

A MORPHOLOGICAL STUDY ON THE VARIATIONS OF SHAPE AND RELATIONS OF THE FETAL SPLEEN AT DIFFERENT GESTATIONAL AGES

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Abstract

Introduction: The thoracic sympathetic trunk possesses 12 ganglia, one corresponding to each thoracic nerve, it lies anterior to head of ribs or side of the body of thoracic vertebrae. Splanchnic nerves arise from the thoracic ganglia and supply thoracic and abdominal viscera.

Material and Method: The present study included 50 preserved fetus specimens sent for routine autopsy in Department of Anatomy, Government medical college and hospital, Chandigarh. The thoracic and abdominal wall of the fetus was incised, then all organs were removed to expose the sympathetic chain. Morphological observations were noted. Next the thoracic ganglion was removed and fixed in paraffin for the histological processing in different gestational ages.

Observation: The fetus were divided into 4 age group (Group A=11-15weeks, Group B=15+_20weeks, Group C=20+_25weeks and Group D=25 weeks onwards)

Morphological observation: The length of thoracic chain was noted which was directly proportional to gestational age. The number of ganglia showed variability 12 in 22 cases, 11 in 18 cases and 10 in 7 cases. The origin of splanchnic nerves from thoracic ganglia was quite variable.

Histological observation: In group A the neuroblast cells were observed with eccentric nucleus. Presence of satellite cells was noticed in group B surrounding neuroblasts. In group C, some neuroblasts were seen undergoing mitosis whereas others showed more differentiation. In group D mature adult like neuroblasts were seen with processes, satellite cell sheath and perinuclear halo.

Keywords: Thoracic, splanchnic, Fetus, Ganglion, Neuroblast.

Introduction

Among the lymphoid organs, spleen is the largest one with rich blood supply. It serves to filter the blood, shows immune responses to antigens and in fetal life acts as a haematopoietic organ to produce erythrocytes and granulocytes (Eroschenko V et al 2013). It consists of an encapsulated mass of lymphoid and vascular tissue situated in the upper left quadrant of the abdominal cavity between the fundus of the stomach and the diaphragm (Standring S 2008). The spleen appears at about 5th week of intrauterine life as a mesenchymal condensation between the two layers of the dorsal mesogastrium (Moore K.L. et al 2008, Sadler T.W 2012, Schoenwolf B.C 2009). The spleen assumes its definitive morphological form in the 3rd month (Varga I et al. 2009). Between the fourth and fifth month the size of the spleen rapidly increases (Gray H. 1854). At birth the weight of spleen is 13 g. It doubles its weight in the 1st postnatal year and triples by end of 3rd year (Bannister LH et al. 2000, Standring S. 2008). Splenic size changes according to the age and weight. Configuration of the spleen is also variable according to the indentations of the organs including stomach, colon, pancreas, and kidney which are in close relation to the spleen. (Gayer G et al. 2001; Dodds WJ et al. 1990; Rabushka LS et al. 1994; Elsayes KM et al. 2005). In the literature, there is limited research about the morphological parameters of fetal spleen at different gestational ages.

Aims and objectives

The aim of the study was desired to investigate and observe the variations in the morphology of spleen in human fetuses at different gestational ages. The results have been statistically analyzed and correlated with other parameters and the variables are documented in the light of the existing literature.

Materials and methods

The present study was carried out on 100 aborted preserved human fetuses of four different gestational age groups ranging from 11-30 weeks in the department of Anatomy, Government Medical College, 32 Chandigarh sent for routine autopsy. An approval from the research and Ethics committee of Government Medical College, 32 Chandigarh was taken prior to the commencement of the study. Congenitally malformed and macerated foetuses were excluded from the study. The spleen specimens have been categorized into following groups:

