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Micrometry of Liver of Non-descript Goats of Jammu Region in Different Age Groups

Lovish Sethi, Shalini Suri, Kamal Sarma and Jasvinder Singh Sasan*

Division of Veterinary Anatomy, F.V.Sc & A.H., SKUAST-J, R.S., Pura (181 102), India

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Corresponding Author

Jasvinder Singh Sasan

e-mail: jssasan216@gmail.com

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Abstract

The present study was conducted on the liver of non-descript goats of Jammu region during 2019. The samples were divided into young (below 1 year), adult (2–3 years) and senile (4 years and above) age groups as per the dentition. Six samples from each age group were collected. The capsule showed maximum thickness in adult age group. Maximum thickness of capsule was seen at upper part of main lobe (UPOML) in the liver of young, adult and senile age group. The diameter of central vein showed highest values in adult, followed senile group probably due to increased liver functions in adult. Inter-central vein distance was maximum in adult age group followed by young and senile groups. The mean values of length of hepatocytes ranged between 13.50 to 22.50 µm in all regions of liver of irrespective of age groups. The mean values showed higher values in adult and senile age groups. The nuclear diameter of the hepatocytes ranged between 9.00 to 13.50 µm with mean values varying between 9.75±0.50 to 10.50±0.64 µm in all the three age groups. Number of liver lobules per field was maximum at MPOML in senile group (14.16±0.61) whereas minimum number was observed at CL in young (4.41±0.22). Maximum number of portal triads per field was seen at VPOML in senile group (5.16±0.32) whereas minimum number was observed at VPOML in young group (3.08±0.19). In general, number of liver lobules and portal triads per field was highest in senile group followed by adult and young.

Keywords: Age, goat, liver, micrometry

1. Introduction

More than 65% of population in India depends on agriculture for their livelihood. About 10–12% of the rural families are landless and 80% of the land holders are marginal and small farmers, having land less than 2 ha (Anonymous, 2013). In the absence of income from crop production, most of the small farmers maintain different species of livestock with goat being popular among the poorest (Hegde and Deo, 2015). Goats are important livestock species in developing countries. They are among the oldest domesticated species very useful to humans. Research, especially on its anatomy, has been largely neglected (Bhattarai, 2012). As per 20th Livestock Census, the total livestock population is 535.82 million showing an increase of 4.6% over the Livestock Census-2012. The goat population is 148.88 million as per 20th Livestock Census showing an increase of 10.1% over the previous census. About 27.8% of total livestock is contributed by goat. The goat husbandry has been playing an important role in the economy of our country with special reference to milk, meat, manure and

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hide production. Goat milk, meat and other by-products are important nutritional components of human diet (Bhardwaj et al., 2018).

Goat being well conformed and stress resilient animals thrives better in the hilly and other inaccessible areas where it is difficult for other livestock to cope the adversities of terrain and harsh environment, warrants food and economic security of the poor communities (Khan et al., 2013). The UT of J&K being a hilly and temperate state is ideally suited for rearing of goat owing to its favourable agro-climatic and topographical conditions and richness in natural fodder resources in the form of pastures, orchards, aquatic vegetation etc (Tomar and Sharma, 2002). Goat rearing as secondary occupation has played an important role in boosting the economy of these rural people. As crossbreeding has webbed the indigenous breeds from last four decades, attempt was made to find the effect of exotic blood through evaluation of morphometric and performance traits (Manzoor et al., 2019).

The liver (hepar) is an extremely important organ in the body of mammals and vertebrates as it provides functions essential for life. It is the largest internal gland in the body, constituting 1–2% of total adult body weight (Frandson et al., 2009). The liver is the "Jack-of-all-trades" of the body, established in strategic position in the vascular system, obligatory to the digestive system. The liver has numerous functions including production of bile and protein, fat and carbohydrate metabolism. The size of the liver varies due to its role in metabolism. The liver is much heavier in young animals than older animals as it atrophies with age (Dyce et al., 2010). The liver plays a vital role in maintaining blood glucose levels. When blood glucose levels are high, the liver converts glucose to glycogen (glycogenesis) and triglycerides so that energy can be stored until needed. When blood glucose levels drop, the liver can break down glycogen to glucose (glycogenolysis) and release the glucose into the bloodstream. In addition, the liver can convert certain amino acids to glucose (gluconeogenesis), as well as lactic acid to glucose (Akers and Denbow, 2013). Hepatocytes synthesize lipoproteins that carry fatty acids, triglycerides, and cholesterol throughout the body. Cholesterol is synthesized in the liver, and used to make bile salts, (Akers and Denbow, 2013). It also has a role in immunoregulation via kupffer cells and the complement synthesis and metabolism.

