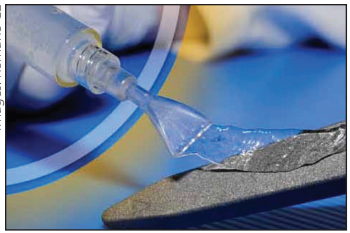
Hydrogel and antibiotic implant coating may help reduce bacterial colonization

PHILADELPHIA — A hydrogel mixed with antibiotics and applied to the surface of bone implants could help reduce bacterial colonization, according to a study presented at the Musculoskeletal Infection Society Annual Meeting, here.

"An implant coated with a fully resorbable, antibacterial-loaded hydrogel may offer an additional protection against bacterial colonization and infection," **Carlo L. Romanò, MD,** director of the Center for Reconstructive Surgery and Bone and Joint Infections at Istituto Ortopedico Galeazzi, in Milan, said.

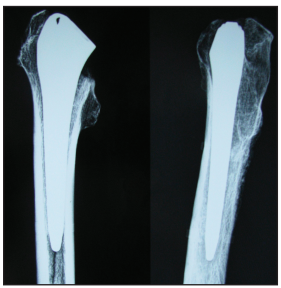
The disposable antibacterial coating (DAC) hydrogel product (Novagenit; Trento, Italy), which is CE-marked, is a resorbable hyaluronan-based hydrogel that contain poly-D and L-lactic acid and

Images: Romanò CL



DAC hydrogel is spread onto an uncemented, sand-blasted titanium prosthesis with a syringe spreader.

Pictured is a hydrogel-coated prosthesis inserted in a human femur.



A radiograph shows the press-fit and fill of the femoral canal.

has a 2-year shelf life, according to Romanò. It can be loaded with antibiotics or antibiofilm agents and implanted in a patient to increase bacterial protection.

"All of these were tested on different substrates from polyethylene to titanium," Romanò said. "A microbiological assay was performed to test antibiotic activity and what we observed was a synergistic effect of the hydrogel when mixed with different antibiotics, even N-acetylcysteine, a normal antibiofilm."

Romanò said in vivo testing of the material on intramedullary (IM) titanium rods used in 35 rabbit femurs showed 99% reduction of bacterial load in the bone and on the nail.

During testing, the researchers inoculated each animal with methicillin-resistant *Staphylococcus aureus* prior to inserting the IM rods, which were coated with either 2% or 5% vancomycin-loaded DACidrogel, into the femurs. They compared the results to controls.

"[The hydrogel allowed] systemic infection prevention — this hyaluronan model significantly controlled infection in animals treated with hydrogel and vancomycin compared to hydrogel alone," Romanò said.

An in vitro analysis found that 15 antibiotics and antibiofilm agents can be retained on the implant surface up to 96 hours and are released for up to 4 days after implantation, including vancomycin, ciprofloxacin, meropenem, gentamycin, amikacin, tobramycin, clindamycin, doxycycline, linezolid, sodium salicylate and N-acetylcysteine, according to Romanò.

The femur was cut with an oscillating saw to show the hydrogel coating along the entire prosthetic stem and adjacent bone.

After IM nail press-fit insertion in the rabbit model, the hydrogel-antibiotic coating stayed homogeneously on 75% of the implant surface, according to Romanò. Similarly, the researchers found that in human femora up to 80% of the hydrogel was retained on the surface of standard titanium femoral stem prostheses after press-fit insertion. The remaining product was adhered to the inner aspect of the IM canal.

"We already have approval for a larger animal study in the Netherlands and clinical trials on cementless joint prostheses and osteosynthesis are starting the end of this year," Romanò said. – *by Renee Blisard Buddle*

Reference:
Romanò C. Resorbable hydrogel provides effective antibacterial coating of implants in vitro and in vivo. Presented at: Musculoskeletal Infection Society Annual Meeting; Aug. 2-3, 2013; Philadelphia.

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Disclosure: The project was funded by a grant from the European Community "Implant Disposable Antibacterial Coating (IDAC): A novel approach to implant-related infections in Orthopaedics and Trauma Surgery," 7th Framework Programme on Research Technological Development and Demonstration.