The hepatic tissue has a great capacity of regeneration and compensation for increased metabolic demands. The perusal of literature revealed that a very limited work has been done on the prenatal development of the liver in goat (Singh et al., 2012; 2013). Hence, the present work has been done to elucidate the histogenesis of liver in the prenatal goat.

MATERIALS AND METHODS

For this research purpose, 18 goat embryos/foetii were collected from the gravid uteri of apparently healthy goats from the aborted/clinical cases arriving at the hospital. These embryos/foetii ranged from early pregnancy (17 days) to near full term were divided into three groups. Each embryo/foetus was measured for its crown rump length (CRL) in centimeters with the help of nylon tape and weighed in grams with the aid of an analytical balance. The age of the embryos/foetii was determined according to the formula derived by Hugget and Widdas (1951) for mammals in general, and Singh et al. (1979) in goat. These embryos/foetii were dissected from ventral side of abdomen to collect tissues for routine processing of light microscopy.

RESULTS AND DISCUSSION

Capsule and stroma: At 0.9 cm CRL (17 days of gestation), a very thin liver capsule was composed of mesenchymal cells and thin reticular fibrils around the hepatocytes (Fig. 1). Differentiating erythrocytes were found in the subcapsular spaces as reported earlier in goat foetus (Kumar et al., 2007; Doley et al., 2006; Purushotam et al., 2006). At 5.8 cm CRL (49 days of gestation), the liver had a very thin connective tissue capsule made up of fine collagen fibrils and mesenchymal cells (Fig. 2). At 8.7 cm CRL (59 days of gestation), the collagen fibres were present in the inner lining of the central vein and blood vessels and in the interlobular connective tissue. Thin reticular fibres were found around the hepatocytes, in capsule and in the blood vessels. At 11.7 cm CRL (69 days of gestation), the thin collagen fibres were present supporting the basement membrane of blood vessels. The fibres were also present in portal area and were extending into liver parenchyma. At 14.6 cm CRL (72 days of gestation), thin collagen and reticular fibres were present in the interlobular connective tissue in addition to previous mentioned places.
Between 17.5 cm-17.7 cm CRL (84-92 days of gestation), well developed collagen in the form of bundles were present in the inter lobular connective tissue and walls of blood vessels. Very thin elastic fibres were present in the elastic lamina of blood vessels as solitary fibrils. At 20.5 cm CRL (92 days of gestation), numerous fibrocytes and mesenchymal cells were present in the stroma. Well developed but thin collagen fibres were observed in the capsule and portal triad area extending into interlobular connective tissue (Fig. 3) as reported by Doley et al. (2006), who observed thin connective tissue capsule made up of mesenchymal tissue and immature collagen and reticular fibres at 90 days of gestation in buffalo.

At 25.3 cm CRL (104-105 days of gestation), the collagen fibres assumed the form of thick bundles in the wall of blood vessels and these were thin in central vein (Fig. 4). At 28.9 cm CRL (126 days of gestation), the reticular fibres formed a fine network around the hepatocytes. The branched and anastomosed elastic fibres were present in stroma and endothelial lining of blood vessels. The collagen fibres started to form bundles from 92 days of gestation onwards. The reticular fibres started to form network from 104-105 days onwards. The elastic fibres were solitary at 92 days of gestation and they started branching and anastomosing from 94 days onwards. The number and density of collagen fibres and reticular fibres increased with the advancement of age.

Parenchyma: The appearance of liver primordium at 0.7 cm-1.3 cm CRL (17-24 days of gestation), was as irregular solid strand of hepatocytes separated by broad irregular blood spaces. The primordium was composed of hepatocytes, haemopoietic cells and nucleated RBCs (Fig. 5) along with irregular blood spaces having wide lumen and lined by endothelium. The hepatocytes were arranged in anastomosing cords and were arranged in one, two and three cell thick irregular plates whose cells were polyhedral or quadrangular and at some places rounded in shape. The cell boundry of hepatocytes was indistinguishable. The hepatoblasts contained large basophilic and ecentricaly nucleus and lighter eosinophilic cytoplasm. Their nuclear chromatin was adhered to nuclear membrane and in the form of clumps. The haemopoietic cells were seen as clusters in the liver parenchyma, forming haemopoietic islands or haemopoietic foci. The haemopoietic cells were rounded in shape with deeply basophilic centrally located round nuclei and formed the primary elements of haemopoietic foci. Large multilobular basophilic nucleated and lighter eosinophilic cytoplasmic megakaryocytes cells were seen in between the hepatocytes and haemopoietic cells. The nuclear chromatin of megakaryocytes in the form of clumps was uniformaly distributed. At the periphery, the parenchyma was mostly occupied by blood islands. Numerous mitotic figures were present among the hepatocytes and haemopoietic foci. At some places bi, tri and tetra nucleated cells were observed. Kumar et al. (2007) reported that some of the hepatocytes contained two to four nuclei at 2.5 cm CRL (38 days) in goat. Bile canaliculi were observed at some places between the two hepatocytes.

