Introduction

1-1 Introduction:

The gallbladder stores and concentrates bile produced by the liver. It releases it in response to food ingestion to aid in fat digestion. The size of the gallbladder varies in an individual between the fed and fasting states.

It is examined sonographically in the fasting state to allow adequate distension with bile for proper visualization of the lumen and walls. The fasting gallbladder volume is the volume of the lumen after eight to twelve hours of nil per oral. Ultrasonography (US) is a non-ionizing, non-invasive, readily available and relatively cheap imaging technique. It has become the modality of choice for the routine examination of the gallbladder in the last two decades.

Ultrasound is the first line investigation for enormous variety of abdominal symptoms because of its non-invasive and comparatively accessible nature. It is depends upon numerous factors, the most important of which is the skill of the operator and machine facility (resolution, contrast, sensitivity, etc).

The skill of effective scanning lies in the operator's ability to maximize the diagnostic information available and in being able to interpret the appearance properly. (Mittal R,2010)

1.2 Problem Statements: to obtain reference value in Sudanese and lack of reference values of normal Gallbladder diameter in Sudanese

1.3 Objectives:

1.3.1 General objectives: estimation of normal gallbladder volume in fasting adults using ultrasonography.

1.3.2 Specific objectives:

1-To mesure normal gallbladder volume in Sudanese

2- To correlate the relationships between gall bladder measurement and several anthropometric factors including age, gender, height and weight.

Literature review

2.1Anatomy:

The gallbladder is a thin-walled (3mm or less in the fasting state) pear-shaped structuresituated in a fossa at the distal end of the main lobar fissure.

Thegallbladder remaintains a constant relationship to the caudal end of this fissure. This is particularlyhelpful in locating a small, contracted, or stone-filled gallbladder(Bonheur,2016)

Normal bile does notcontain particulate matter resulting in an echo free lumen.

The gallbladder has rounded funds which is continuous with the body. The body tapers into the neck. The neck is "S"shaped and is continuous with the cystic duct.

The mucous membrane lining of theneck and cystic duct is in shelf-like folds called the spiral valve ;The spiral valve at thebeginning of the cystic duct is the valve of Heister. The relationship of the gallbladderneck to the right lateral aspect of the main portal vein and common bile duct is constantand is a useful anatomic landmark. The neck sometimes has a small pouch at its junctionwith the body. This pouch is called the infundibulum or Hartman’s pouch [Bonheur,2016].

The gallbladder wall has 4 layers:

-An outer serous (peritoneal) layer which incompletelycovers the underlying echogenic connective tissue layer.

- The muscular layer whichis lined with the innermost layer of mucous membrane.

-The mucous membrane echocentrates the bile by absorbing water.

The sonographic appearance of the normalgallbladder wall varies depending on gallbladder volume. The normally distendedgallbladder (fasting state) has a thin wall (3 mm or less) and appears as a smoothechogenic line [Bonheur,2016].

In contrast, the contracted gallbladder (non fasting state) has a thicker wall which appears as a double walled hypoechoic structure [Bonheur, 2016].

At the neck, the fibromuscular tissue is the thickest. This tissue attenuates the beam andnormally results in a shadow posterior to it. The strong echoes and shadow can simulate gallstone and since the area is the narrowest part of the gallbladder it is a common sitefor impaction of stones [Bonheur, 2016].

In order to differentiate a gallstone from neck tissues it has beensuggested that the patient be scanned in several positions (supine, decubitus and erect)

And if the "stone" is still not dislodged, have the patient cough and rescan the area

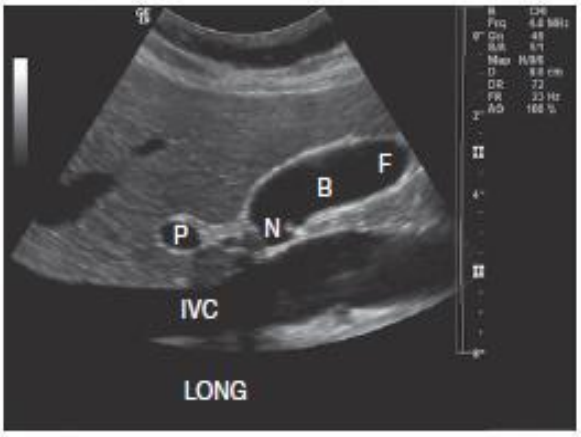

Figure 2.1: normal gallbladder mesuerment show the fundus, body and neck(http: www.scielo.br)

2-1-1 Blood supply:-

The gall-bladder is supplied by the cystic artery (a branch usually of the Right hepatic artery) which lies in the triangle made by the liver, the cystic duct and the common hepatic duct. Other vessels derived from the hepatic artery pass to the gall-bladder from its bed in the liver. Interestingly, there is no accompanying vein to the cystic artery. Small veins pass from the gall-bladder through its bed directly into tributaries of the right portal veinwithin the liver [Carol M.2011].

2.1.2 **Normal gallbladder variations**:

Ideally the scan should be performed after an overnight fast however a minimum fast ofat least 6 hours is required for good distention of the gallbladder with bile. Because thesize and shape of the normal gallbladder vary widely in individual patients, it is difficult toformulate precise size criteria. In general, if its transverse diameter exceeds 5 cm and if it is no longer ovoid but rounded in shape, the gallbladder is likely to be hydropic [Mariat et al., 2000].

Conversely, if its diameter is less than 2 cm despite adequate fasting, the gallbladder is likely to be abnormally contracted.Echogenic folds or septa of variable extent are commonly observed projecting in to the lumen, a junctional fold is usually between the body and the neck and is ofteneliminated after a deep inspiration, further distention or a change in patient position [Mariat et al. 2000}

Reverberation artifact may project in the gallbladder lumen and simulate folds.

Luminal artifacts are usually easy to distinguish from real echoes during the ultrasound study, a Phrygian cap deformity is a constriction at the junction of the gallbladder body and fund's [Mariat et al., 2000].

Any fold in the gallbladder can produce high-amplitude echoes that occasionally may be associated with posterior acoustic shadowing caused by refractive eeffects. This appearance can cause folds to be mistaken for polyps and/or calculi.

Figure 2.2: Normal variationof gallbladder (pharyngeal cap)(http: www.scielo.br)

2.2 physiology:

2.2.1 Bile Storage:

The sphincter at the distal end of the common bile duct is usually closed so that bile which is continuously formed by the liver refluxes into the cystic duct and gallbladder[Bonheur,2016].

Most of the fluid and electrolytes are reabsorbed by the gallbladder mucosal lining. (The liver secretes approximately 500-1000 ml. of bile a day), when food, especially fatty food, enters the small intestine, a hormone, cholecystokinin, is released into the bloodstream by endocrine cells in the duodenal mucosa.

This hormone is carried to the gallbladder where it causes the gallbladder muscle wall to contract and the sphincter at the distal end of the common bile duct to open. Bile is then liberated into the duodenum where it emulsifies the fats and creates an alkaline environment necessary for the pancreatic enzymes to effectively digest food in the duodenum [Bonheur,2016].

