Multidrug Resistant Superbugs: Selective Separation, Identification and Killing Using Fluorescent, Magnetic Multifunctional Carbon Dots

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Antibiotics have been extensively used to treat patients with infectious diseases. As these drugs have been used widely for long time, the organisms the antibiotics are designed to kill have adapted to them, making the drugs less effective. As per CDC each year in the United States, at least 2 million people become infected with bacteria that are resistant to antibiotics. Blood stream infection by superbugs has mortality rate of over 40%. High mortality rate is mainly due to the absence of technology available in clinics which can rapidly detect bacteria from clinical blood sample in early stages of infection. At present the bacterial blood cultures and susceptibility testing are used in the clinic to find the drug that may be effective in treating. The whole process requires several days to obtain accurate results, as result, patient are treated with broad spectrum of antibiotics. This not only inadequate for patients but also encourages antibiotic resistance. Hence there is an urgent need for the new technology which has ability to rapidly diagnose drug resistance bacteria in a point-of-care setting. This work reports newly developed multicolor fluorescent carbon dots conjugated-magnetic nanoparticles are capable of selective separation and accurate identification and killing of superbugs from infected blood. In addition, pardaxin antimicrobial peptide attached carbon dots are designed as superbugs are resistant to antibiotics available in the market. Results indicates that by combining pardaxin antimicrobial peptides with fluorescent magneto-carbon dot nanoparticles, one can develop a novel multifunctional material which has great potential for an accurate identification, selective separation, and effective killing of multi drug resistance superbugs in clinics.