

# Contents

Chapter 10  
Regulation of Activation of B and T Lymphocytes 100  
*John G. Monroe and Leslie B. King*

Chapter 11  
Tolerance and Autoimmunity 115  
*Mark J. Shlomchik*

**PART I**  
**Molecular and Cellular Basis of Hematology** 1  
*Nancy Berliner and Edward J. Benz, Jr.*

Chapter 1  
Anatomy and Physiology of the Gene 2  
*Nancy Berliner and Edward J. Benz, Jr.*

Chapter 2  
Protein Synthesis and Intracellular Sorting 19  
*David L. Wiest and Michael O. Carleton*

Chapter 3  
Protein Architecture: Relationship of Form and Function 33  
*Barbara C. Furie*

Chapter 4  
Plasma Membrane Dynamics and Organization 40  
*Narla Mohandas and Jon S. Morrow*

Chapter 5  
Cell Adhesion 49  
*Rodger P. McEver*

Chapter 6  
Control of Cell Growth and Differentiation 57  
*William M.F. Lee and Chi V. Dang*

**PART II**  
**Immunologic Basis of Hematology** 73

Chapter 7  
Overview of the Immune System (Including Compartmentalization of the Immune Response) 74  
*Ellen Puré*

Chapter 8  
B-Cell Development 80  
*Kenneth Dorshkind*

Chapter 9  
T-Cell Immunity 90  
*Carol Clayberger and Alan M. Krensky*

Chapter 10  
Regulation of Activation of B and T Lymphocytes 100  
*John G. Monroe and Leslie B. King*

Chapter 11  
Tolerance and Autoimmunity 115  
*Mark J. Shlomchik*

Chapter 12  
Stem Cell Model of Hematopoiesis 126  
*David A. Williams*

**PART III**  
**Biology of Stem Cells and Disorders of Hematopoiesis** 125  
*David A. Williams*

Chapter 13  
Anatomy and Physiology of Hematopoiesis 139  
*Catherine M. Verfaillie*

Chapter 14  
Growth Factors, Cytokines, and the Control of Hematopoiesis 154  
*Grover C. Bagby, Jr. and Michael C. Heinrich*

Chapter 15  
Biology of Erythropoiesis, Erythroid Differentiation, and Maturation 202  
*Thalia Papayannopoulou, Janis Abkowitz, and Alan D'Andrea*

Chapter 16  
Granulopoiesis and Monocytopoiesis 220  
*Camille N. Abboud and Jane L. Liesveld*

Chapter 17  
Thrombocytopoiesis 245  
*Michael W. Long and Ronald Hoffman*

Chapter 18  
Inherited Forms of Bone Marrow Failure 260  
*Melvin H. Freedman*

Chapter 19  
Aplastic Anemia 297  
*Neal S. Young and Jaroslaw P. Maciejewski*

Chapter 20  
Paroxysmal Nocturnal Hemoglobinuria 331  
*Wendell F. Rosse*

Chapter 21  
Pure Red Cell Aplasia 342  
*Emmanuel N. Dessimis*

**PART IV**  
**Red Blood Cells**

355

## Chapter 22

**Pathobiology of the Human Erythrocyte and Its Hemoglobins** 356*Martin H. Steinberg and Edward J. Benz, Jr.*

## Chapter 23

**Approach to the Adult and Child with Anemia** 367*Sandra F. Schmalt, Nancy Berliner, Thomas P. Duffy, and Edward J. Benz, Jr.*

