



## Safety and Efficacy of Extracorporeal Low Energy Shockwave Application for the Treatment of Refractory Angina Pectoris and Myocardial Ischemia in Patients with End-Stage Coronary Artery Disease

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**Background:** The number of patients with end stage coronary artery disease increases rapidly due to improved techniques in bypass surgery and interventional cardiology. Myocardial ischemia in these patients often leads to refractory angina, a status of disease which can be treated clinically only with limited success so far. Experimental data indicates, that the application of low energy shockwaves may stimulate the release of nitric oxide and induce angiogenesis. The following study was conducted to investigate the effects of percutaneous myocardial, low-energy shockwave application in a prospective cohort of patients with end-stage CAD and refractory angina pectoris.

**Methods:** 24 patients with end stage coronary artery disease, SPECT documented reversible ischemia, and refractory angina were treated using a shock wave generator system (Cardiospec, Medispec, USA) designed to address the clinical-anatomical requirements of the chest cavity under transthoracic echo guidance. About 300 impulses were applied to the ischemic areas using energy level of 0.09 mJ/mm<sup>2</sup>. This treatment was repeated three times a week on the first week of each month, for three months.

**Results:** Clinical results showed a significant symptomatic improvement regarding CCS class ( $3.2 \pm 0.8$  at baseline vs.  $2.2 \pm 0.1$  at 6-months follow up;  $p < 0.0001$ ), Seattle Angina Questionnaire (mean improvement by 32.6%;  $p = 0.002$ ) and exercise capacity ( $66.6 \pm 6.8$  watt at baseline vs.  $95.8 \pm 5$  watt at 6 months follow up;  $p < 0.025$ ). Blinded SPECT analysis demonstrated that myocardial perfusion at stress and at rest was improved significantly at 6 months follow up versus baseline ( $p < 0.001$ ). Therapy was well tolerated by all patients. No side effects and no rise of cardiac enzymes were observed.

**Conclusions:** The present study shows that the extracorporeal application of low intensity shockwaves to the ischemic myocardium in patients with advanced CAD is safe and feasible. In our cohort, low energy shockwaves improved symptoms, delayed ischemic threshold, and increased myocardial perfusion in these end stage patients.