

ORIGINAL PAPER

Age Related Histological changes of Human Spleen

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Received on July 12, 2016; editorial approval (modified) on September 30, 2016

Abstract

The spleen was a source of intrigue to ancient physician and philosophers. It is the largest lymphoid organ takes important part in body immunity, as high incidences of serious bacterial infections were reported following splenectomy in infancy. A research work was carried out in the department of Anatomy, Gauhati Medical College. The histological characteristics of 21 normal human spleens were studied under light microscope in different age groups and to correlate them functionally. The specimen of spleen varies from newborn to eighty year old cadavers, within stipulated time limit after fulfilling the formalities. The spleens were first washed in normal saline, dried with blotting paper. Tissues were fixed, processed and slides were prepared using standard laboratory procedure of haematoxylin and eosin staining. The size of white pulp that seen on histological sections, increase with age, reach its peak around puberty and then involutes. Sizes of white pulp were measured and then statistically analysed using Student's T-test. P value $d > 0.05$ is considered as statistically significant. The data obtained in this study will help in certain medico-legal practices and will give insight of different clinical presentations. This study may be used as a podium for further sophisticated studies.

Keyword: Human Spleen, White pulp, Red pulp, Marginal Zone

INTRODUCTION

The spleen is the largest of the so called ductless glands. It is functionally connected with blood; since white cells are formed and red cells are destroyed within it.¹ The splenic capsule is rich in elastic fibres in its deeper layers. It contains a few stellate elements beyond the typical fibroblasts.² It is covered by capsule of 1–2 mm thickness. In human the capsule is rich in collagen and contains some elastic fibres with few or no smooth muscle cells and their function is largely related to immunologic protection, hence the human spleen has been categorised as a defence spleen. Many mammals have splenic capsules and trabeculae with abundant smooth muscle cells, which on autonomic stimulation contract to expel large volumes of blood to the general circulation. Such spleen has been described as

storage spleen.³ The splenic sinusoids are supported externally by circumferentially and longitudinally disposed reticular fibres, which are components of the fibrous reticulum.⁴ Macroscopically the spleen appears to consist of discrete 0.5–1 mm white nodules, called white pulp. In the white pulp, the T cell areas surround the central arteries, forming the periarteriolar lymphoid sheath (PALS). These central arterioles are so named because they have a cylindrical cuff of lymphoid tissue around them, the PALS consisting mainly of T lymphocytes. The white pulp is of two types, T cell and B cell, together making upto 5–20% of the total mass of the spleen.⁵ The Malphigian corpuscles are composed of lymphoid tissue gathered up into globular or cylindrical masses of densely packed reticular fibres which envelop the small arterioles.¹ Some small branches of splenic artery leave the trabeculae and their tunica adventitia becomes replaced by a sheath of lymphatic tissue.⁶ These branches are described as arterioles⁷ or small arteries.⁸ Malphigian bodies vary from 0.25mm to 1mm in diameter. With the naked eye, the Malphigian bodies appear as minute whitish dots (white pulp).⁴ The size of the white pulp changes in relation to age, birth to early adulthood, the white pulp forms the greater volume of the spleen, but with increasing age it regresses, the number of splenic nodules decreases, and the red pulp become increasingly prominent.⁹ The follicles usually get atrophy with increasing age and may be absent in very elderly.⁴ The transitional region between lymphoid tissue and red pulp is called marginal zone having a thickness of 80 to 100 micrometer. It is the region of the red pulp that receives the incoming arterial blood, so the blood borne cells and particulate matter first contact the splenic parenchyma. Here, the lymphocytes of the recirculating pool leave the blood of the sinuses to enter the periarterial lymphoid sheath.² Red pulp constitutes the majority (75%) of the total splenic volume.

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It contains large number of venous sinusoids that ultimately drain into tributaries of the major splenic veins.⁴ The cells present in spleen includes erythrocytes, white blood cells and macrophages.⁸ From birth to early adulthood, the white pulp forms the greater volume of spleen, but with increasing age it regresses, the number of splenic nodule decreases and the red pulp become increasingly prominent.¹⁰

OBJECTIVES

- To study histological findings of human spleen in different age groups.
- To compare the histological findings of human spleen in different age groups.

MATERIALS

The study on human spleen was conducted in the department of Anatomy, Gauhati Medical College Guwahati.

Collection of specimen: (i) From the department of Forensic Medicine, Gauhati Medical College, Guwahati, from the cadavers within stipulated time limit after fulfilling the formalities. Care was taken to collect the non-pathological specimens. (ii) From the cases of neonatal deaths in the department of Obstetrics and gynaecology.

