How to Make and Use Antibiotic-Impregnated Poly(methyl methacrylate) Beads to Treat Infected Wounds in Horses

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Antibiotic-impregnated poly(methyl methacrylate) beads were used to help control wound infection in horses. Local elution of antibiotics from the beads can reach up to 50× the toxic serum levels. A wound free of infection provides an environment that is conducive to rapid healing. Authors’ address: Dept. of Large Animal Clinical Sciences, College of Veterinary Medicine, University of Tennessee, Knoxville, TN 37901-1071. © 1997 AAEP.

1. Introduction
Wounds in horses are commonly infected, especially when they involve the distal extremities. Meticulous lavage and debridement may not remove all bacteria from the tissues. Initially, the compromised vascular supply to traumatized tissues may impede the delivery of antibiotics, allowing bacteria the opportunity to adhere, replicate, and establish infection in the affected area.

Antibiotic-impregnated methyl methacrylate is commonly used in cementable joint replacement to minimize the risks of infection. High concentrations of antibiotics are locally discharged by elution from the bone cement. The use of antibiotic-impregnated beads has been described to treat local infections in humans.1

The purpose of this study is to describe the technique of making antibiotic-impregnated poly(methyl methacrylate) beads (AIPMMB’s) for treating infected wounds in horses. A discussion of their use in managing 22 infected wounds in clinical cases is included.

2. Materials and Methods
Case records of 22 horses presented to the University of Tennessee College of Veterinary Medicine that were treated with AIPMMB’s as an augmentation to local treatment were reviewed. Affected tissues included open joints (n = 4), tendon or tendon sheath (n = 3), supraspinous bursa (n = 2), tuber coxae or ischium (n = 2), alveoli (n = 3), bone sequestrum (n = 1), and large wounds, unsuitable for initial closure (n = 7).

Hair was clipped and the intact skin surrounding the wound margins was liberally scrubbed. Systemic antibiotics were administered when deemed necessary. Wounds were irrigated under high pressure by using a high-pressure lavage unita with either 0.1% dilute povidone iodine or 0.05% dilute chlorhexidine solution. Sharp debridement was used to remove traumatized tissue, without remov-
ing viable tissue. Surgical curettage was used to remove infected bone when necessary. Affected synovial cavities were lavaged with a 20% dimethyl sulfoxide solution. Cultures and sensitivities (C/S) were performed. Initially broad spectrum, water-soluble antibiotic powder was used in formulation of the AIPMMB's until C/S results were available.

Sterile AIPMMB's were prepared by using a commercial bone cement. Three grams of water soluble antibiotic powder were thoroughly mixed with 20 g of methyl methacrylate powder. Liquid polymer was added and the compound stirred until it reached a semisolid state. The AIPMMB's were molded into 5–9 mm spheres or 2.5 cm × 5–9 mm cylinders and attached to nonabsorbable, monofilament suture by compressing the compound onto strands of the material.

A suitable length of the AIPMMB's was selected and deposited into the wound. Extremity wounds were then covered by using an adherent plastic sheet, sealing the wound margins. These wounds were then placed under a pressure bandage. When possible, wounds on the upper body were covered with a tie-on, stent bandage. Unused AIPMMB's were placed in a sterile container, frozen, and used repeatedly, unless sensitivity results indicated a need for change in antibiotics. Bandages were changed approximately every 7 days. Wounds were lavaged and a new segment of AIPMMB's was placed into the wounds. Wounds were monitored closely for the cardinal signs of inflammation. Follow-up cultures were performed on synovial cavities. Once wounds reached a clean-contaminated status, dictated by the lack of signs associated with inflammation, or when culture results were reported as negative, AIPMMB's were discontinued. Most wounds were allowed to heal by second intention.

3. Results
The AIPMMB's were well tolerated by all horses. The number of beads placed into the hock joint of one horse did cause discomfort when walking. This was resolved by decreasing the number of beads. Statistical significance was inapplicable because of the variability among few cases. The duration of bead use ranged 6–21 days. There was a tendency for wounds associated with synovial structures to require longer treatment.

Treatment with spherical beads worked well prior to granulation tissue formation. Spherical beads were more difficult to remove than cylindrical beads when they were incorporated into the granulating bed. Clinically, marked local improvement was grossly evident within the first 3–6 days of treatment. Improvement in horses presenting with lameness (n = 8) was seen within 24–48 h with the exception of one horse. There were two failures in the study. One horse with a septic carpus (lame) failed to respond to the beads, as well as aggressive antibiotic therapy and joint lavage. A second horse diagnosed with an apical tooth root abscess was found to have a patent infundibulum on follow-up evaluation.

4. Discussion
High, local antibiotic concentrations can be reached within a few days of application when AIPMMB's are used. Antibiotics diffuse from the beads along a concentration gradient. Local concentrations can reach up to 50× the systemic toxic level, while detectable plasma concentrations remain low. The type and porosity of the methyl methacrylate affect the rate of antibiotic diffusion. Only polymers with known diffusion characteristics should be used when homemade beads are prepared.

Although the number of cases in this study are small and there was marked variability between the cases, the study does demonstrate that AIPMMB's can be used successfully for treating infected wounds in horses, as the response was encouraging. We believe that the duration of systemic antibiotic treatment was decreased, with the exception of those patients with synovial structure involvement. Using adherent plastic over distal extremity wounds treated with the beads prevents the escape of wound fluids that contain high levels of antibiotics into the absorbent layers of a bandage. Evaluating the clinical signs of inflammation was adequate in horses in this study when we monitored wounds that were not associated with synovial structures. We recommend taking follow-up synovial fluid samples for cytology and culture before discontinuing treatment when synovial structures are involved.

Storage of homemade AIPMMB's requires further evaluation. It would appear from this study that this procedure can be done, but one should be cautious of its efficacy until additional information is gathered.

The cost of initial treatment for the materials is moderate. However, one must realize that a high concentration of antibiotic is being deposited at the site of the insult. These antibiotic levels may not be obtainable in the face of a compromised blood supply. If we find that frozen bead storage does not alter the effectiveness of the procedure, cost can be spread out over the treatment period.

5. Conclusions
We found that AIPMMB's were beneficial in the treatment of local wound infections in horses. Controlling bacterial infections in traumatized tissues provides an environment that is conducive to rapid healing, thereby effectively shortening the healing period.

References and Footnotes
4. Ioban 2, 3-M Health Care Group, St. Paul, MN 55144.