Micrometrical information about liver of non-descript goat of Jammu region is meager. Hence, present study was planned with the objective to record the micrometrical data about the liver of non-descript goats during different age groups.

2. Materials and Methods

The present study was carried out in the Division of Veterinary Anatomy, F.V.Sc & A.H., SKUAST-Jammu, India during 2019.

2.1. Collection of samples

Liver samples of non-descript goats were collected from slaughter houses in and around Jammu city. The samples were divided into three age groups i.e. young (below 1 year), adult (2–3 years) and senile (4 years and above) as per the dentition of the goats. Six samples from each age group were collected. Immediately after collection, the liver samples were brought to laboratory in ice. The samples from each group were preserved in 10% neutral buffered formaline for histomorphometrical studies. The micrometrical observations were recorded on Hematoxylin and Eosin stained sections with the help of ocular micrometer duly calibrated with stage micrometer. Different micrometrical observations were recorded at six levels i.e. upper part of main lobe (UPOML), middle part of main lobe (MPOML), ventral part of main lobe (VPOML), caudate lobe (CL), at the level of oesophageal notch (ON) and portal area (PA) in all three age groups. The micrometrical observations recorded were thickness of capsule of liver (µm), diameter of the central vein (µm), inter central vein distance (µm), size of hepatocytes (Length) (µm), nuclear diameter of the hepatocytes (µm), number of liver lobules per field and number of portal triads per field. All the recorded data were put to Standard Statistical procedures (Snedecor and Cochran, 2004) to find Students "t" test using 11.0 version of SPSS software.

3. Results and Discussion

3.1. Thickness of capsule of liver

In non-descript goats the mean thickness of capsule at UPOML was 50.01±7.11 µm, 54.45±3.74 µm and 50.68±6.80 µm in young, adult and senile age group, respectively. The mean thickness of capsule at the level of MPOML was 46.11±1.87 µm, 48.28±2.47 µm and 44.45±4.27 µm in three age groups, respectively. The capsule showed maximum thickness in adult group. Similar pattern was observed at different levels i.e VPOML, CL, ON and PA level. Mean values are given in detail in Table 1. The mean capsule thickness was 58.03±4.87 microns in liver of adult pig (Sasan et al*.,* 2017) whereas Choudhury and Singh (2020) recorded the average thickness of the capsule of liver of sheep during prenatal period which comprised of Group 1 (0–50 days), Group 2 (51–100 days) and Group 3 (101–150 days) of gestation and Group 4 comprised of sheep below one year of age as 6.08±0.18 µm, 9.87±0.15 µm, 11.94±0.60 µm and 41.58±1.52 µm, respectively and suggested a progressive increase in the thickness of the capsule of liver with age.

3.2. Diameter of the central vein

The mean diameter of the central vein at level of UPOML was 93.07±11.13 µm, 109.74±10.94 µm and 94.46±8.29 µm in young, adult and senile, respectively. The mean diameter of the central vein at the level of MPOML was 97.24±16.89 µm, 116.69±13.45 µm and 101.40±13.68 µm in young, adult and senile, respectively. The same at the level of VPOML was 99.40±14.71 µm, 109.29±6.31 µm and 102.02±22.14 µm in young, adult and senile, respectively. At CL, the mean diameter was 98.79±13.58 µm, 109.79±10.42 µm and

Table 1: Micrometrical parameters of different regions of liver of Non-descript goat in different age groups

