SL08 Controlled Drug Delivery: Historical Perspective for the Next Generation

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The controlled drug delivery technology is 60 years old. The 1st generation (1950-1980) of drug delivery was focused on the development of controlled drug delivery technologies for sustained and zero-order release formulations. The zero-order release was found to be not really necessary, and numerous sustained release formulations have been developed to increase patients' convenience and compliance as well as reduced side effects. Currently, it is routine to make once-a-day formulations for oral and transdermal administration. The sustained release technology was also applied to develop month-long depot formulations for parenteral administration. The 2nd generation (1980-2010) was dedicated to development of self-regulated drug delivery systems and nanotechnology-based formulations. Translation of the 2nd generation technologies to clinical application has not been as productive as that of the 1st generation technologies. This requires careful examination of the current status of the drug delivery technologies.

The next generation (2010-2040) of drug delivery technologies requires developing new technologies to solve the problems identified from the 2nd generation formulations. The last decade of the 2nd generation has been consumed by exploring the potential of nanotechnology. The origin of nanotechnology began with an assumption that materials in nanosize may have different properties from those that the same materials may have in macro scales. The information collected from the last two decades indicates that the nanosize of formulations alone does not improve the functions of drug delivery systems. It is important to realize that nanotechnology is not the panacea for the various challenges facing the drug delivery. The current focus on nanotechnology has made significant progresses in formulation science, but it has not yet met its goal of solving important issues, such as self-regulated drug delivery and targeted drug delivery. It seems that nanotechnology was given too much undue potential without any evidence, at least in the drug delivery field.

It is time for the drug delivery scientists to reexamine the progresses made during the past two generations, understand the limitations and capabilities of the current approaches, start open dialogues without any preconceived ideas in drug delivery technologies, and design the future technologies that will propel us to the next level of drug delivery systems. Advances in the next drug delivery systems can be accelerated, if formulation scientists accept the fact that the current technologies, mainly based on elusive nanotechnology, have limits, and clearly understand the problems at hand and on the horizon. The challenges facing the drug delivery scientists are diverse. Developing clinically useful formulations of poorly soluble drugs has been a major issue since the formulation science began. Developing modulated drug delivery systems is still beyond our reach. We need to take different approaches to make meaningful advances in targeted drug delivery. The true drug targeting is probably the single most important property that drug delivery system should acquire for the future. Without targeted drug delivery, we will not be able to cure cancer or achieve gene therapy.

Finding answers starts from defining the problems first. This presentation will discuss a selected number of important formulation problems that need to be overcome, which include formulation of poorly soluble drugs, long-term PLGA depot formulations without initial burst release, abuse-deterrent formulations, improved bioavailability of peptide and protein drugs, self-regulated delivery systems, and targeted drug delivery systems.