## Chapter 24

**Anemia of Chronic Diseases** 383*Lawrence B. Gardner and Edward J. Benz, Jr.*

## Chapter 25

**Erythrocytosis** 388*Jerry L. Spivak*

## Chapter 26

**Disorders of Iron Metabolism: Iron Deficiency and Overload** 397*Gary M. Brittenham*

## Chapter 27

**Heme Biosynthesis and Its Disorders: Porphyrias and Sideroblastic Anemias** 428*James S. Wiley and Michael R. Moore*

## Chapter 28

**Megaloblastic Anemias** 446*Aśok C. Antony*

## Chapter 29

**Thalassemia Syndromes** 485*Bernard G. Forget*

## Chapter 30

**Sickle Cell Disease** 510*Stephen H. Embury and Elliott P. Vichinsky*

## Chapter 31

**Hemoglobin Variants Associated with Hemolytic Anemia, Altered Oxygen Affinity, and Methemoglobinemias** 554*Edward J. Benz, Jr.*

## Chapter 32

**Red Cell Enzymopathies** 561*Josef T. Prchal and Xylina T. Gregg*

## Chapter 33

**Red Cell Membrane Disorders** 576*Patrick G. Gallagher and Petr Jarolim*

## Chapter 34

**Autoimmune Hemolytic Anemias** 611*Robert S. Schwartz, Eugene M. Berkman, and Leslie E. Silberstein*

## Chapter 35

**Extrinsic Nonimmune Hemolytic Anemias** 630*Stanley L. Schrier***PART V****Host Defense and Its Disorders**

639

## Chapter 36

**Immunoglobulins: Polyclonal and Monoclonal Antibodies** 640*Jack Ballantyne, Robert Mandle, and David H. Bing*

## Chapter 37

**Complement Biology** 651*Peter J. Sims and Therese Wiedmer*

## Chapter 38

**Normal Neutrophil Structure and Function** 667*Robert L. Baehner*

## Chapter 39

**Monocyte and Macrophage Development and Function** 686*Douglas V. Faller and Steven J. Mentzer*

## Chapter 40

**Eosinophilia, Eosinophil-Associated Diseases, and the Hypereosinophilic Syndrome** 702*Steven J. Ackerman and Joseph H. Butterfield*

## Chapter 41

**Disorders of Phagocyte Function and Number** 720*John T. Curnutte and Thomas D. Coates*

## Chapter 42

**Disorders of Lymphocyte Function** 762*Richard A. Insel and Emmanuel A. Quaidoo*

## Chapter 43

**Histiocytic Disorders** 783*Jeffrey M. Lipton*

## Chapter 44

**Lysosomal Storage Diseases: Perspective and Principles** 796*Gregory A. Grabowski and Nancy Leslie*

## Chapter 45

**Infectious Mononucleosis and Other Epstein-Barr Virus-Associated Diseases** 812*John L. Sullivan*

## Chapter 46

**The Spleen and Its Disorders** 821*Susan B. Shurin*

## Chapter 47

**Basophils, Mast Cells, and Systemic Mastocytosis** 830*Robert I. Parker and Dean D. Metcalfe***PART VI****Hematologic Malignancies**

