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PATHOLOGICAL ASPECTS OF VASA RECTA FIBROSIS IN KIDNEY OF DROMEDARY CAMELS

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ABSTRACT

Gross and microscopic lesions of the kidneys were examined in 50 adult camels of both sexes at the point of slaughter in AL-Ahsa abattoirs. Grossly out of 50 camels examined, 17 (34%) showed some gross pathological alterations. The affected kidneys were pale, enlarged with swollen capsule. Microscopic examination after staining with Hematoxylin and Eosin, Trichrome and Congo red stains was carried out in all grossly affected renal tissues (n=17). Renal tissues stained with H&E revealed focal areas of degenerative changes in both cortical and medullary tubules. In addition, widening in the interstitial matrix at the medullary vasa recta with capillary congestion was observed in 12 (70.58 %) renal tissue samples. However, using trichrome stain confirmed vasa recta fibrosis, which is characteristic by collagen fibre deposition. Moreover, intratubular homogenous material within vasa recta were shown in 5 (29.41%) renal tissue samples. No evidence of amyloidosis was seen in renal samples after staining with Congo red stain. None of the renal tissue samples showed a defined inflammatory response. These results showed that the camels may be exposed to nephrotoxins in the study area possibly from agrochemicals or from the soil around they graze.

Key words: Dromedary camel, fibrosis, histopathology, kidney, vasa recta

The length of Henle and vasa recta loops, may be an indicator of the kidney's ability to excrete a very concentrated urine and maintain body homeostasis (Abdalla and Abdalla, 1979; Anguo, 1997; Qiusheng and Yi, 2002; Xu *et al,* 2009; Li *et al,* 2020). Pannabecker and Dantzler (2006) have evaluated the pathways and densities of descending and ascending vasa recta in rats. They concluded that the manner in which vasa recta function contribute to the concentrating mechanism depends on their three-dimensional relationships to each other and to tubular elements in the outer zone of the inner medulla. Recently, many reports have shown that camels are not exceptionally resistant to diseases and, like other animals, they can suffer from many disease conditions including those of kidneys and disorders related to dehydration and nephrotoxicity (Abbas and Omer, 2005; Kojouri *et al,* 2014). However, epidemiologic studies have revealed that fibrotic deposition which progresses silently is an important indicator of adverse renal outcomes (Genovese *et al,* 2014). It has been reported that the structure and arrangement of the vasa rectae in camel's kidney is different from that in other animals (Xu *et al,* 2009). However, in the mammalian kidney, several studies have shown that the fenestrated ascending vasa recta (AVRs) drain the interstitial fluid in this region (Bell *et al,* 1968; Fenton and Knepper, 2007; Pallone *et al,* 2003a; Pallone *et al,* 2003b; Kriz and Kaissling, 1992). The objective of the present study was to describe the pathological findings related to renal vasa recta fibrosis in camels.

Materials and Methods

A total of 50 apparently healthy adult camels (*Camelus dromedarius*) of both sexes were included in this study. After slaughtering at abattoirs of Al-Ahsa region, Kingdom of Saudi Arabia, all kidneys were thoroughly examined for gross lesions and small pieces of tissue were collected for microscopic examination.

Histopathological Technique

Renal tissue samples were fixed in 10% buffered formalin, mounted in paraffin, sectioned and stained with Hematoxylin and Eosin (H&E), Gomorri's one-step trichrome and Congo red stain saccording to the method of Bancroft and Gamble (2008).

Results

Grossly out of 50 camels examined 17 (34%) showed pathological alterations. All the affected

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kidneys were pale in colour, enlarged in size and had swollen capsule (Fig 1).

Microscopic findings

1. Renal tissues stained with Hematoxylin and Eosin:

Renal tissues stained with H & E revealed focal areas of degenerative changes in cortical tubules (Fig 2). In addition, widening of the interstitial matrix of medullary ascending and descending vasa recta (AVR and DVR) were observed in 12 renal tissue samples (70.58%) with capillary congestion. This widening of interstitial tissues of vasa recta appeared as islets in the medullary zone, characterised by presence of perivascular and intertubular eosinophilic homogenous material with fibrillar threads (fibrosis) and intratubular eosinophilic homogeneous proteinaceous material (proteinaceous casts) (Fig 3, b, c & d). No inflammatory reaction as seen in all renal tissues.