Fat cannot be digested if bile or the pancreatic enzyme lipase fails to mix with the duodenal contents; the patients will have steatorrhea - the presence of clay colored, Bulky, offensive smelling stools.

2.3 Sonographic Technique:-

The gallbladder should be examined in numerous patient positions: supine, left lateral decubitus, and the left posterior oblique position, in order to convincingly demonstrate stone mobility, scans may need to be performed in prone or erect positions(Saladin, 1998)

To show acoustic shadowing of calculi, it is essential to use the highest frequency possible and to have the transducer focused in the region of the suspected calculi

The sound beam is directed through the most dependent portion of the gallbladder.

In most supine patients this is the region of the gallbladder neck and cystic duct.

In prone and erect positions the fundus is the most dependent region.

Every study of the gallbladder should include an image demonstrating the gallbladder neck to prove or rule out the presence of a stone in this location.

Scanning with high-resolution high frequency curved linear or linear array transducer is mandatory in patients when gallstones are not detected. This minimizes missing tiny gallstones, especially in the fundus of superficial gallbladders(Saladin, 1998)

The gallbladder should be examined in the fasting state to ensure optimal bile volume a contracted, non-fasted gallbladder can be difficult to visualize.

The standard measurement of GB wall thickness is made from the GB lumen to the liver parenchyma. This measurement includes the GB mucosa, smooth muscle of its wall, liver capsule, and any tissue between the liver and GB, the normal measurement is 3 mm or less (Saladin, 1998).

Measurements are taken in the transverse rather than longitudinal plane to avoid any possibility of thickening due to measuring in an off-axis plane.

The normal appearing wall is not routinely measured.

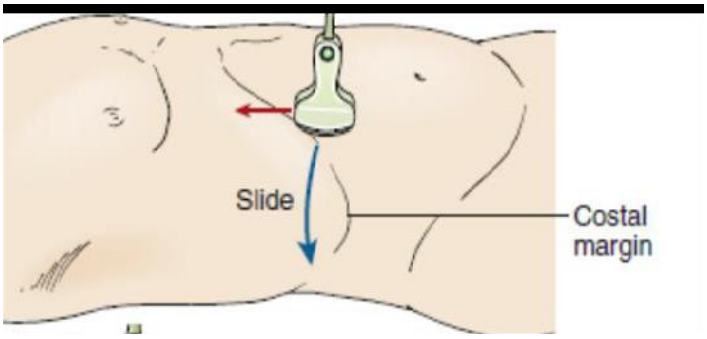

Figure 2.3:gallbladder technique (Radiopeadia ,2016)

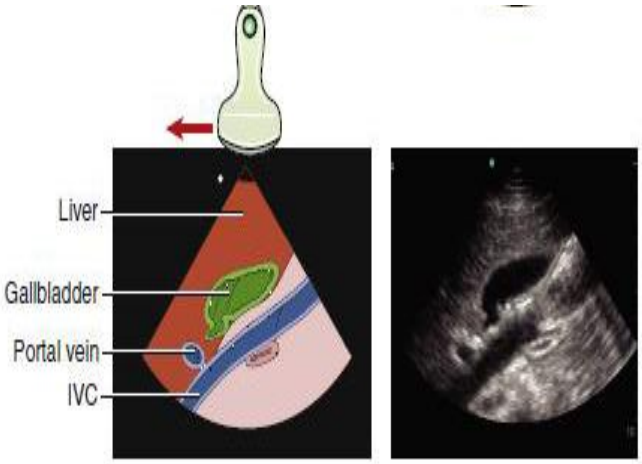

Figure 2.4:gallbladder technique (Radiopeadia ,2016)

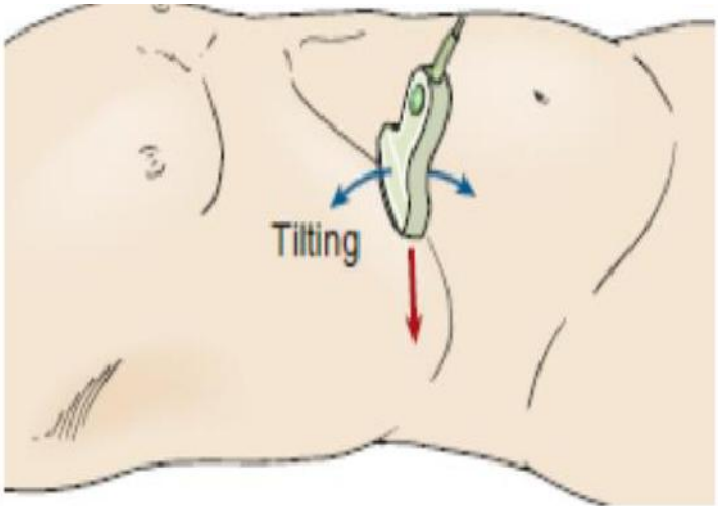

Figure 2.5:gallbladder technique(Radiopeadia ,2016)

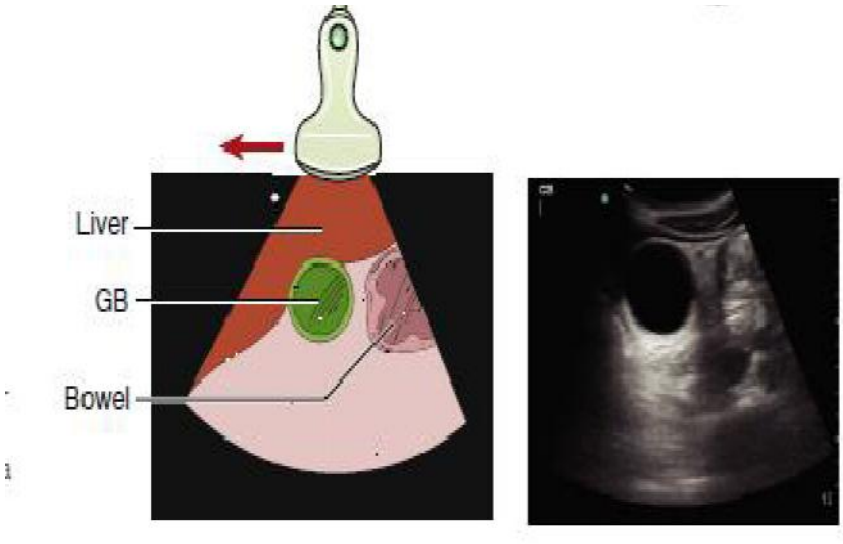

Figure 2.6gallbladder techniquehttp:(Radiopeadia ,2016)

2.3.1 Cholecystosonography:

Ultrasound of the gallbladder is fast, accurate and noninvasive. It can be performed on an acute patient since the quality of the scan is independent of liver function.

Often it can be done without preparation, although a fasting state is preferred. The presence of coexisting disease may also be demonstrated at the time of the gallbladder scan [Mendler et al., 1998].

The Effect of Same - Day Sonography of the GB after Oral or Intravenous iodinatedContrastadministration [Mendler et al., 1998].

Oral cholecystography contrast agents may alter the specific gravity of the bile resulting in small stones floating in the bile. Cholesterol stones and those containing gas fissures can also float [Mendler et al., 1998].

