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PATHOLOGY OF CONGENITAL POLYCYSTIC KIDNEY DISEASE IN A STILLBORN FOETUS OF FAT-TAILED (DUMBA) SHEEP

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ABSTRACT

Polycystic kidney disease (PKD) is comprised of a heterogeneous group of hereditary, developmental and acquired disorders. In the present study, a stillborn female foetus of Dumba sheep was subjected to gross and histopathological examination. On external examination, the foetus was found to be over-weight (3.85 kg) with highly distended abdomen. After opening the carcass, it was found that both kidneys were enlarged, pale yellowish in colour, soft and doughy. After cutting, clear fluid oozed out from the kidneys, numerous fluid filled small cysts (0.3-7.0 mm) were observed diffusely distributed throughout the cortex and medulla. Microscopically, both the kidneys revealed identical histological alterations. The renal parenchyma revealed variable-sized, multiple fusi-form, round and cylindrical cysts. These cysts formed an irregular honeycomb of spaces separated by varying amounts of cellular and stromal components of the interstitium. There was severe dilatation of renal tubules lined by low cuboidal to flattened squamous or flattened columnar epithelium. The glomeruli were sporadic, small, and often hypoplastic or atrophic, located within a dilated Bowman's capsule. Grossly, the liver was enlarged, pale and friable. Microscopically, the hepatocytes revealed vacuolar degenerative changes and multiple small cysts. Characteristic cystic lesions were also observed in cardiac muscles. The present study confirmed congenital cystic kidney disease in fat-tailed (Dumba) sheep similar to autosomal recessive polycystic kidney disease occurring in humans and juvenile polycystic disorders in several animal species.

Key words : Congenital polycystic kidney disease, Pathology, Fat-tailed sheep

Polycystic kidney disease (PKD) is comprised of a heterogeneous group of hereditary, developmental and acquired disorders. It is characterized by the gradual enlargement of the kidneys due to the presence of numerous cysts, widespread reduction in the functional kidney and massive enlargement usually leads to renal failure. PKD is heritable and recognized in two major genetically distinguishable forms: infantile or autosomal recessive PKD (ARPKD) and adult or autosomal dominant PKD (ADPKD). ADPKD form occurs due to germ-line mutations in single *PKD1* or *PKD2* gene. This form of the disease is slowly progressive, frequently associated with a variety of extra-renal manifestations and responsible for death caused by renal failure in adults. ARPKD has been classified into perinatal, neonatal, infantile and juvenile forms on the basis of age of presentation. Reports on genetic studies showed that all forms have an identical genetic defect, namely mutation of a single ARPKD gene linked to chromosome 6p2–cen (McKenna and Carpenter, 1980). In India, 5% of conservative estimate of 0.1 million new cases of end stage renal disease were reported to be caused by ADPKD (Sakhuja and Kohli, 2006);,however, there are

no studies reporting the problem statement of PKD in India (Patil et al., 2013). Syndromes resembling both the recessive and dominant forms of human PKD have been reported infrequently in a variety of domestic, laboratory and wildlife species (Muller et al., 2009). In India PKD, a congenital disease has been rarely reported in animal species (Rajasundaram et al., 2015) and not described adequately either in terms of pathology or epidemiology. In the present study, pathology of a rare case of PKD has been described in a stillborn foetus of fat-tailed (Dumba) sheep from India.

MATERIALS AND METHODS

A carcass of female foetus of Dumba sheep with a history of stillbirth was received for necropsy. The carcass was examined for external and gross abnormalities. During necropsy, the representative tissue samples of kidneys, liver, lung and heart were collected and immersed in 10% neutral buffered formalin for histopathological examination. After proper fixation, the specimens were dehydrated in ascending grades of ethyl alcohol, cleared in xylol and embedded in paraffin. Thin tissue sections about 5 µ in thickness were prepared and stained with hematoxylin and eosin stain for general microscopic examination (Luna, 1968).