847

## Chapter 48

**Cytogenetics and Neoplasia** 848*Michelle M. Le Beau and Richard A. Larson*

<b>Chapter 49</b> <b>The Molecular Basis of Neoplasia</b> 870 <i>Naomi Rosenberg and Theodore G. Krontiris</i>	<b>Chapter 63</b> <b>Agnogenic Myeloid Metaplasia</b> 1172 <i>Ronald Hoffman</i>
<b>Chapter 50</b> <b>Pharmacology and Molecular Mechanism of Action or Resistance of Antineoplastic Agents: Current Status and Future Potential</b> 885 <i>Kapil N. Bhalla, Stanton L. Gerson, Steven Grant, and Daniel M. Sullivan</i>	<b>Chapter 64</b> <b>Primary Thrombocythemia</b> 1188 <i>Ronald Hoffman</i>
<b>Chapter 51</b> <b>Clinical Application of Cytokines and Biologic Response Modifiers</b> 939 <i>Michael S. Gordon and Jeffrey A. Sosman</i>	<b>Chapter 65</b> <b>Myelodysplastic Syndromes and Myeloproliferative Syndromes in Children</b> 1205 <i>Cindy L. Schwartz</i>
<b>Chapter 52</b> <b>Pathobiology of Acute Myeloid Leukemia</b> 979 <i>Wendy Stock and Michael J. Thirman</i>	<b>Chapter 66</b> <b>Pathobiology of Non-Hodgkin Lymphomas</b> 1213 <i>Gianluca Gaidano and Riccardo Dalla-Favera</i>
<b>Chapter 53</b> <b>Clinical Manifestations of Acute Myeloid Leukemia</b> 999 <i>Kenneth B. Miller and Philip R. Daoust</i>	<b>Chapter 67</b> <b>Pathology and Histogenesis of Hodgkin Disease</b> 1229 <i>Marshall E. Kadin</i>
<b>Chapter 54</b> <b>Therapy for Acute Myeloid Leukemia</b> 1025 <i>Elihu H. Estey, Hagop Kantarjian, and Michael J. Keating</i>	<b>Chapter 68</b> <b>Hodgkin Disease: Clinical Manifestations, Staging, and Therapy</b> 1241 <i>Carol S. Portlock and John Glick</i>
<b>Chapter 55</b> <b>Acute Myeloid Leukemia in Children</b> 1042 <i>Howard J. Weinstein</i>	<b>Chapter 69</b> <b>The Pathologic Basis for the Classification of Non-Hodgkin Lymphomas</b> 1263 <i>William C. Pugh and J. Adelia McBride</i>
<b>Chapter 56</b> <b>Pathobiology of Acute Lymphoblastic Leukemia</b> 1052 <i>Jeffrey E. Rubnitz and A. Thomas Look</i>	<b>Chapter 70</b> <b>Clinical Manifestations, Staging, and Treatment of Non-Hodgkin Lymphoma</b> 1293 <i>Koen van Besien and Fernando Cabanillas</i>
<b>Chapter 57</b> <b>Clinical Manifestations of Acute Lymphoblastic Leukemia</b> 1070 <i>Stacey L. Berg, C. Philip Steuber, and David G. Poplack</i>	<b>Chapter 71</b> <b>Malignant Lymphomas in Childhood</b> 1339 <i>John T. Sandlund, Jr.</i>
<b>Chapter 58</b> <b>Treatment of Childhood Acute Lymphoblastic Leukemia</b> 1078 <i>Lewis B. Silverman, Stephen E. Sallan, and Harvey J. Cohen</i>	<b>Chapter 72</b> <b>Chronic Lymphocytic Leukemia</b> 1350 <i>Kanti R. Rai and Dilip V. Patel</i>
<b>Chapter 59</b> <b>Acute Lymphocytic Leukemia in Adults</b> 1089 <i>Dieter Hoelzer</i>	<b>Chapter 73</b> <b>Hairy Cell Leukemia</b> 1363 <i>Martin S. Tallman, David Hakiman, and LoAnn C. Peterson</i>
<b>Chapter 60</b> <b>Myelodysplastic Syndrome</b> 1106 <i>Peter L. Greenberg</i>	<b>Chapter 74</b> <b>Cutaneous T-Cell Lymphomas</b> 1372 <i>Timothy M. Kuzel, Joan Guitart, and Steven T. Rosen</i>
<b>Chapter 61</b> <b>Polycythemia Vera</b> 1130 <i>Ronald Hoffman</i>	<b>Chapter 75</b> <b>AIDS-Related Lymphomas</b> 1388 <i>David T. Scadden</i>
<b>Chapter 62</b> <b>Chronic Myelogenous Leukemia</b> 1155 <i>Helen Enright and Philip McGlave</i>	<b>Chapter 76</b> <b>Multiple Myeloma and Other Plasma Cell Disorders</b> 1398 <i>Guido Tricot</i>