Oral and IV iodinated contrast agents reduce the GB volume. The possibility that pathology can be missed if US is done immediately after these studies must be considered [Mendler et al., 1998].

The GB returns to normal 2 hours after contrast agent administration, therefore, US should be performed before iodinated contrast agent studies or 2 hours after their administration [Mendler et al., 1998].

2.3.2Effectof plane ofsection ofwall thickness:-

An off-axis image plane makes the all bladder wall appear thickened and
In distinct.

A correct image plane (through the diameter) produces a sharply defined,
Thin -walled appearance.

2.3.3Other Imaging Technique:

2.3.3.1Oral Imaging Techniques:

A normal gallbladder will be visualized with iodine based contrast media.

Non visualization of the gallbladder after two consecutive doses of iodine based

Contrast media is highly suggestive of gallbladder disease and there is an 80-90% correlationwith gallstones.

Gallbladder visualization by oral cholecystography is rare with elevated levels of serum bilirubin (i.e. greater than 3 mg/dl) because the hepatic cells are unable to excrete the contrast media.

Opaque gallstones will be visualized with oral contrast media

Most nonopaque gallstones will cause a (negative) filling defect in the gallbladder. (Mendler et al., 1998)

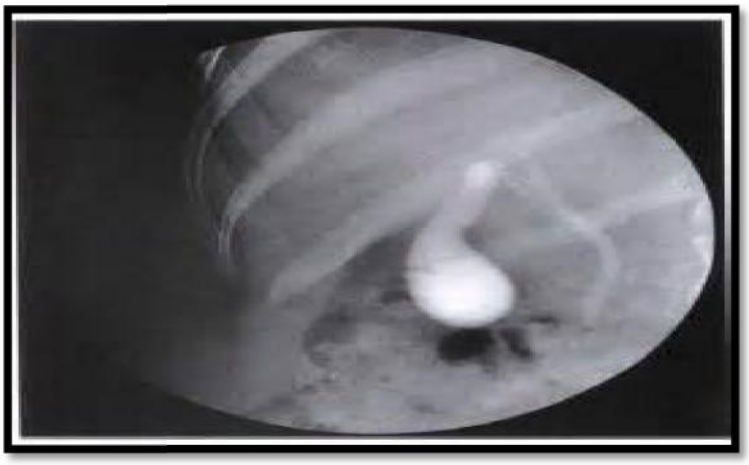

Figure 2.7:normal oral cholecystogram (Radiopeadia ,2016)

2.3.4 Nonvisualization of the Gallbladder on Cholecystosonography:

2.3.4.1Anatomic Variants:

A totally intrahepatic gallbladder may be difficult to distinguish from an hepatic cyst.

In tall, thin patients, the gallbladder may extend into the RLQ, or the fundus may be displaced to the left of midline.

Congenital absence (possible but unlikely since it occurs in only .03% of the population).

2.3.4.2 A non-fasting patient:

The lumen may be too small to see any fluid contents, fasting for 12 hours is ideal however, 6 hours should enable an adequate liver and biliary examination.

A diseased gallbladder with lumen obliteration.

2.3.5 Cholangiography:

- Percutaneous Transshepatic Cholangiography is suggested if dilated bile ducts are apparent without evidence of a cause and if percutaneous

blearyexternal or internal drainage is being considered due to the effects of anadjacent tumor.

Intravenous Cholangiography may be done after two nonvisualized oral cholecystograms. This is not useful if the serum bilirubin levels are greater than 4 mg/dl.

Operative Cholangiography is performed at the time of cholecystectomy toidentify any residual gallstones after the surgeon has explored the bile ductsand removed all the visible stones.

T-tube is inserted into the common duct and the vertical part of the tube protrudes through the anterior abdominal wall incision. Contrast media is introduced into the ducts via the T-tube. Stones will show as negative filling defects. The T-tube is left in position to drain for about 10 days,during this period any residual stones may be passed via the tube. Placement of the T-tube into position is called a T-tube choledochostomy[Mendler et al., 1998].

Postoperative T-tube Cholangiography is performed after the tube has been in position approximately 10 days. Contrast is injected via the tube into the duct system to outline any residual stones. Stones can be removed via the Ttube using a "basket" or stentable catheter. If no stones are visualized and the ducts are not remarkable the T-tube will be removed at this time [Mendler et al., 1998].

Endoscopic Retrograde Cholangiopancreatography (ERCP) is the injection of contrast into the common bile duct through a catheter which has been inserted into the papilla of Vater via an endoscope positioned in the duodenum, Often the pancreatic duct system fills as well [Mendler et al., 1998].

ERCP is an alternative to percutaneous cholangiography especially if normal size intrahepatic ducts were demonstrated on ultrasound. An ERCP is a possible cause of air in the biliary system (Pneumobilia) [Mendler et al., 1998].

2-3-5TheHealth Industry Distributors AssociationNuclear Medicine Scan:-

These tests are excellent for demonstrating cystic duct obstruction. The contrast medium is taken up by the hepatic cells and excreted as part of the bile.

This "tagged bile" will leave the liver by an hepatic duct and proceed down the common bile duct to the closed sphincter and then reflux up into the cystic duct.

Serial imaging displays radioactivity in the liver, bile ducts, gallbladder and duodenum.

If there is an obstruction of the cystic duct no gallbladder will be demonstrated.

The DISIDA has the added advantage over the HIDA scan because it can be

Administered to patients with higher total serum bilirubin levels [Mendler et al., 1998].

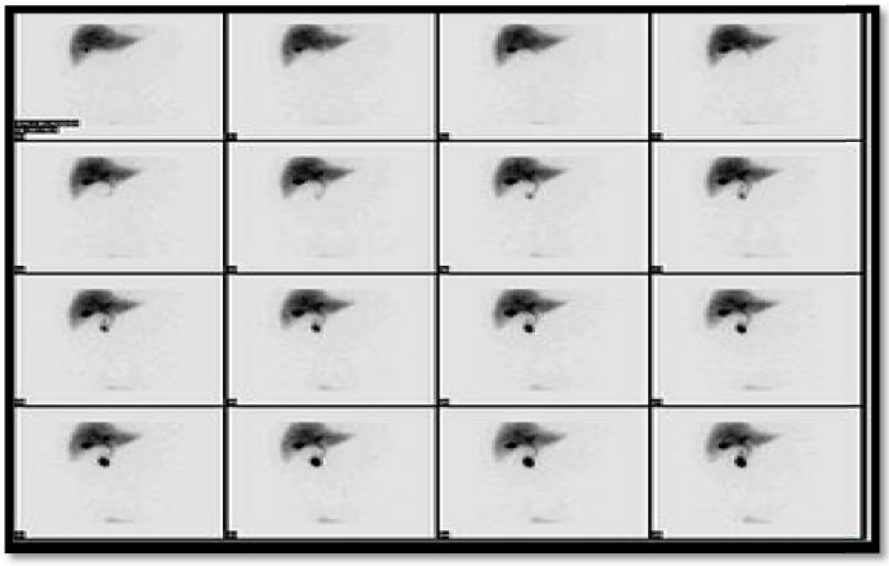

Figure 2.8: Normalhepatobiliary scan HIDA scan (Wikipeadia,2016).

