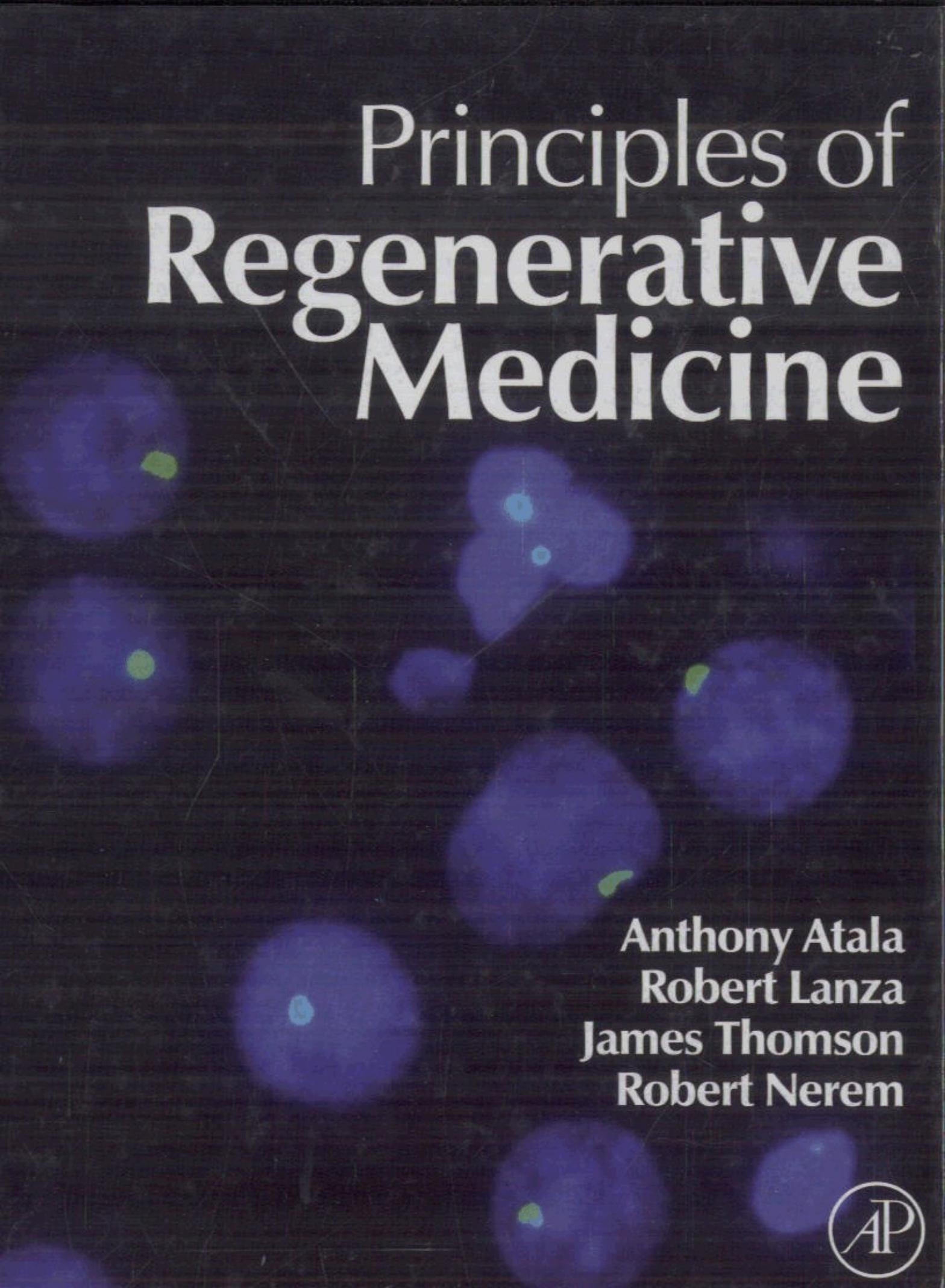


Principles of Regenerative Medicine



Anthony Atala
Robert Lanza
James Thomson
Robert Nerem



Contents

Preface	xiii
List of Contributors	xv
Part I Introduction to Regenerative Medicine	1
1. Current and Future Perspectives of Regenerative Medicine Mark E. Furth and Anthony Atala	2
2. Fundamentals of Cell-Based Therapies Ross Tubo	16
3. Stem Cell Research T. Ahsan, A.M. Doyle, and R.M. Nerem	28
Part II Biologic and Molecular Basis of Regenerative Medicine	49
4. Molecular Organization of Cells Jon D. Ahlstrom and Carol A. Erickson	50
5. Cell–ECM Interactions in Repair and Regeneration M. Petreaca and M. Martins-Green	66
6. Developmental Mechanisms of Regeneration David L. Stocum	100
7. The Molecular Basis of Pluripotency in Principles of Regenerative Medicine Ariel J. Levine and Ali H. Brivanlou	126
8. How Do Cells Change Their Phenotype Peter W. Andrews and Paul J. Gokhale	136
9. Somatic Cloning and Epigenetic Reprogramming in Mammals Heiner Niemann, Christine Wrenzycki, Wilfried A. Kues, Andrea Lucas-Hahn, and Joseph W. Carnwath	148
10. Transgenic Cloned Goats and Cows for the Production of Therapeutic Proteins William Gavin, LiHow Chen, David Melican, Carol Ziomek, Yann Echelard, and Harry Meade	168
Part III Cells and Tissue Development	189
11. Genetic Approaches in Human Embryonic Stem Cells and Their Derivatives Junfeng Ji, Bonan Zhong, and Mickie Bhatia	190
12. Embryonic Stem Cells: Derivation and Properties Junying Yu and James A. Thomson	210

