Optimization of Tissue Sample Processing in Prosthetic Joint Infection

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Background

Tissue samples harvested during revision arthroplasty are invaluable for diagnosis of potential prosthetic joint infection. Tissues are valuable microbiological samples that have proven superiority over swabs[1]. Nevertheless, multiple factors affect the sensitivity of the tissue culture[2]. Examples of these factors are the site of obtaining the sample, the sterility of instruments and containers used to harvest and transport tissues, the number of samples, and prior use of antimicrobials. Furthermore, Laboratory processing of samples has detrimental effect on the culture results.

Aim

The aim of this study is to compare variable laboratory techniques used for tissue preparation in terms of effect on retrieval and survival of viable bacteria in tissue samples.

Methods

Various mechanical and chemical laboratory techniques were used on inoculated pork tissue and known infected human tissue samples. A standard suspensions of Staphylococcus aureus and Escherichia coli were used for inoculation.

Results

Quantitative bacterial recovery from tissue samples differed among samples depending on whether they were homogenized, bead beaten, or vortexed.

Increasing the mechanical force and the duration of tissue processing resulted in more homogeneous product (Figure 1).

For *S.aureus*, means of recovered bacteria by homogenization, bead beating, and vortexing were 394, 36, and 136 cfu (colony forming unit)/ /mL respectively. For *E.coli*, means were 448, 70, and 166 cfu/mL respectively.

Bacterial recovery from homogenized human tissues was significantly higher than from any other method of treatment (Figure2).

Lethal effect of Proteinase K on bacteria was lower when they are suspended in albumin rather than phosphate-buffered saline(Figure3).

There are many factors affecting bacteria recovery from tissues (Figure 4).
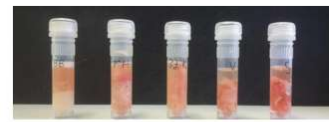

Figure 1: Tissues processed by different methods: from left to right: bead beaten, homogenized, Proteinase K treated, vortexed, and Sonicated

Figure2: Means of bacterial recovery from artificially inoculated pork samples and known infected human tissue samples (All differences are statistically significant $P<0.05$).
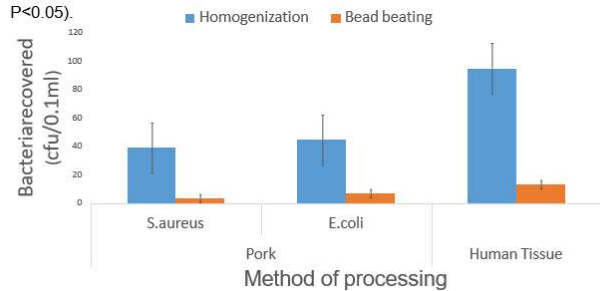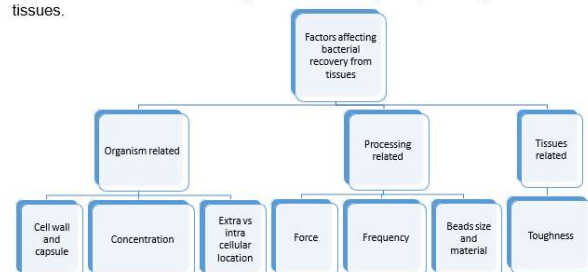

Figure 3 : *E.coli* treated with Proteinase K for 10 minutes. From left to right: control, *E.coli* suspended in albumin, *E.coli* suspended in PBS

Figure 4 : Different factors affecting bacterial recovery from potentially infected tissues.

Conclusion

Although bead beating could be the most efficient method in obtaining a homogeneous tissue product, it significantly reduces the number of viable bacteria within tissues. Homogenization offers the most effective easily controllable retrieval of bacteria from tissue and retains their viability. Guidelines for diagnosing infections using tissue samples should include a standardized processing method

References

1.Aggarwal, V.K., et al., *Swab cultures are not as effective as tissue cultures for diagnosis of periprosthetic joint infection.* Clin Orthop Relat Res, 2013. 471(10): p. 3196-203.
2.Redanz, S., A. Podbielski, and P.Warnke, *Improved microbiological diagnostic due to utilization of a high- throughput homogenizer for routine tissue processing.* Diagn Microbiol Infect Dis, 2015. **82(3)**: p.189-93.