

Sudan University for Science and Technology

College of Graduate Studies

**Measurement of Splenic Volume among Healthy Adults in
AlGazera State using Ultrasonography**

**قياس حجم الطحال لدى البالغين الأصحاء في ولاية الجزيرة باستخدام
التصوير بالموجات فوق الصوتية**

*A thesis Submitted for Partial Fulfillment Of Requirement of
M.Sc. Degree in Medical Diagnostic Ultrasound*

By

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الايه

قال الله تعالى:

(قُلْ لَوْ كَانَ الْبَحْرُ مِدَادًا لِكَلِمَاتِ رَبِّي لَنَفِدَ الْبَحْرُ قَبْلَ أَنْ تَنْفَدَ كَلِمَاتُ رَبِّي وَلَوْ جِئْنَا بِمِثْلِهِ مَدَدًا)

سورة الكهف الايه (109)

Dedication

To:

My family

My friends

MY colleague

Acknowledgment

First of all, I Thank Allah the almighty for helping me to complete this project. I Thank Dr .Afra´a Siddig Hassan Omer supervisor for help and guidance. my great fullness for my all teachers in different educational levels. Finally I would like to thank everybody who helped me in this project.

Abstract

This was a cross sectional descriptive study done in Alhasahissa Hospital in Aljazeera state during the period from August 2018 to December 2018. The problem of study was that there were many disease that can affect the splenic volume in Sudanese, specifically malaria in Aljazeera state and no reference value available. The aim of study to measurement of splenic volume among healthy adult in Aljazeera state using ultrasonography. Trans abdominal scan done among 100 healthy adult subjects 47 males and 53 females by using sonoscape ultrasound machine and 3.5MHZ curvilinear transducer probe by using data collection sheet which included many variables splenic length, width, thickness, volume, age, gender, height, weight and body mass index and analysis using SPSS statistical program.

The result which found that the mean value and standard deviation of spleen length, spleen width, spleen thickness and spleen volume about 10.3 ± 1.4 cm, 8.5 ± 1.7 cm, $4 \pm .83$ cm, 195.8 ± 83.2 cm³ respectively. There were statistically differences between male and female in length, width, thickness and volume, 10.4 ± 1.5 , 8.7 ± 1.7 , $4.1 \pm .86$, 202 ± 92.2 for male, 10.2 ± 1.3 , 8.3 ± 1.7 , $3.9 \pm .81$, 189.5 ± 74.5 for female, that mean the men had larger spleen than female there was significant correlation between spleen length and age of subject (p-value 0.03) and no significant correlation between spleen width, thickness and volume with age (p-value 0.6, 0.3, 0.2), and strong correlation of spleen length and spleen volume with height of subject, spleen width and spleen thickness had strong correlation with weight, body mass index had correlation with spleen thickness and volume and no correlation with spleen length and spleen width. Further study with larger sample volume need for more accurate result and malaria patient to know the effect in spleen volume.

ملخص البحث

هذه دراسة وصفية أجريت في مستشفى الحصاحيصا ما بين أغسطس إلى ديسمبر 2018 بولاية الجزيرة وكانت مشكلة هذه الدراسة أن هنالك حالات مرضية تؤثر على حجم الطحال مثل الملا ريا ولا تتوفر لدينا قيمة مرجعية وهدف هذه الدراسة قياس حجم الطحال لدى البالغين الأصحاء في ولاية الجزيرة باستخدام التصوير بالموجات فوق الصوتية أجريت لعدد 100 شخص 47 ذكور و53 أنثى من البالغين الأصحاء تم المسح باستخدام جهاز سونوسكيب للموجات فوق الصوتية. جمعت البيانات وسجلت النتائج في ورقة موضح عليها كل من الجنس، العمر، الطول، الوزن، ووزن كثافة الجسم، طول الطحال، عرض الطحال، سمك الطحال وحجم الطحال وتم تحليل البيانات بواسطة نظام التحليل SPSS .

نتيجة الدراسة أن القيم المتوسطة والانحراف المعياري لطول وعرض وسمك وحجم الطحال كالتالي (10.3 ± 1.4) cm ، (8.5 ± 1.7) cm ، (4 ± 0.83) cm ، (195.8 ± 83.2) cm³ على التوالي. كما أوضحت الدراسة أن هنالك اختلافات بين الذكور والإناث في طول، عرض، سمك وحجم الطحال على النحو التالي (10.2، 10.4)، (8.3، 8.7)، (3.9، 4.1)، (189، 202) للذكور والإناث على التوالي القياسات اكبر عند الذكور من الإناث، كما وجد أن هنالك علاقة قوية بين طول وحجم الطحال مع طول الشخص وكذلك سمك وعرض الطحال مع وزن الشخص أما سمك وحجم الطحال له علاقة مع وزن كتلة الجسم. طول وعرض الطحال ليس له علاقة مع وزن كتلة الجسم. تحتاج ولاية الجزيرة لبحوث أخرى واخذ اكبر عينة لإجراء البحث لتعطي نتيجة أكثر دقة . كما تحتاج إلي دراسات خاصة لمرضى الملا ريا لمعرفة مدى التأثير في قياس حجم الطحال .

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Chapter One

Introduction

Chapter one

1.1 Introduction

The spleen is the largest single mass of lymphoid tissue in the body. It is part of reticuloendothelial system. The spleen plays an important role in the defense of the body. Although it is often affected by systemic disease processes, the spleen is rarely the primary site of disease. Normal measurements for the average adult should be 8-13cm in length, 7cm in width, and 3to 4cm in thickness. . The spleen decreases slightly in size with advancing age, the size of the spleen may vary in size in accordance with the nutritional status of the body. (Sandra et al;2012)

ultrasound is a very useful imaging modality to diagnose or exclude splenic abnormalities and is also extremely helpful in the follow-up of patients with known splenic abnormalities(Rumak et al ;2011).

The spleen is located in the left hypochondrium beneath the 9th to 11th intercostal spaces. although the spleen is well evaluated by computed tomography and magnetic resonance imaging, sonography has certain advantages, including it is easy availability, lack of ionizing radiation and low cost. Sonography of the spleen plays an important role in the diagnosis of the splenic rupture, oncologic differential diagnosis of the focal lesions and follow up examination of the splenic size, shape, location, and parenchyma. On the sonography, the spleen is crescent shaped. its outer convexity is smooth, whereas the inner margin may be indented or nodular. its echo structure is homogeneous, slightly more echogenic than healthy liver tissue and markedly hyperechogenic compared to kidney tissue.

Malaria is a major cause of morbidity and mortality through the world. over all cases of malaria wide occur in Aljazeera Infection by malaria is most common cause of spleen rupture and splenomegaly, it is the main organ that generates the immune response to malaria parasite and control to removal of red blood cells that have been infected. (Hernando A et al; 2011)

this study was designed with an aim to measure the splenic dimensions to find the correlation between spleen length, width, thickness and volume with physical measurements height, weight and body mass index to the people in the aljazeera state.

Some authors studied sonographic splenic sizes to establish an ultrasonic correlation between splenic dimensions, splenic weight, and body weight. Some previous studies showed significant differences between splenic length and weights of the sexes (Hassan M Rezk et al; 2017).

1-2 problem

If the measurement of splenic volume of the people in aljazeera state within the normal range or affected by some disease for example malaria

1-3 Objectives:

1-3-1 General objective:

Measurement of splenic volume of Sudanese in aljazeera state using ultrasonography.

