Contents

Part I Introduction and Scientific Principles

1 From Hemoglobin Based Oxygen Carrier to Oxygen Therapeutics, Blood Substitutes, Nanomedicine and Artificial Cells ................................... 3
   Thomas Ming Swi Chang

2 From the Atmosphere to the Mitochondrion: The Oxygen Cascade .................................. 27
   George P. Biro

3 Biochemistry of Hemoglobin .................................................. 55
   Andrea Mozzarelli, Stefano Bruno and Luca Ronda

4 The Role of Blood and Plasma Viscosity in Restoring Oxygen Delivery Capacity .................... 75
   Amy G. Tsai, Judith Martini, Beatriz Y. Salazar Vázquez, Pedro Cabrales, Seetharama A. Acharya and Marcos Intaglietta

Part II Hemorrhagic Shock and Current Treatments

5 Pathophysiology of Hemorrhagic Shock and Resuscitation ......... 97
   Fredric M. Pieracci and Walter L. Biffl

6 Allogeneic Blood Transfusion for Surgical and Traumatic Hemorrhage ................................. 117
   Mercy Kuriyan and Jeffrey L. Carson

7 Pre-Hospital Fluid Resuscitation in Civilian and Military Populations ....................... 127
   Robert M. Van Haren, Chad M. Thorson, Col Lorne H. Blackbourne and Kenneth G. Proctor
Part III  Current Issues of HBOCs and Regulatory Framework

8  NIH/FDA/DOD Interagency Working Group on Oxygen Therapeutics ........................................ 141
   Phyllis Mitchell, Richard Weiskopf, Warren M. Zapol
   and Oxygen Therapeutics Working Group

9  Regulatory Framework for Hemoglobin-Based Oxygen Carrier Trials ................................ 149
   Basil Golding

Part IV  Approaches to HBOCs

10 HBOCs from Chemical Modification of Hb ................................................................. 159
    Ronald Kluger and Francine E. Lui

11 Design of Nonhypertensive Conjugated Hemoglobins as Novel Resuscitation Fluids ...................... 185
    Seetharama A. Acharya, Marcos Intaglietta, Amy G. Tsai and Fantao Meng

12 Cellular-Type Hemoglobin-Based Oxygen Carriers to Mimic the Red Blood Cell Structure .................. 235
    Hiromi Sakai

13 Recombinant Octameric Hemoglobins as Resuscitation Fluids in a Murine Model of Traumatic Brain Injury Plus Hemorrhagic Shock ................................................................. 249
    Xianren Wu, Nancy T. Ho, Tong-Jian Shen, Vincent Vagni, David K. Shellington, Keri Janesko-Feldman, Tsuey Chyi S. Tam, Ming F. Tam, Patrick M. Kochanek, Chien Ho and Virgil Simplaceanu

14 Liposome-Encapsulated Hemoglobin as an Artificial Oxygen Carrier: Technological Features, Manufacturing and Issues for Practical Application .................................................. 273
    Shinichi Kaneda, Takanobu Ishizuka, Hiroshi Goto and Hiroaki Kasukawa

15 Zero-Link Hemoglobin (OxyVita): Impact of Molecular Design Characteristics on Pre-clinical Studies .......... 283
    John P. Harrington and Hanna Wollocko
16 Polynitroxylated Pegylated Hemoglobin (PNPH): A Nanomedicine for Critical Care and Transfusion .............. 299
Li Ma, Frances M. Thompson, Dong Wang and Carleton J. C. Hsia

17 ATP-Adenosine-GSH Crosslinked Hb, An Oxygen Carrier with Pharmacological Properties for Multiple Therapeutic Indications ........................................ 315
Jan Simoni, Grace Simoni and John F. Moeller

18 Albumin-Heme Oxygen Carriers ........................................... 339
Teruyuki Komatsu

19 Recombinant Human Hb-SOD Fusion Proteins ................. 349
Marie Grey, Khuanpiroon Ratanasopa and Leif Bülow

20 In-Vitro Production of Functional RBCs from Hematopoietic Stem Cells ......................................................... 359
Eun Jung Baek and Hyun Ok Kim

