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Tulika Prasad, J Pharm Sci Emerg Drugs 2017, 5:2
DOI: 10.4172/2380-9477-C1-001

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Nanomedicine for Infectious Diseases

Nanomedicine, an offshoot of nanotechnology has made a rapid and broad impact on healthcare. Various nanostructures and their combination with existing drugs have shown promising potential to improve the diagnostics and therapeutics for infectious diseases and combat the microbial drug resistance. More than 200 nanomedicine products are either in approval process or under clinical investigations, but their successful clinical translation is still challenging. There is only 10% success rate eventually in approval for nanotherapeutics entering Phase I clinical trials. Therefore, a combinatorial approach is required for translational research to develop a successful strategy for fast Food and Drug Administration (FDA) approval e.g. repurposing of drugs, use of FDA approved nanoparticles platform with existing drugs. Various nanoparticles such as Silver (Ag), Gold (Au), Zinc oxide (ZnO), Iron oxide (Fe_3O4), Titanium oxide (TiO_2), Zirconium oxide (ZrO_2) and combinations of nanomaterials like Chitosan/Guanidine Functionalized Graphene Oxide, Chitosan – Iron Oxide Coated Graphene Oxide have exhibited antimicrobial activity. But the mechanism of antimicrobial activity of these nanomaterials or nanomedicines is still debatable and their safer medical adoption requires detailed investigations on the biological entities.

Among many nanomaterials, silver nanoparticles (AgNps) known for their antimicrobial properties and higher microbial toxicity have gained more impetus in biomedical and industrial applications than other metal nanoparticles. However, safer clinical applications of AgNps still require more clinical trials and research at the level of molecular biology to delineate the intracellular pathways involved before evaluating its potential host toxicity. My presentation will be towards the effect of AgNp on drug efflux pump proteins and evaluation of synergistic potential of AgNp with other antifungals against opportunistic pathogen, *Candida albicans*. Our findings showed that 'nanosilver-based drug combinations' has the potential to address the challenges of multi-drug resistance (MDR) and fungal therapeutics by favoring broad spectrum activity, multiple cellular targets and minimal host toxicity. This paves the way for development of silver-based nano-biopolymer composites having enhanced antifungal activity when combined with other drugs potentiating: i) enhanced cellular effect of otherwise less effective drugs, enabling the use of drugs in lower doses (reduction in doses ranging between 4 times to 200 times for drugs tested), thus, reducing their side effects ii) development as biofilm inhibitors. The clinical benefits of nanoformulations of existing drugs have been realized through their decreased toxicity and improved efficacy.

Biography

Dr. Tulika Prasad is Assistant Professor in Jawaharlal Nehru University (JNU), New Delhi, India and teaches Nanobiotechnology and Nanomedicine at Special Centre for Nano Sciences. She is one of the founder faculty members of AIRF-JNU, a State of Art Research Laboratory. She works on Nanomedicine, Infectious Disease Biology and Multi Drug Resistance (MDR) especially in *Candida albicans* (a fungal pathogen) and *Mycobacterium tuberculosis* (Tuberculosis causing bacteria). She has a research group of 6 PhD students *and* two postdoctoral fellows.

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