Preface

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Guest Editor

Dear Colleagues,

Welcome to this issue of *Clinics in Laboratory Medicine*, an issue devoted to predicting the future of some different aspects of transfusion medicine. The title, ''Transfusion in the Year 2020: The Future of Blood Transfusion,'' was chosen not just as a play on the optical term for ''perfect vision,'' but because I believe that in the next 10 years significant new advances in technology might change the way transfusion medicine and blood banking are practiced and thought about. Much like other medical specialties, transfusion medicine is a science and an art. The science of blood groups, alloimmunization, transmissible disease testing, and component preparation helps produce blood products that, in many ways, are as safe as they have ever been. The art of transfusion medicine really comes down to knowing when to use these blood products—a platelet count of 15,000/mL might for one patient be perfectly acceptable and not require a transfusion whereas for another patient the same platelet count would justifiably trigger a lifesaving platelet transfusion. Just like the mutual fund ads on TV that remind us to consider the risks and benefits of investing in the stock market, patient-centered transfusion strategies are all about mitigating risk while maximizing the benefits for recipients (and hopefully with greater regularity than Wall Street!). This notion of risk reduction is a recurrent theme in the articles that follow, which can be approximately divided into 2 categories: innovative technologies and innovative paradigms.

One way to avoid certain risks of transfusion, especially that of human-to-human transmissible diseases, is to start with blood products that are less likely to harbor these pathogens in the first place. The first in the set of articles dealing with innovative technologies showcases some of the attempts to derive transfusable blood products from unconventional starting materials. David Cooper, Hidetaka Hara, and I provide a fascinating history of xenotransfusion—transfusing blood from different species of animals—and describe some of our recent in vitro attempts to modify swine red blood cells (RBCs) for human transfusion. Then, Abdu Alayash describes some of the setbacks that have been encountered in trying to produce what are commonly known as blood substitutes and highlights some of the obstacles that need to be overcome in

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the production of a clinically suitable oxygen carrier. Next, Luc Douay and Stewart Abbot provide leading-edge insights into the ability to expand stem cells into mature RBCs; think of it, a nearly inexhaustible source of stem cells is discarded with every placenta. These noncontroversial stem cells could be collected from women who have been repeatedly tested and shown to be free of various transmissible diseases; then, using a bioreactor, they would be expanded and matured into functional RBCs suitable for transfusion. The potential for these RBCs is limitless—they could supplement a local hospital's RBC inventory during the traditional lulls in donations around the holidays and in the summer and be lifesaving on the battlefield.

In certain situations, such as patients who receive chronic transfusion therapy or those who have produced an anti-RBC antibody, it is often desirable to provide donor RBC units whose surface phenotype of proteins and carbohydrates are as closely matched as possible to that of the recipient. Although conventional serologic techniques are the current gold standard for antigen typing, there are some significant limitations to their use, such as the lack of availability of Food and Drug Administration (FDA)–approved reagents and the technical difficulty of phenotyping RBCs from recently transfused recipients. To that end, Joann Moulds describes the state of the art in blood group genotyping; this is a particularly relevant topic given the increasing number of testing platforms that are on the market today and the ones that are sure to follow. On the theme of molecular blood group genotyping, Geoff Daniels and colleagues describe a technique that is in widespread use in Europe but has had little penetration in North America. Fetal genotyping from maternal plasma, the ability to derive a fetus' blood group genotype using a sample taken from mother's peripheral vein, for the purpose of quantifying the risk of hemolytic disease of newborns has been shown to be reliable and is not associated with the significant risks that accompany the traditional methods of obtaining fetal DNA. I hope that over the next few years this lifesaving method of deriving fetal DNA becomes more mainstream on the side of the Atlantic where "football" is played with an oblong ball. This section concludes with a thought-provoking article by Monique Gelderman-Fuhrmann and Jaroslav Vostal at the FDA about the regulatory guidelines and certification requirements that these new technologies might encounter as they are brought to market in the United States.

The next section deals with innovative concepts related to the practice of transfusion and is composed of a series of articles that describe current and future ways of dealing with some of the problems faced by transfusion medicine professionals. All of the risks of receiving allogeneic blood (ie, from the blood bank) are avoided if an allogeneic transfusion is not required. Jonathan Waters shares his vision for blood conservation over the next few years and describes ways of reducing the need for allogeneic transfusions by a variety of techniques, including preoperative hemoglobin optimization, intraoperative cell salvage, and the use of point-of-care tests that provide real-time information on hemoglobin and coagulation profiles to guide the ordering of blood products. In vitro, RBCs exist in a milieu with other cells and are always surrounded by a variety of cytokines and other chemical messengers. Up to now it has been unclear why some recipients of cellular blood products become alloimmunized when exposed to foreign RBC antigens whereas most recipients do not produce anti-RBC antibodies. James Zimring and the members of his laboratory are on the vanguard of studying the effects of inflammation on alloimmunization using a unique mouse model and, in his article, he describes the progress that has been made in understanding the modulatory effects of different types of inflammatory mediators on the immune system in mice and humans. Although much has been published about the changes that occur to RBCs during storage (commonly known as the storage lesion), less is known about the changes that platelets undergo during their 5-day shelf

life. Dana Devine and her group detail these changes and speculate on what might be done to extend the shelf life of this blood component that is often in short supply. All blood centers are highly cognizant of the balance between recruiting sufficient numbers of donors yet maintaining the safety of the blood supply. As North Americans travel the world, more and more travel deferrals are being imposed due to the emergence of new and potentially transfusion transmissible diseases. Hannes Hansen-Magnusson looks at the European blood donor situation in light of the significant personal mobility afforded to citizens of the European Union (EU); although EU-wide directives for blood donation exist, the instantiation of these policies varies by country as do rates of various transfusion transmissible diseases. In a related article, Roger Dodd analyzes some of the current and emerging pathogens that threaten the blood supply in North America as the number of potentially transfusion transmissible pathogens increases and alternatives to and avoidance of allogeneic transfusion become more and more attractive.

It is always fun to make predictions—let us come back to this issue in 2020 and see how many came true!

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