2-4-1Previous Study:

Ultrasound quantification of gallbladder volume to establish baseline contraction indices in healthy adults: A pilot study.

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Aims

To evaluate the gallbladder contraction indices in adult Nigerians and derive prediction formulas for gallbladder contraction index in healthy adults in order to help the assessment of gallbladder diseases .

Methods

The length, width and height of the gallbladder of 50 normal subjects (29 males and 21 females) in Ebonyi State, Nigeria were measured by real time ultrasonography between January and November 2005. The gallbladder volume was calculated using the ellipsoid formula. Gallbladder Contraction index (GBCI) taken at the 10th and 20th minute following the ingestion of a standardized fatty meal (SFM) was obtained from the 50 subjects and the mean of the two values adopted as the actual GBCI. Pearson's correlation established relationship between GBCI and anthropometric variables and a t-test was carried out between the GBCI of males and females. Regression equations were established. Tests were two tailed with $P<0.05$ indicating statistical significance.

Results

The mean GBCI (± SD) was 42.8% (± 19.33%) in males and 37.66% (± 16.29%) in females. No statistically significant difference exists between GBCI in males and females (P>0.05). Equations comparing GBCI with subject anthropometric variables based on simple linear regressions gave GBCI (%) = - 110.94 (subject height) m + 236.38 for males and GBCI (%) = - 0.7646 (weight) kg + 82.7798 for females.
Height correlates better with GBCI in males and weight in females

Conclusion

This study has established prediction equations for GBCI in this locality and could be useful in the assessment of gallbladder diseases. This will impact on patient management and diagnosis as cut off values established or predicted should help in assessing prognosis in patients with gallbladder diseases.

Previous 2:

November 1985, Volume 145, Number 5 Sonographic measurement of gallbladder volume. WJ Dodds , WJ Groh, RM Darweesh, TL Lawson, SM Kishk and MK Ker. Sonographic images of the gallbladder enable satisfactory approximation of gallbladder volume using the sum-of-cylinders method. The sum-of-cylinder measurements, however, are moderately cumbersome and time consuming to perform. In this investigation, in vitro and in vivo testing was done to determine that a simple ellipsoid method applied to sonographic gallbladder images yields reasonable volume approximations that are comparable to the volumes calculated by the sum-of-cylinders method. Findings from a water-bath experiment showed that measurement of gallbladder volume by the ellipsoid method closely

approximated the true volume with a mean difference of about 1.0 ml. The results of in vivo studies in five volunteers demonstrated that the gallbladder contracted substantially after a fatty meal and that volumes calculated by the ellipsoid and sum-of-cylinders methods were nearly identical. Thus, a simple ellipsoid method, requiring negligible time, may be used to approximate satisfactory gallbladder volume for clinical or investigative studies

Previous 3:

Sonographic measurements of normal gallbladder sizes in children. Available from. Done in Feb 2003 done by Jeong-Hyun Yoo et al

Our goal was to establish the range of sonographic measurements of normal gallbladders in children. Six hundred ten children aged 0-16 years (male:female ratio, 1.5:1) with normal clinical and laboratory findings were included in this study. The sonographic parameters were the length, width, and calculated volume of the gallbladder, and the clinical parameters were the age, height, weight, and body surface area of the children. Statistical significance was determined through correlation and regression analyses. The length of the gallbladder showed significant positive correlations with age ($r = 0.65$), height ($r = 0.67$), weight ($r = 0.63$), and body surface area ($r = 0.65$; $p < 0.01$). The calculated volume of the gallbladder also showed moderate correlations with age ($r = 0.53$), height ($r = 0.55$), weight ($r = 0.61$), and body surface area ($r = 0.57$; $p < 0.01$). The gallbladder width showed modest but significant correlations with age ($r = 0.48$), height ($r = 0.53$), weight ($r = 0.53$), and body surface area ($r = 0.55$; $p < 0.01$). The highest correlation coefficients were found between the gallbladder length and subject age ($r = 0.65$; $p < 0.01$) and between the gallbladder length and subject height ($r = 0.67$; $p < 0.01$). For all correlations, statistical significance remained after regression analysis ($p < 0.01$). Values for the size of the normal pediatric

gallbladder are defined and will be helpful in the diagnosis of gallbladder abnormalities .

Previous 4:

Sonographic evaluation of gallbladder dimensions in healthy adults in Benin City, Nigeria

Ademola A Adeyekun in 2013

Several disease conditions can affect gallbladder (gallbladder) size and wall thickness (WT). Imaging methods are superior to clinical evaluation in assessing gallbladder dimensions. Ultrasonography is a relatively safe, inexpensive and reproducible imaging modality for assessing normal or diseased gallbladder. There are few reports on normal gallbladder dimensions in the Nigerian medical literature. This study therefore set out to contribute to data on gallbladder dimensions among Nigerians. Materials and Methods: This was a prospective study. Three hundred and twenty-two healthy adult volunteers, consisting of 133 males and 189 females were assessed, by ultrasound, following over night fasting. gallbladder length, width, height and WT were measured for each subject. Gallbladder volume was calculated by the ellipsoid formula. Data analysis included descriptive statistics and comparison of measurements with biometric parameters. Statistical significance between the variables was done with the Students t-test, with 'P' value set at ≤0.05. Results: One hundred and thirty-three males (41.3%) and one hundred and eighty-nine females (58.7%) were studied. The mean age of subjects was 31.92±11.7 years. The mean values of the length (L), height (H), and width (W) of the GB were 6.16±1.09 cm; 2.75±0.58 cm; and 2.98±0.59 cm respectively. Mean GB-V was 27.2±12.8 cm 3 and WT 0.25±0.04 cm. Age and gender did not significantly influence GB measurements. Conclusions: A normal range of GB dimensions for the Benin City locality has

been established. The study confirmed the non-dependence of GB measurements on age and gender

Previous 5:

NuraIdris Nigeria2016, Quantitative assessment of gallbladder volume (gallbladder) is an important tool for evaluating many pathologic conditions affecting the gallbladder (gallbladder). Therefore, there is need to establish a baseline sonographicnormogram of gallbladder in our locality for early detection and follow-up of subjects that may develop gallbladder diseases. Objective: To determine the mean and range of fasting gallbladder and to assess the relationship between gallbladder and age, sex, and body mass index (BMI). Methodology: The study was a cross-sectional prospective study conducted at the Aminu Kano Teaching Hospital, Kano, North-Western Nigeria. Four hundred healthy adults aged 18–60 years were recruited for the study. Subjects were scanned using EsaoteMyLab 40 (Italy) ultrasound and a 3.5 MHz curvilinear transducer after 6–8 h fasting. Scanning was done in supine and right anterior oblique positions. The length, height and width of the GB were obtained and the volume (cm 3) calculated using the ellipsoid formula. The height and weight of the subjects were measured and their respective BMI calculated. Results: There were 238 males (59.5%) and 162 (40.5%) females, with an age range between 18 and 60 years and mean age of 35.6 years (±12.9). The mean fasting GBV was 24.2 cm 3 (±8.4 cm 3), with a volume range of 11.1–50.9 cm 3. The mean BMI was 23.75 Kg/m 2 (±8.25). GBV was found to be significantly larger in males compared to females (P = 0.043); larger in older individuals (P = 0.000); and larger in those with higher BMI (P = 0.000). Conclusion: The study has established a mean fasting GBV of 24.2 cm 3 among healthy adults in Kano, North-Western Nigeria. This mean showed positive correlation and variation with age, sex and BMI. The values obtained in this study

are comparable with values from other geo-political zones in Nigeria and other parts of the world

