

Comparative Anatomy of Spleen: Histomorphometric Study in Human, Goat, Buffalo, Rabbit and Rat

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Date of Submission: 20-10-2015

Date of Acceptance: 16-01-2016

Date of Publishing: 23-06-2016

INTRODUCTION

Spleen is largest of all lymphoid organs for immunological defence. [1] The organ was of central interest by many scientists in different mammals for understanding of its immunological role. [2-4] Medical teaching in majority of the colleges is based on animal tissues. Comparative histology not only gives an insight to understanding of the functions of an organ but also explains detail human features even if tissues from lower mammals are available. This crucial fact stimulated recently some scientists to put on record the relative histological features.

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ABSTRACT

Background: Comparative histology not only provides information regarding tissues of different mammals but also gives insight to understand human features in the background of informations on tissue of lower mammals. **Methods:** Splenic tissues from five mammals i.e., human, buffalo, goat, rabbit and rat were processed for histomorphometric study on capsule, trabeculae, lymphoid follicle and central arteriole. **Result:** Buffalo was one mammal having highest values for all the parameters while rat having lowest. Values in human splenic tissues are in between aforementioned maximum and minimum readings. **Conclusion:** Teaching materials are available in histology labs from lower mammals in medical colleges might give an insight for understanding human tissues if literature on comparative histology is made available.

Keywords: comparative anatomy, spleen, histomorphometry, human, goat, buffalo, rabbit, rat.

Alim et. al. [5] did a comparative histological study on the spleen of human, cow and goat and found marked differences. Architectural designs of spleen of domestic and wild animal were different mainly due to the functional reasons. [6] Onkar and Govardhan [7] compared histological difference between human and dog spleen again due to functional reasons.

Present study is an attempt to provide histomorphometric informations of spleen of five mammals i.e., Human, goat, buffalo, rabbit and rat for better understanding at microscopic level of organisation.

MATERIALS AND METHODS

Histological slides used for teaching of undergraduate medical students, Department of Anatomy, J.N. Medical College, A.M.U., Aligarh-202002, UP, India, were used for the present study.

Tissue of spleen from five mammals i.e., human, goat, buffalo, rabbit and rat, all stained with haematoxylin and eosin, were examined under light microscope (student microscope Olympus) with 10 X, each eye piece and objective making total magnification of 100X. Using ocular and stage micrometers thickness of capsule and trabeculae, diameters of lymphoid follicles and central arterioles were measured for all mammals.

Thickness of capsule and trabeculae were taken at 3 sites and then mean values were calculated. Similarly, minimum and maximum diameters for follicles and central arterioles were measured before determining the mean values. Data collected from histological measurements were processed and statically analysis were done by one-way ANOVA test, using the SPSS 21 version.

This research work was approved by ethical committee of J.N. Medical College, A.M.U., Aligarh.

RESULTS AND DISCUSSION

Capsule of spleen of rat was too thin to be measured. Rabbit has got thinnest capsule (33.33 μm) and the difference with rest of the mammals was statically significant [Table 1,2]. Measurements of capsular thickness in goat and buffalo are nearly same i.e., 146.25 μm and 145.50 μm respectively. Some measurements have been reported for splenic capsule of sheep. [8] Value of human capsular thickness (108.00 μm) is less than those of goat and buffalo and more than that of rabbit but the difference is statistically significant in latter only [Table 2]. Alim et. al., mentioned $111.56 \pm 21.45 \mu\text{m}$ as thickness of splenic capsule in human [5] which was very similar to our record. Earlier reported thickness of capsule in goat spleen ($251.44 \pm 12.56 \mu\text{m}$) [5] was quite high as compared to our finding. This may be due to different species in Bangladesh and India. Thickness of capsule in cow (196.88 ± 11.91) reported earlier [5] is also quite high compared to buffalo in our case.

Trabecula of spleen was found to be thickest (109.50 μm) in buffalo and thinnest (30.00 μm) in rabbit [Table 1] and the difference between two was highly significant statistically [Table 3]. The values in human and Goat were nearly same i.e., 75.00 μm and 76.36 μm respectively [Table 1]. Thickness of trabecula ($82.75 \pm 9.7 \mu\text{m}$) reported by Emam [8] was close to our findings in human and goat [Table 1].

Diameters of lymphoid follicles in buffalo and goat were close to each other i.e. 456.00 μm and 503.18 μm respectively (Table 1). Remaining three mammals in our study i.e., human, rabbit and rat have diameters near to each other i.e., 320.63 μm ,324.64 μm and 295.00 μm respectively. The difference between readings of former group of two animals (buffalo and goat) and second group of three mammals (human, rabbit and rat) were highly significant statistically [Table 4] but the ones among the mammals of same group were insignificant statistically [Table 4]. The sole report of Emam [8] regarding diameter of lymphoid follicle of spleen of sheep of Iraq($505 \pm 34.245 \mu\text{m}$) is close to follicular diameters of spleen in animals of first group i.e. goat and buffalo.

Size of central arteriole is largest (55.71 μm) in buffalo and smallest in rabbit and rat (35.00 μm and 36.00 μm respectively). Human and goat have nearly similar sizes of central arteriole i.e. 48.33 μm and 48.75 μm respectively [Table 1]. The later values are less than that of buffalo and more than those of rabbit and rat. The statistically significant difference was noticed only between values of buffalo on one hand and those of rat and rabbit on the other hand [Table 5]. Apparent differences in readings among goat, human, rat and rabbit were not supported by statistical analysis [Table 5]. Similar reports are lacking in literature.

Accurate values of thickness of capsules and trabeculae and diameters of lymphoid follicles and central arterioles will not only help in identifying splenic tissue from different mammals but also give insight in understanding human splenic features even if tissue from lower mammals are available as teaching material.