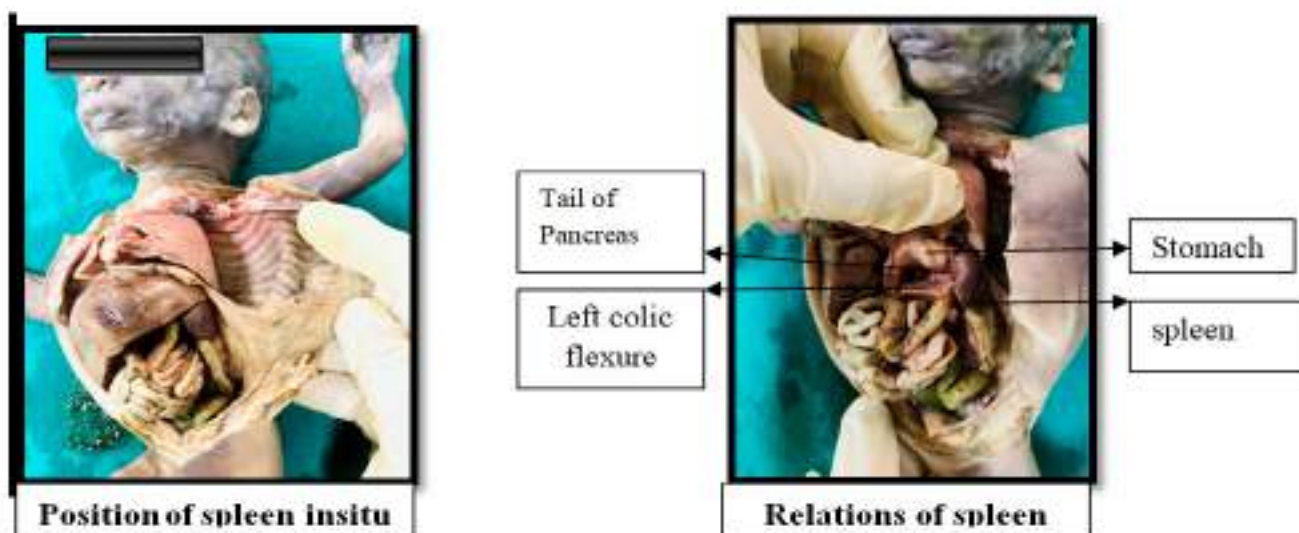
Group I - 11th to 15th gestational weeks.

Group II - 16th to 20th gestational weeks.

Group III - 21st to 25th gestational weeks.

Group IV - 26th weeks onwards

The spleen was exposed after the dissection of fetuses according to Cunningham's text book of Anatomy 12th edition (Romanes GJ. 1981). The position, shape and relations of the diaphragmatic and visceral surface was noted *insitu*. Thereafter, the spleen was removed from its position by dissecting the gastrosplenic and splenorenal ligaments for studying the shape of its hilum.



Gestational age	Groups	Number of Cases
12+ - 16 weeks	A	25
16+ - 21 weeks	B	25
21+- 26 weeks	C	25
26 week onwards	D	25

Table 1: Distribution of fetuses according to their gestational age.

Results:

All the spleens were found in its normal location in the left hypochondric region of abdomen and was intraperitoneal without any variation.

Gestation age group	Shape				Total Count (%)	P
	Tetrahedral	Triangular	Wedge	Segment of orange		
12+ - 16 weeks (A)	17(68%)	2(7.7%)	2(7.7%)	4(15.4%)	25(100.0%)	0.014
16+ - 21 weeks (B)	15(60%)	3(12.5%)	0(0.0%)	7(29.2%)	25(100.0%)	
21+- 26 weeks (C)	21(84.0%)	3(12.0%)	1(4.0%)	0(0.0%)	25(100.0%)	
26 week onwards (D)	9 (36.0%)	7(28.0%)	4(16.0%)	5(20.0%)	25(100.0%)	
Total	62(62.0%)	15(15.0%)	7(7.0%)	16(16.0%)	100(100.0%)	

Table 2: Shape of the fetal spleen in all the gestational age groups.

Concerning the shape of fetal spleen, 4 different shapes of spleen have been observed. Tetrahedral shaped spleen was seen in the majority of the fetuses (62%) whereas the wedged shape spleen was found only in 7 fetuses (7%). Two other shapes were also noticed i.e segment of an orange in 16% of cases and wedge shaped in 15% of cases. Splenic shape and size varies according to the age and weight. The organs which are in close relation to the spleen including stomach, colon, pancreas, and kidney may alter the configuration of the spleen. No association was found in the different shapes of the fetal spleen with that of the gestational age.

Gestation age group	HILUM				Total	p
	V-shape	Longitudinal	Irregular	Triangular		
12+ - 16 weeks (A)	2(8%)	17(68%)	3(12%)	3(12%)	25(100.0%)	0.363
16+ - 21 weeks (B)	0(0.0%)	20(80%)	4(16%)	1(4%)	25(100.0%)	
21+- 26 weeks (C)	1(4.0%)	15 (60.0%)	7(28.0%)	2(8.0%)	25(100.0%)	
26 week onwards (D)	0(0.0%)	18(72.0%)	6(24.0%)	1(4.0%)	25(100.0%)	
Total	4(4.0%)	69(69.0%)	20(20.0%)	7(7.0%)	100(100.0%)	

Table 3: Distribution of sample according to the Hilum in different gestation age groups

Out of 25 spleens in group A longitudinal shaped hilum was observed in maximum number of cases that is 17 which is followed by triangular (3), irregular (3) and V-shaped hilum (2). In group B, 80% had longitudinal shaped hilum, while 16% had irregular shaped hilum and 4% cases had triangular hilum. In group C, it was found that longitudinal shaped hilum was seen in 15 cases followed by irregular in 7, triangular in 2 and V shape in just 1 case. Similarly

in group D, longitudinal hilum was noticed in maximum number of cases (18) followed by irregular shaped hilum in 6 cases and triangular in minimum number of cases (1). Although longitudinal shaped hilum was found in maximum number of cases but variation in shape of hilum with changing age groups was found to be insignificant ($p=0.363$).

