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Characterization of Ascitis using Echo Texture

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Characterization of Ascitis using Echo Texture

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Results: During this period, 53 patients (31males, 22females) underwent Sonography for ascitis,5(9.4%)had abdomen tuberculosis,1(1.9%)acute renal failure,2(3.8%)Ca breast,1(1.9%)Ca prostate,1(1.9%) Ca colon, 2(3.8%) Ca ovaries, 3(5.7%) Congestive heart disease, 6(11.3%) Chronic renal failure,1(1.9%)Cystadenocarcinoma, 2(3.8%) hepato cellular carcinoma,1(1.9%)Hepatitis, 23(43.4%) Liver Cirrhosis,1(1.9%) lymphoma,1(1.9%)portal hypertension, 2(3.8%)Pelvis inflammatory diseases ,1(1.9%) Urinary bladder Schistosomasis. The correlation between the Ascitis Echo Texture with total protein values, total albumin, SAAG, ascitis type, ultrasound findings were found to be significant at *p* value 0.05.liver echo texture has significant relation with Ascitis Echo Texture and laboratory results, but no impact of the spleen texture in the ascites character was noted.

Conclusion: Ultrasound is valuable in the investigation of ascetic patients. It is recommended to replace other methods of laboratory investigation as it can predict the ascitis type from its echo texture, as well as ruling the underlying causes.

Keywords: ascitis, ultrasound, laboratory tests.

I. Introduction

Ascites is defined as the accumulation of fluids in the peritoneal cavity .[1]Two important factors that control the balance exchange of fluids in the body, these including the plasma colloid osmotic pressure and the portal venous pressure and its disturbance may cause Ascites. [2, 3,4]

The most common cause of Ascites from Western Europe and North America is Cirrhosis, which records about 80% of the cases. The other common causes are Malignancy (10%), Cardiac Failure (5%) and Tuberculosis and other causes. [5, 6]

The differentiation between Ascitis causes is important for diagnostic and therapeutic purposes [7] Diagnostic abdominal paracentesis is considered as an essential investigation for differential diagnoses in all patients with clinically noticed Ascites. [8]

Clinically; Ascites is detected by the presence of flank dullness to percussion, [2].In recent years Ultrasound has been proven an accurate and reliable method of detecting abdominal fluid, determining its site [9] but questions have been raised about its capability to differentiate the Ascitis of transudates concept from inflammatory or malignant exudates. Assessment of the Ascites is necessary in monitoring the progress of the disease and in selecting appropriate methods of treatment. [10]

Radiologic evaluation of the abdomen was helpful in confirming the presence of fluid, Computed Axial Tomography are considered quite sensitive in the detection of ascitic fluid .Physical examination findings are consistent with the diagnosis of an intra-abdominal fluid accumulation; but its sensitivity yields varying results.[2]

To evaluate the reflection of Ascitis Echo Texture related to the fluid composition; we have correlated the Ultrasound findings, with patient history, clinical findings of proven Ascites cases and laboratory findings including Total Protein, Total Albumin and the Serum Ascites Albumin Gradient (SAAG) .

II. Materials and Methods

This study was implemented in Wad-Medani Military Hospital, Alia Specialist Hospital- Wad-Madani. Wad-Medani Teaching Hospital, National Cancer Institute- Wad-Madani and Omdurman Military Hospital during the period from 2012 to 2013.

Population and samples size: (53) patients in both genders who were clinically diagnosed proved to have abdominal ascites.

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Instrumentation:
Aloka SSD-500 with frequency (3.5 MHz) convex probe, and Honda SSD-500with frequency (3.5 MHz) convex probe and the facility of printing and computerized reporting system are used.
Data were collected, executed by direct Ultrasound examination; the collected data were analyzed using statistical method, ANOVA independent values, mean and standard deviation. For ethical Issue; permission from the department and patients were taken into consideration.

Techniques for doing examination:

Scanning technique of abdominal and pelvic ultrasound.

For ultrasound examination, each patient was scanned, in international scanning guidelines and protocols and Ascites was determined by Ultrasound Brightness Mode (B-Mode).

The scanning protocol for Sonography of the peritoneal cavity varies, depending on the patient's clinical symptoms, and the differential clinical diagnosis, No patients preparation was done.Patients were scanned in supine position in right lateral decubitus and in left lateral decubitus.

