Formation of physical and chemical properties of ureteral stents surface for treatment of upper urinary tract

Abstract

The study presents results of research regarding the impact of a biodegradable coating with the active substance on the physical and chemical properties of ureteral stents used in the treatment of the upper urinary tract for short-term use.

Despite progress in the development of interdisciplinary research aimed at reducing the complications associated with implantation of polymer stents used in the treatment of upper urinary tracts, the issue of infection initiation and encrustation as well as fragmentation of stents remains unresolved. An attempt to solve the above-mentioned issues has been undertaken in the doctoral dissertation. The author proposed a different comprehensive research program for polyurethane stents, the surface of which was modified with a coating of biodegradable polymer with the active substance, and analyzed its effect on changes in physical and chemical properties essential for clinical practice.

The most commonly used DJ type polyurethane stent was selected for the study. The surface of the ureteral stent were coated with poly (D,L-lactide-co-glycolide) layer containing the active substance - papaverine hydrochloride by the dip coating method. The selection of parameters applied to modify the ureteral stents was based preliminary studies of the release profile of papaverine from the biodegradable coatings. In the study the influence of polymer coating on selected strength and utility properties of ureteral stents was determined, in particular the study of retention strength of stent ends and dynamic frictional forces have been performed. In order to determine the effect of the coating on the process of encrustation as well as the kinetics of papaverine release, the studies were performed under conditions simulating the flow of urine into the ureter. The tests were carried out in a solution of artificial urine at 37±1 °C and pH = 5.5±0,2 for 10, 20 and 30 days. In addition, the influence of artificial urine on the physical and chemical properties of ureteral stents was determined. The polyurethane stents and the biodegradable polymer coating were tested separately in these conditions.

The analysis of the test results indicates suitability of the biodegradable polymer coating containing the active substance for the modification of the surface of polyurethane urological stents. The research results indicate that the use of biodegradable polymer coatings releasing the active substance, which result in limiting the development of infection and the process of encrustation is an interesting proposition for clinical practice. However, this requires additional complementary tests in in vivo tests.