13. Stem Cells Derived from Amniotic Fluid and Placenta	226
Paolo De Coppi, Shay Soker, and Anthony Atala	
14. Stem Cells Derived from Cord Blood	238
Julie G. Allickson	
15. Multipotent Adult Progenitor Cells	258
Catherine M. Verfaillie, Aernout Luttun, Karen Pauwelyn, Jeff Ross, Lepeng Zeng, Marta Serafini, Yuehua Jiang, and Fernando Ulloa Montoya	
16. Bone Marrow Stem Cells: Properties and Pluripotency	268
Munira Xaymardan, Massimo Cimini, Richard D. Weisel, and Ren-Ke Li	
17. Hematopoietic Stem Cell Properties, Markers, and Therapeutics	284
S.M. Chambers, William J. Lindblad, and M.A. Goodell	
18. Neural Stem Cells	300
Yang D. Teng, Filipe N.C. Santos, Peter M. Black, Deniz Konya, Kook In Park, Richard L. Sidman, and Evan Y. Snyder	
19. Mesenchymal Stem Cells	318
Zulma Gazit, Hadi Aslan, Yossi Gafni, Nadav Kimelman, Gadi Pelleg, and Dan Gazit	
20. Hepatic Stem Cells: Lineage Biology and Pluripotency	344
N. Cheng, Hsin-pei Yao, and Lola M. Reid	
21. Skeletal Muscle Stem Cells	386
Jason H. Pomerantz and Helen M. Blau	
22. Islet Cell Therapy and Pancreatic Stem Cells	398
Juan Domínguez-Bendala, Antonello Pileggi, and Camillo Ricordi	
23. Regenerative Medicine for Diseases of the Retina	418
Deepak Lamba and Thomas A. Reh	
24. Peripheral Blood Stem Cells	438
Shay Soker, Gunter Schuch, and J. Koudy Williams	
25. Prospects of Somatic Cell Nuclear Transfer-derived Embryonic Stem Cells in Regenerative Medicine	456
Z. Beyhan and J.B. Cibelli	
26. Somatic Cells: Growth and Expansion Potential of T Lymphocytes	468
Rita B. Effros	
27. Mechanical Determinants of Tissue Development	480
Jonathan A. Kluge, Gary G. Leisk, and David L. Kaplan	
28. Morphogenesis and Morphogenetic Proteins	498
A.H. Reddi	
29. Physical Stress as a Factor in Tissue Growth and Remodeling	512
Robert E. Guldberg, Christopher S. Gemmatti, Yash Kolambkar, and Blaise Porter	
30. Engineering Cellular Microenvironments	536
Wendy F. Liu, Elliot E. Hui, Sangeeta N. Bhatia, and Christopher S. Chen	

31. Applications of Nanotechnology	554
Benjamin S. Harrison	
32. GeneChips in Regenerative Medicine	562
Jason Hipp and Anthony Atala	
Part IV Biomaterials for Regenerative Medicine	579
33. Design Principles in Biomaterials and Scaffolds	580
Hyukjin Lee and Tae Gwan Park	
34. Naturally Occurring Scaffold Materials	594
Stephen F. Badylak	
35. Synthetic Polymers	604
M.C. Hacker and A.G. Mikos	
36. Hybrid, Composite, and Complex Biomaterials for Scaffolds	636
Gilson Khang, Soon Hee Kim, Moon Suk Kim, and Hai Bang Lee	
37. Surface Modification of Biomaterials	656
Andrés J. García	
38. Cell–Substrate Interactions	666
Aparna Nori, Evelyn K.F. Yim, Sulin Chen, and Kam W. Leong	
39. Histogenesis in Three-Dimensional Scaffolds	686
Nicole M. Bergmann and Jennifer L. West	
40. Biocompatibility and Bioresponse to Biomaterials	704
James M. Anderson	
41. Essential Elements of Wound Healing	724
William J. Lindblad	
42. Proteins Controlled with Precision at Organic, Polymeric, and Biopolymer Interfaces for Tissue Engineering and Regenerative Medicine	734
Buddy D. Ratner	
Part V Therapeutic Applications: Cell Therapy	743
43. Biominerilization and Bone Regeneration	744
Jiang Hu, Xiaohua Liu, and Peter X. Ma	
44. Blood Substitutes: Reverse Evolution from Oxygen Carrying to Non-Oxygen Carrying Plasma Expanders	756
Amy Tsai, Marcos Intaglietta, and Mark Van Dyke	
45. Articular Cartilage	766
Francois Ng kee Kwong and Myron Spector	
46. Implantation of Myogenic Cells in Skeletal Muscles	782
Daniel Skuk and Jacques P. Tremblay	

