Long-Acting Drug Delivery Systems
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Contents

List of contributors xiii
Preface xvii

1 Overview of the clinical current needs and potential applications for long-acting and implantable delivery systems 1
Eneko Larrañeta, Thakur Raghu Raj Singh and Ryan F. Donnelly
1.1 Introduction 1
1.2 LADDS versus conventional routes for drug administration 3
1.3 Current applications of long-acting drug delivery system 5
  1.3.1 Contraception 5
  1.3.2 Cancer 5
  1.3.3 Ocular diseases 8
  1.3.4 Chronic conditions and other applications 8
1.4 Future applications of long-acting drug delivery system 9
References 12

2 Classification, material types, and design approaches of long-acting and implantable drug delivery systems 17
Emilia Utomo, Sarah A. Stewart, Camila J. Picco, Juan Domínguez-Robles and Eneko Larrañeta
2.1 Introduction 17
2.2 Implantable polymeric drug delivery device classification 19
  2.2.1 Solid implants 19
  2.2.2 Injectable long-acting formulations 20
2.3 Mechanism of drug release from implantable and long-acting drug delivery systems 22
  2.3.1 Mechanism of drug release from solid implants 22
  2.3.2 Mechanism of release from nano/microparticulate injectable formulations 24
  2.3.3 Mechanism of release from in situ forming implants 25
2.4 Materials used for implantable and long-acting drug delivery systems manufacturing 26
  2.4.1 Materials used for solid implant manufacturing 26
  2.4.2 Materials used to prepare injectable long-acting formulations 36
2.5 Manufacturing methods of implants and long-acting formulations 40
  2.5.1 Manufacturing of solid implants 40
  2.5.2 Methods to prepare in situ forming injectable implants 43
3 Long-acting drug delivery systems for ocular therapies
David Waite, Faris M Adrianto, Febri Annuyanti, Yin So, Wenrui Zhang, Sangdi Wang, Yu Wu, Yujing Wang and Thakur Raghu Raj Singh

3.1 Introduction
3.2 Contact lenses and other ocular inserts on the surface as long-acting systems
3.3 Long-acting systems for the anterior segment
3.4 Periocular delivery of long-acting systems
3.5 Long-acting intravitreal systems
3.6 Long-acting micro/nanoparticulate delivery systems
3.7 In situ forming long-acting implants for ocular delivery
3.8 Conclusion and future directions

References

4 Applications of long-lasting and implantable drug delivery systems for cardiovascular disease treatment
Roxanne Khalaj and Dennis Douroumis

4.1 Introduction: Cardiovascular disease and atherosclerosis
4.2 Pathophysiology of atherosclerosis
4.3 Treatments for atherosclerosis
4.4 Stenting
4.5 Future directions in stent development
4.6 3D printing
4.7 Stents manufactured via selective laser sintering
4.8 Stents manufactured via MJ
4.9 Stents manufactured via stereolithography
4.10 Two-photon polymerization
4.11 Targeted treatments for other CVDs
4.12 Conclusion

References

5 Implantable and long-lasting drug delivery systems for cancer treatment
Catarina Pacheco, Ana Baião, Flávia Sousa and Bruno Sarmento

5.1 Introduction
5.2 Implantable drug delivery systems
5.2.1 Nonbiodegradable versus biodegradable implantable drug delivery systems
5.2.2 Implantable drug delivery systems applications in cancer treatment

References
6 Long-acting drug delivery systems: applications for sexual and reproductive health
Sally Galal, Celine Jones and Kevin Coward

6.1 Introduction 163
6.2 Sexual and reproductive health physical and pathological challenges 164
6.3 Different approaches to conquer the physical and pathological obstacles associated with sexual and reproductive health 164
6.4 Drug delivery systems used in the field of sexual and reproductive health
6.4.1 Nanomedicine and nanoparticles 165
6.4.2 Exosomes 171
6.4.3 Liposomes 173
6.4.4 Micelles 176
6.4.5 Liquid crystals 178
6.4.6 Polymer gels 180
6.4.7 Sperm-hybrid micromotors for drug delivery in the female reproductive tract 181
6.5 Advances in long-acting contraceptive drug delivery systems 182
6.5.1 Copper-bearing intrauterine devices 183
6.5.2 Levonorgestrel-releasing intrauterine system 184
6.5.3 Progestin-containing subdermal contraceptive implants 184
6.5.4 Effervescent microneedle patch 185
6.6 Advances in long-acting drug delivery systems in AIDS prophylaxis 185
6.7 Conclusion 186
Acknowledgments 187
References 187