RESULTS AND DISCUSSION

On external examination, the foetus was overweighted (3.85 kg) with highly distended abdomen. There were no external lesions on the body. After opening of the carcass prominent lesions were observed in kidneys. Both kidneys were enlarged and occupied almost 1/3rd of the abdominal cavity which caused displacement of the normal viscera of the abdomen (Plate 1). The left kidney was slightly more in size (14 x 8 x 3.8 cm) than the right kidney (13 × 7 × 3.7 cm). The total weight of both the kidneys was around one kg. The capsule of the kidneys was thickened with fatty deposits and was found firmly attached to the parenchyma. The kidneys were pale yellowish in colour, soft and doughy. On the external surface very few cysts were observed (Plate 2).

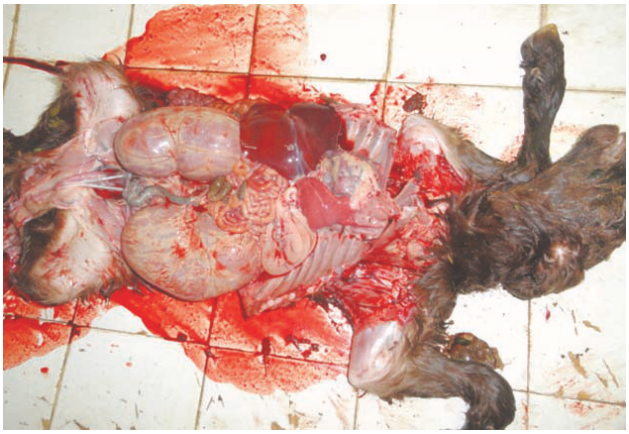

Plate 1. Enlarged kidneys and displacement of the abdominal viscera in foetus of Dumba sheep

Plate 2. Extensively enlarged soft and doughy kidneys with fatty deposits and thickened capsule

After cutting, clear fluid oozed out from the kidneys and the accumulation of fluid was evident at the renal pelvis and in the calyces. On cut surface numerous fluid-filled small cysts ranging between 0.3-7.0 mm were diffusely distributed throughout both cortex and medulla. Comparatively, medulla contained large size of cysts with a spongy appearance than the cortex (Plate 3). The ureters and bladder were grossly normal only with a little quantity of clear pale yellowish urine. Microscopically, both the kidneys revealed identical histological alterations. The normal architecture of renal parenchyma was altered with the absence of clear cut demarcation of the cortico-medullary junction. The kidneys revealed various sized, multiple

fusiform, round and cylindrical cysts. These cysts formed an irregular honeycomb of spaces separated by varying amounts of cellular and stromal components of the interstitium (Plate 4).

There was severe dilatation of renal tubules with little normal renal parenchyma present interspersed among dilated tubules. These tubules were lined by low cuboidal to flattened squamous or flattened columnar epithelium rarely with papillary projections (Plate 5). Most of the dilated tubules were found to be empty, but some contained a homogenous eosinophilic material. Dilated tubules were sporadically separated by variable amounts of expanded, loose interstitial tissue. The glomeruli were less in number and found altered in histological structure. They were sporadic, small, and often hypoplastic or atrophic, located within a dilated Bowman's capsule (Plate 6). Sometimes severely dilated Bowman's capsule was filled with a slightly eosinophilic, proteinaceous fluid. Occasionally Bowman's space contained mild to moderate amounts of fibrin deposits.

