Journal of Animal Research: v.8 n.5, p. 841-845. October 2018

DOI: 10.30954/2277-940X.10.2018.15

Histochemical Studies on the Metanephros in Foetus of Goat (*Capra hircus*)

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Received: 04 June, 2018 **Revised:** 08 Aug., 2018 **Accepted:** 19 Aug., 2018

ABSTRACT

The present study was conducted on the kidneys of 18 goat foetii to enlighten the histochemical composition of the kidney tissue at different stages of growth. The foetii were divided into three groups based on their estimated ages viz. Group 1 (below 50 days of gestation), Group 2 (between 50-100 days of gestation) and Group 3 (above 100 days of gestation up to full term) containing 6 number of foetii in each group. The capsule in the foetii of group-I showed weak reactions to glycogen which intensified in older foetii. Similarly, the other structural components of the kidney showed enhanced histochemical reactions in regard to basic protein, neutral and acidic mucopolysaccharides and glycogen with advancing gestational age of the goat foetii. It could be concluded that different structural histochemical components of the goat kidney showed enhanced localization with advancing prenatal age.

Keywords: Histochemistry, Metanephros, Goat foetus

Kidneys are the main organs of urinary system which are responsible for regulation of fluid volume, acid base balance and electrolyte composition (Banks, 1993). The development of kidney is a complicated process in all the mammals as it develops into pronephros, mesonephros and metanephros (Rouiller and Muller, 1969; Balinsky, 1970; Dyce *et al*., 1987 and Latshaw, 1987). The pronephros and mesonephros degenerated during prenatal life but the metanephros forms in lumbar region and remains on the functional kidney in adults. The development of metanephros started from ureteric bud and nephrogenic blastema during prenatal life (Dubois, 1969; Balinsky, 1970; Carlson, 1985 and Latshaw, 1987). The development of metanephros in animals follows an accelerated time course when compared with the human (Canfield, 1980). Paucity of available literature on the histochemistry of the metanephros in goat foetii prompted this present study.

MATERIALS AND METHODS

The present study was conducted on 18 goat fetuses which were collected from the slaughter houses in and around Jammu city. These foetii were ranged from early pregnancy to near full term. Immediately after collection, the umbilical cords of these foetii were ligated properly and were cleaned with cotton soaked with water to remove the amniotic fluid. The weight of each foetus was recorded with the help of analytical balance. The approximate age of the foetuses were calculated by putting the body weight values in the formula postulated by Singh *et al*. (1979) for estimation of age in goat foetuses as mentioned below:

Formula for estimation of foetal age in goat (Singh *et al.,* 1979).

$$W^{1/3} = 0.096\ (t - 30).$$

Where, W = body weight of foetus in gm.
t = age of the foetus in days.

The collected foetii were then divided into three groups based on their estimated ages viz., Group I (below 50 days), Group II (between 50 to 100 days) and Group III (above 100 days of age), each group containing at least 6 number of foetii in each group. After estimation of age, the kidneys were used for the histochemical studies.

The kidneys were fixed in 10% neutral buffered formalin solution (Luna, 1968). The tissue pieces from the kidneys were processed for paraffin block preparation by alcohol-benzene schedule (Luna, 1968). Tissue sections of 5-6 mm thickness were obtained from these blocks on clean glass slides with the help of rotatory microtome and subsequently subjected to staining with various histochemical methods viz. McManus method, Bromophenol Blue, PAS method and Alcian Blue method (at pH 1.0).

RESULTS AND DISCUSSION

Glycogen

The capsule of group-I of foetii showed weak reactions to glycogen. However, the glomerulus and renal pelvis (Fig. 1) exhibited a moderate to strong reaction. The parietal and visceral layers of the Bowman's capsule and the loop of Henle showed moderate reactions to glycogen. Again, the proximal and distal convoluted tubules, arched collecting tubules, straight collecting tubules and papillary ducts exhibited moderate to strong reactions to glycogen. Comparable histochemical reactions to various components of the metanephros in goat foetii of alike prenatal ages were also reported earlier by Chaudhary (2001).

