Medial calcification is the formation of mineralised tissue within the smooth muscle layer of the vessel wall, and frequently occurs in patients with chronic kidney disease. Calcification within the medial layer of the vessel wall can reduce aortic and arterial elasticity, which impairs cardiovascular haemodynamics and results in a significantly elevated risk of morbidity and mortality in the form of hypertension, cardiac hypertrophy and sudden cardiac death. Protein kinase Cα (PKCα) belongs to the PKC family of serine/threonine kinases and we recently discovered that knocking-down PKCα expression increases high phosphate-induced mineral deposition by vascular smooth muscle cells (VSMCs) in vitro. This study tests the hypothesis that PKCα regulates uraemia-induced medial calcification in vivo.

PKCα-/- mice were generated on the calcification-susceptible DBA/2 background (PKCα-/-) using CRISPR/Cas9 technology. To induce uraemia, wild-type DBA/2 and PKCα-/- mice underwent a two-stage sub-total nephrectomy and were fed a high phosphate (1.5%) diet for 8 weeks. Renal function was measured by blood urea nitrogen (BUN). Calcification in the ascending aorta/aortic arch and abdominal aorta were analysed and quantified by micro CT and histology. On average, 68.6 ± 3% (SD, n=3) of renal mass was removed from wild-type and 65 ± 2.2% (n=5) was removed from PKCα-/- mice (P>0.05). Loss of PKCα significantly increased uraemia-induced medial calcification in the abdominal aorta (20-fold increase, P<0.05) when compared to wild-type controls; there is also a trend for calcification to be increased in the ascending aorta/aortic arch of PKCα-/- mice. Whilst there is a trend for BUN levels to be elevated in PKCα-/- mice (1.3-fold increase compared to wild-type controls, P=0.1), there is no correlation between BUN levels and the extent of calcification in these mice.

We have shown previously that inhibiting transforming growth factor-β (TGF-β) signalling with SB431542 prevents the increase in calcification observed in PKCα-siRNA treated VSMCs. Therefore, to determine the mechanism by which loss of PKCα exerts its effects we examined the relationship between PKCα and TGF-β signalling in vitro and in vivo. Our results show that knock-down of PKCα using siRNA increased TGF-β1-induced Smad2 phosphorylation in VSMCs in vitro (P<0.05). Furthermore, phosphorylated Smad2 immunostaining was detected throughout calcified aortic arches from PKCα-/- mice. In contrast, only small areas of phosphorylated Smad2 immunostaining was detected in calcified wild-type controls.

In conclusion, our study suggests that PKCα may play a protective role in uraemia-induced medial calcification. The PKCα/TGFβ signalling axis could therefore represent a new therapeutic target for uraemia-induced medial calcification.

Conflict of interest None