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# Elucidation of the pathophysiological mechanisms in diabetic kidney disease using intravital imaging

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Recent advances in bioimaging technology have allowed visualization of various biological phenomena *in vivo.* They are expected to be a powerful tool to clarify the renal physiology and pathophysiology. We have established the imaging techniques that can directly visualize glomerular hemodynamics and filtration status *in vivo* with multiphoton laser microscopy (MPM), and detect the production of reactive oxygen species (ROS) and nitric oxide (NO) simultaneously in the tissue specimen. We have been using this technique to elucidate the progressive mechanism of chronic kidney disease, especially diabetic kidney disease (DKD). I would like to introduce our research using the *in vivo* imaging technique to focus on examination of the renal protective effect of sodium–glucose cotransporter-2 (SGLT2) inhibitor (SGLT2i), which have recently been shown to slow the progression of kidney disease in patients with type 2 diabetes mellitus. Improvement in glomerular hyperfiltration via the tubuloglomerular feedback (TGF) is considered as one of the possible pathways for renal protection with SGLT2 inhibition in DKD. We explored the renal protective mechanisms of the SGLT2i empagliflozin, with a focus on the glomerular hemodynamic effects and TGF using *in vivo* MPM imaging techniques in diabetic mice. SGLT2i significantly increased urinary adenosine excretion and reduced hyperfiltration by constriction of the abnormally dilated afferent arterioles that were abolished by adenosine A1 receptor blockade. Thus, the adenosine/A1aR system plays a pivotal role in the regulation of glomerular filtration rate via TGF mechanisms in DKD.