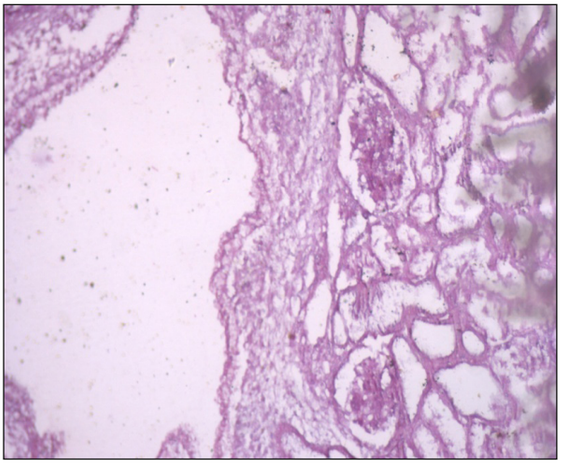

Fig. 1: Photomicrograph of the kidney of 50 days old goat foetus showing reactions to glycogen in the renal pelvis, Mc Manus method, 100X

In group-II, the kidney (metanephros) of these foetii, the capsule showed a moderate to strong reactions to glycogen. Again, the glomerulus and parietal and visceral layers of the Bowman's capsule showed intense and moderate reactions, respectively (Fig. 2). In the present study, the proximal and distal convoluted tubules, loop of Henle, arched collecting tubules, straight collecting tubules and papillary ducts exhibited strong reactions to glycogen. The juxta glomerular cells, renal pelvis, macula densa and renal stroma showed similar kind of reactions as the previous group.

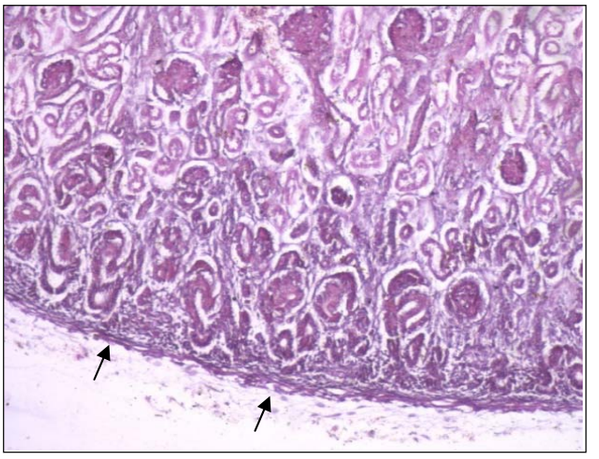

Fig. 2: Photomicrograph of the kidney of 62 days old goat foetus showing reactions to glycogen in the renal capsule (arrows), Mc Manus method, 100X

The capsule showed moderate to strong reactions to glycogen in group-III. Again, where the glomerulus was intensely reactive to glycogen, the parietal and visceral layers of the Bowman's capsule showed moderate reactions. The proximal and distal convoluted tubules, loop of Henle, arched collecting tubules, straight collecting tubules and papillary ducts exhibited strong reactions to glycogen. Longley (1969) reported that glycogen was seen in infra nuclear zone of the epithelial cells lining the proximal convoluted tubules in goat embryos of mid gestation and onwards. The juxta glomerular cells and renal pelvis exhibited strong reactions while the macula densa was intensely reactive to glycogen. The renal stroma also showed moderate to strong reactions the glycogen.

Basic Proteins

In group-I, the capsule showed weak reactions to basic proteins in the present investigation. Similarly,

the glomerulus and parietal and visceral layers of the Bowman's capsule showed strong and weak to moderate reactions to basic proteins, respectively (Fig. 3).

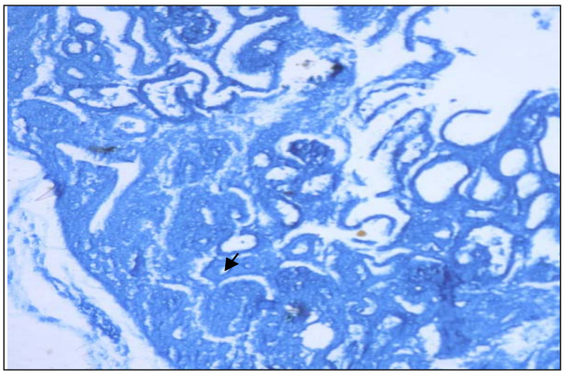

Fig. 3: Photomicrograph of the kidney of 46 days old goat foetus showing reactions by Bowman's capsule to basic proteins (arrow), Bromophenol Blue method, 100X

Again, the proximal and distal convoluted tubules, loop of Henle, arched collecting tubules, straight collecting tubules and papillary ducts exhibited moderate to strong reactions to basic proteins. These findings are in agreement to the findings of Chaudhary *et al.* (2002) and Gopinath (1985). However, Suman and Bansal (2007) reported that the capsule, glomeruli, proximal and distal convoluted tubules showed weak to moderate reactions, whereas loop of Henle did not show any reaction to basic proteins in the metanephros of buffalo foetii of 3 cm to 18 cm CRL, which could be compared to the present findings.