3. Material and methods

3.1 Materials:

This retrospective crossectional study aimed to measure the normal GB volume measurement .The data used in this study was collected from military teaching hospital and nouralhoda medical center Khartoum state in April 2017

3.1.1 Subjects:

Study cases were 64 (32female and 32male) all were normal subject came for the ultrasound department for routine scan, all subjects have liver ,biliary ,pancreatic disease and pregnant ladies were excluded from the study, GB volume was measured in tow plane (longitudinal and transverse). Anthropometric measurements including height, weight, , and were obtained using standard procedures.

3.1.2 Machine used:

All patients where scanned by Toshiba ultrasound machine using curve linear low frequency transducer (3.5-5 M Hz)

3.2 Method

Ultrasound scanning of 64 normal subjects was done by radiologist. GB volume diameter was measured in centimeter.

3.2.1 Technique used:

The gallbladder should be examined in numerous patient positions: supine, left lateral decubitus, and the left posterior oblique position, in order to convincingly demonstrate stone mobility, scans may need to be performed in prone or erect positions.

The area for evaluation was fixed and skin adequately lubricated to facilitate ultrasound transmission. The transducer was gently applied and longitudinal and transverse scan was taken.

The gallbladder should be examined in the fasting state to ensure optimal bile volume a contracted, non-fasted gallbladder can be difficult to visualize.
Measurements are taken in the transverse rather than longitudinal plane to avoid any possibility of thickening due to measuring in an off-axis plane.

3.2.2Data analysis:

It has been carried out by statically package for social sciences SPSS and EXCEL programme

4.1Results:

Table 4.1: Age Groups Percent

Gender	Frequency	Percent
Female	31	48.4
Male	33	51.6

Table 4-2: Age Group Frequency

Age Group	Frequency	Percent
18-29	27	42.2
30-39	13	20.3
40-49	12	18.8
50-60	12	18.8
Total	64	100.0

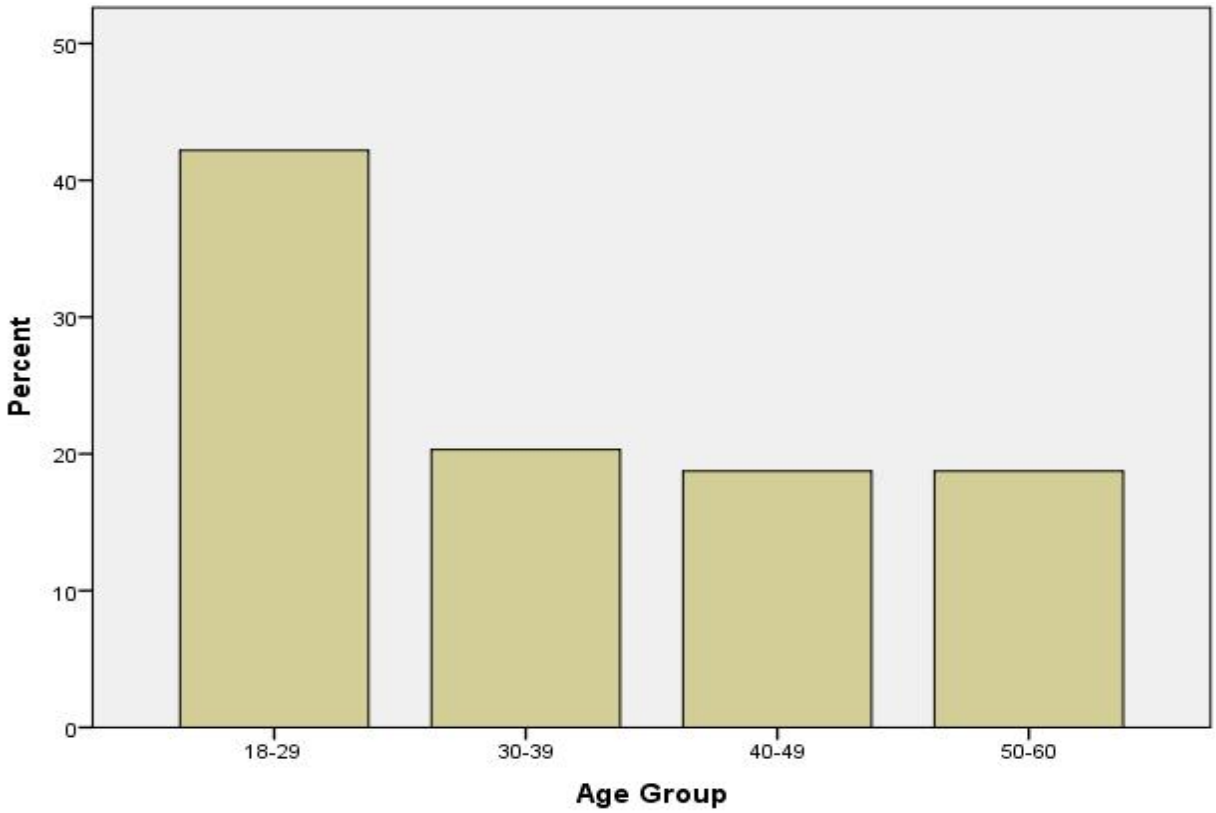
50
40
30
20
10
0
Percent
18-29
30-39
40-49
50-60
Age Group