<b>Chapter 77</b>	<b>Amyloidosis</b>	<b>1416</b>	<b>Chapter 89</b>	<b>Unrelated Donor Stem Cell Transplantation</b>	<b>1609</b>
<i>Madhav V. Dhodapkar, Vittorio Bellotti, and Gaimpaolo Merlini</i>			<i>Nancy A. Kieran and Dennis L. Confer</i>		
<b>Chapter 78</b>	<b>Atypical Immune Lymphoproliferations</b>	<b>1432</b>	<b>Chapter 90</b>	<b>Placental and Umbilical Cord Blood Transplantation</b>	<b>1616</b>
<i>Timothy C. Greiner and Thomas G. Gross</i>			<i>John E. Wagner and Joanne Kurtzberg</i>		
<b>Chapter 79</b>	<b>Clinical Approaches to Infections in the Compromised Host</b>	<b>1443</b>	<b>Chapter 91</b>	<b>Preparative Regimens for Stem Cell Transplantation</b>	<b>1628</b>
<i>Alison G. Freifeld, Thomas J. Walsh, and Philip A. Pizzo</i>			<i>Edward A. Copelan and Sam L. Penza</i>		
<b>Chapter 80</b>	<b>Nutritional Support of Patients with Hematologic Malignancies</b>	<b>1501</b>	<b>Chapter 92</b>	<b>Practical Aspects of Stem Cell Collection</b>	<b>1642</b>
<i>Saundra N. Aker and Polly Lenssen</i>			<i>Scott D. Rowley</i>		
<b>Chapter 81</b>	<b>Psychosocial Aspects of Hematologic Disorders</b>	<b>1514</b>	<b>Chapter 93</b>	<b>Graft-versus-Host Disease and Graft-versus-Leukemia Effect</b>	<b>1658</b>
<i>Jeanne V. Pasacreta and Ruth McCorkle</i>			<i>James L.M. Ferrara</i>		
<b>Chapter 82</b>	<b>Pain Management and Antiemetic Therapy in Hematologic Disorders</b>	<b>1522</b>	<b>Chapter 94</b>	<b>Graft Engineering to Enhance Engraftment, Reduce Graft-versus-Host Disease, and Provide a Graft-versus-Tumor Effect</b>	<b>1672</b>
<i>Janet L. Abraham</i>			<i>Adrian P. Gee</i>		
<b>Chapter 83</b>	<b>Indwelling Access Devices</b>	<b>1534</b>	<b>Chapter 95</b>	<b>Gene Therapy for Hematologic Disorders</b>	<b>1695</b>
<i>Janet L. Abraham and Jane Bradley Alavi</i>			<i>Johnson M. Liu, Christopher E. Walsh, and Arthur W. Nienhuis</i>		
<b>PART VII</b>					
<b>Transplantation</b>					
<b>1549</b>					
<b>Chapter 84</b>	<b>Overview of Stem Cell Transplantation</b>	<b>1550</b>	<b>Chapter 96</b>	<b>Experimental Cell Therapy</b>	<b>1704</b>
<i>Philip McGlave</i>			<i>Robert S. Negrin</i>		
<b>Chapter 85</b>	<b>Hematopoietic Stem Cell Transplantation for Nonmalignant Diseases</b>	<b>1553</b>	<b>Chapter 97</b>	<b>Complications After Stem Cell Transplantation</b>	<b>1715</b>
<i>H. Joachim Deeg</i>			<i>Daniel J. Weisdorf</i>		
<b>Chapter 86</b>	<b>Results of Allogeneic Stem Cell Transplantation for Malignant Disorders</b>	<b>1573</b>	<b>Chapter 98</b>	<b>Megakaryocyte and Platelet Structure</b>	<b>1730</b>
<i>Mary M. Horowitz</i>			<i>Dorothea Zucker-Franklin</i>		
<b>Chapter 87</b>	<b>Results of Autologous Stem Cell Transplantation for Hematologic Malignancies</b>	<b>1587</b>	<b>Chapter 99</b>	<b>The Molecular Basis for Platelet Function</b>	<b>1741</b>
<i>Auayporn P. Nademanee, Anthony S. Stein, and Stephen J. Forman</i>			<i>Edward F. Plow and Mark H. Ginsberg</i>		
<b>Chapter 88</b>	<b>Clinical Results of Autologous Stem Cell Transplantation for Solid Tumors in Adults</b>	<b>1597</b>	<b>Chapter 100</b>	<b>The Molecular Basis for Platelet Activation</b>	<b>1753</b>
<i>Yago Nieto and Elizabeth J. Shpall</i>			<i>Lawrence F. Brass</i>		
<b>Chapter 89</b>	<b>Unrelated Donor Stem Cell Transplantation</b>	<b>1609</b>	<b>Chapter 101</b>	<b>The Blood Vessel Wall</b>	<b>1770</b>
			<i>Aly Karsan and John M. Harlan</i>		

