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Abraham J. Domb • Wahid Khan
Editors

Focal Controlled Drug Delivery

 Springer

Editors

Abraham J. Domb
Institute of Drug Research
School of Pharmacy-Faculty of Medicine
The Hebrew University of Jerusalem
Jerusalem, Israel

Wahid Khan
Department of Pharmaceutics
National Institute of Pharmaceutical
Education and Research (NIPER)
Balanagar, Hyderabad, India

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Preface

The concept of focal drug delivery has been applied for treating illnesses that are localized to a certain tissue or organ. These delivery systems are applied directly to the diseased site and deliver a desired dose for an extended time period while minimizing systemic distribution of toxic drug. Overall, this book contains two sections: first section includes fundamental introductory chapters for focal drug delivery, whereas second section includes chapters describing drug delivery to body sites/system.

Biodegradable polymers have been playing a very important role in delivery aspects of therapeutic molecules because of their biocompatibility and biodegradability. Chapter 1 discusses the importance of these polymeric carriers in focal controlled drug delivery and explores a wide range of polymers, including those from natural and synthetic sources. Chapter 2 presents the role of implantable medical devices such as stents in controlled local drug delivery. Various classes and requirements of implantable devices such as mechanical properties, biocompatibility, and sterilization have been listed in this chapter. A detail about focal drug delivery applications of cardiovascular and orthopaedic implantable devices has been provided.

Tumor targeting comes first in discussion in emphasizing the role of systemic targeting. Chapter 3 provides various means of drug targeting like polymeric nanoparticles, liposomes, polymersomes, and solid lipid nanoparticles, the role and endogenous factors making an impact on EPR effect in tumor targeting along with the ligand-based targeting based on carbohydrates, proteins, antibodies, aptamers, and small molecules for various malignancies. Chapter 4 discusses the emerging role of liposomes in focal drug delivery for cancer and noncancer therapies. Chapter 5 emphasizes the expanding role of polymer drug conjugates and suggests their potential in drug delivery platforms. An understanding of in vivo pharmacokinetics and pharmacodynamics of a delivery system is important in determining the clinical effectiveness of these systems in site-specific targeting. Chapter 6 focuses on the anticancer drug delivery systems for treatment of solid tumors and on the quantitative assessment of the analyzed factors/parameters.

Chapter 7 covers various treatment modalities in brain tumor, describing a brief about locally delivered chemotherapy following surgical resection. Strategies like drug delivery microchips, gene-targeted drugs, and nanocarriers have been explored in their role in effective delivery in this aspect. Chapter 8 describes intranasal administration of neuropeptide-loaded nanoparticles as a feasible means to noninvasively deliver neuropeptides for CNS therapeutics. Chapter 9 examines the scope of focal drug delivery in inner ear therapy, comparing advantages and disadvantages of different techniques like intratympanic perfusion, organ-targeted delivery, and direct cochlear drug delivery. Chapters 10 and 11 focus on the emerging role of nanotechnology in ocular drug delivery that presents a big challenge to current therapies because of its complex anatomical and physiological barriers and the major types of nucleic acids and various strategies that have been used to achieve site-specific delivery of nucleic acids to the eye for the treatment of ocular diseases. Chapter 12 gives a brief about basic mechanisms of transport in iontophoretic drug delivery systems in localized delivery of drugs in addition to its growing investigating potential in treatment of various diseases related to eye and skin. A drug designated to act locally in the oral cavity has to remain in the site for a measured period of time and withstand the dynamic conditions in the mouth such as changing pH levels, masticatory abrasion, slippery mucosa, and smooth teeth surfaces. Chapter 13 focuses on potential of polymeric carriers in treating various oral cavity diseases of bacteriological, viral, and fungal origin. The major reason for the resistance of the oral microbes is their inherent organization into characteristic biofilms. Chapter 14 begins with the introduction of these biofilms and advantages of focal drug delivery in this aspect and concludes with the recent development of various novel technologies for the prevention, control, and treatment of oral infections including controlled focal delivery modalities. Chapter 15 discusses focal drug delivery to stomach that includes gastro-retentive drug delivery systems. A brief for gastro-retentive dosage form (GRDF), different GRDF technologies, and their unique application has been discussed. Chapter 16 discusses focal drug delivery to intestine emphasizing variable intestinal conditions like environmental pH values, transporter expression levels, and CYP3A4 expression necessary for a successful targeted drug delivery.