2. Renal tissues stained with trichrome:

The twelve renal tissues (70.58 %) stained with trichrome stain revealed remarkable renal fibrosis, (Fig 4, b, c&d). However, the medullary ascending and descending vasa recta (AVR & DVR), showed perivascular collagen fibre deposition (fibrosis) and congestion (Fig 4, e&f) with intratubular greenish, homogenous proteinaceous material (Fig 4, g). In addition, intratubular deeply eosinophilic homogenous material (hyalinosis) was exclusively seen in 5 renal tissue samples (29.41%) (Fig 4, h). The renal cortex showed areas of glomerular fibrosis with thickness of the Bowman's capsule basement membranes surrounded by collagen fibres. Moreover, thickening of the mesangial capillary walls (Fig 5, a&b) and mild tubulo-interstitial fibrosis were also observed (Fig 5, c).

3. Tissues stained with Congo red

Renal tissues stained with Congo red have shown no evidence of amyloidosis in the vasa recta (Fig 6 a&b).

Discussion

The results of the present study have revealed some degenerative changes in kidney cortical tubules and widening of the interstitial matrix of the medullary ascending and descending vasa recta characterised by presence of perivascular and intertubular eosinophilic homogenous material with fibrillar threads and intratubular hyaline casts after staining with H&E stain. Previous reports have described the presence of hyalinosis and progressive interstitial fibrosis associated with chronic cyclosporine nephrotoxicity in humans (Young *et al,* 1995). The prevalence of glomerular shrinkage, hyalinisation and portentous cast among the different naturally occurring kidney lesions in camels in Saudi Arabia was previously reported by Barakat *et al* (2017).

Our results have confirmed the occurrence of renal fibrosis with perivascular collagen fibres positive to trichrome stain and deposited at the descending and ascending vasa rectae. Similar sclerotic changes in camel kidneys following

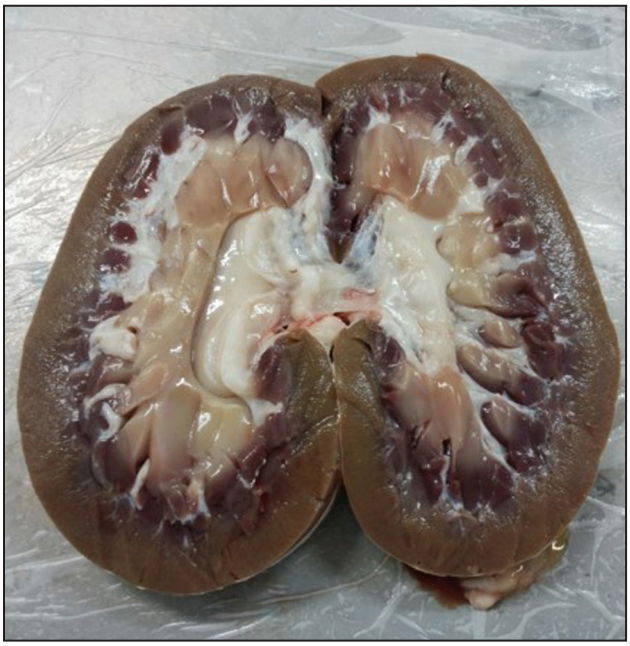

Fig 1. Kidney of camel showing enlargement in size and swollen capsule. The cortex and the medulla appearing pale in colour.