<b>Chapter 102</b>	<b>Molecular Basis of Blood Coagulation</b>	<b>1783</b>
<i>Bruce Furie and Barbara C. Furie</i>		
<b>Chapter 103</b>	<b>Molecular and Cellular Basis of Fibrinolysis</b>	<b>1804</b>
<i>H. Roger Lijnen and Désiré Collen</i>		
<b>Chapter 104</b>	<b>Regulatory Mechanisms in Hemostasis: Natural Anticoagulants</b>	<b>1814</b>
<i>Charles T. Esmon</i>		
<b>Chapter 105</b>	<b>Clinical Evaluation of Hemorrhagic Disorders: The Bleeding History and Differential Diagnosis of Purpura</b>	<b>1824</b>
<i>Barry S. Coller and Paul I. Schneiderman</i>		
<b>Chapter 106</b>	<b>Laboratory Evaluation of Hemostatic Disorders</b>	<b>1841</b>
<i>Samuel A. Santoro and Charles S. Eby</i>		
<b>Chapter 107</b>	<b>Structure, Biology, and Genetics of Factor VIII</b>	<b>1850</b>
<i>Randal J. Kaufman and Stylianos E. Antonarakis</i>		
<b>Chapter 108</b>	<b>Biochemistry of Factor IX and Molecular Biology of Hemophilia B</b>	<b>1869</b>
<i>Robert Flaumenhaft and Bruce Furie</i>		
<b>Chapter 109</b>	<b>Clinical Aspects and Therapy of Hemophilia</b>	<b>1883</b>
<i>Jay Nelson Lozier and Craig M. Kessler</i>		
<b>Chapter 110</b>	<b>Inhibitors in Hemophilia</b>	<b>1904</b>
<i>Donald I. Feinstein</i>		
<b>Chapter 111</b>	<b>Other Clotting Factor Deficiencies</b>	<b>1912</b>
<i>Harold R. Roberts and Maureane Hoffman</i>		
<b>Chapter 112</b>	<b>Quantitative and Qualitative Disorders of Fibrinogen</b>	<b>1924</b>
<i>José Martinez</i>		
<b>Chapter 113</b>	<b>Structure, Biology, and Genetics of von Willebrand Factor</b>	<b>1937</b>
<i>David Ginsburg and Denisa D. Wagner</i>		
<b>Chapter 114</b>	<b>Clinical Aspects of and Therapy for von Willebrand Disease</b>	<b>1946</b>
<i>Gilbert C. White II and Robert R. Montgomery</i>		
<b>Chapter 115</b>	<b>Vitamin K: Metabolism and Disorders</b>	<b>1958</b>
<i>Barbara C. Furie and Bruce Furie</i>		
<b>Chapter 116</b>	<b>Inhibitors of Blood Coagulation</b>	<b>1963</b>
<i>Donald I. Feinstein</i>		
<b>Chapter 117</b>	<b>Disseminated Intravascular Coagulation</b>	<b>1983</b>
<i>David C. Calverley and Howard A. Liebman</i>		
<b>Chapter 118</b>	<b>Hemostatic Defects Associated with Dysproteinemias</b>	<b>1996</b>
<i>Howard A. Liebman</i>		
<b>Chapter 119</b>	<b>Disorders of Coagulation and Platelets in the Neonate</b>	<b>2000</b>
<i>Marilyn J. Manco-Johnson</i>		
<b>Chapter 120</b>	<b>Hypercoagulable States</b>	<b>2009</b>
<i>Kenneth A. Bauer</i>		
<b>Chapter 121</b>	<b>Oral Anticoagulant Therapy</b>	<b>2040</b>
<i>Bruce Furie</i>		
<b>Chapter 122</b>	<b>Heparin</b>	<b>2046</b>
<i>Mark A. Crowther, Jeffrey S. Ginsberg, Douglas M. Tolleson, and Morey A. Binder</i>		
<b>Chapter 123</b>	<b>Thrombolytic Therapy</b>	<b>2056</b>
<i>Victor J. Marder</i>		
<b>Chapter 124</b>	<b>Venous Thromboembolism</b>	<b>2074</b>
<i>Jack Hirsh and Mark A. Crowther</i>		
<b>Chapter 125</b>	<b>Arterial Thromboembolism</b>	<b>2089</b>
<i>Jack Hirsh and Mark A. Crowther</i>		
<b>Chapter 126</b>	<b>Immune Thrombocytopenic Purpura, Neonatal Alloimmune Thrombocytopenia, and Posttransfusion Purpura</b>	<b>2096</b>
<i>James Bussel and Douglas Cines</i>		
<b>Chapter 127</b>	<b>Thrombocytopenia Due to Decreased Platelet Production</b>	<b>2115</b>
<i>Samuel A. Burstein</i>		
<b>Chapter 128</b>	<b>Thrombotic Thrombocytopenic Purpura and the Hemolytic Uremic Syndrome</b>	<b>2126</b>
<i>Keith R. McCrae and Douglas Cines</i>		
<b>Chapter 129</b>	<b>Thrombocytopenia Due to Platelet Destruction and Hypersplenism</b>	<b>2138</b>
<i>Theodore E. Warkentin and John G. Kelton</i>		