1-3-2 Specific objective:

- 1- measurement of splenic length, width and thickness
- 2- correlation of splenic volume with body parameters age, height, weight and body mass index

1-4 Over view of the study

This study five chapters, chapter one, which is an introduction, statement of the study problem, objective of this study, chapter two includes theoretical background and previous study, chapter three discusses the material and method then chapter four include presentation of the results and finally chapter five consist of discussion, conclusion and recommendation.

Chapter Two

Literature Reviews and Previous Studies

Chapter Two

Literature review

2-1 Theoretical Background

2-1-1 Anatomy of spleen:

The spleen lies in the posterior left hypochondrium between the fundus of the stomach and the diaphragm. The inferomedial surface of the spleen comes into contact with the stomach, left kidneys, pancreas, and splenic flexure. The spleen is normally measured with ultrasound on a longitudinal image from the upper margin (near the diaphragm) to the inferior margin at the long axis. Blood is supplied to the spleen by the tortuous splenic artery that travels horizontally along the superior border of the pancreas. Upon entering the splenic hilum. The splenic vein is formed by multiple branches within the spleen and leaves the hilum in a horizontal direction to join the superior mesenteric vein. The splenic vein travels along the posteromedial border of the pancreas.

The lymph vessels emerge from the splenic hilum, pass through other lymph nodes along the course of the splenic artery, and drain into the celiac node(Sandara et al; 2012)

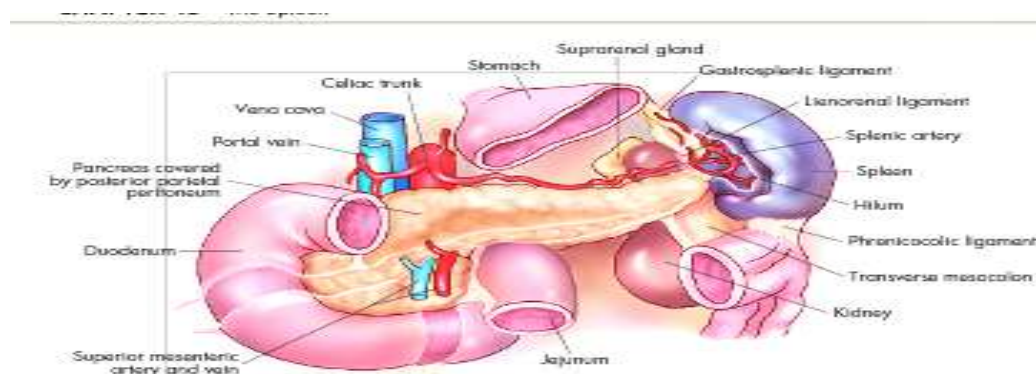


Figure 2-1 Anterior view of the spleen as it lies in the left hypochondrium(Sandara et al 2012)



Figure2-2 cross specimen of the spleen demonstrates its homogeneous texture and shape. (Sandara et al; 2012)

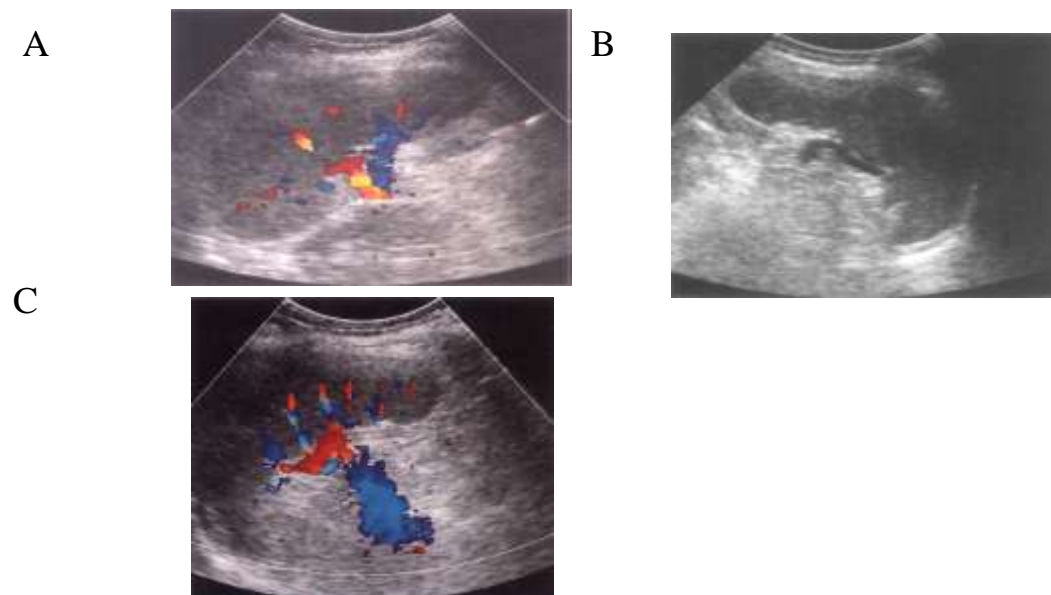


Figure2-3 (A) Left coronal view of the normal spleen demonstrating the main splenic artery and vein at the hilum. (B) Transverse section (TS) demonstrating the splenic vein at the hilum. (C) By increasing the Doppler sensitivity, the intra splenic perfusion can be demonstrated(Jone A 2004)

2-1-2 Physiology of the spleen:

1. Defense against disease
2. Hematopoiesis/erythropoiesis
3. Destruction and removal of flawed red blood cells and platelets
4. Blood reservoir
5. Storage of iron

2-1-3 pathology of the spleen:

2-1-3-1 Splenic variants:

2-1-3-1-1 Accessory spleen: They are typically located near the splenic hilum and have similar echogenicity as the normal spleen.



Figure2-4 Accessory spleen. An isoechoic mass is seen adjacent to the splenic hilum. (Steven et al; 2011)

2-1-3-1-2 A “wandering spleen” (or mobile spleen): can be found in unusual locations and may be mistaken for a mass.

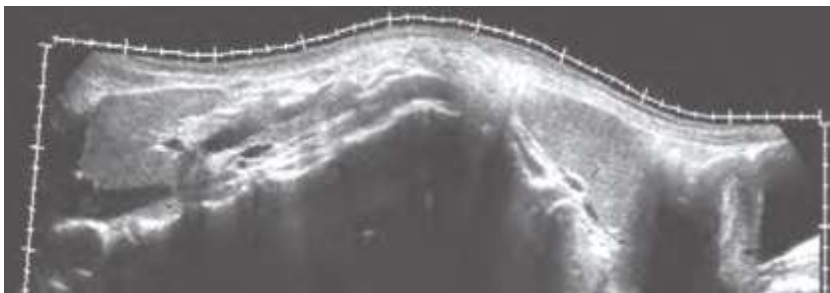


Figure2-5 Wandering spleen. Sagittal extended-FOV image of midline abdomen in asymptomatic young woman; (Rumak et al ;2011)

2-1-3-2 splenomegaly: Enlargement of the spleen is a highly non-specific sign associated with numerous conditions, the most common being infection, portal hypertension, haematological disorders and neoplastic conditions



Figure2-6 Splenomegaly (Rumak et al ;2011)

2-1-3-3 Malignant Splenic Disease:

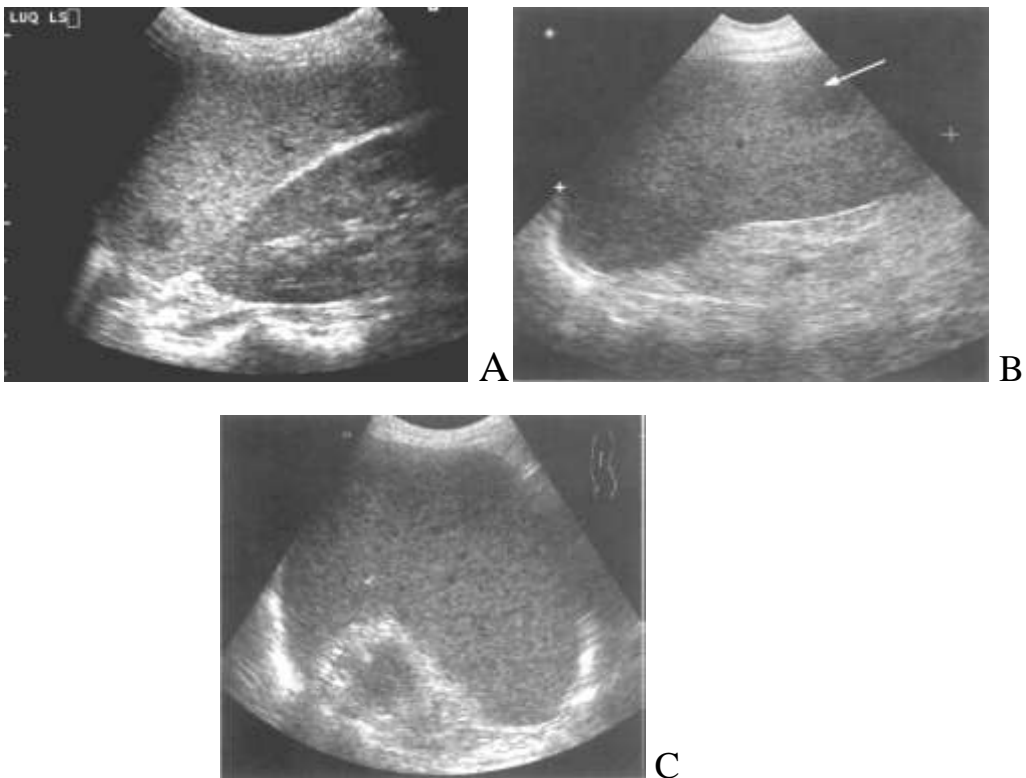


Figure2-7 Lymphoma: (A) Small, focal lesion in a normal-sized spleen. (B) Enlarged, hyperechoic spleen with a hypoechoic focal lesion (arrow). (C) Enlarged, coarse-textured spleen containing multiple tiny lymphomatous lesions(JoneA .2004)

Figure2-8 Patient with acute myelogenous leukemia shows a large mass within the splenic parenchyma and enlarged nodes in the hilum(Sandara et al; 2012)



Figure2-9 Metastases. Metastatic melanomawith multiple echogenic splenic lesions (*arrows*). (*Rumak et al ;2011*)

2-1-3-4 Benign Splenic Conditions:



Figure2-10Primarycongenital cyst. (Jone A .2004)



figure2-11 Calcified granulomas in a patient with sarcoidosis., Multiple tiny bright foci throughout the spleen some demonstrating posterior shadowing. (Rumak et al ;2011)

2-1-3-5 Vascular abnormalities of the spleen

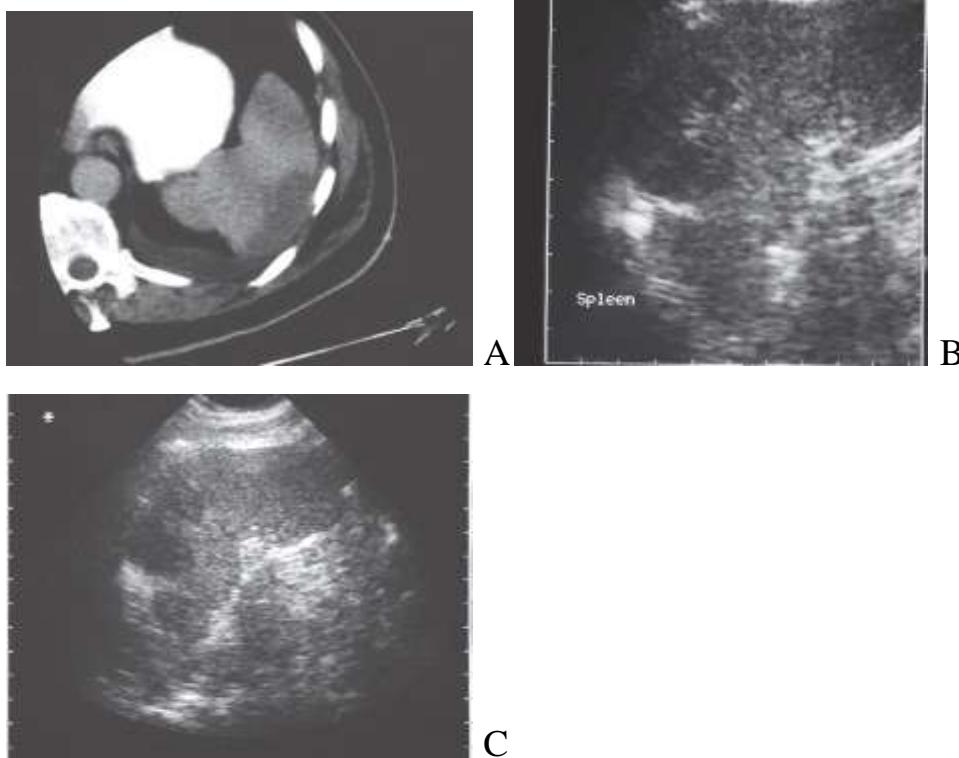


Figure2-12 Splenic infarct. A, Computed tomography demonstrates the area of infarct in the spleen. B and C, Ultrasound shows the hypoechoic area near the peripheral margin of the spleen. (Sandara et al; 2012)

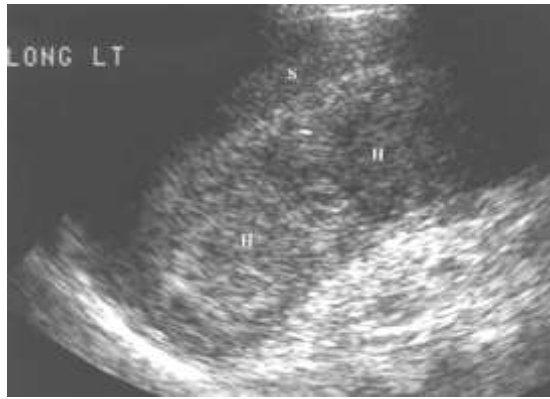


Figure2-13 Splenic hematoma. (Steven et al ;2011)

2-1-4 Normal sonography:

2-1-4-1 splenic measurement

The spleen is normally measured along its long axis. The normal spleen measures 8 to 13 cm in length, 7 cm in anteroposterior diameter, and less than 5 cm in thickness (Sandra et al 2012). The size of the spleen in the adult varies with age and sex. The spleen decreases in size with advancing age and may enlarge when pathology is present.