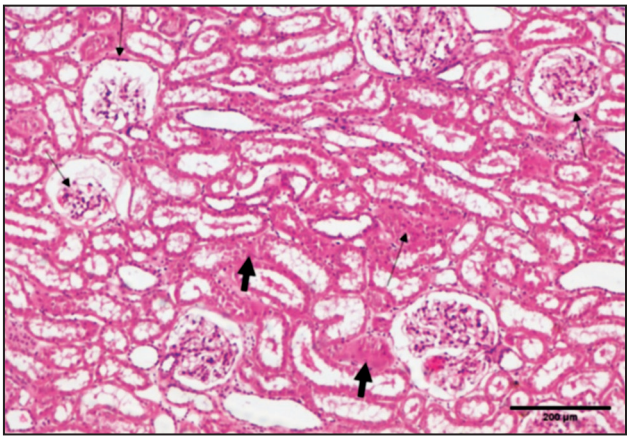

Fig 2. Camel renal cortex showing focal area of degenerative changes (thin arrows) characterised by glomerular tuft shrinkage, widening of Bowman's capsules, thickening of the glomerular membrane and tubular swelling and focal tubular necrosis (thick arrows) bar = 200 µm.

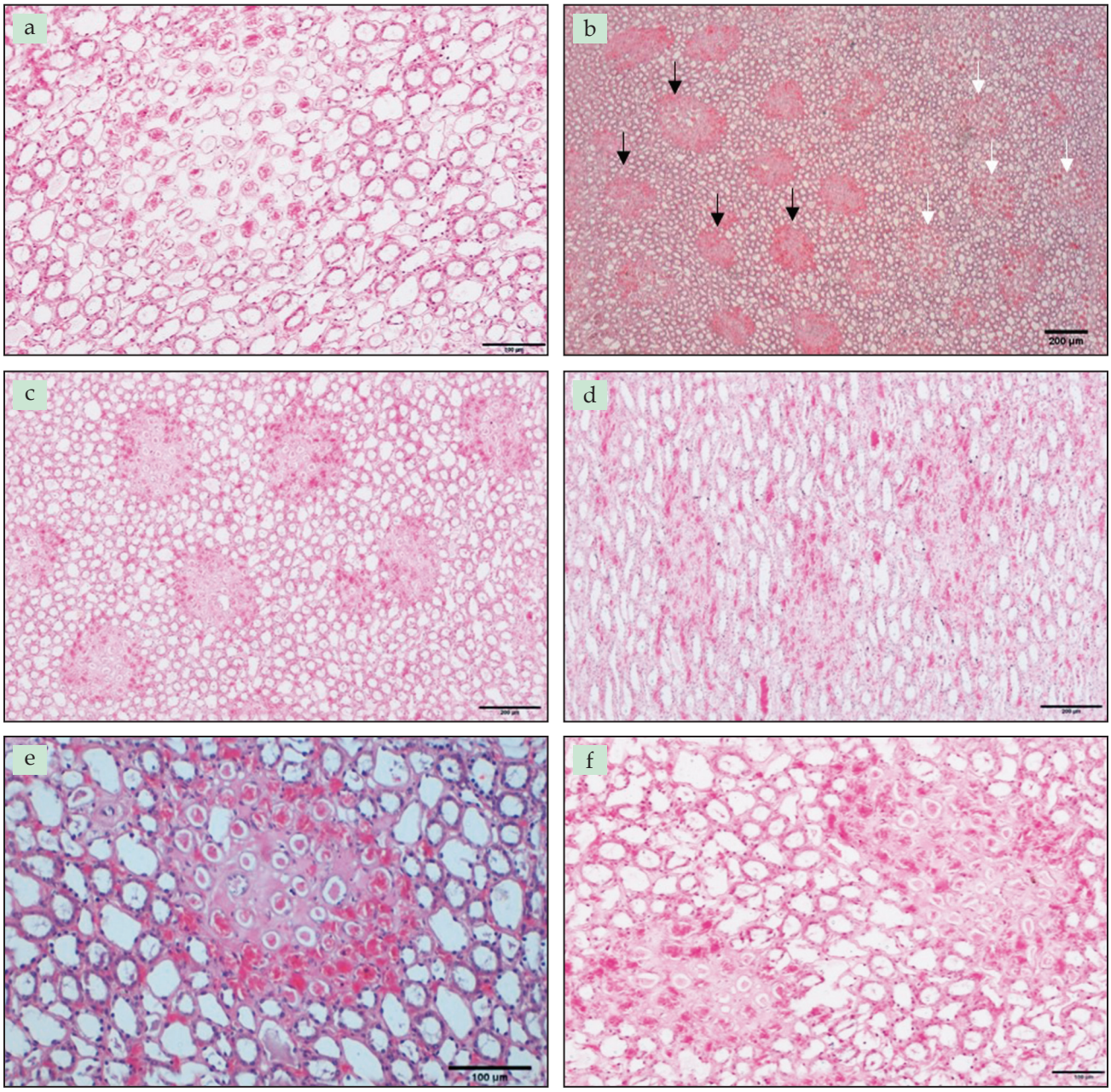

Fig 3. Camel renal tissues showing normal medullary vasa recta (a), widening of vasa recta interstitial matrix appearing as islets in medullary zone (b, black arrows) and normal vasa recta appearance (b, white arrows), presence of perivascular eosinophilic homogenous material with intravascular congestion in medullary AVR and DVR (c&d) and presence of perivascular and intertubular fibrosis and intratubular proteinaceous casts (e&f), (H&E, scale bar =100 and 200 µm).

diminazene aceturate (Berenil) toxicity were reported by Homeida *et al* (1981). Moreover, such changes may be initiated by many insults to the kidney including toxic, ischemic, infectious, paraneoplastic, congenital, genetic, endocrine, and immunological diseases (McGavin and Zachary, 2007; Snyder *et al*, 2009). It seems that many gaps exist in our understanding of the mechanism and pathogenesis of renal fibrogenesis. Efstratiadis *et al* (2009) reported that the main mechanism of renal fibrosis is the transformation of renal tubular epithelial cells to fibroblasts, which migrate to adjacent interstitial parenchyma. In addition, Liu (2011) suggested that a large proportion of interstitial fibroblasts are actually originated from tubular epithelial cells via epithelial to mesenchymal transition (EMT) in diseased kidney.

Kidney tissues stained with Congo red stain revealed no evidence of amyloidosis in all the kidney tissues included in this study. Amyloidosis is a heterogeneous group of diseases characterised by

