Recent Developments in Emergency Blood Transfusion

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The term “Renaissance” was created in the 19th century. It characterized the transition period between the Middle Ages and the Early Modern Age in Europe from the 14th to the early 17th century. In this period the reintroduction of Greco-Roman writings, knowledge, and art led to seminal changes concerning human consciousness, literature, architecture, painting, and science. However, besides this specific meaning of “renaissance,” there is still another more general understanding, in a sense that older, putatively outdated, ideas or practices may reoccur in their field after significant modifications. In this respect it is not the first time that a specific practice in transfusion medicine has experienced a renaissance. Granulocyte transfusion had largely disappeared from clinical use between 1985 and 1995 but was reinvestigated for clinical usefulness after the introduction of granulocyte colony-stimulating factor (G-CSF) for the mobilization of neutrophils in healthy donors [1, 2], and now we witness the renaissance of whole blood transfusion [3]. Similar to G-CSF-stimulated granulocyte concentrates that contained a much higher neutrophil dose than their predecessor products from hydrocortisone-stimulated donors, today’s whole blood products are not comparable to their predecessors that were used in the 1970s. “Modern” whole blood preparations can be leucodepleted [4, 5], thereby avoiding the co-transfusion of unnecessary white blood cells. Leucodepletion provides several well-known advantages: it decreases the potential of inducing antibodies against leucocyte antigens so that the risk of transplant rejection, the risk of transfusion reactions, the risk of CMV infection, and possibly the risk of transfusion-associated immunomodulation are significantly reduced [5, 6]. The hemostatic potential of leucodepleted whole blood may be stronger if the preparations

contain platelets. Cold-preserved platelets retain hemostatic activity despite being stored beyond their natural life span [7]. The risk of inducing a clinically significant hemolytic reaction, if group 0 whole blood is transfused to a non-group 0 patient in an emergency transfusion, is reduced by the selection of donors with low anti-A/anti-B isoagglutinin titers. It has been shown that up to four low titer group 0 whole blood transfusions (LT0WB) can be administered to non-group 0 adult patients without clinical signs of hemolysis [8, 9]. Of note, LT0WB has left the military sphere and is now increasingly used in civilian trauma centers, even in Europe and elsewhere in the world [10–12]. The clinical use of LT0WB in specific vulnerable patient groups such as pediatric trauma resuscitation or females with postpartum hemorrhage is under investigation [11–13].

In this focus issue of *Transfusion Medicine and Hemotherapy* (TMH), we will draw our readers’ attention to recent changes in emergency blood transfusion. The increasing use of whole blood is one “new” practice in this field. In this issue Mark Yazer [14] presents a brief but comprehensive overview on the practice of whole blood transfusion, in particular in the USA. However, perhaps even more important than the reintroduction of whole blood is the development of pre-hospital transfusion. As whole blood may contain red blood cells, plasma (together with preserved clotting factors), and platelets (with considerable hemostatic function after cold storage) combined in one bag, it is obvious that it might become a suitable blood product for pre-hospital blood transfusion. In this special issue of TMH, Dan Levin et al. [15] and Christopher Bjerkvig et al. [16] demonstrate this for Israeli military and civilian casualties as well as for Norwegian civilian patients with severe hemorrhage, respectively. However, the Nor-

wegian group report on whole blood and blood component transfusion (freeze-dried plasma and red blood cell concentrates) depending on the transfusion strategy of different Norwegian helicopter emergency medical services. Recently, pre-hospital blood transfusion has also been established in Germany. Unlike the USA, where LTOWB is increasingly accepted in the pre-hospital transfusion setting [17], German medical rescue centers exclusively use blood components for pre-hospital transfusion. Kathleen Selleng and colleagues [18] from Greifswald, Germany, describe their program, in particular their validation strategy, to implement the repeated use of red blood cell concentrates and liquid (thawed) plasma in a routine helicopter blood component transfusion regimen. An important aspect of severe, life-threatening bleedings is blood volume loss resulting in hemorrhagic shock. In the recent past a resuscitation model based on crystalloid as the main fluid replacement dominated clinical practice in the pre-hospital setting. Improved understanding of the risk of crystalloids and the need for early inclusion of blood products has resulted in newer resuscitation practices including the pre-hospital use of plasma. Kathleen Selleng and Andreas Greinacher [19] report their laboratory as well as clinical long-term experience with the supply of plasma that is stored in

the liquid (thawed) phase at 4°C for the “just in time” availability of plasma for emergencies. Bryon Jackson and colleagues [20] critically review the clinical value of pre-hospital plasma transfusion. Finally, Heiko Lier and Dietmar Fries [21] give an overview on the current standard of care regarding blood product usage in case of massive transfusion needs. They present the current understanding of the usage of crystalloids, blood components, and coagulation factor therapy after the admission of the patients to hospital. We as transfusion medicine specialists are confident that a pre-hospital blood transfusion strategy including whole blood transfusion will be an important part of emergency blood transfusion standards in the (near) future.

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