Different lobes of liver	Thickness of capsule (µm)			Diameter of the central vein (µm)		
	Young	Adult	Senile	Young	Adult	Senile
UPOML	50.01±7.11 (33.34-66.69)	54.45±3.74[b] (33.34-66.68)	50.68±6.80 (33.34-66.69)	93.07±11.13 (50.01-166.70)	109.74±10.94 (66.68-166.70)	91.68±7.25 (50.01-150.03)
MPOML	46.11±1.87[b] (33.34-50.01)	48.28±2.47 (33.34-50.01)	44.45±4.27[b] (16.67-66.68)	97.24±16.89 (50.01-200.05)	116.69±13.45[b] (66.68-216.71)	101.40±13.68[b] (63.34-208.37)
VPOML	44.45±4.45 (33.34-66.68)	51.39±5.96 (33.34-100.02)	41.67±3.24 (33.34-66.68)	99.40±14.71 (33.34-183.37)	109.29±6.31 (66.68-133.36)	102.02±22.14 (50.01-333.40)
CL	47.23±2.78 (33.34-66.68)	47.23±2.78 (33.34-66.68)	41.67±3.24 (33.34-66.68)	98.79±13.58[b] (50.01-200.04)	109.79±10.42 (66.68-166.70)	107.80±14.70 (66.68-233.38)
At the level of ON	46.67±3.24 (33.34-66.68)	47.50±5.74 (33.34-100.02)	41.01±4.10 (33.34-66.68)	96.69±11.96 (50.01-183.37)	103.97±18.96 (66.68-250.05)	101.36±12.97 (66.68-216.71)
PA	45.84±4.17 (33.34-66.68)	48.62±3.81 (33.34-66.68)	43.06±3.21 (33.34-66.68)	97.58±20.90 (50.01-200.05)	107.20±17.42 (83.35-266.72)	99.24±11.01[b] (50.01-166.70)

*Mean with different superscripts with in respective age group (young, adult and senile) in a row differ significantly ($p \leq 0.05$)

107.80±14.70 µm in young, adult and senile, respectively. The mean diameter at the level of ON was 96.69±11.96 µm, 103.97±18.96 µm and 101.36±12.97 µm in young, adult and senile, respectively. At the level of PA, the mean diameter was 97.58±20.90 µm, 107.20±17.42 µm and 99.24±11.01 µm in young, adult and senile, respectively. The diameter of central vein showed highest values in adult, followed by senile and young probably due to increased liver functions in adult. Sasan et al. (2017) recorded mean diameter of central vein in pig liver as 149.25±12.13 microns. Choudhury and Singh (2020) also reported that the average diameter of central vein of liver increased with advancing age in Group 1(0–50) (67.32±2.89 µm), Group 2 (51–100) (102.59±2.03 µm), Group 3 (101-150) (122.85±1.86 µm) days of gestation and Group 4 (140.01±1.70 µm) comprised of sheep below one year of age, respectively and statistical analysed a positive correlation between age and diameter of hepatocytes, as the age increases the diameter of the central vein also increases.

3.3. Inter central vein distance

The mean inter central vein distance at level of UPOML was 640.44±98.28 µm, 797.06±91.15 µm and 611.27±59.62 µm in young, adult and senile, respectively. The same at the level of MPOML was 612.60±56.46 µm in young, 764.02±61.03 µm in adult and 610.16±123.67 µm in senile group. At the level of VPOML, the values were 629.33±99.28 µm, 743.75±56.09 µm and 615.20±87.76 µm in three age groups, respectively. The mean inter central vein distance at the level of CL was 628.25±186.98 µm, 750.69±115.28 µm and 609.32±142.48 µm in young, adult and senile, respectively. At the level of ON, the values for young, adult and senile group were 608.81±78.01µm, 705.97±47.82 µm and 608.00±144.92 µm, respectively. At the level of PA, the values in three age groups were 630.54±147.46 µm, 743.24±102.93 µm and 609.97±165.02 µm, respectively. In present study, the inter-central vein distance was recorded maximum in adult group suggesting bigger size of hepatic lobules in adult group of non-descript goats. Liman (1996) recorded the distance between the two adjacent central veins as 629.77±34.70 µm in the lambs, while 740.00±14.35 µm in adults. This increase was directly proportional to age. Choudhury and Singh (2020) recorded the average inter central vein distance of liver as 140.41±3.99 µm, 264.38±10.83 µm, 295.00±19.62 µm and 402.12±36.44 µm in Group 1(0-50), Group 2 (51-100), Group 3 (101-150) days of gestation and Group 4 comprised of sheep below one year of age, respectively and found a progressive increase in inter central vein distance of liver with age.

