

The Effects of Sterilization Techniques on Bioactivity of PMMA Antibiotic Beads Containing Vancomycin and Tobramycin

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Purpose: Local delivery of antibiotics to prevent and treat musculoskeletal infection has become common practice. Traditionally, polymethylmethacrylate (PMMA) cement is loaded with antibiotics in an operating room (OR), which can be time-consuming and cumbersome. Prefabricating antibiotic beads and storing them may decrease OR times and allow for use in other settings, but requires post-fabrication sterilization. We sought to determine whether the method to ensure sterilization of prefabricated beads or the subsequent shelf storage has any effect on their bioactivity.

Methods: All antibiotic beads were made by mixing a Simplex P bone cement 40-g package containing 1 g of tobramycin with an additional 1 g of vancomycin powder and using the largest bead cavities in a bead mold (Stimulan). Sterile beads were made inside a Class II Biosafety Cabinet, replicating an OR, to be used as controls. Nonsterile beads were made in a similar fashion, but without a sterile environment, and were randomly allocated to be sterilized via autoclave, ethylene oxide gas, or ultraviolet light. Six beads from each of the 4 groups-(1) made sterile, (2) autoclaved, (3) ethylene oxide, and (4) UV (ultraviolet) light-were placed into sterile Eppendorf tubes containing 1 mL phosphate-buffered saline (PBS) in an incubator at 37°C. Additional beads from each group were kept in airtight sterile tubes without light and a shelf life study tested each of the 4 groups after being stored for 1 week, 1 month, and 3 months. This entire process was repeated a second time with a separate package of cement providing a sample size of 12 beads for each sterilization method and time point studied. The beads were placed into PBS solution to elute for 24 hours and then removed from solution and placed into a separate sterile solution at 37°C for 7 more days. A Kirby Bauer assay was then performed by placing disks containing eluted antibiotics from each of the 4 groups onto Mueller-Hinton agar plates inoculated with *Staphylococcus aureus* ATCC 49230. After 16-18 hours of incubation at 37°C, the plates were removed and diameters of zones of inhibition (ZOI) were measured digitally using the ImageJ computer software program.

Results: There were no statistically significant differences at any time point (0 days, 1 week, 1 month, 3 months) for the average ZOI in the first 24 hours and subsequent week of elution in each of the 4 groups.

Conclusion: Antibiotic-containing PMMA beads can be prefabricated in either a sterile field, or fabricated in a nonsterile fashion and then sterilized by autoclave, ethylene oxide, or UV light. Storage for up to 3 months does not reduce the efficacy of the beads in eluting antibiotics.