

Sudipta Ganguly, Ph.D.

Dissertation Abstract (2006)

AN EXOGENOUS PHOSPHOLIPID-BASED LUNG SURFACTANT INHALATION SYSTEM TO ENHANCE PULMONARY DRUG DEPOSITION

Aerosolized drugs are inhaled to deliver drugs to the pulmonary or the systemic circulation in the treatment or prevention of various medical conditions. However, the amount of drug actually reaching the target region in the lung following pulmonary inhalation is often estimated at less than 10%. Current technologies fail to recover this wasted fraction of the drug and deliver it deeper region into the lungs where it can be absorbed. Novel techniques that can facilitate such deep lung delivery are desirable. FDA has approved several exogenous surfactants for prophylaxis and rescue treatment of respiratory distress syndrome (RDS). Their approved mode of administration (intratracheal instillation) and site of action (alveolar spaces) suggest that the phospholipids in the exogenous surfactants can spread from the trachea to alveolar air spaces and exert advantageous effect. The driving hypothesis for this study is that spreading of such surfactant (when administered exogenously) can facilitate the migration of deposited drug particles deeper into the lung. The supposition was tested *in vitro* using airway cell models (A549 and NCI-H441), which served as a screening technique for the exogenous surfactants. An inhalation surfactant formulation was developed and characterized using the *in vitro* method and cascade impaction studies. Changes in total lung and regional deposition will be evaluated by performing *in vivo* studies in rodents, dosed intratracheally or intranasally. The inhalation system thus developed incorporating a surfactant (with a proven history of safe use), will be usable in conjunction with all inhaled products. The following dosing strategy is envisioned: (a) The patient inhales their medication from any type of FDA approved inhaler and the drug particles deposit on the luminal surface at a location which depends on the inhaler characteristics and patient techniques. (b) The patient will immediately inhale a dose of the surfactant from the developed novel inhaler containing surfactant particles larger than the drug particles causing it to deposit higher in the airways, which then displaces drug particles deeper into the lung.

Education Summary

- August 2003 to April 2007, University of Maryland at Baltimore, Ph.D. in Pharmaceutical Sciences with major focus on Pharmaceutics and Drug Delivery Technology (Aerosols) supervised by Dr. Richard N. Dalby.
- August 2001 to August 2003, Creighton University, Omaha, M.S. in Pharmaceutical Sciences with major in Pharmaceutics (Drug Delivery) under the supervision of Dr. Alekha K. Dash.
- August 1996 to May 2000, Birla Institute of Technology, Ranchi (INDIA) graduated with B.S. (Pharmacy) with First Class (Distinction).

Employment Summary

- August 2004 to April 2007, Graduate Research Assistant, University of Maryland at Baltimore. Develop a phospholipid-based inhalation system to enhance pulmonary drug deposition using cell culture models and formulation approaches.
- June 2004 to August 2004, Summer Intern, Biopharmaceutics R&D (Pharmaceutical Research Institute), Bristol-Myers Squibb Co., New Brunswick. Wet granulation end point control using Focused Beam Reflectance Measurement Technology.
- August 2003 to June 2004, Graduate Teaching Assistant (Pharmaceutics and Pharmaceutical Compounding lab courses), University of Maryland at Baltimore.

- September 2001 to May 2002, Co-Investigator, FSI Nutrition, Omaha. Evaluation of solution stability of creatine formulations using reversed phase HPLC and thermal analyses methods (DSC and TGA).
- September 2001 to July 2002, Co-Investigator, AdvoCare, Omaha. Development of a sensitive method of analysis of nutraceuticals and dietary supplements using ion-pairing HPLC.
- June 2000 to July 2001, Medical Service Representative, Ranbaxy Labs, India. Job responsibilities included meeting physicians and pharmacists, maintain stock balances of inventoried products and generate orders at the whole sale level.

Research Skills

Metered Dose Inhalation formulation and characterization (particle size measurements using cascade impaction), cell culture techniques, spray-drying, Instron Material Testing System, high-shear wet granulation, laser diffraction-Malvern and Sympatec systems, sieving, scanning electron microscopy, Focused Beam Reflectance and Particle Vision Measurements for on-line monitoring of granule growth and end-point control as a part of Process Analytical Technology (PAT), powder flow characterization using annular shear cell (cohesivity, angle of friction), formulation and physical characterization of tablet dosage forms (hardness, friability, compactibility and disintegration), USP Type I and Type II dissolution testing, UV, visible and fluorescence spectroscopy, High Performance Liquid Chromatography (reverse-phase, ion-pairing, fluorescence), Differential Scanning Calorimetry, Thermogravimetric Analysis, mucoadhesive performance evaluation (stress-strain, tensile strength, compressibility, peel and shear studies).

Computer Skills

Microsoft Office (Word, Excel and PowerPoint), Instrumental software: Windows TA software for Thermal Analyses; WIN-AGS Lite 2000 software for mechanical testing; Shimadzu and Hitachi software for HPLC analyses.

