# Off-label Usage of Absorbable Beads Containing Antibiotics for Prevention of Surgical Site Infections

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*Disclosure: The authors disclose no financial or other conflicts of interest.*

**Abstract:** Surgical site infections account for about 17% of all nosocomial infections, second only to urinary tract infections. Antibiotic beads deliver high local antibiotic concentrations and maintain low systemic levels. The authors assessed the efficacy of calcium sulfate absorbable antibiotic beads (CSAAB) in the prevention of surgical site infections (SSIs) for complex wound closures. Patient records from the University of New Mexico Hospital (UNMH; Albuquerque, NM) and Dartmouth-Hitchcock Medical Center (DHMC; Lebanon, NH) were retrospectively analyzed from 2004 to 2015. Each patient received CSAAB prophylaxis during operations performed by the principle investigator. Charts were grouped by wound location and category. Outcomes were defined solely by readmission within 30 days for repeat intervention. Zero of the 38 UNMH and 15 of the 104 DHMC patients were readmitted. Data reached statistical significance based on 95% confidence intervals using the binomial distribution. This brief retrospective chart review shows promising use for CSAAB in the prevention of soft tissue SSIs.

**Key words:** antibiotic beads, calcium sulfate absorbable antibiotic beads, surgical site infections, infection prophylaxis

*Wounds* 2017;29(10):E84–E87.



The incidence of surgical site infections (SSIs) is second only to that of urinary tract infections and accounts for about 17% of all nosocomial infections.[1] Surgical site infections increase costs and undesirable outcomes in hospitalized patients. The Centers for Disease Control and Prevention estimates that approximately 500 000 SSIs occur annually in the United States, with costs and outcomes varying by location and procedure.[1] For example, orthopedic SSIs prolong hospitalization by a median of 2 weeks per patient, almost double rehospitalization rates, and increase health care costs by 300%.[2] Overall, SSIs cost $9.8 billion in the United States and $32.5 billion worldwide.[3]

The field of plastic surgery often deals with complex wounds (eg, trauma with exposed bone, exposed hardware, wound dehiscence, and infected vascular grafts). Standard practice involves debridement of infected and devitalized tissues. Whenever vital structures are exposed, coverage is obtained via vascularized muscle or fasciocutaneous flaps.[1,4] The presence of critical structures and prosthetics often prevents both the complete removal

**Figure 1.** Distal flap necrosis re-exposing the carotid artery.

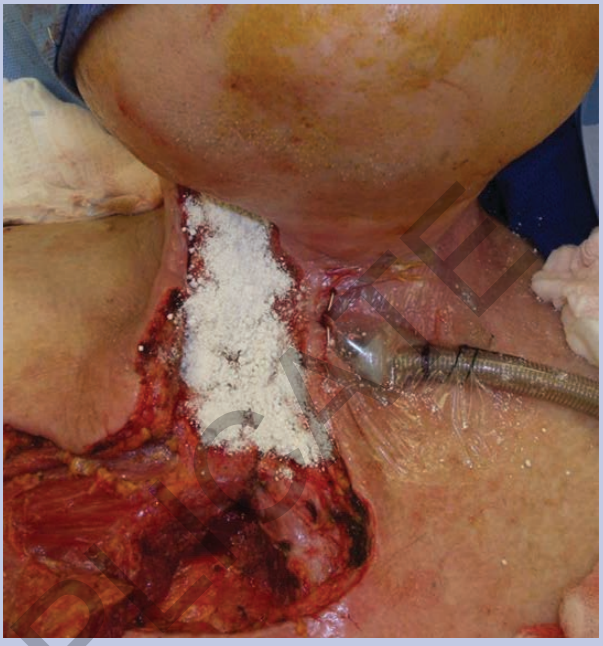

**Figure 2.** Wound packed with crushed calcium sulfate absorbable antibiotic beads.

of critically colonized tissue and the adequate reduction of bioburden. In these cases, the use of nondissolving polymethylmethacrylate (PMMA) and calcium sulfate absorbable antibiotic beads (CSAAB) has been employed. Overall, there is a paucity of data regarding the use and effectiveness of antibiotic beads in reconstructive surgeries.[5] This study seeks to assess the efficacy of off-label CSAAB use in the prevention of SSIs for complex wound closures.

