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Original Reserach Article

Study of Diameter Measurement of the White Pulp of Human Spleen in Different Age Groups

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Abstract: In humans, the spleen is a highly compartmentalized organ. The structure, cell population, and functions are unique for each compartment. The red pulp comprises non-filtering lymphoid areas, the perifollicular zone that separates the red and white pulps, the red pulp cord tissue and sinuses, and the perivascular rim. B-follicles and T-cell areas can be found in the white pulp. The obtained specimens were divided into three groups: Group 1 (0 to 14 years), Group 2 (14 to 50 years), and Group 3. (Over 50 years). The results show diminish diameter of white pulp in spleen with aging in G1, G2, and G3 (279.39±50.61, 354.51±39.44, and 222.48± 46.24) respectively. Conclusion, the white splenic pulp's diameter decreases with advancing years.

Keywords: Spleen, white pulp of spleen, compartmentalized.

1- INTRODUCTION

Because of its unique architecture, the interactions between the immunological, reticuloendothelial, and circulatory systems can be significantly influenced by the spleen (Crane *et al.*, 2021). Histologically, the spleen is divvied up into three functionally interconnected sections: the red pulp, which is mostly used for filtration, the marginal zone (or perifollicular zone), and the white pulp, which is primarily used for adaptive immunity, which connects both functions (William and Corazza, 2007). Targeted removal of lymphocytes and supporting cells from the blood by the white pulp enables the spleen to initiate an adaptive immune response. It is separated into follicles comprised primarily of B cells and T lymphocytes that surround the artery (PALS, periarteriolar lymphocyte sheath), along with dendritic cells and macrophages (Brousse *et al.*, 2014). Moreover, blood access the spleen by a central artery that separates into capillaries, certain of which discharge into the filtering beds of the red pulp as open slow microcirculation and others as closed rapid microcirculation in the cords (Del Portillo *et al.*, 2012). The goal of this study is to know the size of the white pulp in the spleen of different ages in Iraqi people.

2- MATERIAL AND METHODS

2-1- Collected Samples

Cross-sectional descriptive research was undertaken in the Department of Human Anatomy based on the collection of postmortem human spleen from deceased corpses being investigated at the Department of Forensic Medicine of Tikrit Medical Faculty, Salah Al Den. The samples were taken between 24 and 36 hours after the death and showed no signs of putrefaction. These are the three groups into which the specimens were divided: Group 1 (0 to 14 years), Group 2 (14 to 50 years), and Group 3 (over 50 years).

2-2- The Diameter of the Spleen's White Pulp is measured

The spleen's white pulp was irregular, making determining the true diameter difficult. To get over this restriction, measurements were taken twice for each pulp, once for the largest transverse diameter and once perpendicular to the first. The number of ocular micrometer divisions was read from the near to far borders of the white pulp. After that,

while maintaining the same magnification (10 objectives, 10 eyepieces), the correlation factor was increased by the quantity of micrometer divisions.

As a result, the diameter of white pulps was determined as follows: Diameter of white pulp = (Maximum transverse diameter + Maximum perpendicular diameter) ÷ 2 The average diameter in mm was then estimated using an ocular micrometer and a stage micrometer conversion measurement (Rayhan *et al.,* 2008).

2-3- Preparing Histological Slides

In a plastic container, the spleens were fixed in 10% formol saline. The inferior border of the spleen is at the bottom and the higher border is at the top of the iron tray where the spleen was inserted. A 3mm-thick slice of tissue was taken from the spleen's hilum by placing a sharp knife there and cutting quickly. During 24 hours, 10% formol saline was used to fix each sample. On the spleen's superior and inferior surfaces, the splenic capsule was then separated. The tissues were rinsed under running water, dehydrated with progressively stronger alcohol, cleaned with xylene, infiltrated with paraffin, and embedded. The paraffin blocks were cut at a thickness of 5mm and stained with the standard Harris' Haematoxylin and Eosin (H & E) stain. For the study, the five finest prepared slides from each group were selected (Suvarna *et al.,* 2018).

2-4- Analysis

One-way ANOVA was used to statistically analyze the recorded data. Statistics considers a P value of 0.05 to be significant.