Chapter 17 gives a review of the challenges and opportunities in systemic and local drug delivery to the arterial tissue, advances in systemic (e.g., targeted nanotechnology-based formulations) and local (e.g., drug-eluting stent (DES) implantation) delivery technologies, and their future perspective in the development of multifunctional nano-systems resulting in localized intracellular drug delivery with improved efficacy. Chapters 18 and 19 focus on the role of stents and vascular grafts in localized drug delivery to vascular tissues. The first gives the readers an introduction about bare-metal stents (BMS) that have been used in coronary artery diseases, long-term result problems of in-stent restenosis (ISR), and stent thrombosis resulting in introduction of DES to overcome the problems of ISR along with the advancement to development of a more user-friendly bioabsorbable and polymer-free stents. The second one discusses the advantages of drug-eluting vascular graft compared to coronary artery bypass grafting as well as trends in their development

with a prime focus on electrospinning as a promising platform technology for creating a new generation of vascular grafts. Chapter 20 introduces the importance of and major hurdles for lymphatic targeting as well as the potential of new delivery platforms for nanocarriers such as liposomes, solid lipid nanoparticles, etc. for better penetration into diseased areas. Osteomyelitis, a disease of bone and bone marrow, presents a major challenge in therapy. The challenges along with the potential of newer forms of sustained-release antibiotic delivery systems in delivering antibiotics at constant rates over a prolonged period of time, eliminating the need for multiple dosing, are indicated in Chapter 21. Chapter 22 reviews an up-to-date overview of the acellular biomaterial-based strategies, aimed at simultaneous regeneration of bone and cartilage by the controlled focal delivery of the appropriate factors. Development and clinical testing of various delivery systems (microspheres, hydrogels, and macroporous scaffolds) are also discussed.

Chapter 23 presents locally and systemically delivered polymeric drug carrier systems in treatment of solid tumors. Different types of in situ forming injectable hydrogels, various micro- and nanoparticulate systems, and the role of polymeric drug delivery systems in addressing the multidrug resistance are discussed. Chapter 24 describes the advantages offered by multifaceted nanocarrier systems over current conventional formulations for skin ailments and their research and market potential along with factors vital for selection of appropriate nano delivery system. Chapter 25 deals with anatomy of the nail unit, related diseases, and challenges presented by topical and oral anti-infective. It also explores the potential of focal delivery approaches to nails that are currently being investigated. In Chap. 26, the reader is presented with an overview of different wound management dressings and advanced technologies for achieving improved healing for wounds, burns, and diabetes-related ulcers and related pathogenesis. Also pharmacological agents like gene therapy and cytokine, growth factors, stem cells, etc. are also discussed. Chapter 27 previews the potential of vaginal drug delivery systems focusing on the barriers presented by vaginal mucosa. The various strategies discussed include nanomaterials like nanoparticles, electrospun fibers, and HIV microbicide applications for effective and successful vaginal drug delivery. Lastly, discussed in Chap. 28 are the selected developments in the extensive field of prolonged duration of local anesthesia for the goal of enhanced anesthetic duration following administration.

Jerusalem, Israel
Hyderabad, India

Abraham J. Domb
Wahid Khan

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Contributors

Mansoor Amiji Department of Pharmaceutical Sciences, School of Pharmacy, Northeastern University, Boston, MA, USA

Nurit Beyth Faculty of Dentistry, The Hebrew University—Hadassah, Jerusalem, Israel

Department of Prosthodontics, The Hebrew University-Hadassah School of Dental Medicine, Jerusalem, Israel

Hansen Bow Department of Neurosurgery, School of Medicine, The Johns Hopkins University, Baltimore, MD, USA

Henry Brem Department of Neurosurgery, Oncology and BioMedical Engineering, School of Medicine, The Johns Hopkins University, Baltimore, MD, USA