Gestation age group	Liver			Total (Count(%))	p
	Absent (Count(%))	Partially Overlapping (Count (%))	Overlapping (Count (%))		
12+ - 16 weeks (A)	6(23.1%)	10 (42.3%)	9(34.6%)	25(100.0%)	0.38
16+ - 21 weeks (B)	13(52.0%)	6(24.0%)	6(24.0%)	25(100%)	
21+- 26 weeks (C)	11(44.0%)	7(28.0%)	7 (28.0%)	25(100.0%)	
26 week onwards (D)	10(40.0%)	11(44.0%)	4(16.0%)	25(100.0%)	
Total	39(39.0%)	35(35.0%)	26(26.0%)	100(100.0%)	

Table 4: Distribution of sample according to the impression of liver in different gestation age groups

In 39 cases, the liver did not have any contact with spleen while it was in contact in remaining 61 cases. The percentage of non-contact cases (52%) was highest in group B (16-20 weeks of gestation). In 35% of the cases liver was partially overlapping spleen that is only left lobe of liver is covering the spleen. The percentage of spleens with partially overlapping liver was maximum in group D (above 26 weeks of gestation). In 26 cases out of 100 the left lobe of liver was completely overlapping spleen reaching till midaxillary line. The maximum number belongs to group A that is initial period of

development. In 100% cases, the tail of the pancreas was in contact with the visceral face of the.

In all cases, stomach and spleen have been established to be in contact with each other and spleen was located on the left and posterior according to the stomach. When we looked for the relation of the large intestine, it has been established that in 96% cases, left colic flexure was in contact with the spleen and not in contact in the rest 4% cases. These four cases belongs to Group A ranging from 12-16 weeks (at the early periods of fetal development).

Gestation age group	Suprarenal		Total (Count(%))
	Absent (Count (%))	Present (Count (%))	
12+ - 16 weeks (A)	0(0.0%)	25(100.0%)	25(100.0%)
16+ - 21 weeks (B)	3(12%)	22(88%)	25(100.0%)
21+- 26 weeks (C)	5(20.0%)	20(80.0%)	25(100.0%)
26 week onwards (D)	2(8.0%)	23(92.0%)	25(100.0%)
Total	10(10.0%)	90(90.0%)	100(100.0%)

Table 5: Distribution of sample according to the suprarenal in different gestation age groups

For the relation of left kidney with the spleen, there was contact in 45% cases while there was no contact in 55% cases. With the increase of gestational age, percentage value of contact was also increased. In all cases, left kidney was located posterior, inferior and medial to the spleen. The left suprarenal gland was in contact with the spleen in 90% of the cases and was located posterior, inferior and medial to the spleen. In 43% of the spleens, both renal as well as suprarenal impressions were found which fall in the category of group B and C ranging from 16-26 weeks of gestation. In all cases, the diaphragm was in contact with the spleen located superior and lateral to the spleen.

Discussion:

Review of the literature suggests that there are very few studies regarding position, shape and visceral relations of fetal spleen. According to Ungor et al. 2007 and studies done by Saheb et al. 2014 and Ramanujan et al. 2016, all the spleens were located in left hypochondrium of abdomen. In our study also, all the spleens were located

in left hypochondrium and were intraperitoneal. In the present study, the relation of spleen with neighboring viscera was different as compared to adult spleen except its relation with the stomach and diaphragm which followed adult pattern. The relation of spleen with large intestine varied with gestational age. Left colic flexure was in contact with spleen in 96 % cases which belong to group A of our study. Similar to our finding in a study done by Ungor et al. 2007 large intestine was in relation with spleen in late second and third trimester and it was not in contact in first and early second trimester cases.

Regarding the relation of spleen with tail of pancreas, Skandalakis et al and Soyluoglu et al reported that pancreatic tail was in contact with spleen in all the cases they studied, though the position of tail varied with age of foetus. In another study, pancreatic tail was in contact with spleen in 93.6% of cases (Ungor et al. 2007). While in our study tail of pancreas was in contact with spleen in 100% of cases.

Srivani et al. (2019) conducted a study out of 40 spleen, 21 spleen

(52.5%) were wedge or segment of an orange, 14(35%) were tetrahedral, 3(7.5%) were triangular, one spleen showed twisted segment of an orange shape and one oval in shape respectively (2.5%) but in our study spleen was tetrahedral in maximum number of cases (62%) and wedge shaped in 7 cases, in 15 cases it was triangular and in 16% cases it was segment of an orange shape.

