SUMMARY

The presented work deals with the problem of the procedure regimen optimization in immunoadsorption LDL-apheresis.

The author aimed (after an introduction describing theoretical background of the problem) at a set-up and verification of a LDL-apheresis optimization method adopted from literature at first. This adopted method was based on an approximation of a LDL-cholesterol kinetics during the LDL-apheresis to the kinetics of the continuous filtration, described as the exponential decrease of the plasma levels. Based on this assumption then we calculated the volume of plasma, that should be washed through the columns to saturate their indicated adsorption capacity.

The results of 363 LDL-apheresis procedures, optimized using the adopted method, were not satisfactory – the medians of the real and the predicted values of the plasma LDL-cholesterol levels after the procedure were significantly different (0.910 $mmol.L^{-1}$ vs. 0.300 $mmol.L^{-1}$; $p < 0.01$, Wilcoxon test).

The author therefore studied the intra-apheresis kinetics of LDL-cholesterol in a closer detail in the second part of this work. He found the real amount of LDL-cholesterol adsorbed by the columns to be different from the indicated adsorption capacity, and derived a formula for its prediction. The real adsorption capacity was found to be dependent on the plasma level of LDL-cholesterol in the begining of the procedure. This finding became the cornerstone of the new method, which was later verified on the set of another 47 LDL-apheresis procedures. The new method provided better prediction of LDL-cholesterol levels after procedure, although not a perfect one. The difference of medians of the real and the predicted levels was small (1.85 $mmol.L^{-1}$ vs. 1.80 $mmol.L^{-1}$), but statistically significant ($p < 0.01$; Wilcoxon test).

The final comparison of the summary results of 462 procedures planned with the old regimen of the fixed volumes to 116 procedures planned with the newly developed method clearly demonstrated benefits of this research: The new planning method resulted in a significant decrease of the LDL-cholesterol plasma levels after the procedures (medians 0.845 $mmol.L^{-1}$ vs. 0.770 $mmol.L^{-1}$; $p = 0.015$ – Mann-Whitney test), although the plasma levels in the beginning of the procedures differed only insignificantly (medians 5.335 $mmol.L^{-1}$ vs. 5.190 $mmol.L^{-1}$; $p = 0.619$ – Mann-Whitney test). This improvement was accomplished without any increase of the volume of plasma washed (medians 7000 mL vs. 7000 mL; $p = 1.00$ – Mann-Whitney test) and without any significant increase of undesirable HDL-cholesterol elimination (medians 1.110 $mmol.L^{-1}$ vs. 1.065 $mmol.L^{-1}$; $p = 0.083$ – Mann-Whitney test).

The discussion part of this work analyzed possible causes of the observed imprecisions of the predictions of the new planning method – incomplete LDL-cholesterol elimination by the columns, surpassing of the planned volumes (forced by technical reason – fixed column regeneration time), imprecise plasma volume estimate, and a possible influx of LDL-cholesterol from extravascular compartments into circulation. Some additional outcomes of this research were also mentioned here – the verification of the column lifespan and the prediction of an imminent column failure.

The conclusion stated successful fulfillment of the goals of this project and sketched a further scope of the research in this area – the extension of the newly developed method to other types of adsorbers and the problem of an exact plasma volume measurement method suitable for daily use.