Transverse section: Transducer was positioned directly under the Xiphisternum and angled cephalic, Transducer beam was swept through the liver, and then was moved distally to umbilicus, applying graded compression, observing lesser sac (around the pancreas) and transverse mesocolon. The transducer was positioned directly below the right costal margin and the scan was repeated, observing all peritoneal spaces. Transducer was placed directly below the left costal margin; transducer was moved in the transverse plane, throughout the remainder of the abdomen to cover the entire abdomen.

Longitudinal section: Transducer was placed below the Xiphisternum, tipped cephalic: Swept across the abdomen from left to right, moved along right costal margin, angling towards the right lateral border of the liver repeated process to the lateral border of the spleen. Longitudinal scans were performed throughout the remaining abdomen, observing all spaces.

Grading of the findings:

Ultrasound Findings:

The Liver and spleen echo texture had been evaluated as Fine texture when smooth homogeneous contour of the parenchyma is present ,and it was given grade 0 which stands for normal. Coarse texture when irregular contour of the parenchyma and was given grade 1. Diffuse disease is irregular heterogeneous contour with fibrotic changes of parenchyma and was given grade 2.

Sonographic appearance and classification of the ascites was done by giving grades to classify the Ascitis Echo Texture as Clear Ascites and was given grade 0 and Turbid Ascites grade 1

Laboratory investigation after Paracenteses :

Normal Total protein range (6-8)g/dl ,Normal serum albumin range (3.5-6.5) g/dl,The Ascites Serum Ascites Albumin Gradient (SAAG) the Serum Albumin Concentration minus the ascitic fluid albumin concentration.Transudate (low in total protein concentration) < 30g/dl, Excaudate (high in total protein concentration)>30g/dl

III. Results

The sample include 53 patients31 (58.5%) were male and22 (41.5%) were females with ascitis arises from different causes , Clinically 32(60.4%) of the sample have a history of liver disease, 8(15.1%) have history of renal diseases 8 (15.1%) chest pain, 3(5.7%) are with hypertension and the residue acts 2 (3.8%) they came with different signs and symptoms including Nausea3(5.7%), Anorexia7(13.2%), Lower limb edema13 (35.8%), shortness of breathing 22 (41.5%). All were significantly related to Ultrasound findings at *p -value 0.05.*

Table 1 : Ultrasound Findings/Diagnosis in patients with ascitis

Ultrasound Findings /Diagnose	Frequency	Percentages
Abdomen Tuberculosis	5	9.4%
Acute Renal Failure	1	1.9%
Breast Cancer	2	3.8%
Prostate Cancer	1	1.9%
Colon Cancer	1	1.9%
Ovarian cancer	2	3.8%
Congestive Heart Diseases(CHD)	2	3.8%
Congestive Heart Diseases+ Chronic Renal Failure	1	1.9%
Chronic Renal Failure	6	11.3%

Cystoadenocarcinoma	1	1.9%
Hepato Cellular Carcinoma(HCC)	2	3.8%
Hepatitis	1	1.9%
Liver Cirrhosis	23	43.4%
Lymphoma	1	1.9%
Portal Hyper Tension(PHTN)	1	1.9%
Pelvic Inflammatory Diseases(PID)	2	3.8%
Urinary Bladder Schistosomasis	1	1.9%
Total	53	100.0%

Table 2 : Association between ultrasound findings /diagnosis** /classifications& (SAAG Classes *(P-Value = 0.000*)*

Diagnose**	SAAG Classes			Total
	High gradient	Normal	Low gradient	
Inflammatory	7.0(46.7%)	6.0(50.0%)	3.0(11.5%)	16.0(30.2%)
Tumors	6.0(40.0%)	4.0(33.3%)	0.0(0.0%)	10.0(18.9%)
Cardiac & PHT	1.0(6.7%)	1.0(8.3%)	2.0(7.7%)	4.0(7.5%)
Liver cirrhosis	1.0(6.7%)	1.0(8.3%)	21.0(80.8%)	23.0(43.4%)
Total	15.0(100.0%)	12.0(100.0%)	26.0(100.0%)	53.0(100.0%)

*Normal p-value is < 0.05; therefore the statistical difference is highly significant.** The ultrasound findings /diagnosis were classified into inflammatory , tumors, cardiac diseases and portal Hyper tension (PHT) and liver cirrhosis