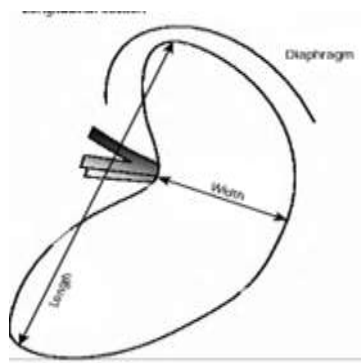


Figure2-14 splenic measurement. Diagram show sonographic approach to measuring splenic length and width (Rmak et al; 2011)

2-1-4-2 Scanning technique

The long axis of the spleen lies along the tenth rib. Remember that the posterior aspect of any given rib is higher than its anterior aspect. This means that the posterior extremity of the spleen will be higher than its anterior extremity. Most authors suggest that the patient be scanned in the right lateral decubitus (left side up) position and that the left tenth or eleventh intercostal spaces be used as access to the spleen. You will be

scanning in the left coronal plane and should be able to achieve a long axis scan and by turning the transducer ninety degrees, a short axis scan. A 5 MHz medium length transducer may be used since the spleen is a poorly attenuating structure located just behind the ribs. Sector scanners are easiest for intercostal work but many prefer the image from a curvilinear transducer, in spite of the larger transducer face, a modest inspiration will depress the diaphragm and spleen inferiorly so they can be visualized. The lower ribs may be elevated by having the patient raise the left arm over their head. Greater access may be achieved by inserting a pillow between the waist and the table. (Hassan M Resk et al; 2017).

2-1-4-3 Sonographic appearances

On sonography, the spleen is crescent shaped. its outer convexity is smooth, where's the inner margin may be indented nodular. its echo structure is homogenous, slightly more echogenic than healthy liver tissue and markedly hyperechogenic compared to kidney tissue(Hassan M Resk et al; 2017).

2. 2 Previous Studies:

The study done in north Indian adults established normal splenic measurement in 150 adult subjects (78 males and 72 females, ages 18 to 76 years) using ultrasonography. The mean values of the age, height, weight and body mass index of subjects, spleen width, spleen length, spleen thickness and spleen volume.

These measurements were found to be 36. 37±10. 83 years, 164. 22±4. 72 cm, 60. 26±7. 11 kg, 22. 30±2. 09 kg/m², 7. 58±1. 56 cm, 9. 87±1. 28 cm, and 3. 34±0. 79 cm and 136. 05±61. 14 cm³ in females respectively. Additionally, in males same dimensions were 40. 50±12. 77 years, 174. 41±6. 57 cm, 76. 33±8. 54 kg, 25. 06±2. 10 kg/m², 8. 75±1. 84 cm, 11. 0cm³ respectively (Narora et al; 2010).

Another study in Turkish adults established normal splenic measurement in 160 subjects (80 males & 80 females) in age between 20 and 60 years. They found that spleen length, weight and thickness were decreased in increase in age with all parameters greater in males than in female and all dimension are greater in male than in female. (Celiktas. m et al; 2015).

Another study established normal spleen dimensions using ultrasound in 400 Nigerian adults, There were 212 males and 188 females, their age ranged between 20 and 70 years. The mean age of the subjects and (±standard deviation) were 33. 0 years (±12. 0), mean height was 1. 64 m (±0. 1) and mean weight was 61. 4 kg (±11. 0). The mean splenic length, width and depth for the subjects studied were 101. 6 mm (±13. 7), 46. 8 mm (±8. 2), and 86. 8 mm (±12. 7), respectively, There was positive correlation between subjects height and weight with splenic length ($P < 0. 001$ and $P < 0. 001$), depth ($P < 0. 01$ and $P < 0. 001$) and width ($P < 0. 01$ and $P < 0. 001$). (MAYahuza et al; 2016).

Furthermore study in a healthy collegiate athletic in Americans found that the Mean splenic length was 10. 65 (1. 55) cm and width, 5. 16 (1. 21) cm.

Chapter Three

Materials and methods

Chapter three

Materials and methods

3-1 Materials:

3-1-1 type of the study

Cross-sectional descriptive study

3-1-2 population of the study

Male and female with different age, selected randomly from colleagues and who came to ultrasound department

3-1-3 sample size

100 Adult subjects of age ranged between 20-70 years

3-1-4 Exclusion criteria:

The following exclusion criteria were used:

clinical evidence of infection ,liver disease(cirrhosis or portal hypertension) , renal failure , history of splenic trauma, malignant lesions, , congenital disorder (accessory spleen)

3-1-5 Area of the study:

This study was conducted at a lhasaheasa hospital, aljazeera state.

3-1-6 Duration of the study:

This study was conducted during the period from August to December 2018

3-1-7 data collection

The data collected by using data collecting sheet itis designed to cover the gender, age, height, weight and body mass index of subject.

3-1-8 Machine used:

The sonographic examination was performed with Sonoscape ultrasound machine and 3. 5MHZcurvilinear transducer probe

3-1-9 Data analysis

Data were analysed using SPSS statistical program for significance of tests:

3-2 Methods :

for trans-abdominal ultrasonography. the ultrasonographic gel was applied on the left hypochondric region and upper abdomen to visualize spleen. Then the patient was asked to lie in right lateral position with the left sided elevated. the individual was made to take a deep breath and hold it for a few seconds to evaluate the spleen and its echogenicity and related structures in general to exclude any disease conditions. the splenic length measured as the maximum distance between most superomedial and the most infrolateral point in longitudinal plane. the splenic width, measured as the maximum anteroposterior dimension on transverse plane. the splenic thickness is measured as mediolateral distance from the hilum to the capsule, being measured on the same transverse plane(Fig. 1). to express splenic volume, it was calculated using the Downey"s formula[$\text{length} \times \text{width} \times \text{depth} \times 0.523$]

3-2-1 Ethical consideration

Sample of the study selected after agreement from hospital , colleagues and who came to ultrasound department .

