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MRI-3D-tagging insight into beta-blocker pharmaco-dynamics on the left ventricle supports theory of inner antagonism

Beta-blockers contribute to treatment of heart failure. Their mechanism of action, however, is incompletely understood. Gradients in beta-blocker sensitivity of helically aligned cardiomyocytes compared with counteracting transversely intruding cardiomyocytes seem crucial. We hypothesize that selective blockade of transversely intruding cardiomyocytes by low-dose beta-blockade unloads ventricular performance. Cardiac magnetic resonance imaging (MRI) 3D tagging delivers parameters of myocardial performance. We studied 13 healthy volunteers by MRI 3D tagging during escalated intravenous administration of esmolol. The circumferential, longitudinal and radial myocardial shortening was determined for each dose. The curves were analyzed for peak value, time-to-peak, upslope and area-under-the-curve. At low doses, from 5 to 25µg/kg/min, peak contraction increased while time-to-peak decreased yielding a steeper upslope. Combining the values revealed a left shift of the curves at low doses compared with baseline without esmolol. At doses of 50 to 150µg/kg/min, a right shift with flattening occurred. In healthy volunteers we found more pronounced myocardial shortening at low compared with clinical dosage of beta-blockers. In patients with ventricular hypertrophy and higher prevalence of transversely intruding cardiomyocytes selective low-dose beta-blockade could be even more effective. MRI 3D tagging could help to determine optimal individual beta-blocker dosing avoiding undesirable side effects.

Biography

Boris Schmitt completed his medical studies in Freiburg, Innsbruck and Berlin. In 2001 he started his career as a Pediatrician at the DHZB in the department of congenital heart disease. He completed his Doctoral thesis in 2005 and his medical specialization in Pediatrics in 2007. He returned to DHZB and became a member of the cardiovascular MRI team. He has been the team leader of KidCathLab since the very beginning in 2009. When the group came to life he shifted his focus from clinical work to research activities. His main interests and abilities are pediatric cardiology, catheterization and imaging. And most importantly, he has an open (h) ear (t) for new ideas. He is also a co-founder of a company for planning, implementation and marketing of telemedicine networks and he is certified in mountain and expedition medicine.

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