Table 4-3 Gall Bladder volume Frequency

	Frequency	Percent
lawest	35	54.7
Normal	13	20.3
Higher	15	23.4
Total	64	100.0

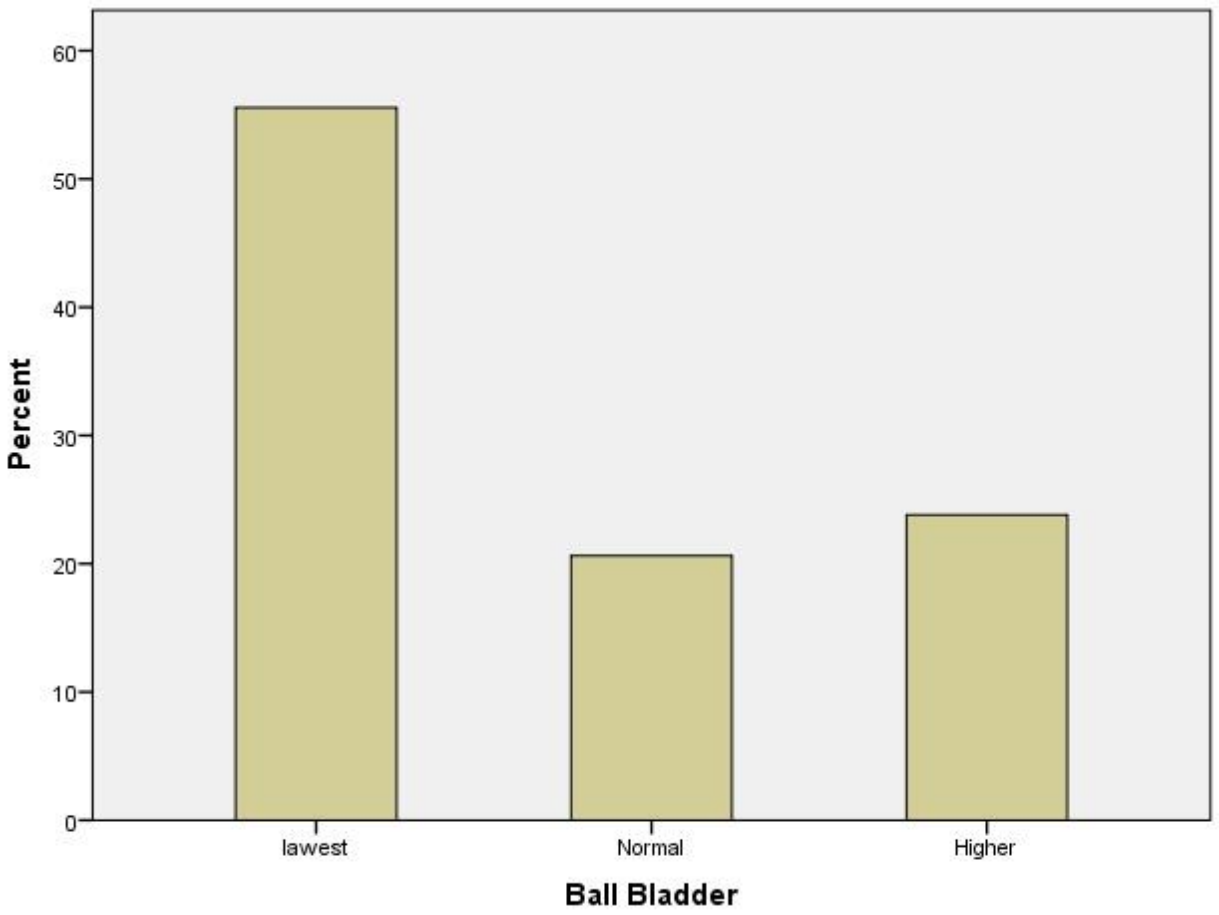

Figure 4.2: show gallbladder present

Table4.4: show the statistical measurement for the study data

	Mean	Median	STD	Min	Max
Age	35.59	32.50	12.716	18	60
BMI	9.319	9.049	1.4299	6.6	13.2
GB Length	5.580	5.300	1.1144	4.0	9.1
GB weight	2.433	2.400	.6079	1.3	5.1
GB AB	2.266	2.200	.5652	1.3	5
GB V Measured	15.755	14.250	5.6772	4.1	31.0
GB V calculated	16.933	14.535	12.2174	3.8	42.6

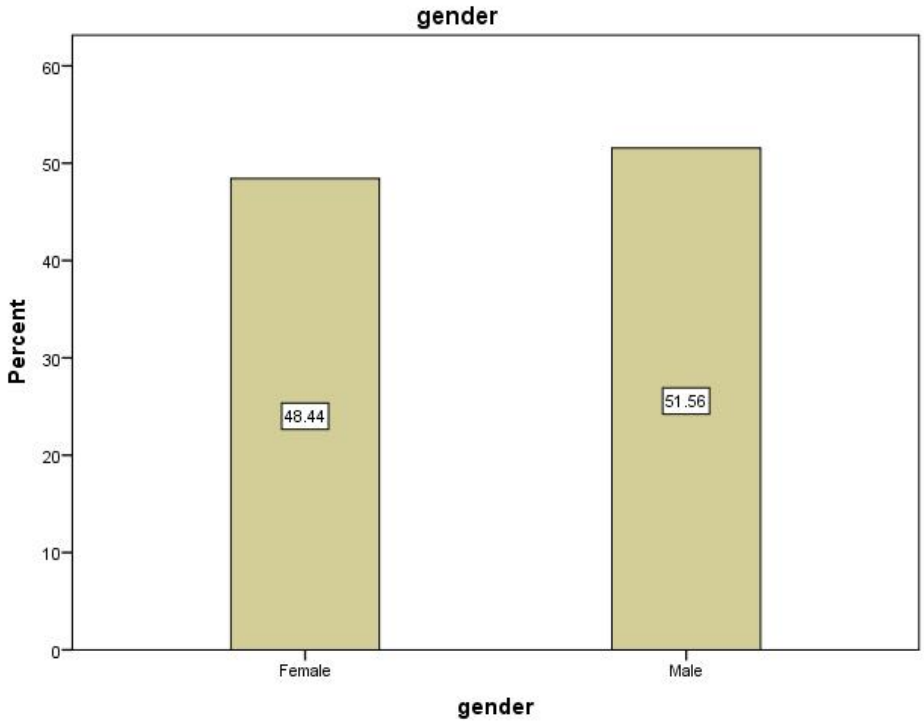

Figure 4.3:show age groups percent.

Table 4-5: show the statistical measurement for the study data for female

	Mean	Median	STD	Min	Max
Age	36.68	35.00	12.483	18	60
BMI	10.099	9.938	1.1191	8.1	13.2
GB Length	5.784	5.300	1.2882	4.2	9.1
GB weight	2.471	2.400	.7170	1.3	5.1
GB AB	2.248	2.200	.6850	1.3	5
GB V Measured	16.190	14.700	6.4116	4.1	31.0
GB V calculated	18.275	14.405	16.1618	3.8	35.1

Table 4.6: show the statistical measurement for the study data for male

	Mean	Median	STD	Min	Max
Age	34.58	30.00	13.041	18	59
BMI	8.586	8.317	1.3069	6.6	12.8
GB Length	5.388	5.100	.9006	4.0	7.2
GB weight	2.397	2.400	.4928	1.5	3.4
GB AB	2.282	2.200	.4341	1.6	3.6
GB V Measured	15.345	14.000	4.9555	8.3	28.0
GB V calculated	15.672	14.664	6.7529	28.0	42.6

Table 4.7: Age Group * Gall Bladder volume Cross tabulation

Age Group	Gall Bladder			Total
	lowest	Normal	Higher	
18-29	15	6	5	26
30-39	7	2	4	13
40-49	8	2	2	12
50-60	5	3	4	12
Total	35	13	15	63