3.4. Size of hepatocytes (Length)

The mean values of length of hepatocytes ranged between 13.50 to 22.50 µm in all regions of liver of irrespective of age groups. The detailed values are given in Table 2. The mean values of hepatocytes showed higher values in adult age group. Maximum size of hepatocytes was seen in UPOML of adult group (18.12±0.86 µm) whereas minimum value was seen in UPOML of young group (16.00±0.95 µm). Aziz and Khatra (1985) in sheep reported that diameter of hepatocytes was 16.08±0.30 µm and the ratio between nucleus and hepatocytes diameter was 1:2.1. Similar findings were reported by Khan and Prasad (1989) in black bengal goat where diameter of hepatocytes was 16.30±0.40 µm and the ratio between hepatocytes and nuclei diameter was 1:2.49. Liman (1996) reported the hepatocyte size (long diameter) as 14.32±0.33 and 16.30±0.42 µm in young and adult sheep, respectively. This increase was directly proportional to age. Modekar et al., (2003) in goats recorded the mean values of length of hepatocytes as 16.08±0.02 µm. Choudhury and Singh (2020) observed the average diameter of hepatocytes of liver in Group 1(0–50), Group 2 (51–100), Group 3 (101–150) days of gestation and Group 4 comprised of sheep below

Table 2: Micrometrical parameters of different regions of liver of Non-descript goat in different age groups

Different lobes of liver	Inter central vein distance (µm)			Size of hepatocytes (Length) (µm)		
	Young	Adult	Senile	Young	Adult	Senile
UPOML	640.44±98.28 (450.07-1500.30)	797.06±91.15 (400.04-1250.25)	611.27±59.62 (633.44-1183.57)	16.00±0.95[b] (13.50-22.50)	18.12±0.86[b] (13.50-22.50)	17.00±1.03[b] (13.50-22.50)
MPOML	612.60±56.46 (433.40-966.86)	764.02±61.03 (433.40-1033.54)	610.16±123.67 (420.08-1467.00)	16.10±0.97 (13.50-22.50)	18.00±1.01 (13.50-22.50)	17.42±0.87 (13.50-22.50)
VPOML	629.33±99.28b (416.75-1216.95)	743.75±56.09 (300.06-1033.54)	615.20±87.76[b] (316.73-1250.29)	16.50±0.84 (13.50-22.50)	17.62±1.03 (13.50-22.50)	17.50±0.85 (13.50-22.50)
CL	628.25±186.98 (266.70-1500.30)	750.69±115.28 (200.04-1333.60)	609.32±142.48 (166.70-1750.35)	16.12±0.86 (13.50-22.50)	17.80±0.84 (13.50-22.50)	17.00±1.10[b] (13.50-22.50)
At the level of ON	608.81±78.01[b] (383.43-1416.95)	705.97±47.82 (400.10-1016.87)	608.00±144.92[b] (366.74-1283.69)	16.62±1.03 (13.50-22.50)	18.02±0.98[b] (13.50-22.50)	17.15±1.01 (13.50-22.50)
PA	630.54±147.46 (350.05-1250.35)	743.24±102.93 (333.40-1233.60)	609.97±165.02 (383.43-2667.20)	16.12±0.86 (13.50-22.50)	18.00±0.96 (13.50-22.50)	17.12±0.98[b] (13.50-22.50)

*Mean with different superscripts with in respective age group (young, adult and senile) in a row differ significantly ($p \leq 0.05$)

one year of age was found to be 8.80±0.11 µm, 10.10±0.18 µm, 13.04±0.36 µm and 16.45±0.48 µm, respectively and suggested a progressive increase in diameter of hepatocytes of liver with age. The estimated diameter of hepatic cells in pig liver was 12.86 ± 0.49 micron with a range from 9.25 to 14.80 micron (Sasan et al*.,* 2017).

3.5. Nuclear diameter of the hepatocytes

The nuclear diameter of the hepatocytes ranged between 9.00 to 13.50 µm with mean values varying between 9.75±0.50 to 10.50±0.64 µm in all the three age groups (Table 3). Khan and Prasad (1989) in black bengal goat, Liman (1996) in young and adult sheep and Modekar et al. (2003) in goat recorded the diameter of nucleus as 6.70±0.17 µm, 6.92±0.19 and 6.70±0.17 µm and 7.56±0.01 µm, respectively. The diameter of the nuclei of hepatic cells was 6.65 ±0.48 microns in pig (Sasan et al*.,* 2017).

