Pressure controlled intermittent coronary sinus occlusion (PICSO) in patients undergoing cardiac resynchronization therapy (CRT): Preliminary results on safety

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Objectives: Patients suffering from ischemic cardiomyopathy necessitate new devices and innovative techniques as a bridge towards heart transplantation or myocardial regeneration. We tested an intervention potentially capable of reversing myocardial damage and inducing regeneration using periodic, balloon driven coronary venous pressure elevation. The mechanical stimulation of blood pressure on coronary venous endothelium has been shown to reduce myocardial infarction size and to induce regenerative pathways in numerous animal studies[1,2]. This study was performed to evaluate the safety of PICSO (pressure controlled intermittent coronary sinus occlusion) in awake patients and its relationship to global hemodynamics and myocardial metabolism.

Results: Up to now (24 controls, 5 PICSO) the study revealed no adverse events, thus fulfilling the primary study endpoints. Different pacing modes resulted in differences in hemodynamic parameters as well as in CS blood samples. According to hitherto collected data an enhanced lactate extraction in PICSO patients indicates improved myocardial metabolism during certain pacing modes, as compared to the control patients. In concordance with this observation hemodynamic parameters tended to show functional improvement in PICSO patients. Most importantly the PICSO use did not produce some of the assumed coronary sinus occlusion side effects and inborn reflexes known to be important in uncontrolled coronary sinus occlusion such as bradycardia, hypotension and reduction of myocardial nutritive perfusion, due to refined inflation algorithms. The inconsistency of the initial data is due to small patient numbers not to be underestimated. Although the limited patient number prevents a definite statement, preliminary results, as well as intraoperative observations on coronary sinus and global hemodynamics, strongly resemble the experimental findings, thus indicating similar effects (Fig. 1) resulting in reduced myocardial ischemia and an improvement of myocardial metabolism. Ultimate response of a PICSO impulse in regeneration remains a definite goal in future research. Of note, in patients under local anesthesia the respiration regimen results in artifacts of the coronary sinus pressure tracing, thus influencing inflation times of the PICSO system. This requires instant adaptation of control algorithms, in order to achieve maximal optimization.

Methods: In the presently ongoing study patients with chronic heart failure undergoing cardiac resynchronization therapy (CRT) are subjected to 20 minutes of PICSO application. Coronary venous pressure dynamics (Fig. 2) as well as global hemodynamics during PICSO intervals of 5 minutes coupled with no pacing, VVI, DDD, and biventricular pacing (Fig. 3) were recorded and analyzed off line (Fig. 4). Coronary venous as well as arterial blood samples were drawn after each of the mentioned intervals.
The 7 French PICSO balloon catheter (Miracor, Vienna, Austria) was inserted trough the subclavian vein using a 10.5 French sheat and was driven by a dedicated PICSO pump (Austrian Research Centers, Wiener Neustadt, Austria).
Hemodynamic parameters were measured by a minimal invasive pulse contour system (LiDCO Ltd., Cambridge, United Kingdom).

Conclusion: These preliminary results show that PICSO can be applied safely in awake patients without potentially hazardous hemodynamic reflexes. One of the major contributions of the hitherto conducted analysis is that the experimentally portrayed mechanisms of action stemming from the mechanical activation of coronary venous endothelium[3] are contoured in the presented clinical setting. The final statistical analysis of hemodynamic, metabolic and regenerative parameters is expected to be supportive of previously documented positive clinical effects[4,5].

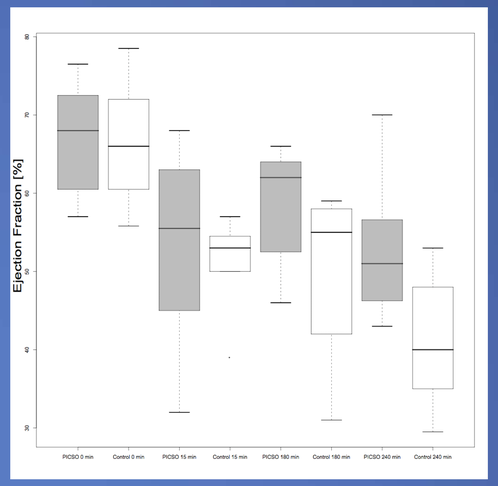

Figure 1 : Experimental data showing positive effects of PICSO on the functional recovery of ischemic hearts.

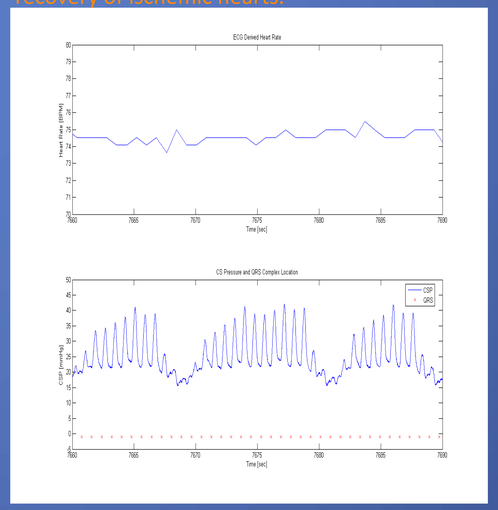

Figure 2 : The change in coronary sinus pressure in a PICSO patient.

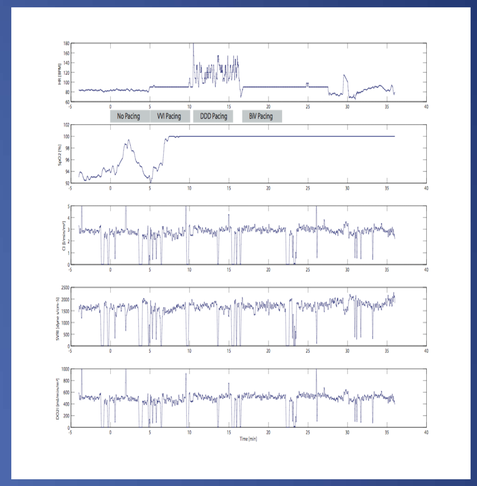

Figure 4: Intraoperative hemodynamic parameters

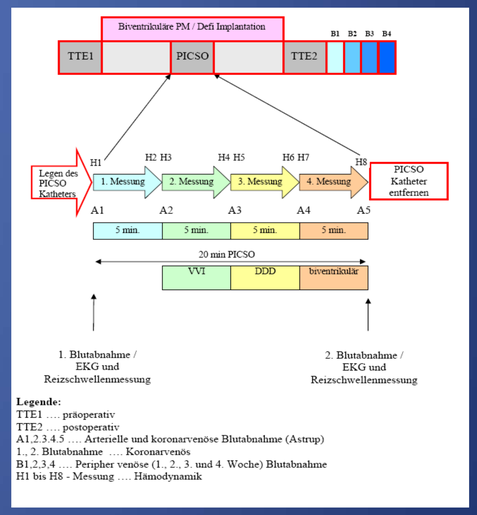

Figure 3 : The study protocol – measurments of lactate extraction, cardiac output, stroke index and oxygen saturation.

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