<b>Chapter 130</b>	<b>Hereditary Disorders of Platelet Function</b>	<b>2154</b>	<b>Chapter 142</b>	<b>Transfusion Reactions</b>	<b>2300</b>
<i>Joel S. Bennett</i>			<i>Edward L. Snyder</i>		
<b>Chapter 131</b>	<b>Acquired Disorders of Platelet Function</b>	<b>2172</b>	<b>Chapter 143</b>	<b>Transfusion-Transmitted Diseases</b>	<b>2310</b>
<i>James N. George and Sanford J. Shattil</i>			<i>Jay E. Menitove</i>		
<b>PART IX</b>			<b>Transfusion Medicine</b>		
<b>2187</b>					
<b>Chapter 132</b>	<b>Human Blood Group Antigens and Antibodies</b>	<b>2188</b>	<b>Chapter 144</b>	<b>Autologous Blood Transfusion</b>	<b>2320</b>
<i>Patrice F. Spitalnik and Steven L. Spitalnik</i>			<i>Margot S. Kruskall</i>		
<b>Part 1: Carbohydrate Determinants</b>	<b>2188</b>				
<b>Part 2: Protein Determinants</b>	<b>2196</b>				
<i>Marilyn J. Telen</i>					
<b>Chapter 133</b>	<b>Human Platelet Antigens</b>	<b>2206</b>	<b>Chapter 145</b>	<b>Transfusion Medicine in Hematopoietic Stem Cell</b>	<b>2326</b>
<i>Thomas J. Kunicki</i>			<i>Richard J. Benjamin, Walter H. Dzik, H.S.P. Garritsen, and Kenneth C. Anderson</i>		
<b>Chapter 134</b>	<b>HLA and Neutrophil Antigen and Antibody Systems</b>	<b>2220</b>	<b>Chapter 146</b>	<b>Red Cell Substitutes</b>	<b>2343</b>
<i>Glenn E. Rodey and Parviz Lalezari</i>			<i>Robert M. Winslow</i>		
<b>Chapter 135</b>	<b>Principles of Red Blood Cell Transfusion</b>	<b>2241</b>	<b>Chapter 147</b>	<b>Hematologic Complications of Liver Disease and Alcoholism</b>	<b>2350</b>
<i>Paul M. Ness and Kate Rothko</i>			<i>Ralph Zalusky and Bruce Furie</i>		
<b>Chapter 136</b>	<b>Principles of Platelet Transfusion Therapy</b>	<b>2248</b>	<b>Chapter 148</b>	<b>Hematologic Complications of Renal Disease</b>	<b>2357</b>
<i>Thomas S. Kickler</i>			<i>Nicholas Dainiak</i>		
<b>Chapter 137</b>	<b>Principles of Neutrophil (Granulocyte) Transfusions</b>	<b>2257</b>	<b>Chapter 149</b>	<b>Hematologic Aspects of Pregnancy</b>	<b>2374</b>
<i>Ronald G. Strauss</i>			<i>Thomas P. Duffy</i>		