Histological Processing and staining of tissue: Then the spleens were first washed in normal saline, dried with blotting paper. Immediately after biometry, depending on the size of spleen, slices were made by cutting the specimen with sharp scalpel in planes passing through hilum to capsule. The sizes of slices were about 3-5 mm thick and 4-5 mm in dimension. The fixation of the slices were done and tissue was processed. The sections of the tissues were stained by routine haematoxylin and eosin according to standard method of Carleton (1957).¹ The stained sections were examined under both low power and high power light microscope to see the capsule, white pulp, red pulp, marginal zone and trabeculae forming the splenic architecture in each age group,

Analysis: The data recorded was analysed statistically using Student’s T-test. P value > 0.05 is considered as statistically significant

RESULTS AND OBSERVATIONS

The results and observations of the present study is tabulated and graphed as follows:

Table 1 Average size of white pulp of human spleen

Age group	Average Size of white pulp in micrometer
Paediatric group (0 to 14 years)	0.425
Adult group (15 to 50 years)	0.569
Geriatric group (More than 50 years)	0.256
SUM	1.239

Table 2 Mean size of white pulp of spleen in different age group

Class interval of different age group	Size of white pulp		
	f (frequency)	fr (relative frequency)	f% (percentage)
Pediatric	0.425	0.334	33.400
Adult	0.569	0.460	46.000
Geriatric	0.256	0.206	20.600
SUM	1.239	1.000	100.000

In **Table 2** for mean size of white pulp of the spleen the highest relative frequency 0.460 is seen in the ‘adult age group’ with a simple frequency of 0.569 and percentage of 46.000 and the lowest relative frequency 0.206 is seen in the ‘geriatric age group’ with a simple frequency of 0.256 and percentage of 20.600 which is evident in **Figure 1**.

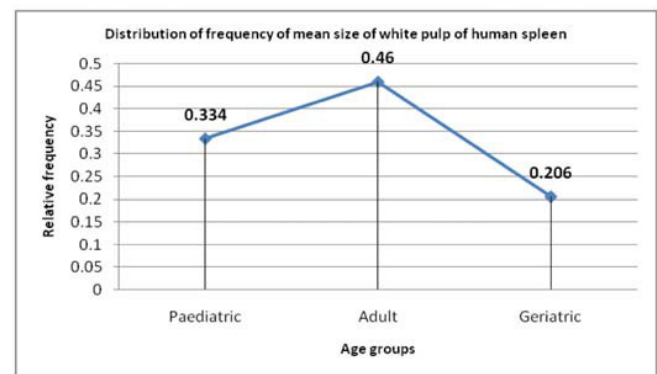


Figure 1 Distribution of relative frequency

Interpretation: After statistical calculation, it is observed that there is positive correlation for size of white pulp (0.98) in relation to age in pediatric age group so there is increase size of white pulp in relation to age but there is negative correlation exist between size of white pulp in relation to age in adult (-0.92) and geriatric age groups (-0.85) that means size of white pulp decreases with increasing age.

Tabulated t for degree of freedom 12 at 1% 5% and 10% level of significance are- $t_{0.01}=3.06$, $t_{0.05}=2.18$ & $t_{0.1}=1.78$

Calculated t between pediatric and adult group=1.155 = statistically not significant. Calculated t between adult and geriatric group= 3.915 = statistically significant. The parameters are statistically analysed by t test and comparisons between pediatric and adult age group found to be statistically not significant but between adult and geriatric age group is found to be statistically significant.

Red pulp: The red pulp in a freshly cut section indicates red blood cells filled areas of spleen .With age, white pulp is replaced by red pulp.

Marginal zone: It is the interphase between white pulp and red pulp. It lies immediately peripheral to white pulp. From birth to early adulthood, the white pulp forms the greater volume of spleen, but with increasing age it regresses, the number of splenic nodule decreases and red pulp become increasingly prominent,

hence marginal zone also decreases with age. So, immunological activity also decreases with age. In newborn and young child, white pulps are not well formed. So, marginal zone is not fully developed hence, immunity is comparatively low in these age groups. B lymphocytes are the prominent lymphocyte in marginal zone.

DISCUSSION

Studies on microanatomy of spleen in different age groups have been forwarded many by research workers. Observations suggests that, the size of white pulp reaches its maximum dimensions around puberty and it has quite peculiar growth curve.¹¹ That white pulp of spleen reaches its maximum size in second decade of life then gradually involutes.^{9,12,13} In this study emphasis is mainly on measurement of the size of white pulps and red pulp, in histological sections. With increasing age white pulp regresses, the number of splenic nodules decrease and the red pulp becomes increasingly prominent.^{8,9} Our study is consistent with these universal observation.

Size of white pulp of human spleen in different age groups been measured in matched sets of observation using the null hypothesis: Reject H_0 if $P \leq t_a$ when $t_a = t_{0.05}$ setting the level of confidence at 95% probability signifying that if the differences in observation between the matched groups is significant at the level of $P < 0.05$, the hypothesis will be rejected establishing differences in size of white pulp of spleen between the tested groups.

CONCLUSION

In the present study the size of white pulp in pediatric and adult age group found to be statistically not significant but between adult and geriatric age group is found to be statistically significant. Hence, the present study has highlighted the histological changes of human spleen in different ages. The size of the white pulp seen on histological sections, increases with age, reaches its peak around puberty and then involutes. These changes indicate that the chances of infections are more common in very young and elderly persons. This can be correlated clinically, as post splenectomy sepsis is more common in newborn and infants. This study may be used as a pedestal for further sophisticated studies.

Conflict of interest: Nil

Contribution of Authors: We declare that this work was done by the authors named in this article and all liabilities pertaining to

claims relating to the content of this article will be borne by the authors.

Ethical Clearance: Taken from Institutional Ethical Committee.

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