At 1.1 cm CRL (20 days of gestation), few of the hepatocytes nuclei were in degenerating stage and vacuolization was observed. The number of the blood cells was more than the hepatocytes. At this stage, small capillary spaces in between the hepatic cords were noticed. At 1.3 cm CRL (24 days of gestation), the number of blood cells was fewer than the previous stages. The hepatic parenchyma at 5.8 cm CRL (49 days of gestation), the hepatocytes were present in the form of irregularly arranged 2-3 cell thick plates. Radial arrangement of hepatocytes was also observed at some places. In some hepatocytes two nucleoli were observed. Different cells of haemopoietic series ranging from the erythroblast to granulocytes and large and small lymphocytes were encounterd. The enucleated RBCs were present in the lumen of blood vessels and in the sinusoids indicating the process of maturation of RBCs. Few mast cells were also observed among the haemopoietic cells. Developing central veins and branched, circular, coma and heart shaped blood vessels were present in the hepatic parenchyma. The haemopoietic cells were present in between hepatocytes in the form of circular to irregular foci (Fig. 6). At this stage, blood spaces and sinusoids were also present. Kumar et al. (2007) observed these structures at 0.7-4.0 cm CRL (29-44 days of gestation) in goat foetii. Lobule formation first observed at this stage but due to less amount of interlobular connective tissue it was not so distinct. Mandal et al. (2002) observed indistinct lobulation in the goat foetus of Singh et al.
Fig. 1. Photomicrograph of liver at 0.9 cm CRL (17 days) showing liver primordium with reticular fibres (Rf) in capsule and around the hepatocytes.
Wilder’s reticular stain × 1000

Fig. 2. Photomicrograph of liver at 5.8 cm CRL (49 days) showing collagen fibres (Cf) in the central vein endothelial lining.
Masson’s trichrome × 400

Fig. 3. Photomicrograph of liver at 20.5 cm CRL (92 days) showing collagen fibres (Cf) in the portal triad area.
Masson’s trichrome × 100

Fig. 4. Photomicrograph of liver at 25.3 cm CRL (105 days) showing elastic (Ef) and collagen (Cf) fibres in the blood vessel.
Weigert’s stain × 400

Fig. 5. Photomicrograph of liver at 0.9 cm CRL (17 days) showing sinusoid (S) and blood islands (Bis).
H. & E. × 1000

Fig. 6. Photomicrograph of liver at 5.8 cm CRL (49 days) showing capsule (Cp), haemopoietic foci (hf) and sub-capsular blood space.
H. & E. × 400

Fig. 7. Photomicrograph of liver at 8.7 cm CRL (59 days) showing hepatocytes (Hc) and haemopoietic foci (Hf).
H. & E. × 400

Fig. 8. Photomicrograph of liver at 25.3 cm CRL (105 days) showing monocyte (Mo), mesenchymal cells (Mc), Kupffer cell (Kc) and hepatocytes (Hc).
H. & E. × 1000

Fig. 9. Photomicrograph of liver at 28.9 cm CRL (126 days) showing radial arrangement (Rad) of hepatocyte and central vein (Cv).
H. & E. × 100

5.0 cm CRL (45 days of gestation). Bryden et al. (1972) observed that the foetal sheep liver was divided into lobules at 21-33 days of gestation.

At 8.7 cm CRL (59 days of gestation), the haemopoietic cells were scattered in between the hepatocytes in the form of foci. The hepatocytes were arranged in irregular anastomosing cords. Large megakaryocytes were present in the parenchyma. Numerous developing central veins of different shapes and sizes were present in the liver parenchyma. Radial
arrangement of hepatocytes was observed around the central veins. Numerous developing bile ductules were also observed (Fig. 7).

At 11.7 cm CRL (69 days of gestation), the number of haemopoietic cells was more as compared to previous stages. Differentiating monocytes and lymphocytes among the haemopoietic cells were observed at this stage. Radial arrangement of hepatocytes was present around central vein. At other places, irregular arrangement in the form of one to three cell thick plates was observed. A well developed portal triad comprising of branch of portal vein, branch of hepatic artery and a branch of bile ductule was observed. Kumar et al. (2007) observed portal triad at 67 days of gestation (CRL 13.5 cm) in goat foetus. At 14.6 cm CRL (72 days of gestation), trinucleated cells and mesenchymal cells were observed. At 14.2 cm CRL (80 days of gestation), pentanucleated cells and fibroblasts were also observed.

At 92 days of gestation, the radial arrangement of hepatocytes was present around the central vein. Large and small hepatocytes were also observed. Kupffer cells were observed in the wall of blood vessels and a few in sinusoids. Large and small lymphocytes were also observed. At 20.5 cm CRL (94 days of gestation), well developed radial arrangement of hepatocytes was present around the central vein. At other places, the hepatocytes tended to come in parallel plates. At 25.3 cm CRL (104-105 days of gestation), typical radial arrangement of hepatocytes was observed around the central vein as reported in sheep and goat foetus (Leydyaeva, 1973; Mandal et al., 2002). Haemopoietic activity was more toward the periphery of lobule than the centre. At few places, a few monocytes, mast cell and Kupffer cells were observed (Fig. 8). Portal triad and hepatic lobulation was distinct after this stage.

At 28.9 cm CRL (126 days of gestation), radial arrangement of hepatocytes was well established (Fig. 9). Blood spaces were reduced in size and were few in number. Haemopoietic foci were present at scattered places. At full term stage, round to polyhedral large hepatocytes presented large, round and centrally located nuclei. The occurrence of megakaryocytes was lesser. The liver at this stage resembled to the histological profile of the adult stage.

REFERENCES