Part V Potential Applications of HBOCs

21 Liposome-Encapsulated Hemoglobin: Potential Clinical Applications ....................................................... 369
Akira T. Kawaguchi, Chieko Murayama, Fumiaki Yoshiba, Hiroyuki Furuya, Mariko Yamano and Munetaka Haida

22 Biocompatibility of Hemoglobin Vesicles, a Cellular-Type Artificial Oxygen Carrier, on Blood Cells and Plasma Proteins In Vitro and In Vivo ............................ 385
Hiroshi Azuma, Mitsuhiro Fujihara and Hiromi Sakai

23 Polymerized Human Placenta Hemoglobin: Organ Protective Effects and Alternative Clinical Uses .................. 399
Tao Li, Chengmin Yang, Jin Liu, Jiaxin Liu and Wang Hong

24 Low Volume Resuscitation with HBOCs in Hemorrhagic Shock .............................................................. 411
P. S. Reynolds, R. W. Barbee and K. R. Ward

25 Ischemic Rescue with Hemoglobin-Based Oxygen Carriers ........ 435
Raymond C. Koehler
Part VI  Preclinical Evaluations of HBOCs

26 Pre-clinical Evaluation of Hemoglobin Based Oxygen Carriers: Animal Models and Biomarkers.................. 457
Paul W. Buehler and Felice D’Agnillo

27 The Hemoglobin-Based Oxygen Carrier, HBOC-201, as a Resuscitation Fluid for Traumatic Hemorrhagic Shock: The Naval Medical Research Center Experience .................. 475
Charles Auker, Paula Moon-Massat, Anke Scultetus, Richard McCarron and Daniel Freilich

28 Cellular-Type Hemoglobin-Based Oxygen Carrier as a Resuscitative Fluid for Hemorrhagic Shock: Acute and Long-Term Safety Evaluation Using Beagle Dogs ............ 501
Tatsuhiko Ikeda, Hirohisa Horinouchi, Yoraro Izumi, Hiromi Sakai and Koichi Kobayashi

Part VII  HBOC Clinical Trials

29 Key Adverse Events in Recent HBOC Phase III Clinical Trials and Their Causal Relationship to Test HBOC’s........ 527
Colin F. Mackenzie

30 Some Critical Comments on the Major HBOC Clinical Trials . . . 543
George P. Biro

31 Compassionate Use Cases Treated with Hemoglobin-Based Oxygen Carriers ........................................... 563
Paula Moon-Massat and Daniel Freilich

Part VIII  HBOC-Mediated Adverse Effects

32 Acellular Hemoglobin-Based Oxygen Carrier Mediated Blood Pressure Elevation and Vasoconstriction: A Review of Proposed Mechanisms and Contributing Factors ............... 587
Hae Won Kim

33 HBOCs and Cardiac Integrity .................................................. 621
T. N. Estep
34 Effects of Hemoglobin-Based Oxygen Carriers on Blood Coagulation ................................. 647
Jonathan S. Jahr, Molly Chung, Afsaneh Anvarhosseini and Hae Won Kim

35 Redox Activity of Cell-Free Hemoglobin: Implications for Vascular Oxidative Stress and Endothelial Dysfunction ..... 665
Felice D’Agnillo

36 HBOC Interferences with Routine Clinical Laboratory Tests . . . . 683
Younes Smani

37 Vasoconstriction, Hypertension and Oxidative Toxicity are Regulated by Polymerized Hemoglobin Size ..................... 693
Brian M. Belcik and Andre F. Palmer

38 Acellular Hemoglobin-Based Oxygen Carrier Induced Vasoactivity: A Brief Review of Potential Pharmacologic Remedies .......................................................... 713
Hae Won Kim, Chi-Ming Hai and A. Gerson Greenburg

Part IX A Call for Collaborative Research and Development

39 International Consortium for Development of Hemoglobin-Based Oxygen Carriers, Oxygen Therapeutics and Multifunctional Resuscitation Fluids–A White Paper . . . . . . . . 737
Hae Won Kim, Jonathan S Jahr, Andrea Mozzarelli and Hiromi Sakai
Hemoglobin-Based Oxygen Carriers as Red Cell Substitutes and Oxygen Therapeutics
Kim, H.W.; Greenburg, A.G. (Eds.)
2013, XXIII, 746 p. 130 illus., 77 illus. in color., Hardcover
ISBN: 978-3-642-40716-1