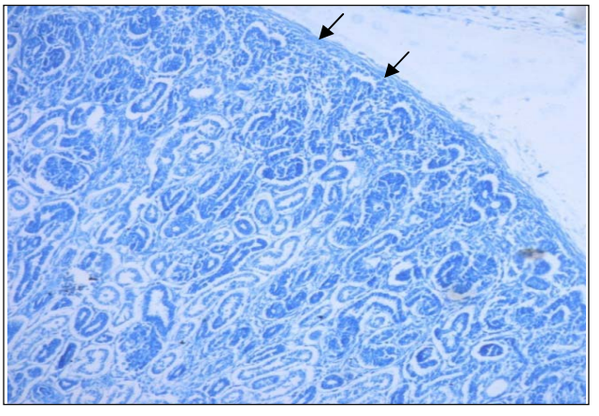

Fig. 4: Photomicrograph of the kidney of 50 days old goat foetus showing reactions by renal capsule to basic proteins (arrows), Bromophenol Blue method, 100X

In group-II, the capsule showed moderate reactions to basic proteins (Fig. 4). Again, the glomerulus and parietal and visceral layers of the Bowman's capsule showed strong and weak to moderate reactions to basic proteins, respectively. The proximal and distal convoluted tubules, loop of Henle, arched collecting tubules, straight collecting tubules and papillary ducts exhibited moderate to strong reactions to basic proteins. The juxta glomerular cells were moderately reactive to basic proteins. Similar histochemical reactions were also seen in the glomeruli, capsule, proximal and distal convoluted tubules of the metanephros in buffalo foetus of 21.5 to 32.5 cm CRL (Suman and Bansal, 2007).

In these goat foetii of group-III, the capsule showed a moderate to strong reactions to basic proteins. The glomerulus exhibited an intense reaction. Again, the parietal and visceral layers of the Bowman's capsule, the proximal and distal convoluted tubules, loop of Henle, arched collecting tubules, straight collecting tubules and papillary ducts exhibited strong reactions to basic proteins (Fig. 5). The juxta glomerular cells were moderate to strongly reactive to basic proteins. Such intensification of histochemical reactions to various components of the metanephros was also reported in buffalo foetii at later stages of gestation (Suman and Bansal, 2007).

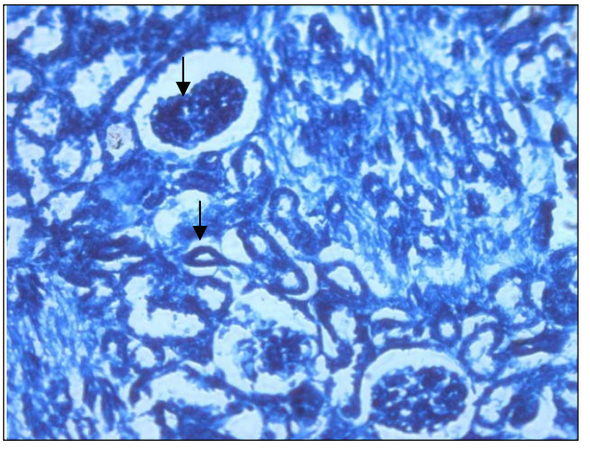

Fig. 5: Photomicrograph of the kidney of 121 days old goat foetus showing reactions to basic proteins (arrows), Bromophenol Blue method, 200X

Neutral mucopolysaccharides

In the present study, the capsule showed a moderate

reaction to neutral mucopolysaccharides in the fetuses of group-I. Similarly, the glomerulus and parietal and visceral layers of the Bowman's capsule showed moderate to strong and moderate reactions to neutral mucopolysaccharides, respectively. The renal capsule in general exhibited weak to moderate PAS positive activity in different post natal ages in buffalo (Chugh, 1971). The proximal convoluted tubules showed moderate to strong reactions while the distal convoluted tubules, loop of Henle, arched collecting tubules, straight collecting tubules, papillary ducts, renal pelvis, macula densa and renal stroma exhibited moderate reactions to neutral mucopolysaccharides. It may be correlated with the secretory and reabsorptive activities of these tubules (Banks 1993). Chaudhary (2001) also reported similar findings in goat foetii.

In group-II, all the compartments of the foetal kidney (metanephros) showed almost similar reactions to neutral mucopolysaccharides as the previous group except the juxta glomerular cells was moderately reactive to neutral mucopolysaccharides (Fig. 6). The macula densa showed PAS positive reaction in the cytoplasm of the cell as also described by Vensa and Spomenka (1980) in rats.