Chapter four

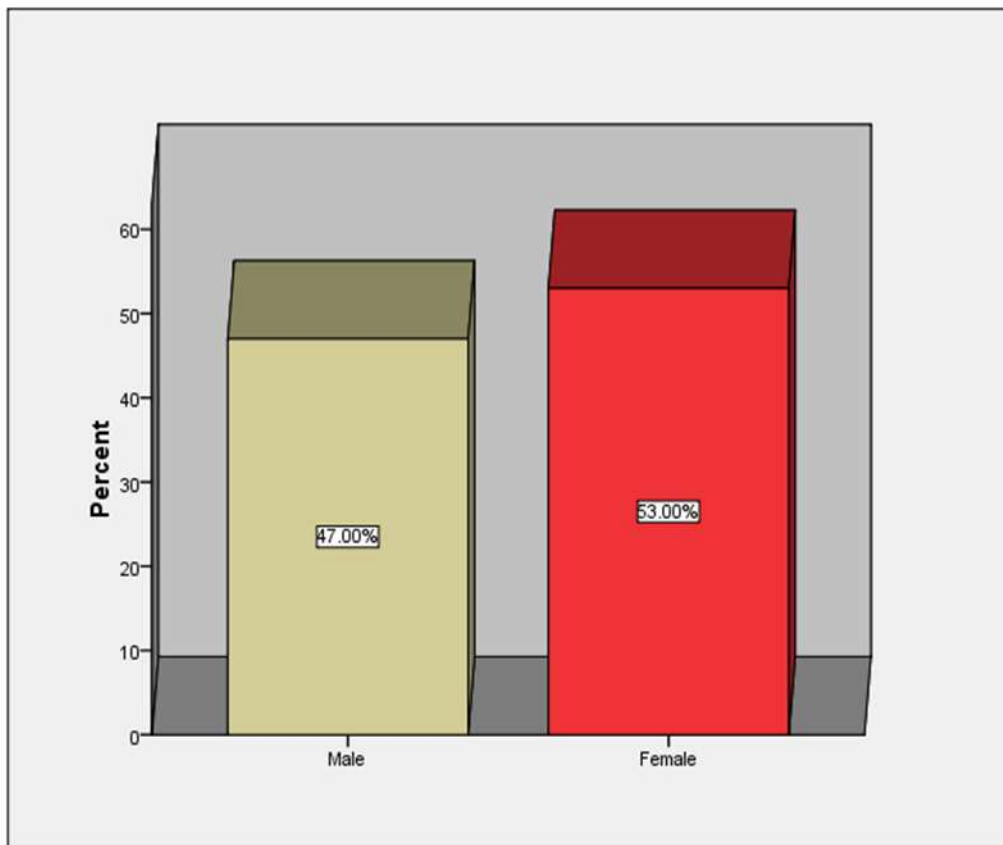
Results

Chapter four

The Results

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	47	47.0	47.0	47.0
Female	53	53.0	53.0	100.0
Total	100	100.0	100.0	

Table (4. 1) frequency distribution of gender



Figure(4. 1) frequency distribution of gender

Table (4. 2) frequency distribution of age group

Age group	Frequency	Percent	Valid Percent	Cumulative Percent
20-30 years	37	37.0	37.0	37.0
31-40 years	19	19.0	19.0	56.0
41-50 years	19	19.0	19.0	75.0
51-60 years	12	12.0	12.0	87.0
61-70 years	13	13.0	13.0	100.0
Total	100	100.0	100.0	

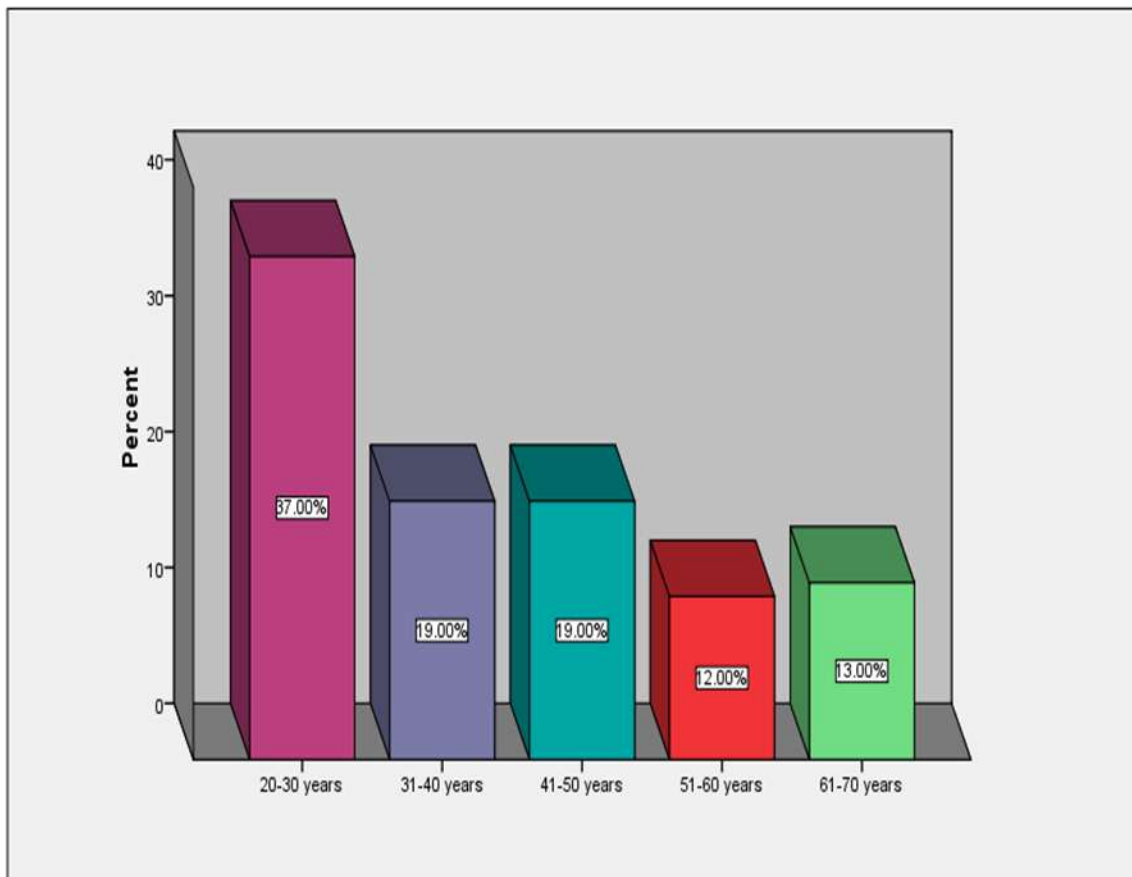


Figure (4. 2) frequency distribution of age group

Table (4. 3) Descriptive statistic of age, height, weight, BMI and splenic measurements (mean± Std. Deviation)

Variables	N	Minimu m	Maximu m	Mean	Std. Deviation
Ag	100	20	70	39. 98	15. 609
Height	100	150	185	167. 22	8. 349
Weight	100	44	95	62. 94	12. 769
BMI	100	10. 1	39. 5	22. 601	4. 9322
SL	100	7. 1	14. 0	10. 334	1. 4015
SW	100	5. 0	12. 8	8. 543	1. 7793
ST	100	2. 1	6. 3	4. 006	. 8322
SV	100	62. 4	488. 6	195. 874	83. 2096
Valid (listwise)	N 100				

Table (4. 4) Compare mean age and splenic measurements (mean± Std. Deviation)

Age group		SL	SW	ST	SV
20-30 years	Mean	10. 481	8. 600	3. 830	188. 399
	Std. Deviation	1. 4776	1. 6357	. 8475	75. 2298
31-40 years	Mean	10. 032	8. 653	4. 047	196. 811
	Std. Deviation	. 9470	1. 7743	. 5327	58. 1562
41-50 years	Mean	10. 537	8. 337	4. 274	208. 189
	Std. Deviation	1. 2628	2. 0638	. 9462	89. 0251
51-60 years	Mean	9. 342	7. 983	3. 875	160. 050
	Std. Deviation	1. 2667	1. 6370	. 4845	64. 9961
61-70 years	Mean	10. 977	9. 038	4. 177	230. 846
	Std. Deviation	1. 6544	1. 9619	1. 1461	1. 27622
Total	Mean	10. 334	8. 543	4. 006	195. 874
	Std. Deviation	1. 4015	1. 7793	. 8322	83. 2096
P value		0. 03	0. 642	0. 344	0. 266