47. Islet Cell Transplantation	794
Juliet A. Emamallee and A.M. James Shapiro	
48. Cell-Based Repair for Cardiovascular Regeneration and Neovascularization: What, Why, How, and Where Are We Going in the Next 5–10 Years?	812
Doris A. Taylor and Andrey G. Zenovich	
49. Retinal Pigment Epithelium Derived from Embryonic Stem Cells	852
Irina Klimanskaya	
50. Cell Therapies for Bone Regeneration	868
Rehan N. Khanzada, Chantal E. Holy, F. Jerry Volenec, and Scott P. Bruder	
51. Cell-Based Therapies for Musculoskeletal Repair	888
Wan-Ju Li, Kiran Gollapudi, David P. Patterson, George T.-J. Huang, and Rocky S. Tuan	
52. Hepatocyte Transplantation	912
Stephen C. Strom and Ewa C.S. Ellis	
53. Bioartificial Livers	928
Randall E. McClelland and Lola M. Reid	
54. Neuronal Transplantation for Stroke	946
Douglas Kondziolka and Lawrence Wechsler	
55. Cell-Based Drug Delivery	954
Grace J. Lim, Sang Jin Lee, and Anthony Atala	
 Part VI Therapeutic Applications: Tissue Therapy	 967
56. Fetal Tissues	968
Seyung Chung and Chester J. Koh	
57. Engineering of Large Diameter Vessels	978
Saami K. Yazdani and George J. Christ	
58. Engineering of Small Diameter Vessels	1000
Chrysanthi Williams and Robert T. Tranquillo	
59. Vascular Assembly in Engineered and Natural Tissues	1020
Eric M. Brey and Larry V. McIntire	
60. Cardiac Tissue	1038
Milica Radisic and Michael V. Sefton	
61. Regenerative Medicine in the Cornea	1060
Heather Sheardown and May Griffith	
62. Alimentary Tract	1072
Mike K. Chen	
63. Liver Cell-Based Therapy – Bioreactors as Enabling Technology	1086
Jörg C. Gerlach, Mariah Hout, Kenneth Gage, and Katrin Zeilinger	

64. Intracorporeal Kidney Support	1106
James J. Yoo, Akira Joraku, and Anthony Atala	
65. The Kidney	1114
William H. Fissell and H. David Humes	
66. Genitourinary System	1126
Anthony Atala	
67. Tissue Engineering of the Reproductive System	1138
Stefano Giuliani, Laura Perin, Sargis Sedrakyan, and Roger De Filippo	
68. Therapeutic Opportunities for Bone Grafting	1164
Jeffrey O. Hollinger, John P. Schmitz, Gary E. Friedlaender, Chris R. Brown, Scott D. Boden, and Samuel Lynch	
69. Cartilage Tissue Engineering	1176
Paulesh Shah, Alexander Hillel, Ronald Silverman, and Jennifer Elisseeff	
70. Phalanges and Small Joints	1198
Makoto Komura, Daniel Eberli, James J. Yoo, and Anthony Atala	
71. Functional Tissue Engineering of Ligament and Tendon Injuries	1206
Savio L.-Y. Woo, Alejandro J. Almarza, Sinan Karaoglu, and Steven D. Abramowitch	
72. Tissue Therapy: Implications of Regenerative Medicine for Skeletal Muscle	1232
Shen Wei and Johnny Huard	
73. Tissue Therapy: Central Nervous System	1248
Jordan H. Wosnick, M. Douglas Baumann, and Molly S. Shoichet	
74. Peripheral Nerve Regeneration	1270
Mahesh C. Dodla and Ravi V. Bellamkonda	
75. Dental Tissue Engineering	1286
Yan Lin and Pamela C. Yelick	
76. Innovative Regenerative Medicine Approaches to Skin Cell-Based Therapy for Patients with Burn Injuries	1298
Jörg C. Gerlach, Steven E. Wolf, Christa Johnen, and Bernd Hartmann	
77. Military Needs and Solutions in Regenerative Medicine	1322
Sara Wargo, Alan J. Russell, and Colonel John B. Holcomb	
Part VII Regulations and Ethics	1333
78. Ethical Considerations	1334
Louis M. Guenin	
79. To Make is to Know: The Ethical Issues in Human Tissue Engineering	1346
Laurie Zoloth	

80. US Stem Cell Research Policy	1354
Josephine Johnston	
81. Overview of FDA Regulatory Process	1366
Celia Witten, Ashok Batra, Charles N. Durfor, Stephen L. Hilbert, David S. Kaplan, Donald Fink, Deborah Lavoie, Ellen Maher, and Richard McFarland	
82. Current Issues in US Patent Law	1386
Patrea L. Pabst	
Index	1402