3- RESULTS

3-1- Diameter Measurement of the White Pulp

3-1-1- Numerical Measurement of the Diameter of White Pulp

The white pulp is made up of lymphatic tissue which is randomly dispersed throughout the splenic pulp. The spleen's white pulp was irregular, which made determining the true diameter measurement difficult. To overcome this limitation, From the close to far borders of the white pulp, the number of ocular micrometer divisions was counted, also for each pulp, measurements were taken twice, once for the greatest transverse diameter and once per-pendicular to the first one. However, there were differences in the groups' white spleen pulp diameters. The results show diminish diameter of white pulp in spleen with aging in G1, G2, and G3 (279.39±50.61, 354.51±39.44, and 222.48± 46.24) respectively. Table 1 shows spleen white pulp the diameter of various groups.

Table 1: Diameter of white pulp between groups and samples

Groups	Samples	Length, Width	Size diameter of white pulp in slide section for five area (µm)					Mean± S.D/Diameter	Mean± S.D/G
			Diam.1	Diam.2	Diam.3	Diam.4	Diam.5		
G1	S1	L, W	265.07	485.99	308.15	422.59	342.12	364.7±89.02	**279.3**±50.61***
	S2	L, W	232.71	259.93	251.74	239.15	244.05	245.5±10.6	
	S3	L, W	266.16	261.78	209.19	331.85	345.73	282.9±55.9	
	S4	L, W	269.53	269.20	239.06	274.18	266.15	263.6±14.03	
	S5	L, W	176.49	193.73	224.64	393.05	212.44	240.08±87.4	
G2	S1	L, W	283.23	265.89	331.70	395.81	285.61	312.4±52.5	**354.5**±39.44*
	S2	L, W	363.24	274.41	435.62	340.58	465.62	375.9±76.3	
	S3	L, W	332.52	372.28	324.19	504.74	51.14	316.9±165.2	
	S4	L, W	352.04	200.61	397.21	379.90	482.69	362.4±102.8	
	S5	L, W	340.66	384.21	385.86	437.97	475.06	404.7±52.2	
G3	S1	L, W	263.16	255.7	278.2	267.63	266.85	266.3±8.1	222.4±46.24****
	S2	L, W	176.6	198.4	180.19	178.4	172.7	181.2±9.9	
	S3	L, W	232.82	225.7	241.02	248.30	242.87	238.1±8.8	
	S4	L, W	161.47	165.4	170.3	170.49	161.05	165.7±4.5	
	S5	L, W	255.25	258.60	262.47	270.77	257.4	260.9±6.1	

*P value: **** P < 0.0001; * P < 0.01; *** P < 0.0006*

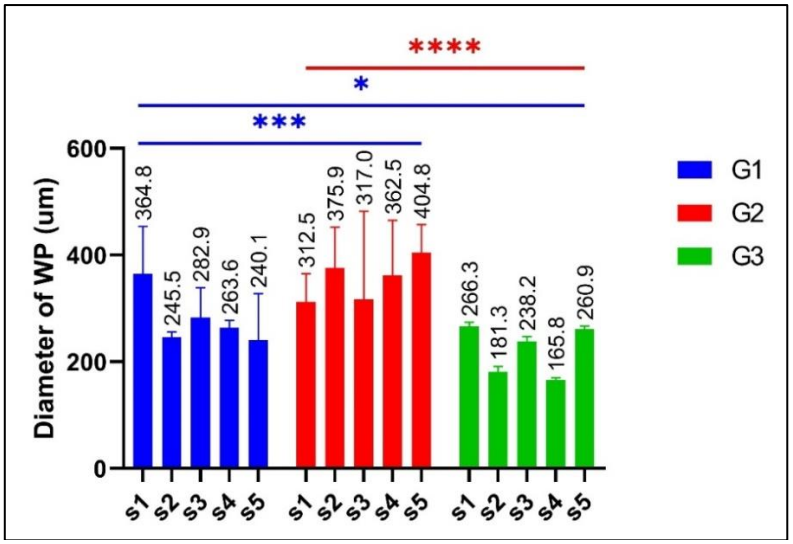

Figure 1: The p-values differences of white pulp the diameter of in different groups and sample. Small number above column represents the mean of each sample, ***** P < 0.0001; * P < 0.01; *** P < 0.0006*.

3-1-2- Histological Measurement of the Diameter of White Pulp

In this investigation, 5 slides from each age group were selected, and a power goal of 10,20X was used to measure the white pulp's diameter.

