different letters.

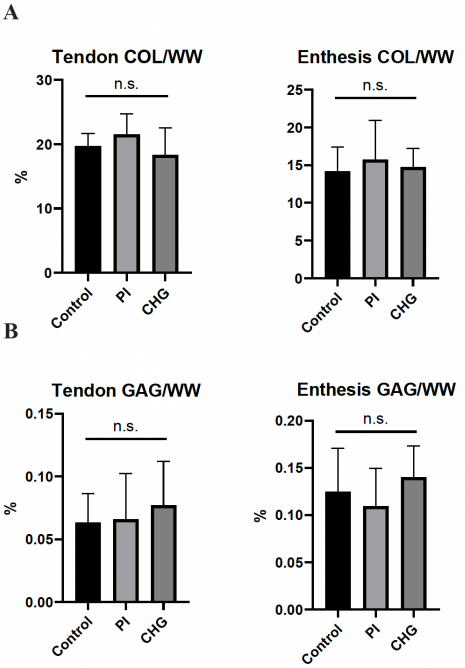

Figure 3: Both CHG and betadine exposure showed no impact on collagen or GAG content per wet weight, as depicted in (A) and (B). Statistical significance ($p<0.05$) among groups is indicated by groups marked with different letters.