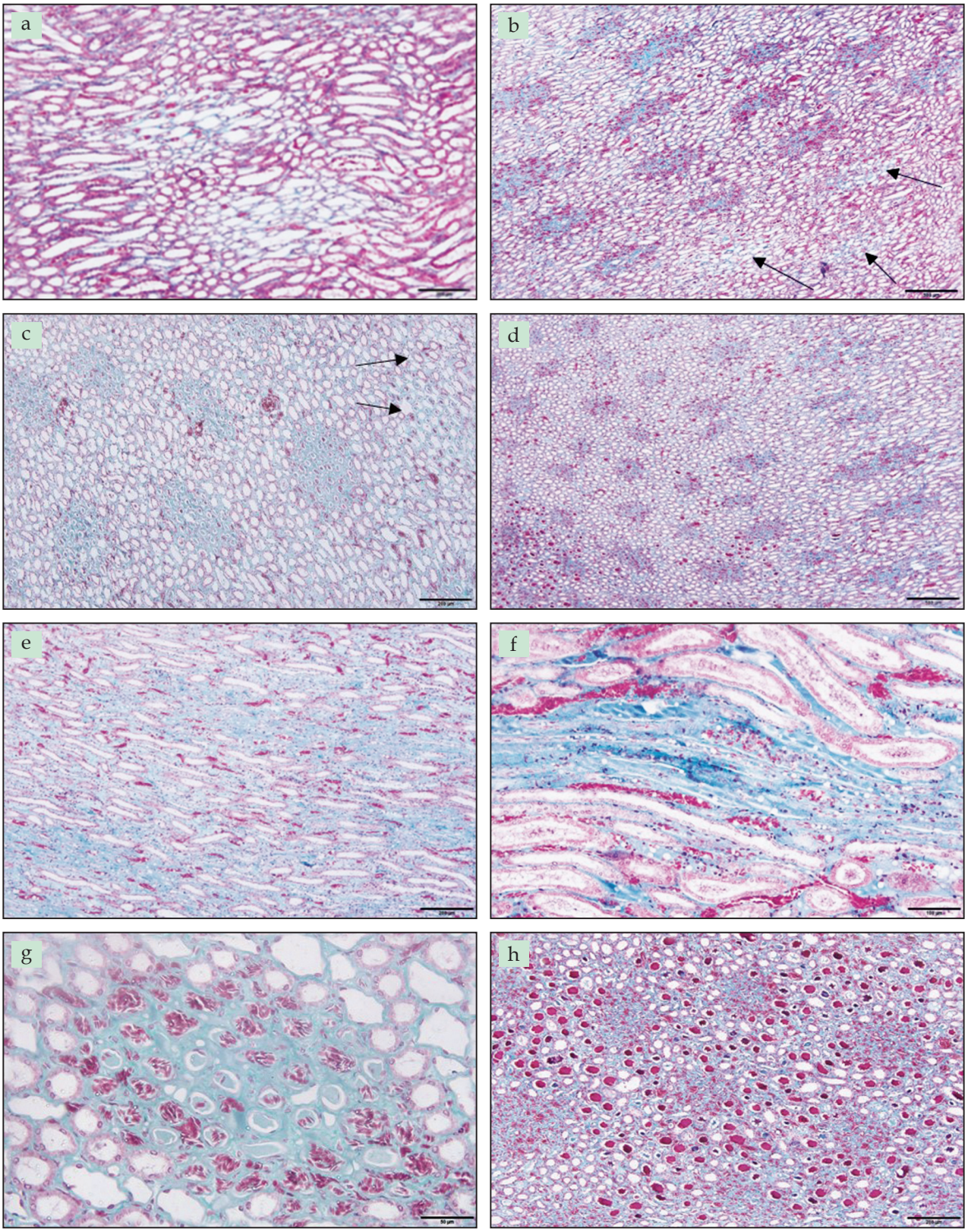

Fig 4. Camel renal tissues showing normal medullary vasa recta (a), fibrosis of vasa recta accompanied with some normal vasa recta (b&c, arrows), AVR and DVR fibrosis appeared as islets in the inner and outer medullary zone (d), perivascular and tubulointerstial fibrosis of vasa recta (e&f), perivascular collagen fibre deposition and congestion in vasa recta with intratubular greenish, homogenous proteinaceous material (g), intratubular deeply eosinophilic homogenous material (hyalinosis) (h), (Gomori's trichrome stain, scale bar =500, 200, 100 and 50 µm).

