

Contents

Contributors	xi
Preface	xix
1. The Meritocracy of Stem Cells for Therapy	1
<i>Myrtle Y. Gordon and Nagy A. Habib</i>	
References	4
2. Overview of Adult Stem Cell Therapy in Cardiac Disease	7
<i>Georgios Nteliopoulos, Nataša Levičar and Ioannis Dimarakis</i>	
Introduction	7
Regenerative Potential of the Native Myocardial Tissue	7
Adult Stem Cells	10
Other Cell Types	13
Homing to Ischaemic Myocardium	15
Mechanisms of Cardiac Function Improvement	16
Final Comments	18
References	20
3. Embryonic Stem Cells and Their Therapeutic Potential	29
<i>Tomo Šarić, Shuhua Chen, Naidu Kamiseti, Marcel Halbach, Michael Xavier Doss, Johannes Winkler, Jürgen Hescheler and Agapios Sachinidis</i>	
Embryonic Stem Cells	29
ES Cell-Derived Cardiomyocytes	30
Other Animal Models for ES Cell-Based Therapeutics	38
Barriers to Successful Use of ES Cell-Based Therapies	43
Conclusions	49
References	50
4. Umbilical Cord Blood Cells for Cardiac Repair	59
<i>Elad Maor, Arnon Nagler and Jonathan Leor</i>	
Introduction	59
Myocardial Infarction and Heart Failure	59

Myocardial Regeneration and Cell-Based Therapy	60
Problems with the Available Cell Sources	60
The Rationale for Using UCB Progenitor Cells for Myocardial Repair	61
Data from Animal Models	62
How Do Cord Blood Cells Repair Ischemic Tissue?	66
<i>Ex vivo</i> Expansion	67
Immunosuppression and Graft versus Host Disease	68
Summary	68
References	69
5. Amniotic Stem Cells	73
<i>Paolo De Coppi, Anthony Atala and Saverio Sartore</i>	
Introduction	73
Amniocentesis	73
Differentiated Cells from Amniotic Fluid	73
Mesenchymal Stem Cells from Amniotic Fluid	74
Amniotic Fluid Stem Cells	76
Conclusion	82
References	83
6. Stem Cell Homing to Injury in Cellular Cardiomyoplasty	85
<i>Adil Al Kindi, Dominique Shum-Tim and Ray Chu-Jeng Chiu</i>	
Introduction	85
The Prelude: Insights from Bone Marrow Transplantation	85
Animal Studies	86
The Signaling Molecules	89
Summary and Conclusions	99
References	100
7. A Molecular Imaging Perspective on Cardiac Repair with Stem Cells	105
<i>Kishore Bhakoo</i>	
Introduction	105
Radionuclide Imaging	106
Optical Imaging	106
Ultrasound	107
MRI Imaging	107
Intracellular MRI Contrast Agents	109
MRI Tracking of Stem Cells in the Heart	110
Multimodality	111

Conclusions	112
References	113
8. Marrow Stromal Cells as Universal Donor Cells for Cardiac Regenerative Therapy: Fact or Fancy?	117
<i>Jun Luo, Dominique Shum-Tim and Ray Chu-Jeng Chiu</i>	
Introduction	117
Maternal-Fetal Cell Microchimerism: A Whisper of the Nature?	118
Stem Cell Therapy and Immune Rejection	119
Marrow Stromal Cells for Cellular Cardiomyoplasty: An Experimental Study in Porcine/Rat Xenotransplant Model Without Immunosuppression	120
Mechanisms of MSC Immune Tolerance	130
Conclusions	134
References	134
9. The Preclinical Basis to Find the Right Choice of Stem Cells for Cardiac Transplantation	139
<i>Matthias Siepe</i>	
Introduction	139
Skeletal Myoblasts (SM)	139
Bone Marrow Stem Cells	144
Cord Blood Cells	148
Cardiac Precursor Cells	149
Embryonic Stem Cells	150
Closing Remarks	151
References	151
10. Bone Marrow-Derived Stem Cells for Treatment of Ischaemic Heart Disease: Background and Experience from Clinical Trials	157
<i>Ketil Lunde and Svend Aakhus</i>	
Introduction	157
Cell Populations	160
Selection of Patients	161
Administration of the Cells	162
Clinical Studies	163
Safety	175
Discussion	179

Conclusion	180
References	181
11. Skeletal Myoblast Transplantation for Ischemic Heart Failure	189
<i>Philippe Menasché</i>	
Theoretical and Experimental Basis for the Use of Skeletal Myoblasts	189
Update on Clinical Studies	190
Remaining Issues	194
Economic Issues	197
Methodologic Issues	198
References	199
12. Myocardial Tissue Regeneration Observed in Stem-Cell Seeded Bioengineered Scaffolds	203
<i>Yen Chang, Chun-Hung Chen, Hao-Ji Wei, Wei-Wen Lin, Shiaw-Min Hwang, Huihua Kenny Chiang, Sung-Ching Chen, Po-Hong Lai and Hsing-Wen Sung</i>	
Introduction	203
Materials and Methods	204
Results	207
Discussion	215
References	218
13. Stem Cells and Heart Valves	223
<i>Danielle Gottlieb, Fraser W. H. Sutherland and John E. Mayer Jr.</i>	
Introduction	223
Modes of Failure in Existing Heart Valves	224
Embryologic Development of Native Semilunar Valves	226
Structure and Function of the Native Semilunar Heart Valves	226
Approaches to a Tissue Engineered Heart Valve	228
Differentiated and Stem Cells for Tissue Engineered Heart Valves	228
Scaffolds: Polymers	231
Tissue Formation: Biochemical and Biophysical Pre-Conditioning	233
<i>In Vivo</i> Experiments	235
Heart Valve Tissue Engineering: Present and Future	237
References	238

14. Potential Applications of Combined Stem Cell and Gene Therapy for the Treatment of Infarcted Heart	243
<i>Husnain Khawaja Haider and Muhammad Ashraf</i>	
Introduction	243
Stem Cells for Cellular Cardiomyoplasty	244
Gene Therapy for Myocardial Repair	246
Combining Cellular Cardiomyoplasty with Gene Delivery	249
Cell Based Gene Delivery to Alleviate Cellular Apoptosis	249
Cell Based Gene Delivery for Myogenesis and Electromechanical Integration	251
Cell Based Gene Delivery for Angiogenesis	252
Angiogenesis Using Genetically Engineered Cells	253
Future Directions	255
References	257
15. Optimal Expansion and Differentiation of Cord Blood Stem Cells Using Design of Experiments	265
<i>Mayasari Lim, Hua Ye, Nicki Panoskaltzis and Athanasios Mantalaris</i>	
Introduction	265
Hematopoiesis	266
Design of Experiments	269
Results and Discussion	275
DOE Application in Stem Cell Bioprocessing	278
Conclusion	279
References	280
Index	283