Histological Diameter of White Pulp of Group 1

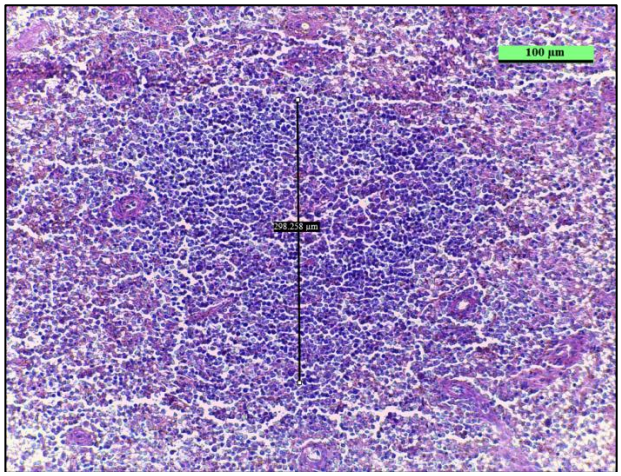

Figure 2: Size diameter of white pulp in group 1/sample 1 (H&E stain, 10X)

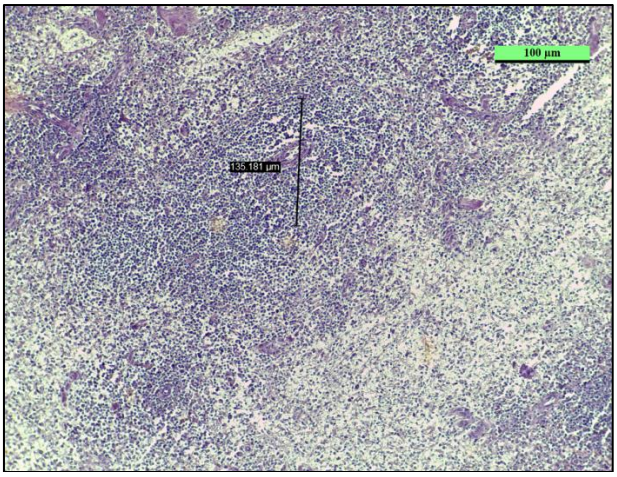

Figure 3: Size diameter of white pulp in group 1/sample 2 (H&E stain, 10X)

Histological Diameter of White Pulp of Group 2

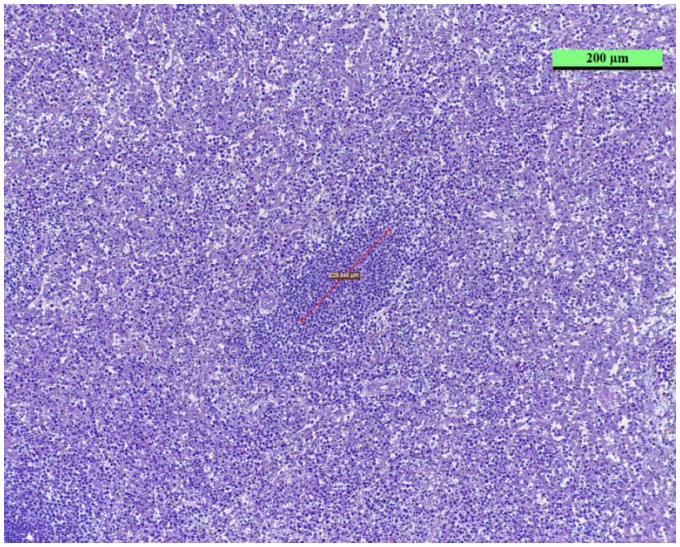

Figure 4: Size diameter of white pulp in group 2/sample 1 (H&E stain, 20X)

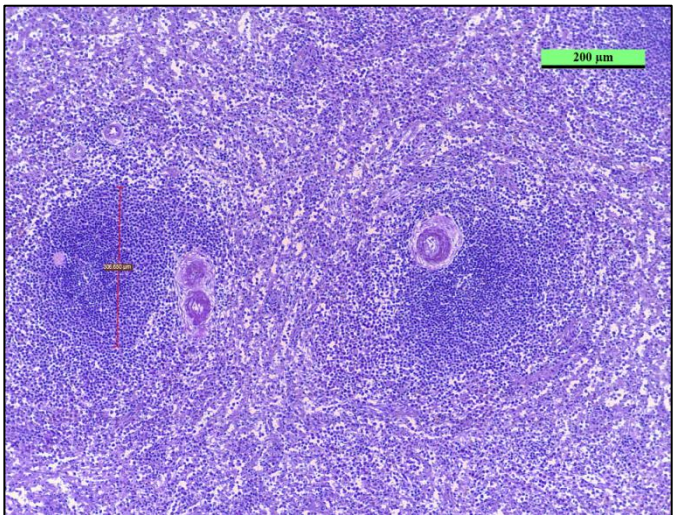

Figure 5: Size diameter of white pulp in group 1/sample 2 (H&E stain, 10X)

