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SONOGRAPHIC SPLENIC SIZES IN NORMAL ADULT NIGERIAN POPULATION

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ABSTRACT
This study aimed to establish ultrasonic splenic dimensions which can be used as normogram for adult Nigerians.

250 adult subjects were scanned prospectively using a 3.5MHZ ultrasound sector probe. The splenic length, width and thickness were obtained in the supine position and the weight calculated using Downey's formula. Differences in splenic dimensions were determined using Z test, while the relationship between the splenic dimension and the subjects age, BMI, and height were analysed using Pearson Moment Correlation.

The normal splenic sizes obtained ranged from 9.9 -11.5cm (length - L), 6.0-7.5cm (Width W) and 4.0- 4.5cm (thickness -T). The splenic dimensions for males were 11.1 $\pm$ 0.7cm (L), 7.3 $\pm$ 0.2cm (w) and 4.2$\pm$ 0.2cm (T). The corresponding values for females were 10.6 $\pm$ 0.7cm, 6.8 $\pm$ 0.5cm and 4.2 $\pm$ 0.2cm respectively; thus showing a statistically significant difference between the males and females ($P < 0.05$). A poor correlation was shown to exist between splenic dimensions and age but splenic weight increased with body weight ($r=0.75$). Even though value of the splenic sizes were similar to those of a Caucasian population compared with them ($P>0.05$), the maximum splenic weights occurred in the 4th decade in Nigerians and in the 2nd decade in Caucasians. This finding appears to bear credence to existing opinion by Chauhan et al that splenic recession rather than splenomegaly is prevalent in adults living in endemic falciparum zones.

Statistically significant differences between splenic length and weights of the sexes have been established by the study. The good correlation between subject height and splenic length portends profound options of predicating subjects splenic size and matching his ultrasound values with this predicted splenic length (SPL = 1.2 + 0.063)

ABSTRAIT
Cette étude a visé à établir les dimensions spléniques ultrasoniques qui peuvent être employées comme normogram pour des nigériens d'adulte.

250 sujets d'adulte ont été balayés pour l'avenir en utilisant une sonde de secteur des ultrasons 3.5MHZ. La longueur splénique, la largeur et l'épaisseur ont été obtenues en position en supination et le poids a calculé en utilisant la formule de Downey. Des différences dans des dimensions spléniques ont été déterminées en utilisant Z - examinez, tandis que le rapport entre la dimension splénique et les sujets vieillissent, BMI, et la taille ont été analysées en utilisant

la corrélation de moment de Pearson.

Les tailles spléniques normales ont obtenu étendu de 9.9 - 11.5cm (longueur - L), 6.0-7.5cm (largeur - W) et 4.0 - 4.5cm (épaisseur - T). Les dimensions spléniques pour des mâles étaient 11.1 + 0.7cm (l), 7.3 + 0.2cm (w) et 4.2+ 0.2cm (T).

Les valeurs correspondantes pour des femelles étaient 10.6 + 0.7cm, 6.8 + 0.5cm et 4.2 + 0.2cm respectivement ; de ce fait montrant une différence statistiquement significative entre les mâles et les femelles ($P < 0.05$). Une corrélation faible a été montrée pour exister entre les dimensions spléniques et l'âge mais le poids splénique accrus avec le poids corporel ($r=0.75$). La valeur des tailles spléniques étaient semblable à ceux d'une population caucasienne comparée à elles ($P>0.05$) cependant, les poids spléniques maximum se sont produits dans la 4ème décennie dans les nigériens et dans la 2ème décennie dans les Caucasiens.

Le normogram établi peut être employé comme modalité complémentaire à l'évaluation clinique et en tant que des moyens plus sensibles d'évaluer et d'interviewer des patients pour des désordres spléniques.

INTRODUCTION

The spleen responds to different pathologic states by dimensional changes. Diseases like malaria and sickle cell disease with a geographical bias are known to cause changes in splenic sizes[1]. Indeed Chauhan et al[2] concluded that splenic recession rather than splenomegaly is prevalent in adult patients who have suffered from malaria or who live in endemic falciparum zones. A rapid increase in splenic size, secondary to sequestration of red blood cells, platelets and other haematological elements, was observed in neonates on extracoporal membrane oxygenation(ECMO)[3]

Ultrasound has made possible, direct visualization and assessment of abdominal organs. It is a cheap imaging modality that is realistic for developing nations. Prior to the advent of ultrasonography and other tomographically based imaging modalities, it was difficult to image the spleen. Clinical evaluation of the splenic size is difficult and unreliable due to the spleen being concealed in its anatomic location under the ribs and considerable enlargement needing to occur before the spleen is clinically palpable[4].

Arkes[5] had noted that a palpable spleen is not necessarily enlarged. This view was supported by Gerspacher et al[4] who compared ultrasonography and splenic palpation for evaluation of size changes and concluded that abdominal palpation was a poor method for estimation of splenomegaly.