Yaron S. Brin Department of Orthopaedic Surgery, Meir Medical Center, Tel Aviv University, Kfar-Saba, Israel

Venu Gopala Swami Challa Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Hyderabad, India

Kun Cheng Division of Pharmaceutical Sciences, School of Pharmacy, University of Missouri-Kansas City, Kansas City, MO, USA

Smadar Cohen Avram and Stella Goldstein-Goren Department of Biotechnology Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel

The Ilse Katz Institute for Nanoscale Science and Technology, Ben-Gurion University of the Negev, Beer-Sheva, Israel

The Regenerative Medicine and Stem Cell (RMSC) Research Center, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Arik Dahan Department of Clinical Pharmacology, School of Pharmacy, Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Preshita P. Desai Department of Pharmaceutical Sciences and Technology, Institute of Chemical Technology, Matunga, Mumbai, India

Dipti Deshpande Department of Pharmaceutical Sciences, School of Pharmacy, Northeastern University, Boston, MA, USA

Fahima Dilnawaz Nanomedicine Laboratory, Institute of Life Sciences, Bhubaneswar, Orissa, India

Abraham J. Domb Faculty of Medicine, Institute of Drug Research, School of Pharmacy, The Hebrew University of Jerusalem, Jerusalem, Israel

Sean Essex Department of Pharmaceutical Sciences, Center for Pharmaceutical Biotechnology and Nanomedicine, Northeastern University, Boston, MA, USA

Shady Farah Faculty of Medicine, Institute of Drug Research, School of Pharmacy, The Hebrew University of Jerusalem, Jerusalem, Israel

Taís Gratieri Faculdade de Ciências da Saúde, Universidade de Brasília, Brasília, DF, Brazil

School of Pharmaceutical Sciences, University of Geneva & University of Lausanne, Geneva, Switzerland

Uri Hadelsberg Technion-Israel Institute of Technology, Haifa, Israel

Jingjia Han Department of Pediatrics, School of Medicine, Emory University and Parker H. Petit Institute of Biotechnology and Biosciences, Georgia Institute of Technology, Atlanta, GA, USA

Orith Haramaty Department of Prosthodontics, The Hebrew University-Hadassah School of Dental Medicine, Jerusalem, Israel

Michael Jaffe Medical Device Concept Laboratory, New Jersey Institute of Technology, Newark, NJ, USA

Sonam Jain Department of Pharmaceutics, National Institute of Pharmaceutical Education & Research (NIPER), Mohali, Punjab, India

Aziza Jamal-Allial Department of Pharmaceutical Sciences, School of Pharmacy, Northeastern University, Boston, MA, USA

Yogeshvar N. Kalia School of Pharmaceutical Sciences, University of Geneva & University of Lausanne, Geneva, Switzerland

Wahid Khan Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Balanagar, Hyderabad, India

Daniel S. Kohane Department of Anesthesiology, Laboratory for Biomaterials and Drug Delivery, Division of Critical Care Medicine, Boston Children's Hospital, Harvard Medical School, Boston, MA, USA

Division of Health Sciences and Technology, Harvard-Massachusetts Institute of Technology, Boston, MA, USA

Emily A. Krogstad Department of Bioengineering, University of Washington, Seattle, WA, USA

Daniel J. Kubek Department of Anatomy and Cell Biology, Indiana University School of Medicine, Indianapolis, IN, USA
School of Dentistry, University of Louisville, Louisville, KY, USA

Michael J. Kubek Department of Anatomy and Cell Biology, Indiana University School of Medicine, Indianapolis, IN, USA

Department of Psychiatry, Indiana University School of Medicine, Indianapolis, IN, USA

Program in Medical Neuroscience, Indiana University School of Medicine, Indianapolis, IN, USA

Dinesh Kumar Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Hyderabad, India

Neeraj Kumar Department of Pharmaceutics, National Institute of Pharmaceutical Education & Research (NIPER), Mohali, Punjab, India

Robert Langer Department of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, MA, USA

Peter I. Lelkes Department of Bioengineering, College of Engineering, Temple University, Philadelphia, PA, USA