Table (4. 5) independent sample t-test for compare means splenic measurements (mean± Std. Deviation) in different gender

a. Means

Gender		N	Mean	Std. Deviation	Std. Error Mean
SL	Male	47	10.430	1.5030	.2192
	Female	53	10.249	1.3135	.1804
SW	Male	47	8.726	1.7679	.2579
	Female	53	8.381	1.7905	.2459
ST	Male	47	4.066	.8638	.1260
	Female	53	3.953	.8076	.1109
SV	Male	47	202.983	92.2774	13.4600
	Female	53	189.569	74.5864	10.2452

b. t-test for comparing means

	t-test for Equality of Means						
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
SL	.642	98	.523	.1807	.2816	-.3782-	.7396
	.637	92.054	.526	.1807	.2839	-.3832-	.7446
SW	.966	98	.337	.3444	.3566	-.3633-	1.0521
	.966	96.854	.336	.3444	.3563	-.3629-	1.0517
ST	.677	98	.500	.1131	.1672	-.2187-	.4449
	.674	94.643	.502	.1131	.1679	-.2202-	.4464
SV	.803	98	.424	13.4141	16.7019	-19.7303-	46.5585
	.793	88.472	.430	13.4141	16.9156	-20.1996-	47.0278

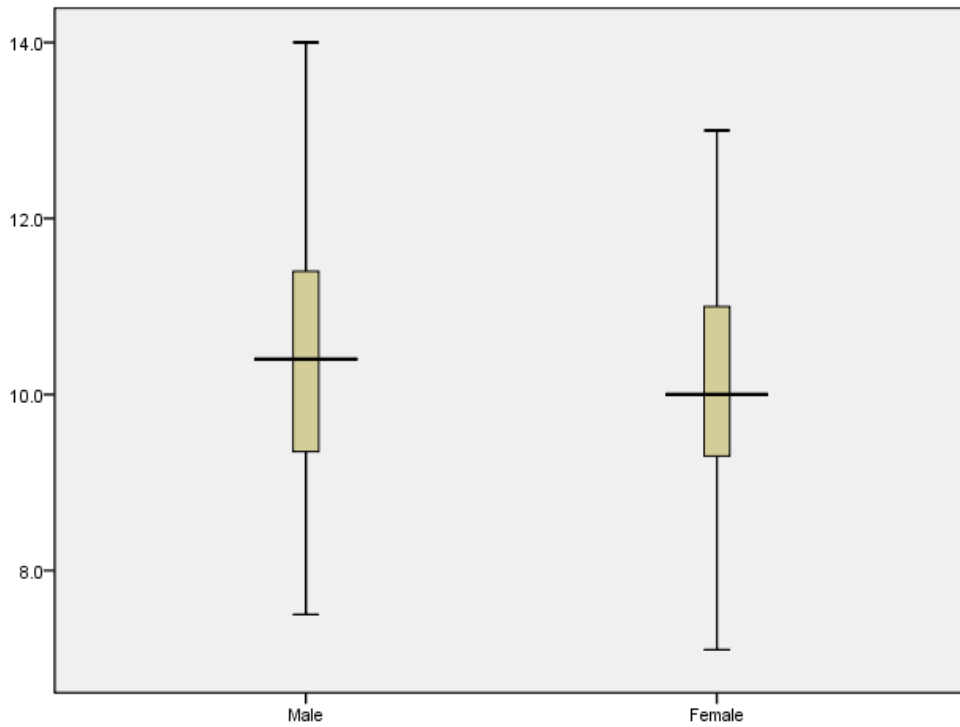


Figure (4. 3) plot box shows mean splenic length in different gender

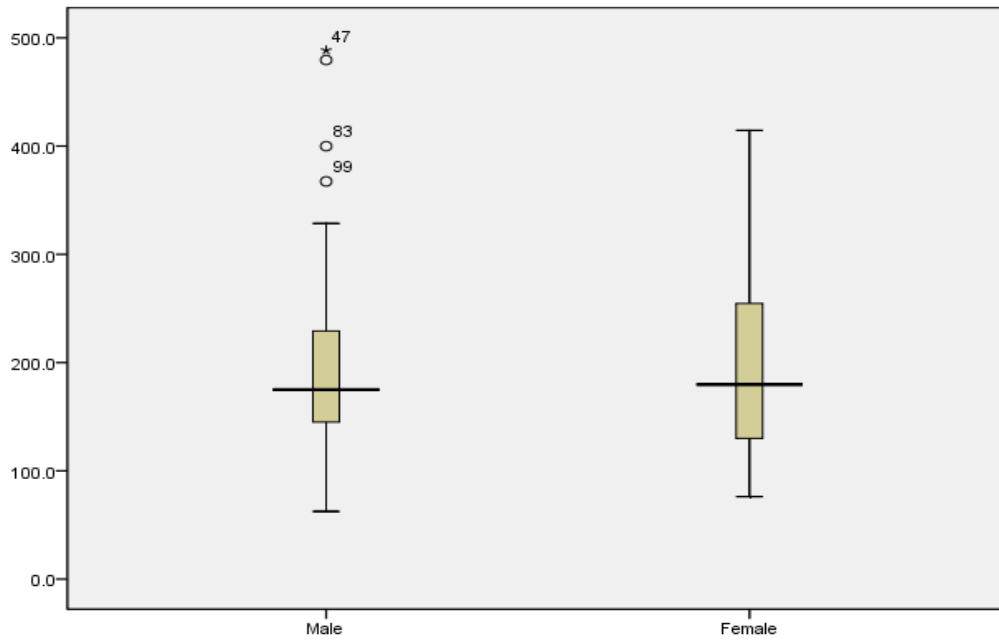


Figure (4. 4) plot box shows mean splenic volume in different gender

Table (4. 6) Correlation between splenic measurements and body characteristic (age, height, weight and BMI).

		Age	Height	Weight	BMI
SL	Pearson Correlation	-. 007-	. 290 ^{**}	. 229 [*]	. 079
	Sig. (2-tailed)	. 947	. 003	. 022	. 433
	N	100	100	100	100
SW	Pearson Correlation	. 037	. 183	. 316 ^{**}	. 193
	Sig. (2-tailed)	. 718	. 068	. 001	. 054
	N	100	100	100	100
ST	Pearson Correlation	. 149	. 141	. 311 ^{**}	. 233 [*]
	Sig. (2-tailed)	. 139	. 161	. 002	. 020
	N	100	100	100	100
SV	Pearson Correlation	. 110	. 281 ^{**}	. 420 ^{**}	. 255 [*]
	Sig. (2-tailed)	. 278	. 005	. 000	. 011
	N	100	100	100	100
** . Correlation is significant at the 0. 01 level (2-tailed).					
* . Correlation is significant at the 0. 05 level (2-tailed).					