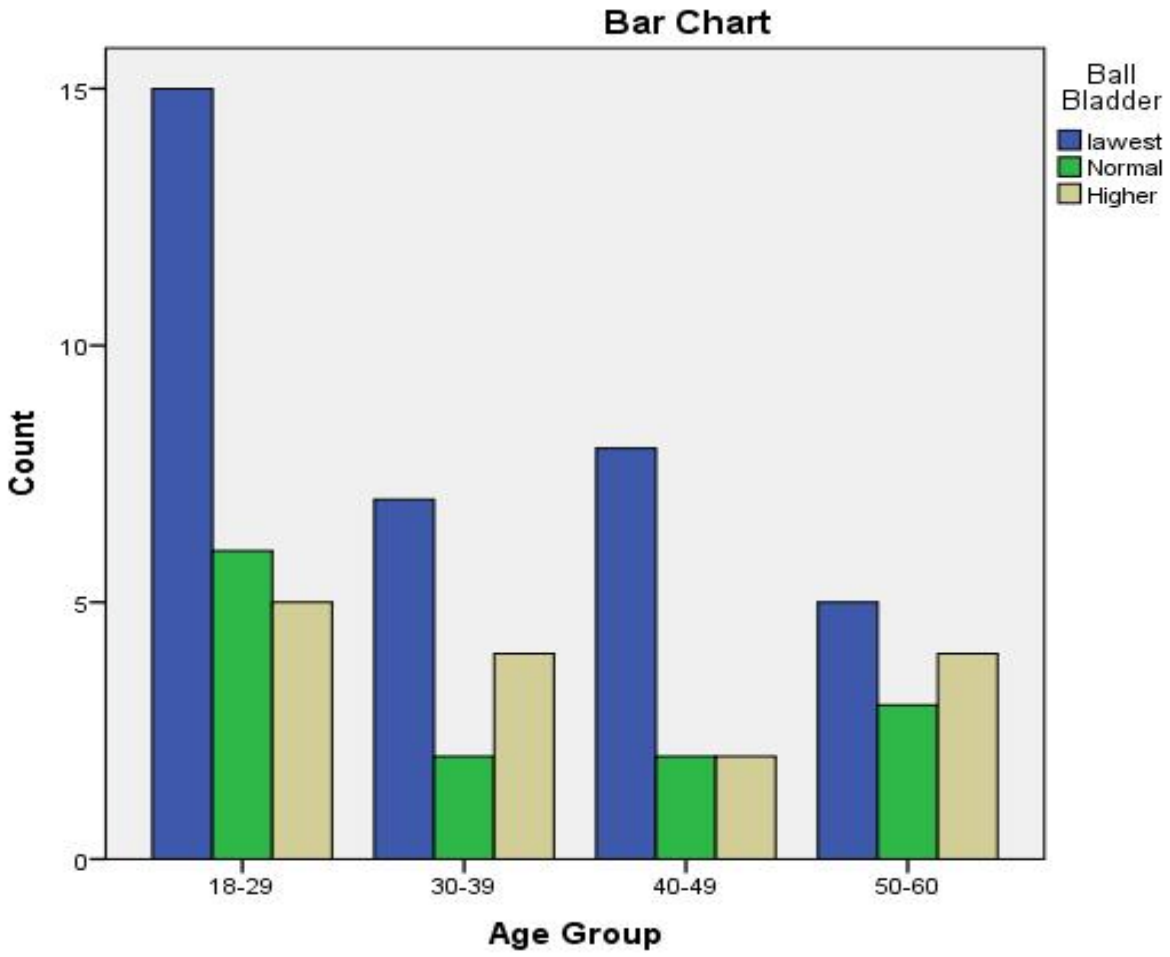

Figure 4.4 : show age group *gallbladder volume cross tabulation

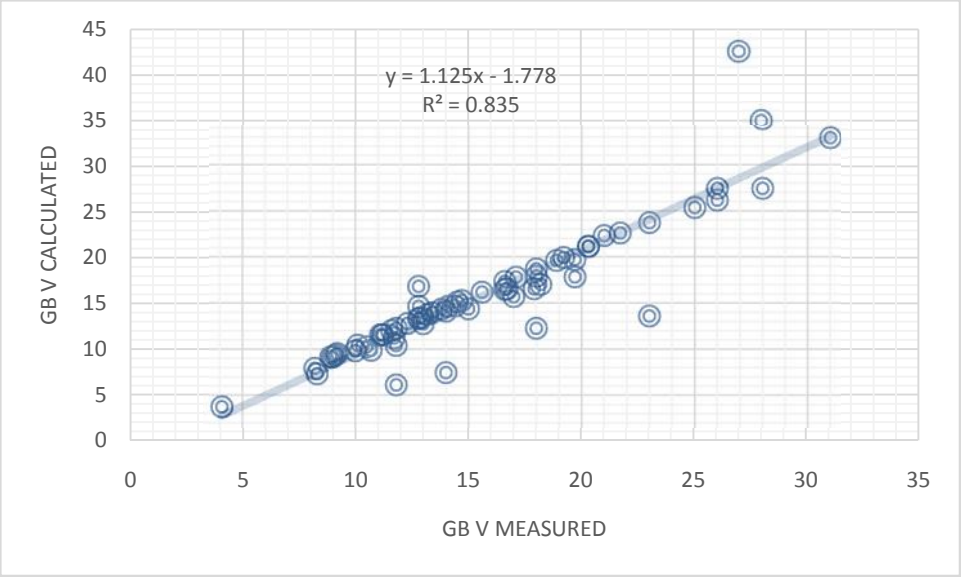

Figure 4.2: A scatter plot diagram show GB measurement in machine and GB calculation . the calculation is increased by (1 to 1.7 cm than the machine)

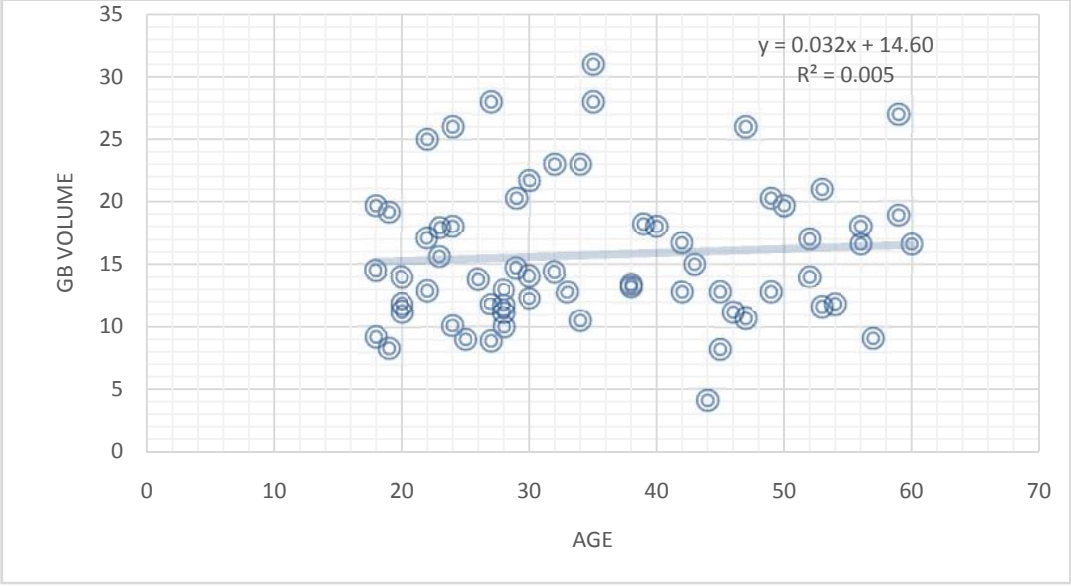

Figure 4.3: A scatter plot diagram show age correlation with GB VOLUME .the volume decrease by .03cm from 14.6 each 20 year of age.