Histological Diameter of White Pulp of Group 3

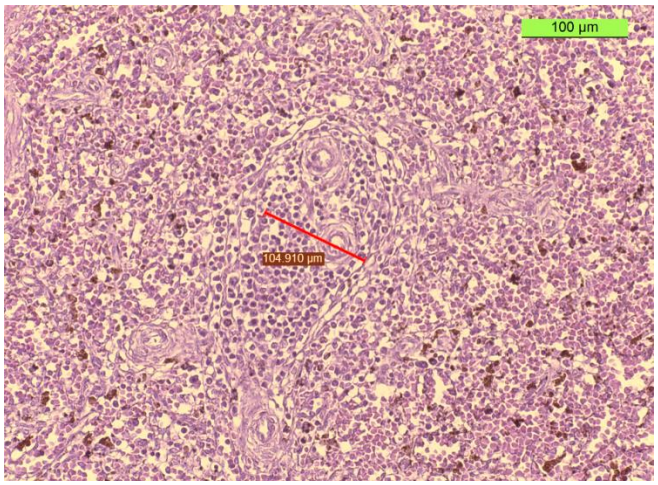

Figure 6: Size diameter of white pulp in group 3/sample 1 (H&E stain, 20X)

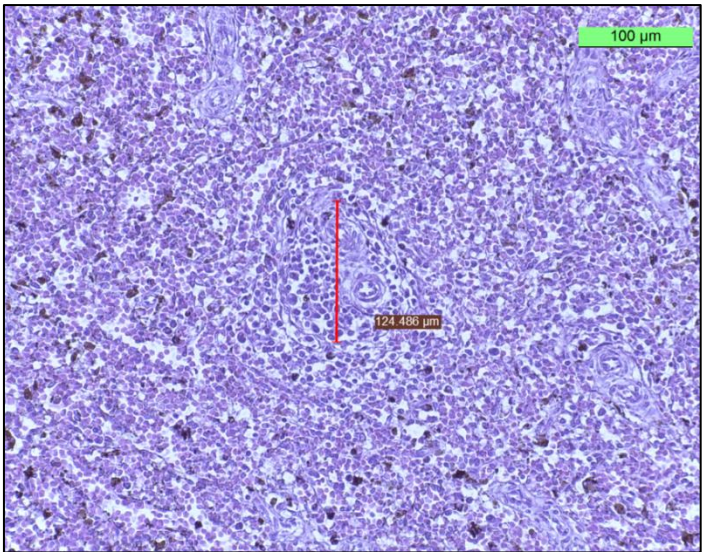

Figure 7: Size diameter of white pulp in group 3/sample 2 (H&E stain, 10X)

4- DISCUSSION

The findings of the current investigation demonstrated that spleen white pulp diameter decreases with aging (table 1), the mean± S.d (279.39± 50.61, 354.51±39.44, 222.48±46.24), in group 1, 2 and 3 respectively. And, these results agreement with (Himamoni and Talukdar, 2016) who reported that the dimensions of the white pulp seen on histological sections, upsurge with age, it peaks around puberty and subsequently involutes. Also, (Roach and Partrick, 2006) who described that the spleen's white pulp achieves its greatest size in the second decade of life and then gradually involutes. A different study also noted that as people age, the white pulp regresses, the number of splenic nodules falls, and the red pulp becomes more noticeable (Leeson *et al.*, 1985). Turner and Mabbott (2017) who reported that the Both the spleen and lymph nodes undergo structural modifications when a human is present. These structural alterations have an impact on how the immune cells within operate, which might ultimately lead to diminished or less effective immune responses. Moreover, the percentages of T lymphocytes rose with age from childhood through maturity before falling (Valiathan *et al.*, 2016).

5- CONCLUSION

In conclusion, the diameter of the white splenic pulp decreases with advancing years, while the red pulp increases with ageing.

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