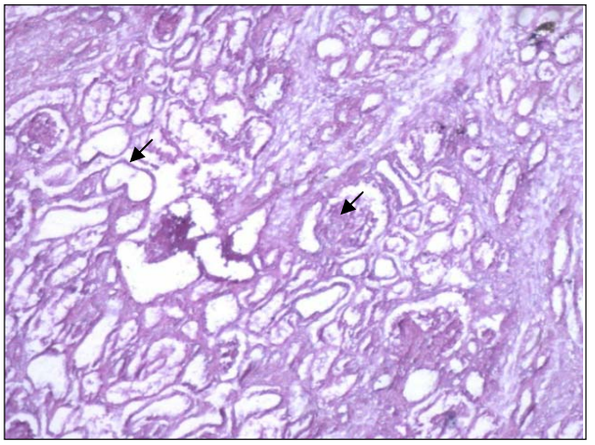

Fig. 6: Photomicrograph of the kidney of 62 days old goat foetus showing reactions to neutral mucopolysaccharides (arrows), PAS method, 100X

In these goat foetii of group-III, the capsule showed moderate reactions to neutral mucopolysaccharides. The glomerulus exhibited an intense PAS reaction (Fig. 7). Similarly, an extensive PAS positive reaction was also reported in microvilli of luminal surface of PCT in rat kidney (Dellman, 1993). Chaudhary *et al*. (2002) also reported an intense PAS-positive reaction in the PCT of goat foetii. The arched collecting tubules, straight collecting tubules and papillary ducts exhibited moderate to strong PAS reactions. The renal pelvis and macula densa showed strong reactions to neutral mucopolysaccharides, while the juxta glomerular cells and renal stroma exhibited moderate to strong PAS reactions.

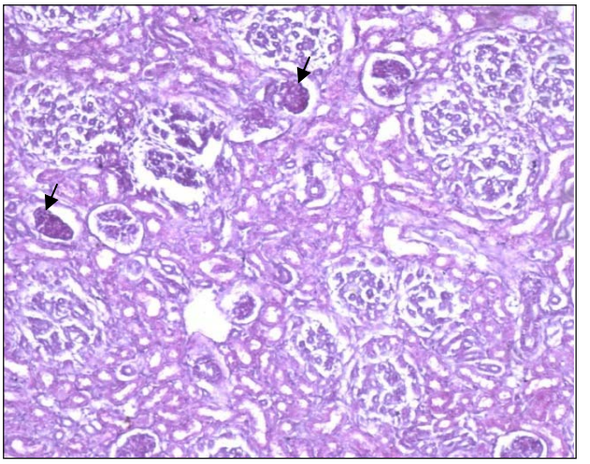

Fig. 7: Photomicrograph of the kidney of 134 days old goat foetus showing reactions to neutral mucopolysaccharides, PAS method, 100X

Acidic mucopolysaccharides

In the present study, the capsule showed a weak reaction to acidic mucopolysaccharides in group-I. However, the glomeruli exhibited a moderate to strong reaction. The parietal & visceral layers of the Bowman's capsule and proximal convoluted tubules showed moderate to weak reactions while the distal convoluted tubules exhibited moderate reactions to acidic mucopolysaccharides. These findings are in agreement to the findings of Chaudhary *et al*. (2002) and Gopinath (1985) who also observed similar reactions of acid mucopolysaccharides in the various components of foetal goat kidneys.

In group-II, the capsule showed moderate to strong reactions to acidic mucopolysaccharides (Fig. 8). The glomerulus exhibited a strong reaction. The parietal and visceral layers of the Bowman's capsule and proximal convoluted tubule were moderate to strongly reactive. These findings are in corroboration with those of Suman and Bansal (2007) in buffalo foetii. Again, distal convoluted

tubules, loop of Henle, arched collecting tubules, straight collecting tubules and papillary ducts exhibited moderate reactions to acidic mucopolysaccharides. The renal pelvis and macula densa showed moderate to strong reactions to acidic mucopolysaccharides, while the juxta glomerular cells and renal stroma exhibited moderate reactions. These findings are similar to the findings of Chaudhary *et al*. (2002) in goat foetii of similar gestational age.

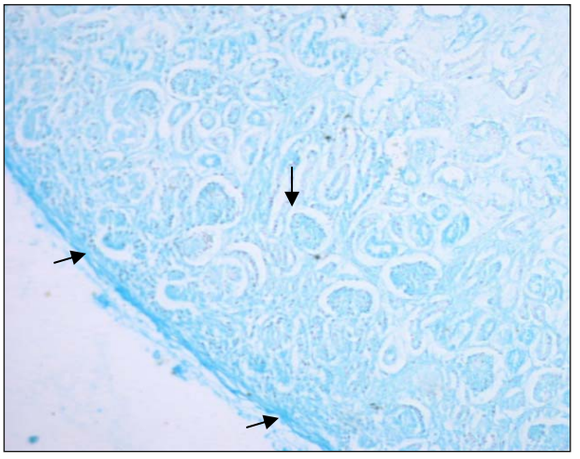

Fig. 8: Photomicrograph of the kidney of 82 days old goat foetus showing reactions to acidic mucopolysaccharides, Alcian Blue method, 100X

In group-III, all the compartments of the foetal kidney (metanephros) showed almost similar reactions to acidic mucopolysaccharides as the previous group.

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