7 Long-acting drug delivery systems for schizophrenia treatment
Vanteemar S. Sreeraj, Venkataram Shivakumar, Naren P. Rao and Ganesan Venkatasubramanian

7.1 Introduction 203
7.1.1 LAI formulations 204
7.2 Who would benefit from LAI antipsychotics: understanding the indications through mechanism
7.2.1 Adherence translates into effectiveness 205
7.2.2 Direct medical supervision enhances the outcome 205
7.2.3 Pharmacokinetics of LAI antipsychotics influencing the clinical decisions 208
7.2.4 Pharmacodynamics: differences in dopamine receptor antagonism
7.2.5 LAI antipsychotic may reverse altered receptor sensitivity
7.2.6 Neuroplasticity
7.3 Special indications
7.4 Evidence for superiority of LAI antipsychotic over oral antipsychotics
7.5 When to start LAI?
7.6 Comparative tolerability of LAI antipsychotics
7.7 How to initiate LAI antipsychotic?
7.8 Choosing among FGA LAIs and SGA LAIs: newer the better or old is gold?
7.9 Clinical utility of LAI antipsychotics: the ground reality
7.10 Noninjectable long-acting formulations
7.11 Conclusion
Acknowledgment
Conflict of interest
References

8 Implantable and long-lasting drug delivery systems for infectious, inflammatory, endocrine, and neurodegenerative diseases
Essyrose Mathew, Sarah A. Stewart, Emilia Utomo, Eneko Larrañeta and Dimitrios A. Lamprou

8.1 Introduction
8.2 Implantable and long-lasting drug delivery systems for infectious diseases
8.2.1 Tuberculosis
8.2.2 Malaria
8.2.3 Hepatitis B
8.3 Implantable and long-lasting drug delivery systems for inflammatory diseases
8.3.1 Osteoarthritis
8.3.2 Long-acting delivery of NSAID drugs
8.3.3 Long-acting delivery of steroid drugs
8.4 Implantable and long-lasting drug delivery systems for endocrine diseases
8.4.1 Hypothyroidism
8.4.2 Growth hormone
8.5 Implantable and long-lasting drug delivery systems for neurodegenerative diseases
References

9 Long-lasting drug delivery systems based on microneedles
Lalitkumar K. Vora, Kurtis Moffatt and Ryan F. Donnelly

9.1 Introduction
9.2 Microneedle array patch as a long-acting drug delivery tool
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.2.1 Type of microneedle array patch formulations</td>
<td>251</td>
</tr>
<tr>
<td>9.3 Long-acting microneedle array patch formulations</td>
<td>255</td>
</tr>
<tr>
<td>9.3.1 Microneedle array patches formulation methodologies for</td>
<td></td>
</tr>
<tr>
<td>long-acting delivery</td>
<td>255</td>
</tr>
<tr>
<td>9.4 Application of microneedle array patches for long-acting</td>
<td></td>
</tr>
<tr>
<td>drug delivery</td>
<td>263</td>
</tr>
<tr>
<td>9.4.1 Vaccine</td>
<td>264</td>
</tr>
<tr>
<td>9.4.2 Lymphatic targeting</td>
<td>265</td>
</tr>
<tr>
<td>9.4.3 HIV infection</td>
<td>267</td>
</tr>
<tr>
<td>9.4.4 Contraceptives</td>
<td>268</td>
</tr>
<tr>
<td>9.4.5 Antipsychotics</td>
<td>269</td>
</tr>
<tr>
<td>9.4.6 Insulin</td>
<td>269</td>
</tr>
<tr>
<td>9.4.7 Skin diseases</td>
<td>271</td>
</tr>
<tr>
<td>9.5 Laboratory to large-scale considerations</td>
<td>272</td>
</tr>
<tr>
<td>9.6 Conclusion and future prospects of microneedle array patch</td>
<td>274</td>
</tr>
<tr>
<td>References</td>
<td>275</td>
</tr>
</tbody>
</table>

