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Rossi’s Principles of Transfusion Medicine

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FOURTH EDITION
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More than 6 years have elapsed since the third edition of Rossi’s *Principles of Transfusion Medicine* was published. During that time, the field has continued to be dynamic and many advances have been made. Molecular techniques are increasingly utilized; measurements of cell kinetics have been further refined; new treatments for bleeding disorders have been developed; progenitor cell transplantation protocols have matured; hemovigilance efforts have become more organized globally; pathogen inactivation and apheresis techniques have advanced; new treatments have emerged for iron overload; gene therapy and regenerative medicine are having an impact on the field; and regulation has become more complex in a global environment.

As expected, some controversies remain unresolved. For example, the effect of red cell age on clinical outcome and whether transfusion itself affects patient recovery are at the center of recent articles that commanded attention from both professionals and the public. At the same time, pharmacologic agents intended to reduce the need for transfusion have also become subjects of controversy. Whether recombinant human erythropoietin has deleterious effects on patients, the potential for cell-free hemoglobin solutions to cause more harm than good, and the balance between efficacy and toxicity of recombinant Factor VIIa are being discussed at the national level of health-care decision-making.

This edition provides updated comprehensive assessments of the subjects that remain important to the daily work of those who practice transfusion medicine today. The contents include information on controversies that are still percolating, as well as those new developments that have been widely adopted in practice. This volume also features those scientific areas that represent the frontiers of transfusion medicine such as cellular and gene therapy and regenerative medicine.

Section I reviews the preparation and use of components and derivatives of blood used in clinical practice. Section II provides information and approaches to the major clinical issues related to transfusion in medical, obstetric, pediatric, oncology, and surgery patients, including transplant recipients. Section III focuses attention on both donor and patient apheresis. Section IV introduces the major concerns related to hazards of transfusion and covers the infectious and noninfectious risks in separate chapters. Section V covers the broad issues related to cells and tissue therapy in our field. Section VI contains an overview of the logistic and regulatory aspects of the profession.

The fourth edition is an example of both continuity and change. We have retained the general organizational plan of the prior edition. The comprehensive scope has been retained with emphasis on the scientific and clinical over the technical. Our objective is to create the best single reference for the professional who is managing transfusion issues both at the bedside and at the interface of the laboratory and the clinic. Yet at the same time, the volume is intended to provide a helpful resource for trainees.

New chapters that have either combined material from several chapters in prior editions or ventured into new areas include cell kinetics, obstetric practice, cord blood, transfusion alternatives, regenerative medicine, hemovigilance, iron overload, and transplant organization and regulation. Once again, case studies have been included to enhance the educational aspects, but with this edition they are in an electronic format. In addition to the CD-ROM containing the case studies a second CD-ROM contains the 66 book chapters as searchable PDF files.

Four of the editors from the last edition have returned along with many of the expert chapter authors. This edition also welcomes new chapter contributors with fresh approaches and two new editors—Bjarte G. Solheim, who has led the effort to include more international perspectives, and Marian Petrides, who developed the software for, and managed the transition to, the interactive case study format. Joining the team effort for this edition are publishing staff at AABB Press and Wiley-Blackwell.

In a work of this magnitude, there are many to whom we owe words of appreciation. Clearly, thanks are due to the authors for their superb chapters, AABB Press staff for their expertise and assistance, and personnel at Wiley-Blackwell for their professional and collegial efforts on behalf of the book.
important, the editors thank our families, colleagues, employers, teachers, and students for the support that sustained us throughout the development process.

All of us have chosen to work in this field because of our commitment to improving and saving the lives of those in our communities who can benefit from transfusion therapies. Some have used the analogy of those who work backstage in a theatrical production; the actors take the bows but the play can go on only with the contributions of the unseen workers behind the curtains. When the surgeons, oncologists, pediatricians, obstetricians, intensive care specialists, other physicians, and nurses are successful in treating the patients, those of us in transfusion medicine and related therapies can take satisfaction in the work we do. Our hope is that this book will help support those who can make a difference in transfusion medicine and serve as an example of the teamwork so urgently needed to move all of health care forward for the benefit of the global community.