To the best of our knowledge, there is only one study regarding the shape of fetal splenic hilum by Ungor et al who reported longitudinal hilum in 69.5% cases, triangular in 20.6% cases, 2.8% had irregular shape and 2.8 % having V shaped hilum. In our study we also found 69% cases having longitudinal hilum, 7% cases it was triangular, in 4% cases it was V shaped and in 20% cases it was irregular in shape. We did not find T or bow shaped hilum in our study as was reported by Ungor et al in 4.2 percent cases.

Conclusion

The morphological study of fetal spleen provide necessary details to sonologist to access the stages of growth of the spleen in utero. Awareness of morphological variations, antenatal detection and diagnosis of splenic anomalies are helpful to elucidate developmental defects, early diagnosis and elicit treatment of intrauterine infections. The present study is of great importance to the clinicians, radiologists, Hematologists, surgeons and paediatric surgeon while performing surgical procedures on spleen.

References:

- Bannister LH, Spleen- haemolymphoid system, in: Williams P L, Bannister L H, Berry M M, Collins P, Dyson M, Dussek J E, Ferguson M W J. (Eds.), Gray's Anatomy, 38th edition, Churchill Livingstone. Harcourt publishers Ltd, Edinburgh UK, 2000. 1437–1442. [5]
- Dodds WJ, Taylor AJ, Erickson SJ, Stewart ET, Lawson TL. Radiologic imaging of splenic anomalies. *Am J Roentgenol*.1990; 4(155): 805–810.
- Elsayes KM, Narra VR, Mukundan G, Lewis JS, Menias CO, Heiken JPMR imaging of the spleen: spectrum of abnormalities,” *Radiographics*.2005; 4(25): 967–982.
- Eroschenko V, Fiore M (2013). DiFiore's atlas of histology with functional correlations. 12th ed.: Wolters Kluwer Health/Lippincott Williams and Wilkins Philadelphia.256.
- Gayer G, Zissin R, Apter S, Atar E, Portnoy O, Itzhak Y. CT findings in congenital anomalies of the spleen. *Brit. J. Radiol*. 2001;74(884): 767–772.
- Gray H. On the Structure and Uses of the Spleen, John Parker and Sons, London. 1854.
- Herald Ellis. Clinical Anatomy. Blackwell publications. 2002;110-13.
- Moore KL, Persaud TVN, Torchia MG. The Digestive System. The Developing Human: Clinically Oriented Embryology, eighth ed., Elsevier publication, New York, New Delhi.2008;224.
- Rabushka LS, Kawashima A, Fishman EK. Imaging of the spleen: CT with supplemental MR examination. *Radiographics*. 1994;2(14): 307–332.
- Romanes GJ (1981). Cunningham's Text Book of Anatomy, 12th Ed. Vol II, Oxford University Press (oxford); 144-158.
- Sadler TW. Langman's Medical Embryology, twelfth ed., Wolters Kluwer, Lippincott Williams & Wilkins, Philadelphia.2012;213.
- Schoenwolf BC, Bleyl SB, Brauer PB, Francis PH. Spleen in: the Development of the Gastrointestinal Tract. *Larsen's Human Embryology*, ninth ed., Elsevier Churchill Livingstone, Philadelphia. 2009;454.
- Shaik Hussain Saheb, Subhadra Devi Velichety, Haseena S. Morphological And Morphometric Study of Human Foetal Spleen. *Int J Anat Res*.2014;2(1):234-238.
- Singh R, Kumari G. Morphological assessment of human foetal spleen. *Asian J Biomed Pharmaceut Sci*.2016;6(52):19-21.
- Skandalakis P, Colborn GL, Skandalakis LJ, Richardson DD, Mitchell WE, Skandalakis JE. The surgical anatomy of the spleen. *Surg Clin North Am*.1993;73(4):747–767.
- Soyluoglu AA, Tanyeli E, Marur T, Ertem AD, Özkuo K, Akkân SM. Splenic artery and relation between the tail of the pancreas and spleen in a surgical anatomical view. *Karadeniz Tıp Dergisi*.1996;9(2):103– 107.
- Srivani D, Pillai JJ. A study of histology & histogenesis of fetal spleen at different gestational ages. *Int J Med Biomed Stud*. 2019;3(12):74-78.
- Standring S. Spleen. Gray's Anatomy. The Anatomical Basis of the Clinical Practice, 40th edition, Elsevier Churchill Livingstone, Edinburgh.2008; 1239–1244.
- Ungor B, Malas MA, Sulak O, Albay S (2007). Development of spleen during the fetal period. *Surg Radiol Anat*.2007; 29(7):543-50.
- Varga I, Galfiova P, Adamkov M, Danisovic L, Polak S, Kubikova E, Galbavy S, Congenital anomalies of the spleen from an embryological point of view. *J Med. Sci. Monit*. 2009;15(12):269--276.