10 Safety, biodegradability, and biocompatibility considerations of     | 289  |
| long-acting drug delivery systems                                      |      |

Deepakkumar Mishra, Katie Glover, Shilpa Gade, Rahul Sonawane            |      |
and Thakur Raghu Raj Singh                                               |      |

10.1 Introduction                                                       | 289  |
10.2 Biodegradation as per international regulatory bodies              | 289  |
10.2.1 Experimental design consideration for the fabrication           |      |
| of biodegradable implants                                              | 290  |
10.2.2 Initial quantification of implants before degradation studies    | 290  |
10.2.3 Preparation of biodegradation medium                            | 292  |
10.2.4 Containers                                                       | 292  |
10.2.5 Number of samples                                                | 292  |
10.2.6 Experimental procedure                                           | 292  |
10.2.7 Real-time biodegradation                                         | 293  |
10.2.8 Accelerated degradation                                          | 295  |
10.2.9 Final characterization                                           | 295  |
10.3 Methods to study the biodegradation of long-acting implants        |      |
| under in vitro conditions                                              | 295  |
10.3.1 Estimation of physical changes during biodegradation             | 295  |
10.3.2 Estimation of mechanical changes during biodegradation           | 297  |
10.3.3 Estimation of chemical changes during degradation                | 297  |
10.4 Models for prediction of implant degradation                       | 299  |
10.4.1 Arrhenius equation                                               | 299  |
10.4.2 Weibull model                                                    | 299  |
10.4.3 Korsmeyer—Peppas model                                           | 300  |
10.5 Parameters affecting in vitro polymer degradation                  | 301  |
10.5.1 Temperature                                                     | 301  |
10.5.2 pH 302
10.5.3 Enzymes 302
10.6 Physiological considerations of assessing in vivo degradation 303
10.6.1 Biological factors affecting in vivo degradation 303
10.7 Immunological consideration of long-acting implants 305
10.7.1 Acute inflammatory response 306
10.7.2 Chronic inflammation 307
10.7.3 Foreign body response and fibrous encapsulation 308
10.7.4 Mechanical properties 309
10.7.5 Chemical properties 310
10.7.6 Surface properties 311
10.8 Conclusion 312
References 312

11 Characterization methodologies for long-acting and implantable drug delivery systems 319
Karsten Mader
11.1 Introduction 319
11.2 Characterization methods for the general physicochemical properties 322
11.3 Characterization of the microenvironment (microviscosity, micropolarity, and microacidity) 323
11.4 Methods for in vivo characterization 331
11.4.1 Electron spin resonance spectroscopy and imaging 331
11.4.2 Nuclear magnetic resonance spectroscopy and imaging 333
11.4.3 Ultrasound imaging 336
11.4.4 Optical imaging (in vivo fluorescence imaging) 337
11.4.5 Photoacoustic imaging 337
11.4.6 Computer tomography (also X-ray imaging) 340
11.5 Summary 341
References 341

12 Challenges for clinical translation of long-acting and implantable drug delivery systems 347
Michael Colvin and Jason Colvin
12.1 Introduction 347
12.2 Combination products 348
12.3 Combination products in the United States 348
12.3.1 Background and history 348
12.3.2 US regulatory center 350
12.3.3 Combination products regulatory process 351
12.3.4 Draft guidance 352
12.3.5 Applicable regulation—the United States 353
12.4 Combination products—EU 356
12.4.1 Background and history 356
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.4.2 Medical Device Regulation</td>
<td>356</td>
</tr>
<tr>
<td>12.4.3 Applicable regulations—EU</td>
<td>357</td>
</tr>
<tr>
<td>12.4.4 Applicable regulation—EU</td>
<td>358</td>
</tr>
<tr>
<td>12.5 Regulation outside the United States and EU</td>
<td>361</td>
</tr>
<tr>
<td>12.6 How the United States and EU diverge?</td>
<td>361</td>
</tr>
<tr>
<td>12.7 Patients and combination products</td>
<td>362</td>
</tr>
<tr>
<td>12.8 Future steps</td>
<td>362</td>
</tr>
<tr>
<td>References</td>
<td>363</td>
</tr>
</tbody>
</table>