Nigeria is situated in the malaria endemic geographical region of the world, where a large population suffers from malaria[4]. Nigeria also ranks second in the world in incidence of the sickle cell trait. Loftus et al[6] inferred that racial differences in splenic length could result in incorrect interpretation of the splenic size. No published work on splenic size assessment by sonography was found to have been done on a Nigerian population in the reviewed literature.

A normogram of splenic sizes based on a normal Nigerian population would provide more reliable values that would confidently detect minimal changes in splenic size and thus predicate early splenic pathology.

MATERIALS AND METHODS

Subjects were recruited from referrals for abdominal or pelvic ultrasound scans to

the Radiology Department of the University of Nigeria Teaching Hospital between July 2003 to October 2004.

The hospital receives referrals from both the southern and northern parts of the country. From an initial of 3,000 subjects enlisted within the study period, only 250 met the inclusion criteria. These included subjects who had, no fever either at the time of scan or four weeks prior, who had no splenic resection, and no recurring illness on haematologic disorders that may compromise the splenic size. Subjects further qualified to be included if they had laboratory tests to exclude MP and check their haematological status as part of their medical work-up by the managing clinician, and been scored normal. The women selected were in addition non-gravid and had no recent abortion. All the subjects had their height, weight, age and sex recorded before the scan. Each subject was then scanned using a SONOACE 3200 Ultrasound machine with a sector probe of 3.5 MHZ frequency fitted with an electronic caliper. Longitudinal and transverse scans were performed in the supine position and the length, width and thickness of the spleen were measured. The measurement was then categorized according to age and sex and the splenic weight was calculated using Downey's formula[7]. Z test compared any differences in the splenic sizes between the sexes. Pearson Mount correlation Analysis was used to establish any relationship between splenic sizes and age, height and weight of the subjects.

RESULTS

There were 164 females and 86 males in the study group and the modal age was 30-80year age group as shown in Table 1.

The splenic length for both sexes ranged from 9.9 11.5cm with a mean of 10.9$\pm$ 0.7 as shown in Table 2

The mean splenic length for the males is 11.1$\pm$ 0.7cm while that of the female is 10.6$\pm$ 0.07cm and the difference was statistically significant ($P< 0.05$). The splenic length increased with age till 39years and thereafter showed a decrease with age. There was also a positive correlation between splenic length and subject height.

The splenic width for the study population range from 6.0-7.5cm for both sexes as shown in Table 2
The mean splenic width for males is 7.2$\pm$ 0.2cm and that for the female is 6.8$\pm$ 0.5cm. The splenic width reached maximum size at 39years in males while the maximum width occurred at 49years in females, thereafter, there was a decrease in the width for both sexes.

The splenic thickness for the males is 4.2$\pm$ 0.2cm and that of the female is 4.2 $\pm$ 0.2cm.

The range of the computed splenic weight is 105-158gm for both sexes. However while the mean splenic weight for the males is 145.0$\pm$ 11gm, that for the female is 130$\pm$ 11gm indicating that statistical significant differences between the sexes of $P<0.05$

There was a positive correlation between splenic weight and body weight ($r=0.75$) for those who weighed 60kg and above only.

DISCUSSION

Racial differences in splenic length could result in inaccurate interpretation of the splenic size as noted by Lotus et al[6]. The observation by Loftus et al[6], suggests that a population specific splenic normogram would provide more accurate standards. This is moreso in Nigeria where sickle cell anaemia and falcipanum malaria are prevalent, both of which are documented causes of changes in splenic size.

In this study, the maximum splenic size for the locality is 120 x 80 x 46mm. These values are similar to those obtained in the studies by Bisset et al[8] and Tamayo et al[9] who had 130 x 80 x 30m for Caucasian populations (P >0.05). This suggests that no racial differences exist in splenic sizes. This finding is surprising and important as changes in splenic size are expected to occur in falciparum malaria and sickle cell endemic areas like Nigeria. However, the presence of splenic sizes less than 7.8cm was noted in 2% of our sample similar to the results obtained by Chauna et al[2].

There were statistically significant differences between the splenic lengths of males and females with mean values of 11.1±0.7cm and 10.67±0.7cm respectively (P<0.05). This may be due to the general trend that organ size in males are larger than those of females. The normal splenic length for adults in the locality range from 95mm to 120mm for both sexes and has a positive correlation with subject height (r = 0.65). This relationship was represented by this study in an equation SPL = 1.2 + 0.063H.

This study also showed that the splenic length and width of both sexes increase linearly with age until the middle age with a maximum of 120mm, and thereafter undergoes gradual diminution, a phenomena earlier documented by Diland in 1970[8].

This study also documents that, males attained maximum splenic sizes 5-10 years earlier than the females. For example, while the maximum splenic length occurred at the 39 years age range in males, it occurred at 44 years age in females. Similarly, maximum splenic width is noted at 39 years age range in the male and in the female at 49years. These differences should have implications in the clinical evaluation of splenic sizes.