<b>Chapter 138</b>	<b>Transfusion of Plasma Derivatives: Fresh-Frozen Plasma, Cryoprecipitate, Albumin, and Immunoglobulins</b>	<b>2263</b>	<b>Chapter 150</b>	<b>Hematologic Problems in the Surgical Patient: Bleeding and Thrombosis</b>	<b>2381</b>
<i>Silvana Z. Bucur, Eugene M. Berkman, and Christopher D. Hillyer</i>			<i>Charles W. Francis and Karen L. Kaplan</i>		
<b>Chapter 139</b>	<b>Preparation of Plasma-Derived and Recombinant Human Plasma Proteins</b>	<b>2273</b>	<b>Chapter 151</b>	<b>Hematologic Manifestations of Childhood Illness</b>	<b>2391</b>
<i>William N. Drohan and David B. Clark</i>			<i>A. Kim Ritchey and Frank G. Keller</i>		
<b>Chapter 140</b>	<b>Transfusion Principles for Congenital Coagulation Disorders</b>	<b>2282</b>	<b>Chapter 152</b>	<b>Hematologic Problems in Patients with Cancer and Chronic Inflammatory Disorders</b>	<b>2410</b>
<i>Joan Cox Gill</i>			<i>Irwin M. Weinstein and Barry E. Rosenbloom</i>		
<b>Chapter 141</b>	<b>Hemapheresis and Cellular Therapy</b>	<b>2291</b>	<b>Chapter 153</b>	<b>Hematologic Manifestations of Infectious Disease</b>	<b>2420</b>
<i>Ellen F. Lazarus and Harvey G. Klein</i>			<i>David S. Rosenthal</i>		
<b>Chapter 142</b>	<b>Transfusion Reactions</b>	<b>2300</b>	<b>Chapter 154</b>	<b>Hematologic Manifestations of HIV Infection</b>	<b>2430</b>
<i>Edward L. Snyder</i>			<i>James A. Hoxie</i>		

## PART XI

---

### Special Tests and Procedures

2459

## Chapter 155

**Bone Marrow Aspiration and Morphology** 2460*Daniel H. Ryan and Harvey J. Cohen*

## Chapter 156

**Automated Analysis of Blood Cells** 2469*Daniel H. Ryan*

## Chapter 157

**Laboratory Detection of Hemoglobinopathies and Thalassemias** 2481*Martin H. Steinberg and Junius G. Adams III*

## Chapter 158

**Antenatal Diagnosis of Hematologic Disorders** 2490*Kim Kramer and Harvey J. Cohen*

## Chapter 159

**Electrophoretic and Immunochemical Analysis of Human Immunoglobulins** 2503*John P. Leddy*

## Chapter 160

**Use of Molecular Techniques in the Analysis of Hematologic Diseases** 2511*Nancy Berliner*

## Appendix

**Normal Blood Values: Selected Reference Values for Neonatal, Pediatric, and Adult Populations** 2520*Sharon M. Geaghan*

## Index 2529