Diabetes mellitus currently affects 8.3% of the world’s population, roughly 387 million people as of 2014, with numbers rising steadily. Diabetes is a major risk factor for vascular pathology, affecting the vascular wall at the cellular and extracellular level. The field of tissue engineering has proven to have great potential in treating cardiovascular disease and kidney failure. In order to develop tissue-engineered replacements resistant to the alterations induced by a diabetic environment, the modifications of the native tissues are important to be elucidated.

Cardiovascular remodeling is due to elevated levels of fatty deposits along the vessel wall, hyperglycemia and chronic inflammation. The major vascular matrix components, such as collagen and elastin, interact irreversibly with the elevated levels of blood glucose and lipids via oxidation and crosslinking processes resulting in the formation of advanced glycation end products and vascular stiffening. Adventitial fibroblasts, the “first-responder” to vascular injury, are involved in normal maintenance of blood vessels, contributing to repair and remodeling. Adventitial fibroblasts play an active role in the arterial response to injury, cytokines and stretch, which stimulate their activation and differentiation into myofibroblasts.

Diabetes is also the most common cause of chronic renal disorders and end stage renal disease. Diabetes results in a wide range of alterations in renal tissue such as glomerular sclerotic lesions, hypertrophy of glomeruli, tubulointerstitial fibrosis, increased expression of myofibroblasts and inflammation that contribute to kidney dysfunction and diabetic nephropathy. The aim of this study was to show the histological changes of renal tissue associated with diabetes with an emphasis on remodeling of the renal vasculature.

Kidney samples were explanted at a time point 3 months from diabetic and non-diabetic rats and were histologically analyzed for indications of pathological remodeling. The sample cross sections were stained and analyzed for early signs of diabetic nephropathy including glomerulus deterioration, vessel wall remodeling, and vascular cell dysfunction. This was done using hematoxylin & eosin, Masson’s trichrome, periodic acid schiff and various immunostainings for α-SMA, CD146, CD68, von Willebrand factor and collagen type IV. Dense perivascular collagen deposition could be seen under diabetic conditions. Increased macrophage infiltration was observed in diabetes as well as increased pericyte and endothelial cell expression suggesting upregulation of angiogenesis and increased remodeling and repair within the kidney. Myofibroblast activity, the main contributing cell to organ fibrosis, was upregulated in diabetics showing early signs of kidney fibrosis – a common outcome in diabetic nephropathy.

In conclusion, determining the modifications induced by diabetes at a vascular cell and extracellular level could lead to finding optimal treatments for renal artery disease and improved kidney tissue engineering approaches.