Table 1: Mean value of different parameters of spleen of Human, Goat, Buffalo, Rabbit and Rat (μm).

Mammal	Capsular Thickness	Trabecular Thickness	Lymphoid Follicular Diameter	Central Arteriolar Diameter
Human	108.00	75.00	320.63	48.33
Goat	146.25	76.36	503.18	48.75
Buffalo	145.50	109.50	456.00	55.71
Rabbit	33.33	30.00	324.64	35.00
Rat	-	-	295.00	36.00

Table 2: Thickness(μm) of capsule of spleen in different mammals.

	Sum of Squares	df	Mean Square	F	Sig.
Between groups	81155.152	3	27051.717	12.105	.000
Within groups	82688.750	37	2234831		
Total	163843.902	40			

A-Anova, B. Multiple Comparisons Bon ferroni

(I)Animal	(J)Animal	Mean difference (I-J)	SE	Sig.
Human	Goat	-38.25	20.24	0.400
	Buffalo	-37.50	21.14	0.506
	Rabbit	74.67	21.72	0.009
Goat	Human	38.25	20.24	0.400
	Buffalo	0.75	20.24	1.000
	Rabbit	112.92	20.85	0.000
Buffalo	Human	37.50	21.14	0.506
	Goat	-0.75	20.24	1.000
	Rabbit	112.17	21.72	0.000
Rabbit	Human	-74.67	21.72	0.009
	Goat	-112.92	20.85	0.000
	Buffalo	-112.17	21.72	0.000

Table 3: Thickness(μm) of trabeculae of spleen in different mammals.

	Sum of Square	df	Mean Square	F	Sig.
Between groups	28169.923	3	9389.974	7.627	0.000
Within groups	41858.945	34	1231.145		
Total	70028.868	37			

A-Anova, B-Multiple comparisons Bonferroni

(I)Animal	(J)Animal	Mean difference (I-J)	SE	Sig.
Human	Goat	1.36	15.77	1.000
	Buffalo	-34.60	16.12	0.234
	Rabbit	45.00	17.05	0.075
Goat	Human	-1.36	16.77	1.000
	Buffalo	-35.96	15.33	0.150
	Rabbit	43.64	16.30	0.068
Buffalo	Human	34.60	16.12	0.234
	Goat	35.96	15.33	0.150
	Rabbit	79.60	16.64	0.000
Rabbit	Human	-45.00	17.05	0.075
	Goat	-43.64	16.30	0.068
	Buffalo	-79.60	16.64	0.000

Table 4: Diameters (μm) of lymphoid follicles of spleen in different mammals.

	Sum of squares	df	Mean square	F	Sig.
Between groups	334069.131	4	83517.283	9.801	0.000
Within groups	340843.369	40	8521.084		
Total	674912.500	44			

A-Anova, B-Multiple comparisons Bon ferroni

(I)Animal	(J) Animal	Mean difference (I-J)	SE	Sig.
Human	Goat	-182.56	42.89	0.001
	Buffalo	-135.38	43.79	0.036
	Rabbit	-4.02	47.77	1.000
	Rat	25.63	44.85	1.000
Goat	Human	182.56	42.89	0.001
	Buffalo	47.18	40.33	1.000
	Rabbit	178.54	44.63	0.003
	Rat	208.18	41.49	0.000
Buffalo	Human	135.38	43.79	0.036
	Goat	-47.18	40.33	1.000
	Rabbit	1.36	45.49	0.062
	Rat	161.00	42.41	0.005
Rabbit	Human	4.02	47.77	1.000
	Goat	-178.54	44.63	0.003
	Buffalo	-131.63	45.49	0.062
	Rat	29.64	46.52	1.000
Rat	Human	-25.63	44.85	1.000
	Goat	-208.18	41.49	0.000
	Buffalo	-161.00	42.41	0.005
	Rabbit	-29.64	46.52	1.000

Table 5: Diameters(μm)of central arteriole of spleen in different mammals.

	Sum of square	df	Mean square	F	Sig.
Between groups	1995.357	4	498.839	5.109	0.003
Within groups	2928.929	30	97.631		
Total	4924.286	34			

A-Anova, B- Multiple Comparisons Bonferroni

(I)Animal	(J)Animal	Mean difference (I-J)	SE	Sig.
Human	Goat	-0.42	4.80	1.000
	Buffalo	-7.38	4.98	1.000
	Rabbit	13.33	5.21	0.157
	Rat	12.33	5.51	0.328
Goat	Human	0.42	4.80	1.000
	Buffalo	-6.96	5.11	1.000
	Rabbit	13.75	5.34	0.151
	Rat	12.75	5.63	0.31
Buffalo	Human	7.38	4.98	1.000
	Goat	6.96	5.11	1.000
	Rabbit	20.71	5.50	0.007
	Rat	19.71	5.78	0.019
Rabbit	Human	-13.33	5.21	0.157
	Goat	-13.75	5.34	0.151
	Buffalo	-20.71	5.50	0.007
	Rat	-1.00	5.98	1.000
Rat	Human	-12.33	5.51	0.328
	Goat	-12.75	5.63	0.310
	Buffalo	-19.71	5.79	0.019
	Rabbit	1.00	5.98	1.000

CONCLUSION

Teaching materials are available in histology labs from lower mammals in medical colleges might give an insight for understanding human tissues if literature on comparative histology is made available.

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How to cite this article: Battan G, Tandon R, Vasenwala SM, Faruqi NA. Effects of Methotrexate on Ovary: An Experimental Study on Albino Rat. *Acad. Anat. Int*. 2016;2(1):28-32.

Source of Support: Nil, **Conflict of Interest:** None declared.