Gross and microscopic lesions observed in the present case of Dumba foetus were found similar to

Plate 3. Cut surfaces of kidney showing numerous fluid filled small cysts throughout the cortex and medulla and accumulation of clear fluid in renal pelvis and in the calyces

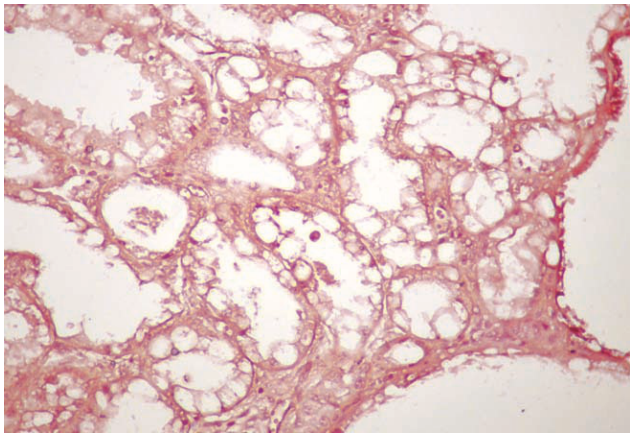

Plate 4. Renal parenchyma showing multiple cysts formed an irregular honeycomb of spaces that were separated by varying amounts of cellular and stromal components of the interstitium (40X)

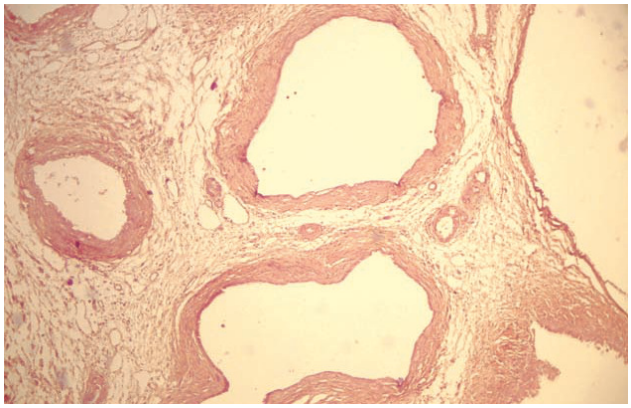

Plate 5. Large cysts in the medullary area destroying the physiologic architecture of the renal cortex. The severely dilated renal tubules lined by low cuboidal to flattened squamous epithelium rarely with papillary projections (40X)

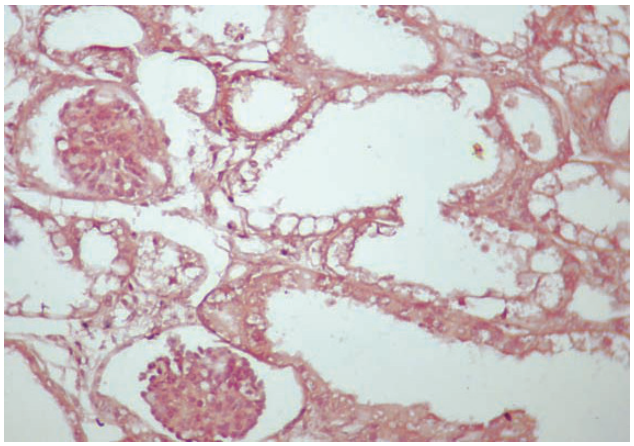

Plate 6. Sporadic, small and hypoplastic glomeruli, located within a dilated Bowman's capsule (40X)

the renal polycystic lesions previously reported by various workers in domestic animals and closely resembles ARPKD seen in young children. A similar case of ARPKD, diagnosed on the basis of clinical and pathological investigation, has been reported in Herrik lamb in the Middle East (Akbari et al., 2012). Johnstone et al. (2005) reported PKD in 25 lambs at a farm in New Zealand and suggested that a related pathogenic and genetic base was consistent with an autosomal recessive disorder. A recent report from Tamil Nadu described PKD lesions in a foetus recovered from dystocia affected primiparous goat (Rajasundaram et al., 2015). Similar renal lesions have also been previously reported in Nubian goat (Krotec et al., 1996), white-tailed deer (Palmer and Carpenter, 2004), Cairn Terriers (McKenna and Carpenter, 1980), White Terriers (McAloose et al., 1998) and in Persian kittens (Crowell et al., 1979). In the present study cystic dilatation in renal tubules was more pronounced in the distal convoluted tubules and collecting ducts. The cystic lesions were also observed in glomerular tufts with hypoplastic or atrophic glomeruli, but with less intensity as compared to the renal tubules. Summerfield et al. (1986) reported variable involvement of renal tubules in congenital PKD. The cysts resulted from the dilatation of the glomeruli was observed only in a few cases (Reindel et al., 1988).