Table 3 : ultrasound findings/Diagnosis classifications, Total protein and Albumin values

Diagnose	Total protein	Albumin
Inflammatory	8.2 ± 0.9	2.8 ± 0.7
Tumors	8.5 ± 0.7	3.2 ± 0.7
Cardiac & PHT	7.1 ± 1.3	2.7 ± 1.0
Liver cirrhosis	6.3 ± 0.9	2.0 ± 0.4
P-value	0.000*	0.000*

*Values are expressed as Mean ± SD; * Significant at P-value < 0.05.*

Table 4 : Association between (ultrasound findings /diagnosis classifications) & (ascitis echo texture) *(P-Value = 0.000*)*

Diagnose	*Ascitis Echo Texture*		Total
	Clear	Turbid	
Inflammatory	10.0(25.0%)	6.0(46.2%)	16.0(30.2%)
Tumors	3.0(7.5%)	7.0(53.8%)	10.0(18.9%)
Cardiac & PHT	4.0(10.0%)	0.0(0.0%)	4.0(7.5%)
Liver cirrhosis	23.0(57.5%)	0.0(0.0%)	23.0(43.4%)
Total	40.0(100.0%)	13.0(100.0%)	53.0(100.0%)

*Normal p-value is < 0.05; therefore the statistical difference is highly significant.

Table 5 : Association between (Ascites type) & (Sonographic Appearance) *(P-Value = 0.000*)*

Sonographic Appearance	Ascites type		Total
	Transudate	Excaudate	
Clear	34.0(85.0%)	6.015.0%)	40.0(100.0%)
Turbid	1.0(7.7%)	12.0(92.3%)	13.0(100.0%)
Total	35.0(66.0%)	18.0(34.0%)	53.0(100.0%)

*Normal p-value is < 0.05; therefore the statistical difference is highly significant.

Table 6 : Ascites type, Total Protien, Albumin value, Ascitis Serum albumin gradient (SAAG), Sonographic Appearance

Ascites type	Total Protein	Albumin value	SAAG Value	Sonographic Appearance
Transudation	6.7 ± 1.1	2.3 ± 0.7	1.7 ± 0.6	0.02 ± 0.2
Exudates	8.5 ± 0.9	2.9 ± 0.8	0.3 ± 0.6	0.7 ± 0.5
P-value	0.000*	0.009*	0.000*	0.000*

Values are expressed as Mean ± SD; * Significant at P-value < 0.05.

Table 7 : Association between ultrasound findings /Diagnosis classifications & Asites type *(P-Value =0.000*)*

Diagnose		Asites type		Total
		Transudate	Excaudate	
Inflammatory	Count	7.0(20.0%)	9.0(50.0%)	16.0(30.2%)
Tumors	Count	1.0(2.9%)	9.0(50.0%)	10.0(18.9%)
Cardiac & PHT	Count	4.0(11.4%)	0.0(0.0%	4.0(7.5%)
Liver cirrhosis	Count	23.0(65.7%)	0.0(0.0%)	23.0(43.4%)
Total	Count	35.0(100.0%)	18.0(100.0%)	53.0(100.0%)

*Normal p-value is < 0.05; therefore the statistical difference is highly significant.

Table 8 : Association between Liver texture & Ascitis Echo Texture *(P-Value = 0.005*)*

Liver texture	Ascitis Echo Texture		Total
	Clear	Turbid	
Fine	13(32.5%)	11(84.6%)	24(45.3%)
Coarse	10(25.0%)	1(7.7%)	11(20.8%)
Diffuse	17(42.5%)	1(7.7%)	18(34.0%)
Total	40(100.0%)	13(100.0%)	53(100.0%)

*Normal p-value is < 0.05; therefore the statistical difference is highly significant.

Table 9 : Association between Liver texture &SAAG Class *(P-Value = 0.000*)*

Liver texture	SAAG Class			Total
	High gradient	Normal	Low gradient	
Fine	10(66.7%)	11(91.7%)	3(11.5%)	24(45.3%)
Coarse	2(13.3%)	0(0.0%)	9(34.6%)	11(20.8%)
Diffuse	3(20.0%)	1(8.3%)	14(53.8%)	18(34.0%)
Total	15(100.0%)	12(100%)	26(100%)	53(100.%)

*Normal p-value is < 0.05; therefore the statistical difference is highly significant.

