

COMBINING NANOCRYSTALS AND MEDICAL DEVICES TO ENHANCE DRUG BIOAVAILABILITY AND PATIENT COMPLIANCE

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The dissolution rate of many poorly water-soluble drugs limits their bioavailability. Among the several strategies widely described in the literature, drug nanocrystal technologies are considered one of the most valuable approaches to formulation of poorly soluble drugs.

Nanocrystals are nanoparticles of pure drug without any matrix material with an average diameter below 1 μm (typically in the range of 200–500 nm). The drug nanocrystals can be suspended in an outer liquid phase, usually composed of water and/or water-miscible solvents and stabilized using an ionic or non-ionic surfactant or polymers, to obtain a nanosuspension. The reduction of the drug crystal mean diameter below 1 μm dramatically increases the particle surface area and decreases the diffusion layer thickness if compared to coarse and micronized drug. In addition, nanocrystals are characterized by an enhanced saturation solubility.

In recent years, the research group “Technologies for Drug Delivery” of the University of Cagliari has been studying the delivery of drug nanocrystals through medical devices to further increase bioavailability and simultaneously improve patient compliance.

In particular, microneedle arrays and microneedle rollers were combined with nanosuspensions, for the skin delivery of diclofenac. Microneedles are minimally invasive platforms that allow the delivery of drugs within/across the skin through the temporary mechanical disruption of the stratum corneum. Transdermal delivery of diclofenac nanocrystals was also studied in combination with needle-free liquid jet injectors, which are medical devices used to administer pharmaceutical solutions through the skin.

Finally, the ability of an electronic nicotine delivery systems (commonly called electronic cigarette) to deliver drug nanocrystals of beclomethasone dipropionate through the produced aerosol was investigated. The use of electronic cigarette with bronchodilators or corticosteroids nanosuspensions might be advantageous in the treatment of chronic obstructive pulmonary disease in those patients that are chronic smokers in the pursuit of a stop-smoking aid