Grossly, the liver was found to be enlarged, pale and friable. Microscopically, light pink colour material was found in the sinusoidal spaces and around the blood vessels. The hepatocytes were swollen and enlarged with clear cytoplasm without nuclear displacement. Vacuolar degenerative changes in hepatocytes were also observed at some places in the parenchyma. Islands of extramedullary haematopiesis were present throughout the section (Plate 7). The congenital cystic lesions of the liver has been consistently observed together with kidney lesions and represent an intricate group of disorders (Palmer and Carpenter, 2004; Gerhauser et al., 2009). The heart chambers were without blood clots. Microscopically, cardiac muscles revealed pale colour oedematous fluid with fibrin into the pericardial and inter-fibrillar spaces. The muscles revealed numerous, small, clear cystic spaces throughout the section (Plate 8). Cardiac abnormalities such as mitral valve prolapse, mitral regurgitation, aortic insufficiency, tricuspid regurgitation and ventricular hypertrophy have been reported in humans affected with PKD (Igarashi and Somlo, 2002). However, the cystic lesions in cardiac muscles observed have not been reported earlier in human and animal PKD.

Thus, gross and microscopic studies of renal cysts along with cysts in other organs confirmed the

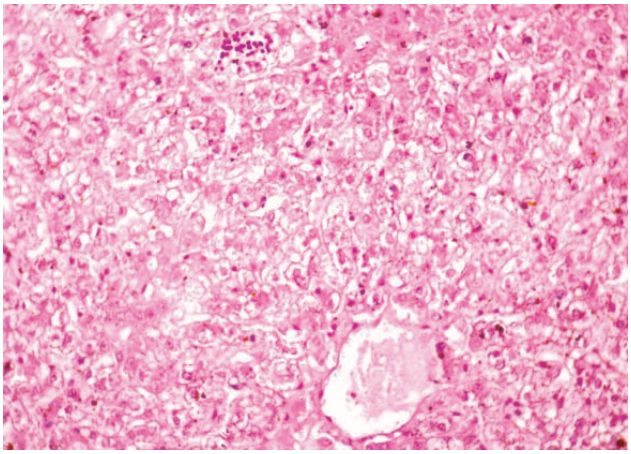

Plate 7. Liver showing swollen and enlarged hepatocytes with clear cytoplasm without nuclear displacement and clear vacuolization (40X)

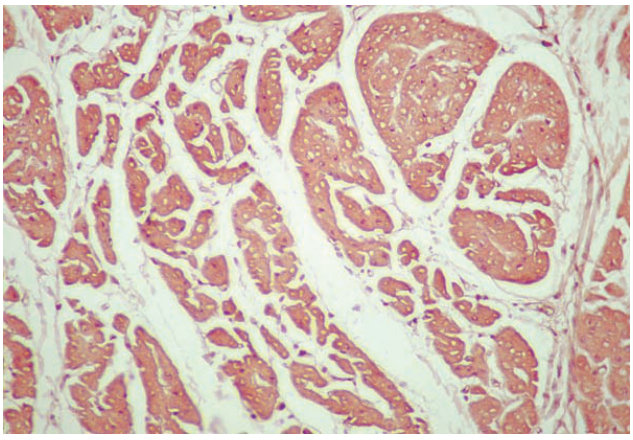

Plate 8. Cardiac muscles with pale colour oedematous fluid with fibrin in to the pericardial and inter-fibrillar spaces and small, clear cystic spaces (40X)

congenital polycystic kidney disease in fat-tailed (Dumba) sheep. The lesions are similar to autosomal recessive polycystic kidney disease occurring in humans; however, genetic studies are required to identify autosomal recessive genes involved in the disease.

