Therapeutic Apheresis

The prospects of apheresis in the 21st century by new adsorption technologies

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Introduction

From the ancient method of bloodletting until the recent possibilities by immunoadsorption, the removal of pathologic substances from blood is one of the oldest therapeutic approaches in medicine.

The list of indications for this procedure has always been abundant and its scientific background remains a matter of discussion.

On December 8, 1914, John Abel performed the first therapeutic apheresis of modern times. Despite impressive technical developments in both centrifugal and membrane plasmapheresis the method remains unspecific and lacks controlled studies.

In the last 15 years more than 1200 reports in scientific journals obviously did not provide enough evidence to persuade the governmental authorities as well as the reimbursement institutions to accept therapeutic apheresis in general as an evidence-based therapeutic approach.

From unspecifity to selectivity

In the 21st century, however, we can predict a breakthrough in clinical application, based upon the development of new adsorber technologies. These new technologies enable us to move from unspecificity to specificity and, recently, to selectivity by developing different ligands for plasma processing.

At present the following ligands with immune binding properties are available:

a) Dextran sulfate
b) Protein A
c) Anti-human IG
d) CI q
e) Hydrophobic amino acid
f) Hexamethylene-di-isocyanate
g) Acetylcholine receptor peptides
h) Other synthetic peptides

Single- as well as double-column systems for single or multiple use have been developed. There is, however, a distinct difference in the availability of these systems in different countries. Europe is certainly ahead in both the development and availability with the USA and especially Japan trailing behind.

After the recent FDA approval of Protein A for treatment in rheumatoid arthritis in the USA and the extensive use of Protein A in Europe also for autoimmune diseases, the indication of Protein A ranges from the general elimination of circulating immune complexes and the removal of immunoglobulin subclasses to the more specific treatment of rheumatoid arthritis. Therefore Protein A is today considered the ‘Gold-Standard’ in immunoadsorption. In this regard it is remarkable, that Protein A is not available at present in Japan.

Further developments for the adsorption of immune cells include:

(i) Non-woven polyester fabrics for leucocyte removal.
(ii) Cellulose acetate beads for granulocyte removal.
(iii) Non-woven polyester fabrics with immobilized monoclonal antibodies for selective cell removal.

Recent developments also include the possibility of influencing blood rheology and, therefore, microcirculation-disturbances by fibrinogen adsorption. This technology allows the continuous elimination of fibrinogen from human blood at a desired level and influences the plasma viscosity. It opens a wide spectrum of possible indications including the diabetic foot, macula degeneration, sudden deafness, apoplectic stroke, disseminated coronary heart disease, etc.

Most promising is a newly developed platform technology, using a microporous polyamide membrane for the coupling of any desired ligand. This device combines in a unique way membrane efficacy with specific adsorption capacity. The highest specificity today can be achieved by the patient specific immunoadsorber (psIA). This method allows the isolation of...
the patient’s own antibodies, which are then coupled in an extracorporeal way to a matrix and used for patient specific treatment.

**Conclusion**

This paper summarizes the new developments in adsorption technology and compares its clinical efficacy and tolerability with the unspecific classical plasmapheresis treatment modalities.

It is the author’s firm belief, that with the availability of these new technologies, therapeutic apheresis may soon become the fastest growing specialty in blood-purification therapy, clearly exceeding the dialytic treatment modalities in volume.

Its acceptance by the medical community as well as by the reimbursement institutions will depend on the availability of convincing data from randomized, controlled clinical trials, which should be carried out on an international basis with the cooperation of all the professional organizations working in this field.