Abstract: P289

Express diagnosis of myocardial injury using laser-induced fluorescence ("first-in-man" experience)

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Objective. The aim of the study was to develop new method for operative diagnostics of intra-operative myocardial injury during cardiac surgery.

Materials and Methods. A total of 15 patients aged 60.0±9.4 years underwent cardiac surgery under cardiopulmonary bypass and cardioplegia. The status of the right atrium was evaluated by the method of laser-induced fluorescence during four time periods: before aortic occlusion, after aortic occlusion following cardioplegic solution introduction, before the end of aortic occlusion period, and after coming off bypass. Non-transmural and transmural radiofrequency ablation was performed before and after aortic occlusion followed by recording of the indicators (four more data points). The following parameters were assessed: induced residual fluorescence at wavelengths corresponding to fluorescence of collagen, elastin, NADH, pyridoxine, flavines, and lipofuscin.

Results. Data analysis demonstrated that induced collagen fluorescence did not significantly differ during all time periods analyzed. When elastin levels were assessed in intact myocardium, elastin fluorescence coefficients significantly differed before aortic occlusion (24.3±12.9) and in the beginning of aortic occlusion (35.9±24.2) compared with the levels after aortic occlusion (41.5±29.0) and in the end of cardiopulmonary bypass period (17.5±11.6) (late {ischemic} myocardial injury) at p=0.02. NADH was considered a marker of injury transmurality under the aortic occlusion (early myocardial injury); the NADH values significantly differed when determined in intact myocardium after aortic occlusion (83.2±44.7) and when radiofrequency injury was applied to the myocardium (100.3±60.6) at p=0.015. In the presence of preserved coronary blood flow, this indicator did not significantly change (p=0.54). The level of pyridoxine significantly decreased at the end of cardiopulmonary bypass period (24.0±14.9) compared with the corresponding values before aortic occlusion (36.7±20.4) and in the beginning of aortic occlusion (41.4±26.7) at p=0.014.

Conclusions. Laser-induced myocardial biopsy allowed to determine the markers of early (radiofrequency-induced) and late (ischemic) myocardial injury in online mode; this method can represent new modality for express-diagnostics of pathological conditions in the myocardium.