Myocardial protection by ischemic preconditioning is already evident during early index ischemia: analysis of ST-segment deviation during ischemia/reperfusion in pigs

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Ischemic preconditioning (IPC), i.e. brief periods of ischemia/reperfusion (I/R) prior to prolonged ischemia, protects the myocardium from irreversible damage and reduces final infarct size. IPC is believed to act through reduction of reperfusion injury. We have now analyzed continuously recorded ECG-derived parameters, notably the time course of ST-segment deviation and the number of ventricular arrhythmias.

Methods: Anesthetized open-chest pigs were subjected to 60 min LAD occlusion and 180 min reperfusion. IPC (n=8; 2 x 3 min LAD occlusion, separated by 2 min reperfusion) was induced 15 min before the sustained ischemia. Pigs without IPC served as controls (CON; n=8). Regional myocardial blood flow was measured by microspheres, area at risk was determined by Patent-Blue and infarct size by TTC-staining. ST-segment deviation was analyzed on ECG-lead II, defined as the voltage difference between a point 30 ms before the P-wave and 20 ms after the J-point. Ventricular arrhythmias were counted during ischemia and reperfusion.

Results: Transmural blood flow at 5 min ischemia was not different between IPC (0.033 ± 0.072 ml/min/g; mean ± SEM) and CON (0.023 ± 0.005; n.s.; t-test) as was area at risk (IPC: 26 ± 1% of the left ventricle; CON: 24 ± 1%; n.s.). IPC reduced infarct size from 44 ± 3% of the area at risk to 16 ± 3% (p<0.05). The ST-segment deviation prior to ischemia was similar in both groups (IPC: 0.077 ± 0.017 mV; CON: 0.041 ± 0.017; n.s.; 2-way ANOVA) and increased with the onset of ischemia. However, the amplitude of ST-segment deviation was markedly smaller with IPC already at 5 min ischemia (IPC: 0.277 ± 0.027 mV; CON: 0.374 ± 0.067; p<0.05) and remained smaller throughout ischemia (55 min ischemia; IPC: 0.197 ± 0.036; CON: 0.303 ± 0.045; p<0.05). The number of severe arrhythmias (ventricular fibrillation/sustained tachycardia) was not different between groups. With IPC, there were more ventricular extrasystoles (1-3 consecutive VES) during the first 30 min of reperfusion than with CON (IPC: 41(28-61) VES/30 min; median(IQR); CON: 21(18-22); p<0.05; Mann-Whitney-Test).

Conclusion: Contrary to common notion, IPC impacts the myocardium already during early index ischemia. The increased number of VES during reperfusion with IPC might be related to the larger amount of viable, nevertheless still injured myocardium. It remains to be elucidated how the attenuation of ST-segment deviation during I/R is mechanistically related to the cardioprotective properties of IPC.