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Differentiation of the tubular components and collecting duct system of nephron in buffalo kidney during prenatal life

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In literature differentiation of the duct system was reported in goat (Gopinath 1985, Chaudhary *et al.* 2002)) but no work has been reported in buffaloes so the present study was conducted. The present study was made on kidneys of 17 Indian buffalo foetii, collected from pregnant buffaloes slaughtered at abattoir, Saharanpur and from Veterinary Clinics, GADVASU, Ludhiana. The curved crown rump length (CVRL) of the foetal body was measured in centimeters and age of the foetus was calculated by using the formulae given by Soliman (1975). On the basis of CVRL, the foetii were divided into 3 groups i.e. group 1 (3.0 cm to 20.0 cm), group 2 (20.1 cm to 40.0 cm) and group 3 (above 40.1 cm). The tissue of kidneys were fixed in Bouin's and 10% neutral buffered formalin (NBF) fixatives.

After fixation the tissues were processed for paraffin blocks preparation by acetone - benzene schedule and sections of 5–7 µm were cut with rotary microtome. The paraffin sections were stained with hematoxylin and eosin and Masson's trichrome (Luna 1968). The formation of S - shaped vesicles along with metanephric tubules was seen at 3.0 cm CVRL. The tubular segments of nephron were differentiated into proximal convoluted tubules, loop of Henle, distal convoluted tubules and collecting ducts from buffalo foetii of 4.1 cm CVRL onwards.

Proximal convoluted tubules (PCT): The PCT was first observed in the 4.1 cm CVRL foetii. These were first formed in to the juxtamedullary area and then appeared in the intermediate and sub capsular areas of the metanephros in the buffalo foetii at the age of 10.3 cm CVRL onwards. These tubules were lined by simple columnar epithelium in the foetii of 4.1 cm and 5.7 cm. The formation of microvilli (future brush border) at the luminal end of the epithelial cells was first formed at the age of 11.2 cm CVRL. The coiling of PCT also appeared at this age. In the foetii of 23.0 cm CVRL these tubules were lined by simple cuboidal to pyramidal type of cells along with microvilli, which indicated its reabsorptive and secretory activities as reported in goat embryos by Gopinath (1985) and Chaudhary *et al.* (2002).

Loop of Henle: The PCT continue into the medullary ray to become the proximal straight tubule (PST) also referred as the descending thick limb of loop of Henle. This proximal straight part of the tubule differentiated in the kidneys of buffalo foetii at 15.0 cm CVRL in the medullary rays (Figs 1, 2). It was lined by simple columnar epithelium. The epithelium of PST abruptly changed from simple columnar to simple squamous. The thick ascending limb of loop of Henle was demonstrated at the age of 23.0 cm CVRL. Similar findings were reported by Gopinath (1985) and Chaudhary *et al.* (2002) in goat embryos. In present study, loop of Henle was observed to be having thin and thick segment in the medulla and medullary rays of metanephos but occasionally it was also recorded in cortical area. This might be due to the location of subcapsular glomeruli in which the loop did not reach up to the medulla (Banks 1993). The thin segment of the loop was lined by simple squamous epithelium (Fig.4). It is similar to the earlier reports of Gopinath (1985) in goat embryos.

Distal convoluted tubules: The distal convoluted tubules appeared in the buffalo foetii of 4.1 cm CVRL. Some of these tubules were observed nearer to the vascular pole of juxtamedullary glomeruli, which may be responsible for the formation of future macula densa cells. From 23.0 cm CVRL, these tubules were lined by simple cuboidal epithelium with relatively less eosinophilic cytoplasm and had darkly stained nuclei.

