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Applications of kidney organoids derived from hPSCs

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Kidney organoids can be generated from human pluripotent stem cells (hPSCs) in vitro. Recently, we and others established protocols for the generation of kidney organoids from hPSCs. hPSCs derived-kidney organoids containing segmented structures with podocytes, proximal tubules, and distal tubules in nephron-like arrangements. We have previously revealed that direct comparison of gene expression and localization between kidney organoids in vitro and human kidneys revealed that podocytes derived from hPSCs resemble podocytes in vivo at the capillary loop stage of glomerular development. hPSCs derived-kidney organoids have potential applications in regenerative medicine as well as in modeling of renal diseases, drug screening, and nephrotoxicity testing of compounds. In this lecture, I will highlight the applications of hPSCs derived-kidney organoids based on our experiments.

1. Chronic kidney disease (CKD) is characterized as gradual loss of nephron, which has emerged as a crucial healthcare issue worldwide. Regenerative medicine, in which the nephrons lost during the progression of CKD are replaced by stem cells, is potential therapeutic option for CKD. may be attractive sources for regenerative medicine for CKD. However, it is unclear the regenerative therapeutic effect or safety after transplantation of hPSCs derived-kidney organoids into kidneys in vivo. In this lecture, I will review hPSCs derived-kidney organoids as the possible option of regenerative medicine for CKD as well as their limitations.

2. hPSCs derived-kidney organoids have nephron-like structures and can recapitulate the development and diseases of the human kidney. For this reason, kidney organoids-derived from human hPS cells have considered as one of the promising systems for drug nephrotoxicity testing. Recently, the researches for the predictive efficacy of drug-induced nephrotoxicity in this system are challenging. Tacrolimus, a calcineurin inhibitor, was clinically used as an immunosuppressive agent in organ transplantation or glomerulonephritis. Despite the therapeutic benefits, tacrolimus's use is limited due to its nephrotoxicity. In this lecture, I will show the experimental model of tacrolimus nephrotoxicity using hPSCs derived-kidney organoids and its applications.