Index 365
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Preface

Long-acting drug delivery systems are attracting significant interest among researchers in academia and industry alike. These drug delivery systems provide long-term drug release, making them the ideal option for treating chronic conditions, such as HIV, age-related macular degeneration, or schizophrenia. Current therapies for these chronic conditions typically include frequent administration of therapeutics, leading to continuous long-term fluctuations in peak-to-trough drug levels. This traditional practice leads to several issues such as side effects due to high drug levels, subtherapeutic drug levels, patient adherence, efficacy, and patient compliance. Therefore, to overcome these limitations, multiple doses are required to keep drug levels within the bloodstream’s optimal therapeutic level. Long-acting drug delivery systems can provide sustained therapeutic drug levels without relying on intermittent drug administration, improving patient compliance and adherence. This can contribute to lower relapse rates for specific conditions. Additionally, the treatment of some diseases requires high drug levels in a localized part of the body. Long-acting drug delivery systems can be applied to provide local drug delivery, minimize systemic drug exposure, and reduce side effects. Therefore long-acting drug delivery systems can improve the treatment of a wide variety of conditions while improving patients’ quality of life. There are many long-acting drug delivery systems, ranging from solid implants to injectable formulations, resulting in a multidisciplinary research area. Researchers from several disciplines, such as pharmacy, engineering, chemistry, or biomedical sciences, are working together to develop novel long-acting drug delivery systems and methods of characterizing the same.

This book summarizes the current state-of-the-art research on long-acting drug delivery systems, providing a comprehensive overview of the field. The first section of the book provides an introduction to the types of devices and formulations used in long-acting drug delivery systems. An overview of current clinical needs is provided, and the primary types of materials and approaches used in the preparation of these systems are described. The next section of the book focuses on describing specific applications of long-acting drug delivery systems in chronic conditions and their ability to provide a more consistent therapeutic delivery of drugs, improving patient outcomes. Finally, the last two sections of the book focus on describing practical issues that are sometimes left behind in the scientific literature. These chapters cover aspects such as characterization methodologies, scale-up manufacturing, and regulatory considerations.

We believe that this book covers all the relevant aspects of this novel field, and we are indebted to the contributors for their hard work producing and delivering each chapter. Editing this book took time and effort, and, therefore, we want to...
thank our families for their patience and support during the project. Finally, we also like to thank the publisher, Elsevier, for their assistance and encouragement as we completed this project.

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Overview of the clinical current needs and potential applications for long-acting and implantable delivery systems

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1.1 Introduction

Clinical therapies are currently based on intermittent drug administration. For this purpose, different drug delivery routes can be used, but the most commonly used are oral and intravenous. These two routes provide high drug levels in blood soon after administration [1]. Nevertheless, drug concentrations in the blood often decrease below therapeutic levels after a few hours [1]. This is conventionally known as the “peak-and-valley” effect. This approach is not ideal, as high drug levels in the blood can be toxic, while low levels are often inefficient [1]. Moreover, if the drug is administered using the oral route, there are other factors to consider. In this case, the drug needs to survive the harsh conditions in the gastrointestinal tract where the strongly acidic environment and presence of a plethora of enzymes can degrade the drug even before absorption. First-pass metabolism is also a significant issue decreasing bioavailability for many therapeutic compounds [1]. Therefore, to overcome these limitations, multiple doses are required to keep the drug levels within the therapeutic window. This is critical for the management of long-term and chronic conditions [2]. In addition, the treatment of some conditions requires high drug levels at specific sites of action. High drug doses can facilitate this, but this can also lead to toxic drug levels in the bloodstream or certain organs [1]. Considering these limitations, there is a clear need for advanced drug delivery systems that are capable of providing continuous drug administration. In this way, drug concentrations in the bloodstream can be kept within the therapeutic window, minimizing toxicity and side effects while maximizing efficacy. Long-acting drug delivery systems (LADDSs) show much promise in this area [1–3].

LADDSs are disparate in design, including implants and nanoparticle-based suspensions [1,2,4–7]. Fig. 1.1 shows the number of items published containing the words “implant” or “long-acting” combined with “drug delivery.” To create this type of system, a multidisciplinary approach is required, which combines areas such as material science, engineering, pharmaceutical sciences, biology, and medicine [1].