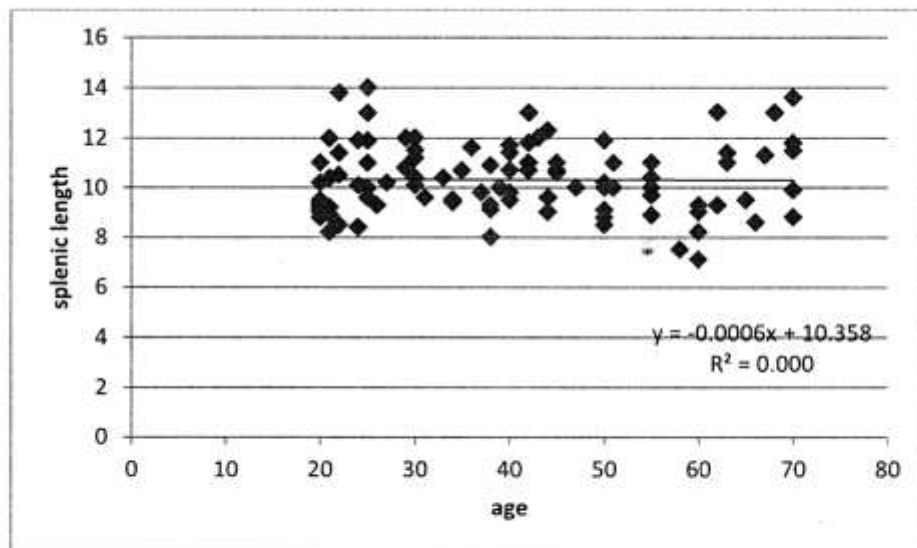


Figure (4. 5) scatter plot shows relation between splenic length and age

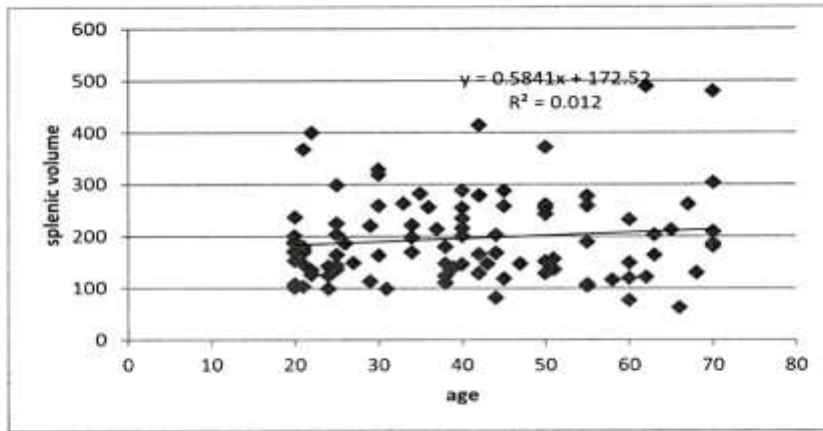


Figure (4. 6) scatter plot shows relation between splenic volume and age

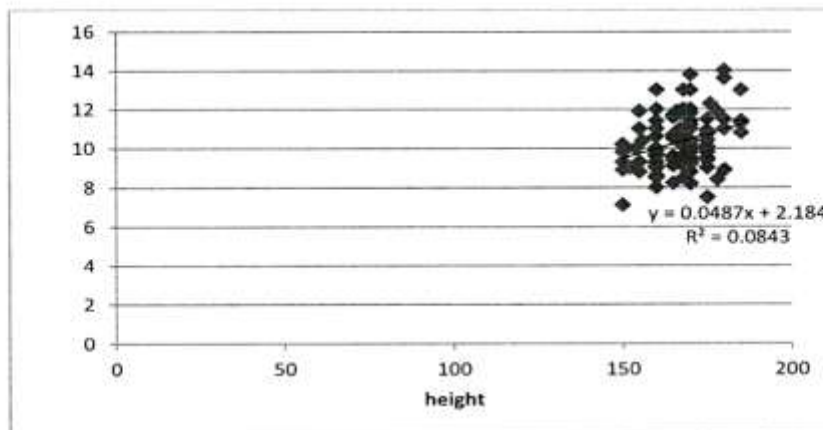


Figure (4. 7) scatter plot shows relation between splenic length and height

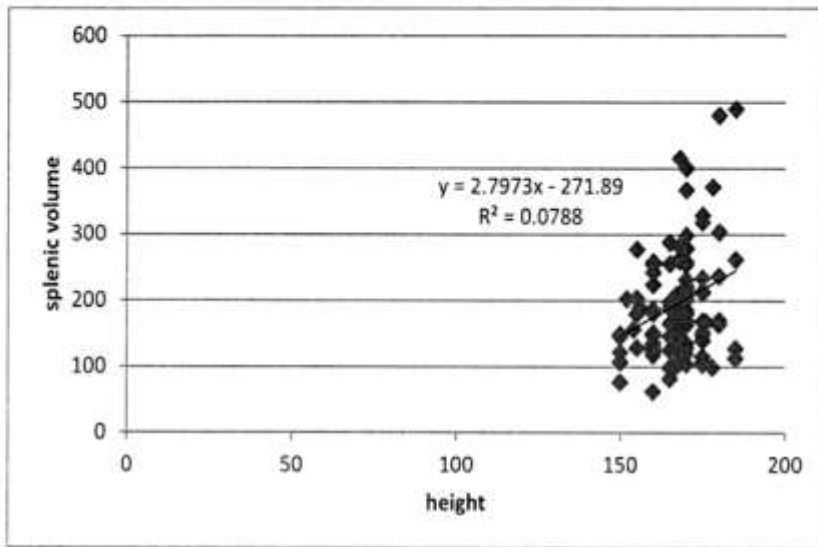


Figure (4. 8) scatter plot shows relation between splenic volume and height

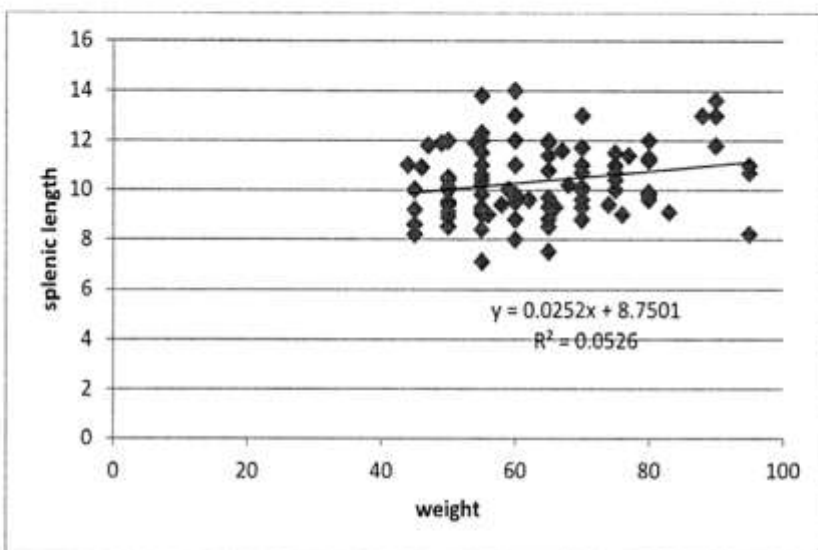


Figure (4. 9) scatter plot shows relation between splenic length and weight

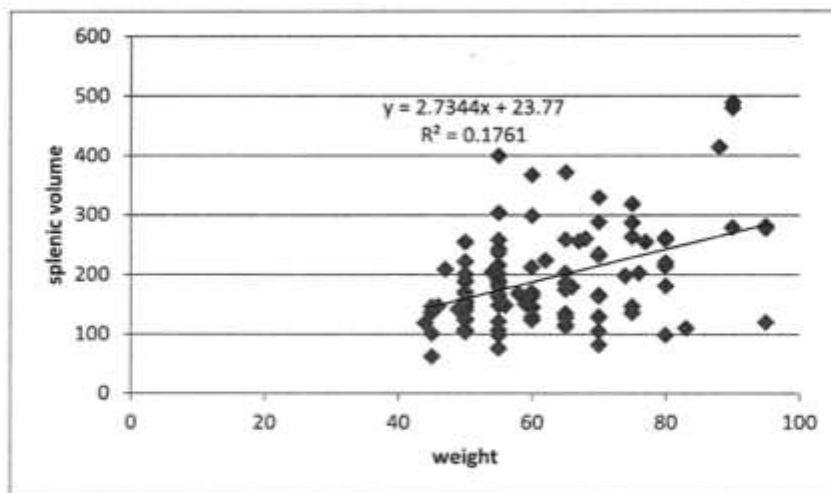


Figure (4. 10) scatter plot shows relation between splenic volume and weights

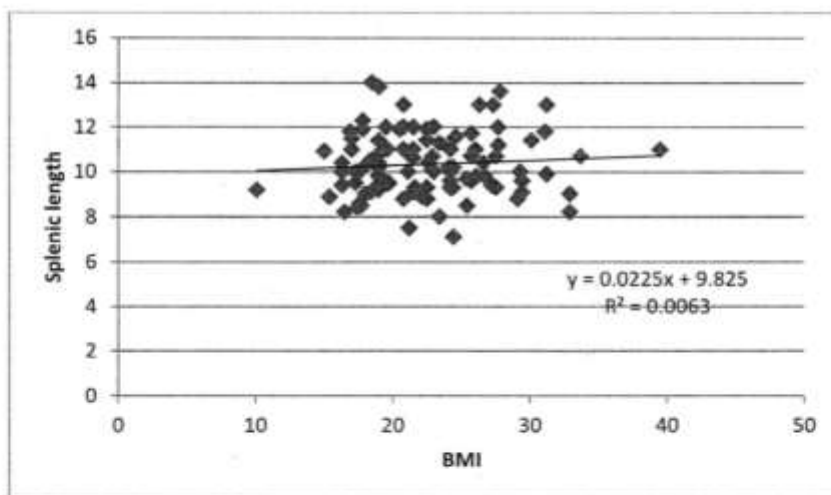


Figure (4. 11) scatter plot shows relation between splenic length and BMI

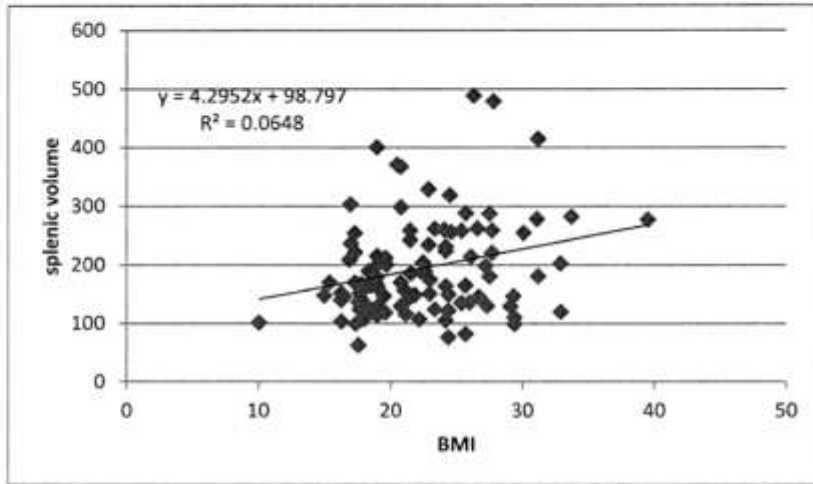


Figure (4. 12) scatter plot shows relation between splenic volume and BMI

Chapter Five

Discussion, conclusion and Recommendation

Chapter five

Discussion, conclusion and Recommendation

5-1 Discussion

In this study 100 subjects from (20-70 years). male 47 (47%) and female 53(53%) were examined using ultrasound machine, the mean values for body characteristic age, height, weight and BMI are 39. 98±15. 6years, 167. 2±8. 3 cm, 62. 9±12. 7kg, 22. 6±4. 9 kg/m respectively. The more frequency age groupe age from 20-30 years figure (4-2). The result of the mean value of SL, SW, ST and SV are 10. 3±1. 5, 8. 7±1. 7, 4± . 9cm, 202±92. 2 cm³ for male respectively and 10. 2±1. 3, 8. 3±1. 8, 3. 9±8 cm, 189±74. 5cm³ for female respectively. table 4-5 , There was statistically difference between males and females in SL ,SW,ST and SVB that mean the men had larger spleen than female figure (4-3 and 4-4)which agree with study done in Indian by (Narora et al;2010) the men value of SL,SW ,ST and SV was 9.9±1.3 , 7.6±1.6 , 3.3±.8cm and136.05±61.14cm³ for female and11.01±1.9 , 8.8±1.8 , 4.1±1.1cm and202±92.2 cm³ for male respectively ,also agree with study done in Americans by(Hosey, 2006), study done in Egypt by (Hassan M Reazk et al. 2017) and study done in sudan by (Marwa Abaker 2016) which the mean value of these study of SL,SW ,ST and SV were 10.3±1.2 ,3.3±0.4 ,3.9±0.6 , 73.3 ±2.3 and 9.2±0.9 ,3.1±0.3 , 3.6±0.6 cm ,56.5±18.0cm³ for male and female respectively but the volume in our study 189±74.5 for female ,202±92.2 for male and the volume in study done Indian by(Narora et al;2010) was136.05±61.1 for female,220.06±115.3,study done in Egypt by (Hassan M Rezk ; 2017) 166.3 or male and 180.06cm³ for male and the study done in sudan by (Marwa Abaker 2016)56.5±18.0 for female,73.3±2.3 for male that mean the spleen volume of female in our