Table 10 : Association between Liver texture & Asites type *(P-Value = 0.003*)*

Liver texture	Asitestype		Total
	Transudate	Excaudate	
Fine	10(28.6%)	14(77.8%)	24(45.3%)
Coarse	9(25.7%)	2(11.1%)	11(20.8%)
Diffuse	16(45.7%)	2(11.1%)	18(34.0%)
Total	35(100.0%)	18(100.0%)	53(100.0%)

*Normal p-value is < 0.05; therefore the statistical difference is highly significant.

Table 11 : Association between Spleen texture & Ascitis Echo texture (P-Value = 0.326)

Spleen texture	Ascitis Echo texture		Total
	Clear	Turbid	
Fine	29(72.5%)	12(92.3%)	41(77.4%)
Coarse	10(25.0%)	1(7.7%)	11(20.8%)
Diffuse	1(2.5%)	0(0.0%)	1(1.9%)
Total	40(100.0%)	13(100.0%)	53(100.0%)

Table 12 : Association between Spleen texture & SAAG Class *(P-Value = 0.336)*

Spleen texture	SAAG Class			Total
	High gradient	Normal	Low gradient	
Fine	13(86.7%)	11(91.7%)	17(65.4%)	41(77.4%)
Coarse	21(3.3%)	1(8.3%)	8(30.8%)	11(20.8%)
Diffuse	0(0.0%)	0(0.0%)	1(3.8%)	1(1.9%)
Total	15(100.0%)	12(100.0%)	26(100.0%)	53(100.0%)

Table 13 : Association between Spleen texture& Asitestype *(P-Value = 0.101)*

Spleen texture	Asites type		Total
	Transudate	Excaudate	
Fine	2468.6%	1794.4%	4177.4%
Coarse	1028.6%	15.6%	1120.8%
Diffuse	12.9%	00.0%	11.9%
Total	35100.0%	18100.0%	53100.0%

Table 14 : Liver texture with Total Protein & total albumin

Liver Texture	Total Protein	*Total Albumin*
Fine	8.2 ± 0.8	3.0 ± 0.7
Coarse	7.0 ± 1.1	2.4 ± 0.5
Diffuse	6.3 ± 1.2	2.0 ± 0.5
P-value	0.000*	0.000*

Values are expressed as Mean ± SD; * Significant at P-value < 0.05.

Table 15 : Spleen texture with Total Protein & total albumin

Spleen Texture	Total Protein	Total Albumin
Fine	7.6 ± 1.3	2.7 ± 0.8
Coarse	6.4 ± 1.2	1.9 ± 0.3
Diffuse	6.8 ± 0.0	2.1 ± 0.0
P-value	0.028	0.005

Values are expressed as Mean ± SD; * Significant at P-value < 0.05.

IV. Discussion

The evaluation of Ascites is one of the earliest uses of abdominal ultrasound, since this method is suitable for fluids characterization [11] the ultrasound findings and diagnosis as frequency and percentage were presented in table [1].

The clinical signs and symptoms, causes hint that may be due to pressure on the internal organs, veins, diaphragm and sodium and water retention [12] . Association between ultrasound findings/diagnosis and clinical findings were found to be significant at *P-Value* (0.001) .These clinical history associated with the ascitis criteria may narrow the line for diagnoses and may predict the underlying cause of the diseases.The knowledge about the patients' previous history of diseases is important to be correlated with ultrasound findings as it was mentioned in the guidelines on the ascites management. [6]

Ultrasound has great value in diagnosing asitis causes. The study showed that the causes are either from presence of malignancies, inflammatory, or cardiac in origin where the highest score of the ascitis causes was found in patients affected by liver cirrhosis 23(43.4%) table[1] another studies had mentioned similar causes of ascites. [5,6]

For studying the character of ascites; SAAG, Total Albumin, Total Protein values have been evaluated and correlated with ultrasound findings .The study showed a significant relation with the variables at P-Value (0.000)table. [2,3]

15 out of 53(28.3%) were of high Serum Ascitis Albumen Gradient (SAAG), 12(22.6%) were normal and 26(49.1%) were of low Serum Ascitis Albumen Gradient (SAAG).The study showed that the cases of congestive heart diseases and portal hypertension as well as liver cirrhosis have low SAAG values table [2],In Mauer and Mazione,[13] assessment of ascitis show that SAAG best reflected elevated hydrostatic pressure, contributing significantly to the development of portal hypertensive ascites, even in patients with a low serum albumin concentration as well as SAAG have value in distinguishing congestive heart failure and malignant ascites .