J. Brian McAlvin Department of Medicine, Medicine Critical Care Program, Boston Children's Hospital, Harvard Medical School, Boston, MA, USA

Laboratory for Biomaterials and Drug Delivery, Department of Anesthesiology, Division of Critical Care Medicine, Boston Children's Hospital, Harvard Medical School, Boston, MA, USA

Division of Health Sciences and Technology, Harvard-Massachusetts Institute of Technology, Cambridge, MA, USA

Eameema Muntimadugu Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Hyderabad, India

Sudaxshina Murdan Department of Pharmaceutics, UCL School of Pharmacy, London, UK

Meir Nyska Department of Orthopaedic Surgery, Meir Medical Center, Tel Aviv University, Kfar-Saba, Israel

Vandana B. Patravale Department of Pharmaceutical Sciences and Technology, Institute of Chemical Technology, Matunga, Mumbai, India

Prasad V. Pawar Department of Pharmaceutics, National Institute of Pharmaceutical Education & Research (NIPER), Mohali, Punjab, India

Rajendra P. Pawar Department of Chemistry, Deogiri College, Aurangabad, India

Michael Perez-Davidi Department of Prosthodontics, Hadassah School of Dental Medicine, Hebrew University, Jerusalem, Israel

David Polak Department of Prosthodontics, The Hebrew University-Hadassah School of Dental Medicine, Jerusalem, Israel

Gustavo Pradilla Department of Neurosurgery, School of Medicine, The Johns Hopkins University, Baltimore, MD, USA

Sheeba Qureshi Braun School of Public Health, The Hebrew University of Jerusalem, Jerusalem, Israel

Sistla Ramakrishna Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Hyderabad, India

Department of Pharmacology, Indian Institute of Chemical Technology, Hyderabad, India

Michael J. Rathbone School of Pharmacy, International Medical University, Kuala Lumpur, Malaysia

Emil Ruvinov Avram and Stella Goldstein-Goren Department of Biotechnology Engineering, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Sanjeeb Kumar Sahoo Nanomedicine Laboratory, Institute of Life Sciences, Bhubaneswar, Orissa, India

Kinjal Sankhe Department of Pharmaceutical Sciences, School of Pharmacy, Northeastern University, Boston, MA, USA

Nalini Shastri Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Hyderabad, India

Ariella Shikanov Lurie Biomedical Engineering, University of Michigan, Ann Arbor, MI, USA

Ravi S. Shukla Division of Pharmaceutical Sciences, School of Pharmacy, University of Missouri-Kansas City, Kansas City, MO, USA

Indu Singh Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Hyderabad, India

David Stepensky Department of Clinical Biochemistry and Pharmacology, Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Ian Suk Department of Neurosurgery, The Johns Hopkins University School of Medicine, Baltimore, MD, USA

Rajan Swami Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Hyderabad, India

Rajesh Thipparaboina Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Hyderabad, India

Vladimir Torchilin Department of Pharmaceutical Sciences, Center for Pharmaceutical Biotechnology and Nanomedicine, Northeastern University, Boston, MA, USA

Betty M. Tyler Department of Neurosurgery, School of Medicine, The Johns Hopkins University, Baltimore, MD, USA

Michael C. Veronesi Department of Radiology, University of Chicago School of Medicine, Chicago, IL, USA

Judah Z. Weinberger Cardiovascular Division, Department of Medicine, Columbia University, New York, NY, USA

Ervin I. Weiss Department of Prosthodontics, The Hebrew University-Hadassah School of Dental Medicine, Jerusalem, Israel

Omri Wolk Department of Clinical Pharmacology, School of Pharmacy, Faculty of Health Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel

Kim A. Woodrow Department of Bioengineering, University of Washington, Seattle, WA, USA

Jing Zou Hearing and Balance Research Unit, field of Otolaryngology, School of Medicine, University of Tampere, Tampere, Finland

Department of Otolaryngology-Head & Neck Surgery, Center for Otolaryngology-Head & Neck Surgery of Chinese PLA, Changhai Hospital, Second Military Medical University, Shganghai, China