Preventing Hospital Acquired Infections Using Permanent Nanostructure Surface Coatings on Invasive Devices

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One out of every twenty hospital patients will contract a nosocomial infection from invasive devices. We investigated the hypothesis that graphene, graphene oxide and silver nanoparticles possess antimicrobial properties, and could therefore be used to develop a graphitic nanostructure-based compound to function as a permanent antimicrobial coating for hospital based devices. Our project consisted of three phases: 1. Support the hypothesis that the nanoparticles possess antimicrobial properties 2. Understand the physical structure of the nanoparticles in relation to invasive device materials 3. Develop a permanent antimicrobial coating used to prevent nosocomial infections. We tested various concentrations of the nanoparticles with a representative gram-positive bacterium, B. thuringiensis, as well as a representative gram-negative bacterium, E. coli. Optical density measurements, plating, and SEM microscopy were used to measure both growth and viability of each species and understand structural properties of the nanoparticles, respectively. In phase 1, B. thuringiensis was more susceptible to graphene. The silver nanoparticles exhibited a greater effect on B.thuringiensis whereas graphene oxide appeared to inhibit growth for E.coli. In phase 2, structural properties of the three nanoparticles may contribute to the differences seen in the growth experiments. Interaction of “polymer only” and bacteria may suggest physical inhibition of growth. In phase 3, bacteria may not be able to adhere to the PVC pipe itself. Polymer coating may serve as a reinforcer to protect PVC from bacterial colonization. Differences in antibacterial properties seen between gram-positive and gram-negative examples illustrate the need for appropriate models while testing our hypothesis.

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