The Total Protein and Total Albumin, were found to be significantly correlated with the ultrasound findings at *P*-Value (0.000) .The high value was found in patients

with tumors and low values in patients with congestive heart failure, portal hypertension, and liver cirrhosis table [3].Similarly in the study of Rector and Reynolds [14] patients with chronic heart failure and cirrhosis ascites had lower fluid total protien concentrations.

After ultrasound scanning, the ascities echo texture has been evaluated table [4] and were classified into 2 main appearances: 40out of 53(75.5%) were clear and 13 out of 53(24.5%) were turbid. The cause of changing the echo texture of the ascitis fluid collections may be either due to debris appears as multiple fine echoes in the cases of inflammation, or the course network of echoes generated from the fibrous strings. The clear appearance of most ascitic fluids reflects the etiology as cirrhosis.[15] similarly in our study the cases of cirrhosis acts 23(43.4%) with clear ascitis and no turbid ascitis is noted, but in the inflammatory cases which acts 16(30.2%) patients; 10 cases were found to be clear and 6cases were turbid. Turbidity, may be due to presence of neutrophils or malignancy due to triglyceride seen in the fluid.[16]as our study include5 cases of abdominal TB (9.4%) ,1case of Hepatitis (1.9%),2 cases of pelvis inflammatory diseases(3.8%) and many cases of malignancies in the breast, prostate, colon, bladder, ovaries, hepatocelluler carcinoma (HCC), and lymphoma .A number of different proteins have been present in the malignant cases and should be evaluated for their usefulness in diagnosing malignancy-related ascites in combination with other parameters such as SAAG, that may change the character of the ascitis. [17,18]

The importance of differentiation between ascitis type; is that malignant ascitis is of critical predictive significance with survival. [19]

The clear sonographic texture of ascitis were found to be transudate in origin 34.0(85.0%) and exudates 6.0(15.0%) where turbid texture were found to be transudate 1.0(7.7%) and exudates in12.0 (92.3%) table. [5]

The ascitis type had also been evaluated and was found to be related significantly at P-value < 0.05. With total protein values, Total Albumin value, Ascitis Serum albumin gradient (SAAG)and sonographic ascitis texture as turbid and clear table. [6]

The causes of ascites formation as transudate or exudate do not always follow the expected pattern [20] it was therefore proposed that the transudate or exudate concept for the classification of ascites should be terminated. [21] Additional tests and methods should be considered.

The Ascitis Total Protein (TP) attempting to reflect the different processes of fluid formation, studies supported that SAAG act as a marker of portal hypertension this approach has been adopted in the British and the American Guidelines.[6]

The demonstration of ascites has been aided by Ultrasound, as it can scan through many anatomic planes and it can detect as little as 10 ml of free fluid [22,23]therefore, uses of Ultrasound was found to be useful as it can characterize the ascitis and find out the causes.

The clinical findings do not reflect the changes in the echo texture in both the liver and spleen. We consider that ultrasound is valuable in the investigation of patients who are difficult to examine clinically, abdominal ultrasound scan should be done in order to evaluate the appearance of the liver, pancreas, and lymph nodes as well as the presence of splenomegaly, which may be a sign of portal hypertension. [6]

Association between liver Echo Texture with Total Protein, Total Albumin, SAAG, ascitis type ,ascitis echo texture was found to be significant at p-value < 0.05 table [8,9,10,14] but the spleen echo texture have significant relations only with Total Protein and Total Albumin values but no relationship was noted signify-cantly with the other examined parameters, as seen in table. [11,12,13]

We believe that Ultrasound should take place in the investigation of abdomen and pelvis for ascitis, it is also valuable in the investigation of ascetic patients with large or small ascitis amount of fluids and patients who are difficult to be examined clinically. It is recommended to replace other methods of laboratory investigation as it can predict the ascitis type from its echo texture, as well as ruling the underlying causes.

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