Table 3: Micrometrical parameters of different regions of liver of non-descript goat in different age groups

Different lobes of liver	Inter central vein distance (µm)		
	Young	Adult	Senile
UPOML	10.12±0.58 (9.00-13.50)	10.12±0.58 (9.00-13.50)	10.05± 0.50 (9.00-13.50)
MPOML	10.50±0.63 (9.00-13.50)	10.12±0.58 (9.00-13.50)	10.50±0.58 (9.00-13.50)
VPOML	10.00±0.63 (9.00-13.50)	10.12±0.58 (9.00-13.50)	10.12±0.58 (9.00-13.50)
CL	9.75±0.50 (9.00-13.50)	9.75±0.50 (9.00-13.50)	10.50±0.64 (9.00-13.50)
At the level of ON	10.12±0.58 (9.00-13.50)	10.12±0.58 (9.00-13.50)	10.12±0.58 (9.00-13.50)
PA	9.75±0.50 (9.00-13.50)	10.50±0.64 (9.00-13.50)	10.12±0.58 (9.00-13.50)

*Mean with different superscripts with in respective age group (young, adult and senile) in a row differ significantly ($p \leq 0.05$)

3.6. No. of liver lobules field^{-1}

The number of liver lobules per field of liver was recorded in all three age groups at 40X. The mean number of liver lobules at level of UPOML was 5.50±0.41, 6.91±0.28 and 8.25±0.46 in young, adult and senile, respectively. The mean number of liver lobules at the level of MPOML was 10.16±0.48, 9.58±0.46 and 14.16±0.61 in young, adult and senile, respectively. At the level of VPOML, the mean number in young, adult and senile group was 5.83±0.44, 8.00±0.60 and 9.75±0.25, respectively. The mean number at the level of CL was 4.41±0.22, 6.41±0.62 and 6.91±0.54 in young, adult and senile, respectively. Number of liver lobules per field was maximum at MPOML in senile group (14.16±0.61) whereas minimum number was observed at CL in young (4.41±0.22).

3.7. No. of portal triads field^{-1}

The number of portal triad per field of was recorded in all three age groups at 40X. The mean number of portal triad per field at level of UPOML was 3.81±0.41, 3.78±0.24 and 3.68±0.37 in young, adult and senile, respectively. The number of portal traids per field was also recorded at different levels i.e. MPOML, VPOML, CL, at levels of ON and PA level and mean values are given in (Table 4). Maximum number of portal triads per field was seen at VPOML in senile group (5.16±0.32) whereas minimum number was observed at VPOML in young group (3.08±0.19). In general, number of portal triads per field was highest in senile group followed by adult and young.

Table 4: Micrometrical parameters of different regions of liver of non-descript goat in different age groups

Different lobes of liver	Number of liver lobules per field			Number of portal traids per field		
	Young	Adult	Senile	Young	Adult	Senile
UPOML	5.50±0.41[b] (3.00-8.00)	6.91±0.28 (6.00-9.00)	8.25±0.46[b] (6.00-11.00)	3.81±0.41 (2.00-5.00)	3.78±0.24 (2.00-5.00)	3.68±0.37 (3.00-6.00)
MPOML	10.16±0.48[b] (6.00-12.00)	9.58±0.46[b] (4.00-11.00)	14.16±0.61[b] (8.00-11.00)	3.38±0.08 (2.00-4.00)	3.16±0.19 (3.00-6.00)	5.00±0.26 (4.00-6.00)
VPOML	5.83±0.44[b] (5.00-9.00)	8.00±0.60[b] (5.00-11.00)	9.75±0.25[b] (4.00-11.00)	3.08±0.19 (2.00-4.00)	4.50±0.26[b] (2.00-6.00)	5.16±0.32 (4.00-7.00)
CL	4.41±0.22 (3.00-6.00)	6.41±0.62 (4.00-10.00)	6.91±0.54 (4.00-10.00)	3.58±0.25 (2.00-5.00)	4.75±0.39 (2.00-6.00)	4.88±0.25[b] (2.00-6.00)
At the level of ON	5.41±0.28 (4.00-7.00)	6.75±0.61 (4.00-10.00)	6.88±0.33[b] (4.00-7.00)	3.75±0.32 (3.00-6.00)	4.93±0.20 (4.00-6.00)	5.08±0.39[b] (2.00-7.00)
PA	5.66±0.35 (4.00-8.00)	6.33±0.33 (4.00-8.00)	8.66±0.35[b] (3.00-10.00)	3.91±0.28 (3.00-6.00)	3.83±0.30[b] (2.00-5.00)	4.33±0.35[b] (2.00-6.00)

*Mean with different superscripts with in respective age group (young, adult and senile) in a row differ significantly ($p \leq 0.05$)

4. Conclusion

Most of the micrometrical parameters such as capsule thickness, central vein diameter, inter-central vein diameter, size and nuclear diameter were maximum in adult age group. This result might probably due to increased liver functions in adult non-descript goats as compared to young and senile groups. In general, number of liver lobules and portal triads per field was highest in senile group followed by adult and young.

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