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REFERENCES

Akbari, H., Javanbakht, J., Hobbenaghi, R., Dalir-Naghadeh, B., Tavassoli, A., Kamyabi-moghaddam, Z., Jani, M., Golami, S. and Rajabian M. 2012. The first report of clinical and pathological studies of polycystic kidney disease in a Herrik lamb in the Middle East. Journal of Bacteriology and Parasitology 3:138. doi:10.4172/2155-9597.1000139 (accessed on 10.1.2017).

Crowell, W.A., Hubbell, J.J. and Riley, J.C. 1979. Polycystic renal disease in related cats. Journal of the American Veterinary Medical Association 175: 286.

Gerhauser, I., Philipp, U., Distl, O. and Beineke, A. 2009. Multiple cyst formation in the liver and kidneys of a lion (*Panthera leo*): a case of polycystic kidney disease? European Journal of Wildlife Research 55: 433-437.

Igarashi, P. And Somlo, S. 2002. Genetics and pathogenesis of polycystic kidney disease. Journal of the American Society of Nephrology 13: 2384-2398.

Johnstone, A.C., Davidson, B.I., Roe, A.R., Eccles, M.R. and Jolly, R.D. 2005. Congenital polycystic kidney disease in lambs. New Zealand Veterinary Journal 53: 307-314.

Krotec, K., Meyer, B.S., Freeman, W. and Hamir, A.N. 1996. Congenital cystic disease of the liver, pancreas, and kidney in a Nubian goat (*Capra hircus*). Veterinary Pathology Online, 33: 708-710.

Luna, L.G. 1968. Manual of Histological Staining Methods of the Armed Forces Institute of Pathology. 3rd edn., McGraw Hill Book Company, New York, USA, pp 34-157.

McAloose, D., Casal, M., Patterson, D.F. and Dambach, D.M. 1998. Polycystic kidney and liver disease in two related West Highland White Terrier litters. Veterinary Pathology Online 35: 77-80.

McKenna, S.C. and Carpenter, J.L. 1980. Polycystic disease of the kidney and liver in the Cairn Terrier. Veterinary Pathology Online 17: 436-442.

Muller, D.W.H., Szentiks, C.A. and Wibbelt, G. 2009. Polycystic kidney disease in adult Brazilian agoutis (*Dasyprocta leporina*). Veterinary Pathology Online 46: 656-661.

Palmer, M.V. and Carpenter, J.G. 2004. Congenital polycystic kidney in a white-tailed deer (Odocoileus *virginianus*). Journal of Veterinary Diagnostic Investigation 16: 475-477.

Patil, S.B., Paricharak, M.D., Paricharak, D.G. and More, S.S. 2013. Fetal polycystic kidney disease: Pathological overview. Journal of the Scientific Society 40: 106-108.

Rajasundaram, R.C., Sarath, T., Pazhanivel, N. and Balachandran, C. 2015. Dystocia due to congenital polycystic kidney disease (PKD) of foetus in a non-descript doe. Indian Veterinary Journal 92: 70-72.

Reindel, J., Mullaney, T. and Matzat, P. 1988. Polycystic disease of neonatal piglets. Laboratory Investigation 58: 76.

Sakhuja, V. and Kohli, H.S. 2006. End-stage renal disease in India and Pakistan: incidence, causes, and management. Ethnicity and Disease 16: 23.

Summerfield, J.A., Nagafuchi, Y., Sherlock, S., Cadafalch, J. and Scheuer, P.J. 1986. Hepatobiliary fibro polycystic diseases: a clinical and histological review of 51 patients. Journal of Hepatology 2: 141-156.