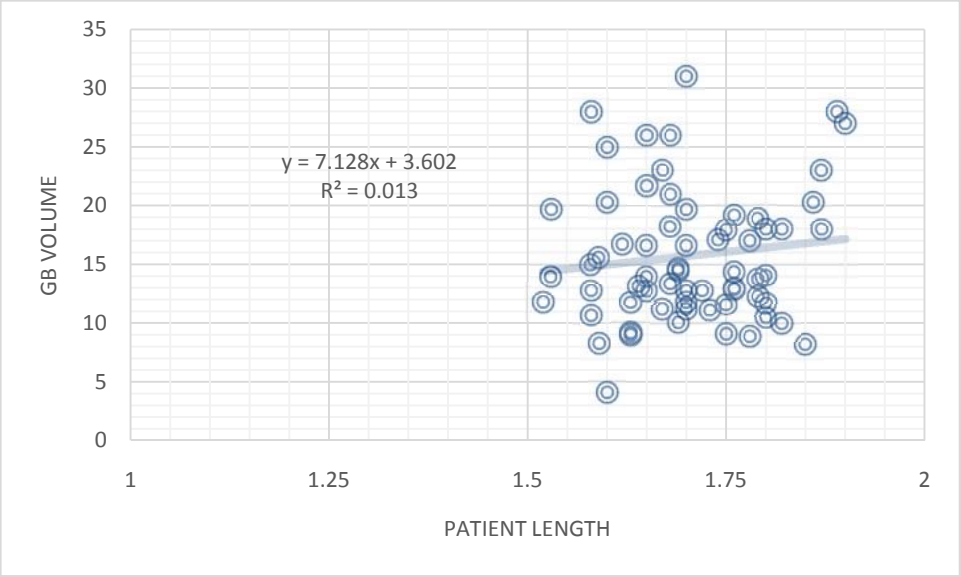

Figure 4.4: A scatter plot diagram show patient length correlation with GB VOLUME .the volume increase by .7.1cm from 3.6 each 25cm of length

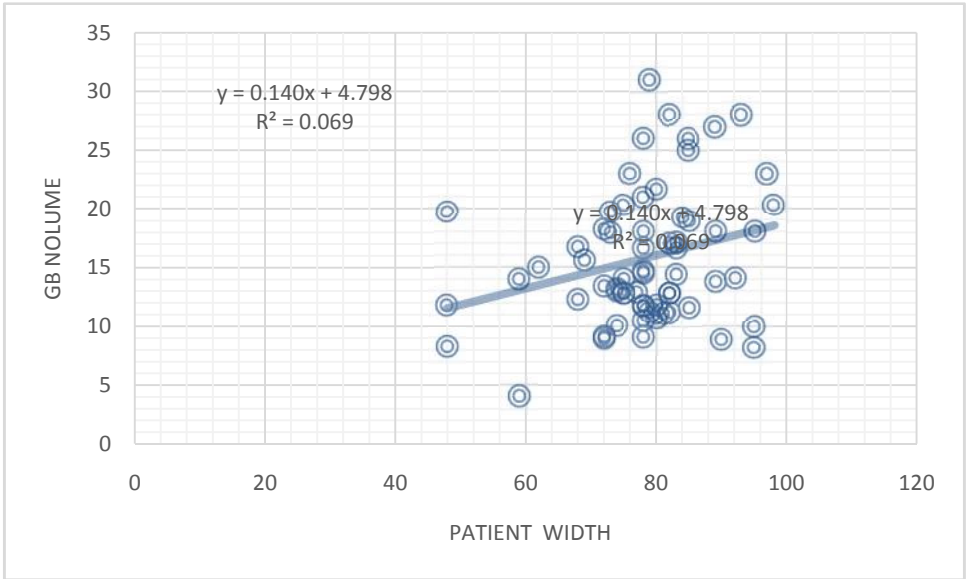

Figure 4.5: A scatter plot diagram show patient width correlation with GB VOLUME .the volume increase by .140 cm from 4.7kg of width

5.1 Discussion:

Aims:

To determine the mean and range of fasting gallblaader volume GBV and to assess the relationship between GBV and age, sex, and body mass index (BMI).

Methodology:

The study was a cross-sectional prospective study conducted at the military Teaching Hospital, and nour alhoda medical center in Khartoum state. For hundred healthy adults aged 18–60 years were recruited for the study. Subjects were scanned using Toshiba ultrasound machine and a 3.5 MHz curvilinear transducer after 6–8 h fasting. Scanning was done in supine and right anterior oblique positions. The length, height and width of the GB were obtained and the volume (cm) calculated using the ellipsoid formula (L*W*H*0.52). The height and weight of the subjects were measured and their respective BMI calculated.

Results:

There were 33 males (51.6%) and 31 (48.4%) females As recorded in Table 4.2, with an age range between 18 and 60 years and mean age of 35.59 years (±12.71) as mentioned in Table 4.1. The mean BMI was 9.319 Kg/m 2 (±1.4299.) as mentioned in Table 4.1. GBV was found to be significantly larger in females compared to males (P = 2.603) as mentioned in Table 4.3 and Table4.4; Larger in older individuals (P = 0.000); and larger in those with higher BMI (P = 0.000). Conclusion: The study has established a mean fasting GBV of 16.933 among healthy adults Khartoum state.

Figure 4.2 A scatter plot diagram show GB measurement in machine and GB calculation. The calculation is increased by (1—1.7 cm than the machine)

Figure 4.3 A scatter plot diagram show age correlation with GB VOLUME .the volume decrease by .03cm from 14.6 each 20 year of age.

Figure 4.4 A scatter plot diagram show patient length correlation with GB VOLUME .the volume increase by .7.1cm from 3.6 each 25cm of length

Figure 4.5 A scatter plot diagram show patient width correlation with GBV VOLUME .the volume increase by .140 cm from 4.7kg of width

This mean showed positive correlation and variation with age, sex and BMI. The values obtained in this study are comparable with values from other geo-political zones in Nigeria and North-West, Nigeria done In 2016 Done by NuraIdris, other parts of the world

5-2 Conclusion

This retrospective crossectional study conducted that the average diameter of the normal GBV is 16.933CM, study also achieved that there is significant correlation of GBV with age as it decrease by 0.03 cm from 14.6 for each 20 years of age and there is no significant association between BMI and anthropometry measurement and the GBV

5.3 Recommendation:

- Measurement with different patient body posture for more accuracy and to have limits of normal diameter according to the position of the patient.
- Educating and training technologist sonographers and radiologists to perform optimum examination and correct measurements.
- The most profound limitation of the study was the small sample size. So we recommend that study with larger sample be considered.

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