Publications

- **Ganguly S**, Shapiro PS, Somaraju S, Dalby RN. Semi-automated detection of particle migration on cultured lung epithelial cells. *Respiratory Drug Delivery X*, 2006, 3: 865-868.
- **Ganguly S**, Shapiro PS, Somaraju S, Dalby RN. An *in vitro* technique for evaluating exogenous surfactants. *Respiratory Drug Delivery Europe*, 2005, 1: 277-280.
- **Ganguly S** and Dash AK. A novel *in situ* gel for sustained drug delivery and targeting. *Int J Pharm*, 2004; 276(1-2): 83-92 (2004).
- **Ganguly S**, Jayappa S, Dash AK. Evaluation of the stability of creatine in solution prepared from effervescent creatine formulations. *AAPS PharmSciTech*, 2003; 4(2): article 25.
- LeDay AM, **Ganguly S**, Kulkarni KH, Dash A, Opere CA, Ohia SE. Effect of hydrogen peroxide on amino acid concentrations in bovine retina and vitreous humor, ex vivo. *Methods Find Exp Clin Pharmacol*, 2003; 25(9): 695-701.

Abstracts

- **Ganguly S**, Shapiro PS, Somaraju S, Dalby RN. A phospholipid-based metered-dose inhalation system: formulation and characterization of particle migration on pulmonary cell surface. American Association of Pharmaceutical Scientists-Philadelphia Pharmaceutical Forum Poster Night 2007, Ambler, PA.

- **Ganguly S**, Shapiro PS, Somaraju S, Dalby RN. A phospholipid-based inhalation system: formulation and characterization of particle migration on lung epithelial cell surface. Abstract No. M1249. American Association of Pharmaceutical Scientists Annual Meeting 2006, San Antonio, TX.
- **Ganguly S**, Nithyanandan P, Hoag SW, Dalby RN. Characterization of metered dose inhaler robustness: a stress analysis and mechanical failure study. The AAPS Journal, 2005; 7(S2): Abstract No. W4268. American Association of Pharmaceutical Scientists Annual Meeting 2005, Nashville, TN.
- **Ganguly S** and Gao JZ. Application of on-line Focused Beam Reflectance Measurement Technology in high shear wet granulation. The AAPS Journal, 2005; 7(S2): Abstract No. T3216. American Association of Pharmaceutical Scientists Annual Meeting 2005, Nashville, TN.
- **Ganguly S** and Dash AK. Effect of cross-linking on the *in vitro* drug release and water uptake in an *in situ* gel system. AAPS PharmSci, 2003; 5(4): Abstract No. T3024. American Association of Pharmaceutical Scientists Annual Meeting 2003, Salt Lake City, UT.
- **Ganguly S** and Dash AK. Development of a sustained release *in situ* gel delivery system. AAPS PharmSci, 2003; 5(4): Abstract No. T3023. American Association of Pharmaceutical Scientists Annual Meeting 2003, Salt Lake City, UT.
- **Ganguly S**, Jayappa S, Baisa M, Dash AK. Preparation and characterization of solid dispersion of creatine in polyethylene glycol. AAPS PharmSci, 2003; 5(4): Abstract No. W4255. American Association of Pharmaceutical Scientists Annual Meeting 2003, Salt Lake City, UT.
- **Ganguly S** and Dash AK. Development of a novel *in situ* gel system for oral drug delivery. AAPS PharmSci, 2002; 4(4): Abstract No. W4138. American Association of Pharmaceutical Scientists Annual Meeting 2002, Toronto, Canada.
- **Ganguly S**, Carnazzo J, Dash AK. Evaluation of the solution stability of creatine in large volume creatine supplements. AAPS PharmSci, 2002; 4(4): Abstract No. R6248. American Association of Pharmaceutical Scientists Annual Meeting 2002, Toronto, Canada.
- **Ganguly S** and Dash AK. Development of a novel biodegradable gel system for oral drug delivery. Pharmacy Student Research Conference (Western Region), 2002. Abstract No. 13; Denver, CO.

Honors and Awards

- Recipient of Dunning Fellowship, University of Maryland.
- Best Poster Award at Poster Night, AAPS-Philadelphia Pharmaceutical Forum.
- Pharmaceutics and Drug Delivery (PDD) Section Travel Award from AAPS.
- Inducted into Ro-Chi Honor Society (Alpha-Alpha Chapter).
- Bachelor of Music Award (*Sangeet Visharad*) in Indian Classical Music (Vocal).
- Various honors at college and high school level in creative writing, scientific poster presentations, quizzes and music.

Organizations

- American Association of Pharmaceutical Scientists (AAPS): Chair and Vice-Chair of University of Maryland-AAPS student chapter (2004-2006).
- Pharmacy Graduate Student Association, University of Maryland: Vice-President (2004-2005).
- Indian Association, University of Maryland: Secretary and Treasurer (2004-2006)