study larger than spleen volume in that previous study that needed more study with larger sample to know the causes. Also SL had strong correlation between spleen length with Height of subject and had no correlation with age and BMI this result agrees with study in Egypt by (Hassan M Rezk et al 2017), SL had correlation with weight and height of subject which matches with study done in Nigerian by (MAYahuza et al;2016) . the SW had strong correlation with weight which matches result done in Egypt by (Hassan M Rezk ;2017)and study done in Nigerian by(MAYahuza et al;2016) while the ST showed strong correlation with weight of subject, the result agrees with study done in Nigerian by(MAYahuza.et al;2016) and disagrees with study done in Egypt by (Hassan M Rezk.; 20017).SV strong correlation with height matches with study done in Egypt done by (Hassan M Rezk .et al; 2017) and with weight disagrees, ST and SV had correlation with BMI(table4-6)

5-2 Conclusion

By the end of thi study concluded that the people in aljazeera all the SL,SW ,ST and SV in the men was larger than female, strong correlation of SL and SV with subject height. weight had strong relation with SWand ST . BMI had relation with ST and SV, The spleen volume from our study is larger than previous study.

5-3 Recommendations

1-Further study in measurement of spleen dimension and spleen volume with larger sample for more accurate results is needed.

2-Used ultrasonography as the atool to diagnosis Malaria.

3-More studies for patient of malaria and the liver disease to know the effect of this disease to spleen volume.

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Appendix2

Images



Image1 Trans abdominal ultrasound image show measurement of spleen dimensions and volume for 35 years female with subject in right lateral decubitus.

spleen length 7.34cm

spleen width 2.65cm

spleen thickness 3.22cm

spleen volume 35.22ml



Img 2 Trans abdominal ultrasound image show measurement of spleen dimensions and volume for 26 years female with subject in right lateral decubitus

spleen length 10.3cm

spleen width 2.6cm

spleen thickness 4.3cm

spleen volume 90.9ml



Img 3Trans abdominal ultrasound image show measurement of spleen dimensions and volume for 30 years female with subject in right lateral decubitus

spleen length 9.2cm

spleen width 4.4cm

spleen thickness 4.5cm

spleen volume 92.0ml