The use of Downey's formula enabled the conversion of measured splenic dimensions to splenic weight. The splenic weight so calculated showed a positive correlation with subject body weight (r = 0.75) only for subjects with weight greater the 60kg. The normal Splenic weights range from 103-150gm for both sexes with mean values of 145± 11gm and 130± 11gm for males and females respectively. In the study group the spleen attained maximum weight in the mid-forties whereas among the Caucasian as reported by Deland[10] maximum splenic weight occurs at the 20-29 years age range.

CONCLUSION

This study has been able to establish population specific ultrasonic splenic sizes that can be more reliably used as standards to evaluate splenic disorders in a Nigerian, though a racial bias was not confirmed by our study. However, the authors noted that maximum splenic weights occurred in the 4th decade in Nigerians and in the 2nd decade in Caucasian.

Statistically significant differences between splenic length and weights of the sexes have been established by the study. The good correlation between subject height and splenic length portends profound options of predicating subjects splenic size and matching his ultrasound values with this predicted splenic length (SPL = 1.2 + 0.063)

The established normogram can be used as both a complementary modality to clinical evaluation and as a more sensitive means of evaluating and screening patients for splenic disorders.

TABLE 1: Age and Sex Distribution of the Sample

Age (years)	Males	Percentage	Females	Percentage	Total %
20-24	14	5.6%	25	10%	39(15.6%)
25-29	14	5.6%	21	8.4%	35(14%)
30-34	17	6.8%	40	16%	57(22.8%)
35-39	10	4.0%	26	10.4%	36(14.4%)
40-44	8	3.2%	26	10.4%	34(13.6%)
45-49	7	2.8%	11	4.4%	18(7.2%)
50-54	4	1.6%	4	1.6%	8(3.2%)
55-59	4	1.6%	4	1.6%	8(3.2%)
60-64	4	1.6%	2	0.8%	6(2.4%)
65-75	4	1.6%	5	2.0%	9(3.6%)
Total	86	34.4%	164	65.6%	250(100%)

Table 2: Mean Splenic Length (L), Width(W) and Thickness(T) for both Sexes at 2SD

Age (years)	Males							Females						
	F	L (cm)	SD (cm)	W (cm)	SD (cm)	T (cm)	SD (cm)	F	L (cm)	SD (cm)	W (cm)	SD (cm)	T (cm)	SD (cm)
20-24	14	10.9	0.7	7.2	.22	4.3	.12	25	10.4	.9	6.8	.48	4.0	
25-29	14	11.2	0.96	7.2	.24	4.4	.11	21	10.8	.75	7.0	.40	4.0	.22
30-34	17	11.5	0.8	7.4	0.1	4.3	.08	40	10.8	.94	7.1	.41	4.0	.22
35-39	10	11.5	0.6	7.5	.08	4.2	.11	26	11.0	.7	7.1	.38	4.1	.24
40-44	8	11.2	0.7	7.3	.24	4.5	.15	26	11.2	.85	7.2	1.30	4.5	.18
45-49	7	11.0	0.7	7.1	18	4.2	.6	11	10.7	.84	7.4	80	4.4	.20
50-54	4	10.9	0.4	7.2	15	4.0	.11	4	10.7	.44	7.0	.27	4.4	.20
55-59	4	10.9	0.5	7.2	.16	4.0	.12	4	10.5	.57	6.6	.31	4.1	.16
60-64	4	10.9	0.5	7.4	.23	4.3	.8	2	9.9	.7	6.1	.38	4.0	.13
65-75	4	10.6	0.7	6.8	.14	4.1	0.6	5	9.9	.13	6.0	.40	4.0	.16
Total	86	11.1	0.7	7.25	0.2	4.2	0.17	164	10.6	.07	6.8	0.56	4.15	0.2

Table 3: Sex Distribution of Mean Splenic Weight

Age (years)	Male (gms)	Female (gms)
20 -24	145	122
25-29	152	131
30-34	157	132
35-39	157	138
40-44	158	156
45-49	141	150
50-54	135	140
55-59	134	122
60-64	140	104
65-75	127	103
	Mean = 145 $\pm$ 11gm	Mean = 130 $\pm$ 11gm

Table 4: Relationship between Mean Splenic Length (cm) with Heights (cm) of females of 40-44years old

Subject Height (cm)	Splenic Length (cm)
150-154	10.06
155-159	10.75
160-164	10.75
165-169	11.40
170-174	11.60
175-180	12.50

The table shows relationship between subject height and splenic length. A good correlation of r = 0.65 was noted between subject height (H) and splenic length (Spl).
Spl = 1.2 + 0.063H

Table 5: Relationship between calculated Splenic weight and body weight

Body weight (Kg)	Splenic weight (gm)	
(Kg)	Female	Male
40-49	101	-
50-59	101	-
60-69	119	139
70-79	142	161
80-89	158	204
Mean	124$\pm$ 20gm	168 $\pm$ 13gm

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