Acta Biochimica Polonica

Vol. 44 No. 2/1997

365–365

QUARTERLY

Blood substitutes. Winslow, R. M., Vandegriff, K. D., Intaglietta, M., eds., Birkhäuser, Boston, Basel, Berlin 1996. 209 pages.

All vertebrates have hemoglobin contained in erythrocytes where it is exposed to the action of 2,3-bisphosphoglycerate that facilitates oxygen offloading in tissues. Nature takes special care to ensure that accidentally liberated hemoglobin binds to certain plasma proteins and is cleared from circulation. Transfusion scientist, however, disregard these hints of nature and for the past 60 years have been trying to use free hemoglobin as blood substitute. That is what the book is all about. Strictly speaking free hemoglobin is a blood substitute though on the other hand it is a natural product of human origin. This is an important distinction because in contrast to plasma expanders like dextran, hydroxyethylstarch or polivinylpyrrolidine, that may be easily obtained in unlimited quantities, hemoglobin must be isolated from human blood, unless it is a recombined hemoglobin. Thus, natural, human hemoglobin as blood substitute cannot be an answer to the predicted short supply of blood in a near future due to aging of human population in developed countries (about half of all blood transfusions is being performed in patients over 65 who in most countries are not permitted to donate blood). To be honest one should mention that hemoglobin for transfusion is isolated from outdated blood but outdating of stored blood may be easily prevented through better organization of blood banks, especially now when erythrocytes may be conveniently frozen and stored for a long time. Still hemoglobin is attractive as blood substitute because in theory it is both plasma expander and oxygen supplier. Unfortunately free hemoglobin fails on both counts; due to its dissociation in circulation into $\alpha\beta$ dimers the half life of hemoglobin is very short and its function as oxygen supplier debatable because in the absence of 2,3-bisphosphoglycerate its oxygen affinity is too high. Thirty two authors of 12 chapters of the book describe how these undesired properties of hemoglobin may be corrected through chemical modification and genetical engineering. They discuss also other properties of hemoglobin that are relevant to blood transfusion. These are likewise not too optimistic for future usage of hemoglobin as blood substitute. Among others free hemoglobin produces a rise of blood pressure and potentiates toxic effects of bacterial endotoxins. These critical remarks of the reviewer are not meant to discourage prospective readers. On the contrary, in spite of all the above mentioned shortcomings of free hemoglobin as blood substitute, two commercial preparations of hemoglobin, one made of chemically polymerized protein, the other a genetically engineered product made in bacteria, are entering the third phase of clinical trials. The latter product is of course a true blood substitute that can be obtained in unlimited quantity. It should be added that the book makes interesting readings. It will inform specialists and people just interested in blood transfusion alike about state of the art in blood substitutes. An exception is the problem of fluorocarbons that is referred to in the book only briefly.

Jerzy Kościelak