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Prehistoric man left drawings of himself pierced by arrows. This means he was as aware of blood as he was of his own limbs. The flint implements he used as tools and weapons distinguished him from other creatures and contributed to the violence of his era. As he hunted food and fought enemies, he observed bleeding and the properties of blood. If the cut was shallow, there was little blood. But if the cut was deep, a red torrent flowing from the stricken victim quickly led to death, with shed blood congealed and darkening in the sun. Fatal hemorrhage was commonplace. Nonetheless, the sight must have been fearful and possibly existential as life flowed red out of the body of an enemy or a wounded animal. It is no wonder, then, that at the dawn of recorded history, blood was already celebrated in religious rites and rituals as a life-giving force.

The cultural expressions of primitive and ancient societies, though separated by time or space, can be strikingly similar. Whether these expressions emerged independently or were diffused about the world by unknown voyagers will probably always remain clouded in mystery. Nonetheless, there is a common thread in the ancient rituals that celebrate blood as a mystical vital principle. In Leviticus 17:11, “the life of the flesh is in the blood,” and the Chinese Neiching (circa 1000 BC) claims the blood contains the soul. Pre-Columbian North American Indians bled their bodies “of its greatest power” as self-punishment. Egyptians took blood baths as a recuperative measure, and Romans drank the blood of fallen gladiators in an effort to cure epilepsy. The Romans also practiced a ceremony called taurobolium—a blood bath for spiritual restoration. A citizen seeking spiritual rebirth descended into a pit or fossa sanguinis. Above him on a platform, a priest sacrificed a bull, and the animal’s blood cascaded down in a shower upon the beneficiary. Then, in a powerful visual image, the subject emerged up from the other end of the pit, covered with blood and reborn.

The legend of Medea and Aeson taken from Ovid’s Metamorphoses and quoted in Bulfinch’s Mythology also ascribed rejuvenating powers to blood. Jason asked Medea to “take some years off his life and add them to those of his father Aeson.” Medea, however, pursued an alternative course. She prepared a cauldron with the blood of a sacrificed black sheep. To this, she added magic herbs, hoarfrost gathered by moonlight, the entrails of a wolf, and many other things “without a name.” The boiling cauldron was stirred with a withered olive branch, which became green and full of leaves and young olives when it was withdrawn. Seeing that all was ready, Medea cut the throat of the old man and let out all his blood, and poured into his mouth and into his wound the juices of her cauldron. As soon as he had imbibed them, his hair and beard laid by their whiteness and assumed the blackness of youth; his paleness and emaciation were gone; his veins were full of blood, his limbs of vigour and robustness. Aeson is amazed at himself and remembers that such as he now is, he was in his youthful days, 40 years before. This legend seems to echo in the apocryphal story of Pope Innocent VIII, who is said to have received the blood of three young boys in 1492 while on his deathbed. As the story goes, a physician attempted to save the pope’s life by using blood drawn from three boys 10 years of age, all of whom died soon thereafter. Some 19th-century versions of this tale suggest the blood was transfused. However, earlier renditions more plausibly suggest that the blood was intended for a potion to be taken by mouth. In any event, there is no evidence the pope actually received any blood in any form.

The folklore that flowed with blood was not accompanied by a great deal of accurate information. The ancient Greeks believed that blood formed in the heart and passed through the veins to the rest of the body, where it was consumed. Arteries were part of an independent system transporting air from the lungs. Although Erasistratos (circa 270 BC) had imagined the heart as a pump, his idea was ahead of its time. As long as veins and arteries were dead-end channels transporting blood and air, there was little need for a pump in the system. Although Galen (131-201 AD) finally proved that arteries contain blood, communication with