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Enhanced sphingosine-1-phosphate levels by pharmacological or genetic approaches attenuate cardiac dysfunction in experimental septic cardiomyopathy

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Introduction: The role of Sphingosine-1-phosphate (S1P) and its receptors S1PR₁₋₅ in septic cardiomyopathy is not known. The S1P mimetic FTY720-P acts as an agonist on S1PR₁ and S1PR₃₋₅ and a functional antagonist on S1PR₁.

Methods: Cardiomyopathy was mimicked by co-administration of the bacterial cell-wall components lipopolysaccharide (LPS) and peptidoglycan (PepG) in wild-type (WT) and sphingosine kinase 2 deficient mice (SPHK2^{-/-}). At 1h after LPS/PepG mice received FTY720 alone, or they received a phosphatidylinositol 3 kinase (PI3K) inhibitor or a S1P₂ receptor antagonist prior to FTY720. 18h later cardiac function was assessed by echocardiography, serum-S1P was measured by LC/MS/MS and expression of signalling molecules was determined by immunoblot analysis.

Results: Compared to sham, mice subjected to LPS/PepG demonstrated a reduction in ejection fraction (EF) as well as a decrease of serum-S1P. In SPHK2^{-/-}-mice, which have higher endogenous S1P-levels, LPS/PepG-induced reduction of EF was lower than in WT-mice. Treatment with FTY720 attenuated the impaired EF in WT-mice accompanied by an increase of serum-S1P and an increased phosphorylation of AKT and eNOS in heart tissue. Cardioprotective effects of FTY720 were abolished following co-administration of either a PI3K inhibitor or a S1PR₂ antagonist. **Conclusion:** We show here for the first time that the impaired left ventricular systolic contractility caused by LPS/PepG is attenuated by a pharmacological or genetic approach to alter S1P-serum levels. Mechanistically, our results indicate that activation of S1PR₂ by increased serum S1P and the subsequent activation of PI3K signalling contribute to the observed cardioprotective effect of FTY720 in experimental sepsis.