## Materials and Methods

Records of 142 patients were retrospectively analyzed following University of New Mexico – Health Sciences Center Institutional Review Board approval. These included 104 Dartmouth-Hitchcock Medical Center (DHMC; Lebanon, NH) patients (2004–2010) and 38 University of New Mexico Hospital (UNMH;Albuquerque, NM) patients (2013–2015). Each patient received CSAAB prophylaxis during operations performed by the principle investigator. Charts were grouped based on wound location as well as the following categories: orthopedic, breast, mediastinitis, vascular, and other. Orthopedic wounds included those with infected or exposed hardware, traumatic open fractures, and wounds with exposed bone. Vascular cases included those with infected grafts. The other group included all other infected or nonhealing soft tissue wounds that did not fall into any of the former categories. Wound cultures were taken using swabs of the affected tissue. Outcomes were defined solely by readmission within 30 days for repeat intervention.

## Results

Zero of the 38 UNMH patients and 15 of the 104 DHMC patients were readmitted. Combined data showed that 10.56% required reoperation (confidence interval [CI], 6%–16.8%). The UNMH data showed a CI of 0% to 7.58%; DHMC data showed a CI of 8.3% to 22.7%. Data reached statistical significance using exact 95% CIs using binomial distribution.

## Case Report

A 55-year-old man with a history of T2N1 (Stage IIb) squamous cell carcinoma of the hypopharynx underwent chemoradiation therapy. A 7-month recurrence necessitated a total laryngopharyngectomy. Reconstruction utilized an anterolateral thigh free flap. A persistent, high-output pharyngocutaneous fistula developed and was conservatively managed with local wound care and without negative pressure wound therapy. Two months after development of the fistula, he developed skin loss, infection, and an exposed right carotid artery. After judicious debridement, a chest perforator flap was rotated

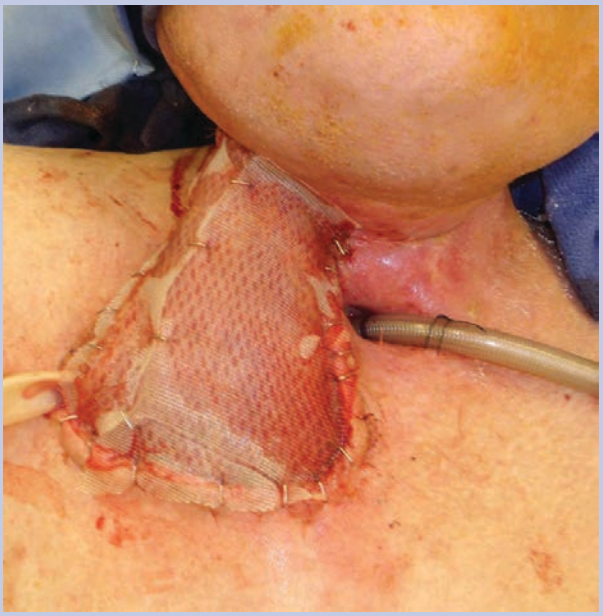

**Figure 3.** Postsurgical flap with graft completion.

**Figure 4.** Wound healing at 13-month follow-up.

to cover the defect. The fistula healed; however, distal flap necrosis re-exposed the carotid artery (Figure 1). The patient was taken to the operating room for debridement with pectoralis flap closure, but safe removal of all colonized tissues could not be performed due to the presence of the carotid artery. Wound cultures were positive for methicillin-resistant *Staphylococcus aureus* and *Serratia* spp, and CSAAB were used (Figure 2). The pectoralis muscle flap was covered with a split-thickness skin graft (Figure 3). At 13-months follow-up, the wound remained healed without evidence of breakdown or fistula (Figure 4).

## Discussion

The use of CSAAB for complex surgical wound management allows for the local delivery of extremely high concentrations (suprainhibitory levels) of therapeutic antibiotic dosages for weeks while maintaining low systemic levels.[6] These concentrations cannot be achieved systemically, especially in fibrotic wounds. This approach avoids concentration-associated side effects such as those in the gastrointestinal tract.[7] Conceivably, these concentrations can impede and/or combat biofilm. In addition, the use of CSAAB avoids secondary surgical removal.[8] Currently, antibiotic beads are most commonly prescribed for orthopedic applications, such as in the treatment or prevention of osteomyelitis. Also, PMMA beads have been shown to provide adequate wound sterilization and graft preservation in the management of extracavitary prosthetic vascular graft infections.[9] Moreover, infected breast implants as well as left ventricular assist devices have been salvaged with antibiotic-impregnated PMMA.[10,11] These studies, in addition to the present results, highlight the importance of conducting a controlled prospective study to further assess their novel use in decreasing infection rates and bioburden of complex surgical wounds.

## Conclusions

This brief retrospective study shows promising use of CSAAB in the prevention of soft tissue SSIs in the reconstruction of complex wounds. These data also may be useful for promoting further research and establishing protocols for their utilization in the management of colonized complex wounds in reconstructive surgery.

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