In group 3, the DCT had nuclear condensation, which is referred to be as the future macula densa forming the juxtaglomemlar apparatus as reported earlier in goat embryos at 50 days of gestation (Chaudhary *et al.* 2002). Leeson (1957) and Gopinath (1985) also reported the similar type of epithelium of distal convoluted tubules in the embryos of rabbit and goat, respectively. Some of the tubules had more than one layers of epithelium at 21.5 cm CVRL, which

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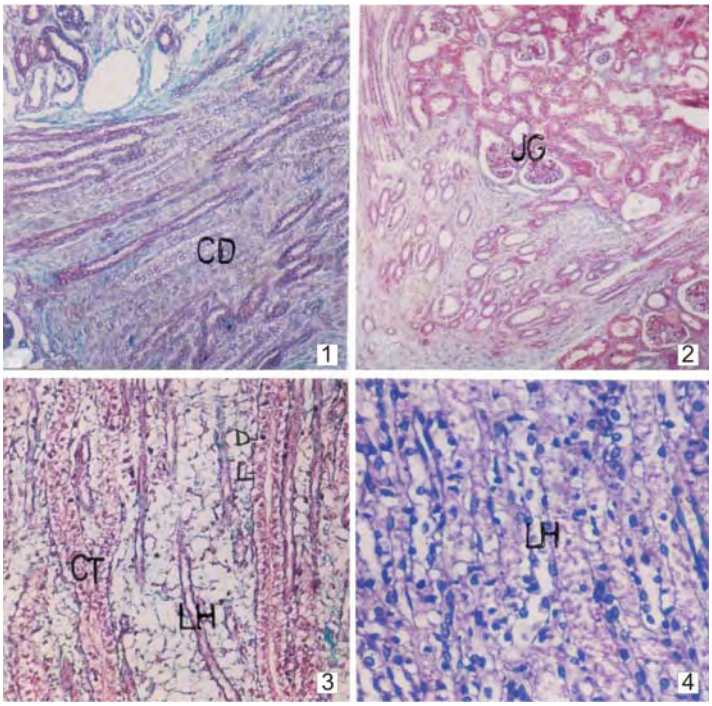

Figs 1–4. **1.** The formation of loop of Henle and collecting ducts (CD) in the medulla of 15.0 cm CRL buffalo foetus. Masson's Trichrome stain×87.5. **2.** The continuation of medulla as medullary rays in between cortex to form renal pyramid in 18.0 cm CRL buffalo foetus. Two adjoining juxtamedullary (JG) glomeruli could also be observed. Masson' s Trichrome stain × 87.5. **3.** The flattened epithelial cells lining the loop of Henle (LH), light (L) and dark (D) epithelial cells of collecting tubules (CT) in 44.0 cm CRL buffalo feotus. Masson' s Trichrome stain×175. **4.** Formation of a bend with bulging epithelial cells into the lumen of loop of Henle (LH) in 75.0 cm CRL buffalo feotus. Hematoxylin and Eosin stain×350.

indicated the process of canalization at this stage that completed afterwards. Similar type of canalization of DCT was also reported in metanephros of goat embryos by Chaudhary *et al.* (2002).

Collecting ducts: After the formation of cortex and medulla, the intra-renal collecting duct from its dorso-lateral surface continued into juxtamedullary areas in the form of medullary rays. The lining epithelium of these collecting ducts was simple cuboidal to simple columnar type with the chromatic nuclei in the apical region. The relative occurrence of these tubules was more in the juxtamedullary area of the cortex and in the medulla. The shape of collecting ducts varied from round to ovoid. The collecting ducts were lined by two types of cells, viz. light cells and dark cells (Fig. 3 as reported earlier by Dellmann (1993). The light cells were more in number as compared to the dark cells. The light cells showed pale cytoplasm which might be due to the lack of many organelles in these cells as reported by Dellmann (1993). These ducts ultimately formed the large papillary ducts which terminated at the renal papilla.

SUMMARY

Differentiation of the tubular components and collecting system of nephron in buffalo kidney during prenatal, was observed and reported in this study. For this study kidneys of 17 Indian buffaloes foetii were used. The tubular segments of nephron were differentiated into proximal convoluted tubules, loop of Henle, distal convoulted tubules and collecting ducts from buffaloes foetii of 4.1 cm CVRL onwards.

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