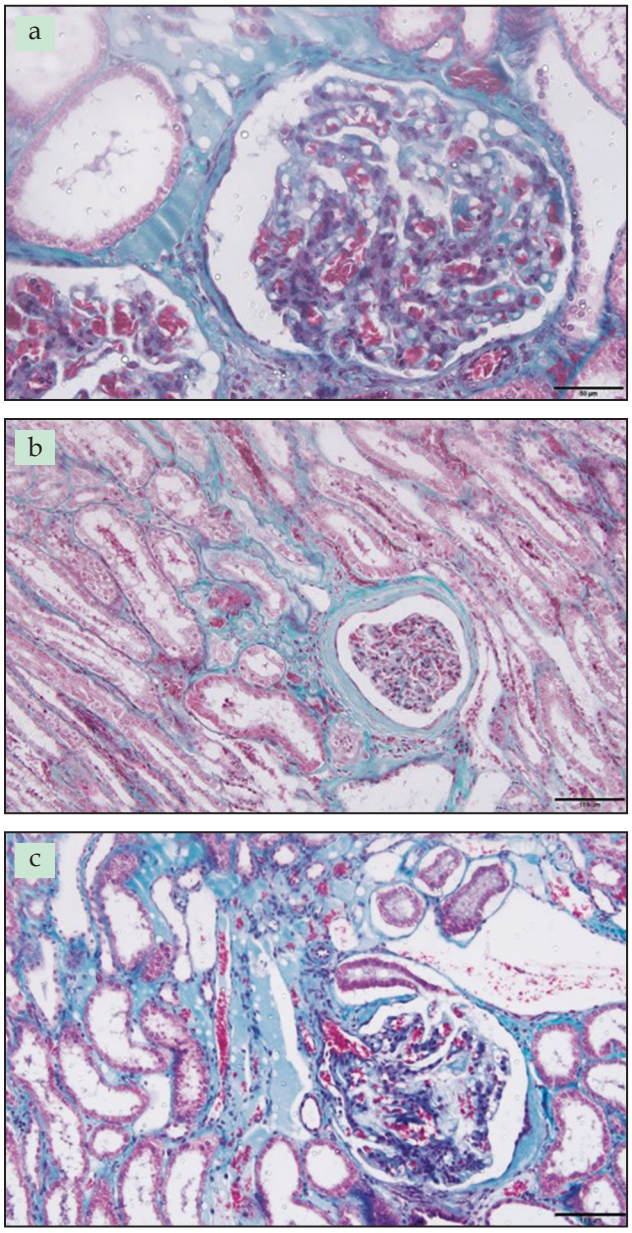

Fig 5. Camel renal cortex showing fibrotic area in the glomeruli (positive trichrome stain) characterised by thickness of the Bowman's capsule basement membranes surrounded by collagen fibres, thickening of the mesangial vessels (a&b), and mild tubulo-interstitial fibrosis and degeneration (c), (Gomori's trichrome stain, scale bar =100 and 50 µm).

deposition of an insoluble amyloid fibrils in various organs and tissues of animals and humans (Saraiva, 2002; Woldemeskel, 2012). The gross changes in kidney tissues shown in our result may be due to the degenerative changes and fibrosis. However, further microscopic examination are needed to identify and confirm the amyloidosis and differentiate it from other apparently similar extracellular deposits such as collagen and fibrin. Furthermore, analysis methods such as immunohistochemistry are more reliable

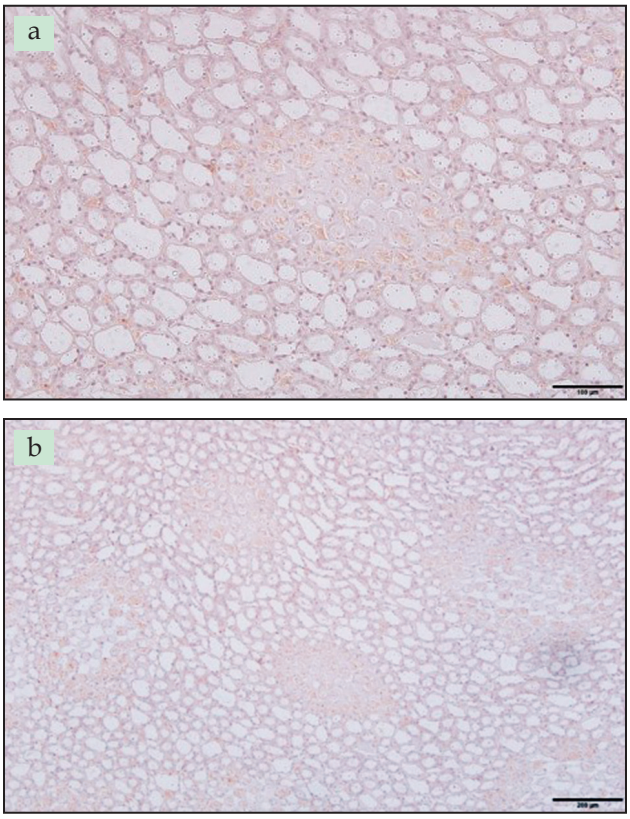

Fig 6. Camel renal vasa recta showing negative reaction for amyloidiosis (a & b), (Congo red stain, scale bar =100 and 50 µm).

procedures for accurate identification of amyloidosis (Wisniowski and Wechalekar, 2020; Iadanza *et al,* 2018).

In conclusion, vasa recta fibrosis is one of the causes of chronic renal disease (CRD), which currently is not well studied in camels.

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