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Abdominal computed tomographic scan-merits and demerits over ultrasonography: evaluation of 70 cases

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Summary
Computed tomography (CT) and Ultrasonography (USS) are commonly used to ascertain the cause of abdominal symptoms. In a retrospective study of 70 Nigerian patients who had abdominal ultrasonography prior to abdominal CT scans, the most frequent clinical feature was abdominal pain, which was reported in 20.8% of the patients. The prevalent ultrasonographic finding was hepatomegaly (12.2%) while bowel displacement was the most frequently reported CT finding (18.3%). There was no correlation between USS and CT findings in 11 patients (15.7%). There was some agreement in the findings of both tests in 75.7% of cases. Additional findings were noted in 38 (54.3%) of the latter group of patients on CT scans. Hundred percent agreement was reported in both imaging techniques in 5 radiological findings namely: dilated gall bladder, renal cysts, ascites, adrenal mass and utero-cervical mass. These findings suggest a high yield of diagnostic accuracy from abdominal sonography and increased diagnostic details provided by CT imaging. Our overall impression is that the diagnostic information provided by the two techniques are complimentary.

Keywords: *Abdominal, computed tomography, ultrasonogrpahy.*

Résumé
Les examens tomographique calculé (TC) et l'échographique (uss) calculée sont souvent utilisés pour déterminer la cause des symptômes abdominaux. A travers une étude rétrospective de 70 malades nigérians, qui avaient fait l'échographie abdominale avant qu'ils n'aient fait une scanographie, la caractéristique la plus fréquente était les maux abdominaux ce qui était le cas de 20,8% des malades. La constations échographique principal était « l'hépatomégalie » (12,2%) alors que le déplacement de l'intestin était la constation scanographique le plus fréquemment signalé (18,3%). Il n'avait pas de corrélation entre les constations scannographiques et échographiques de 11 malades (15,7%). Il y avaient quelques accords dans les conclusions dérivées des deux essaie à propos de 75,7% des cas. Les constations supplémentaires avaient été remarquées dans 38 (54,3%) du dernier groupe des malades qui ont fait le scannographie. Un accord de cent pourcent avait été signalé dans les techniques d'imagerie à propos de 5 constations radiologiques : La vessie de ballon dilatée, le Kyste rénal, « l'ascites », la masse surrénale, et la masse utéro-cervicale. Ces constations suggèrent un important rendement de précision diagnostique obtenue de la sonagraphe abdominale et une augmentation des détails diagnostiques fourni par l'imagerie de scannographie. En gros, notre impression est que l'information diagnostique fourni par les deux techniques sont complémentaires

Introduction

Computed tomography (CT) and sonography (USS) are modern imaging modalities for examining the abdomen. Previous reports [1-5] show that they are accurate methods of evaluating patients with abdominal complaints. With the exception of Magnetic Resonance Imaging (MRI), both techniques are capable of displaying cross-sectional anatomy of the body in a manner suitable for radiodiagnosis [3]. This report reviewed 70 patients who had both studies done in the University College Hospital (UCH) Ibadan; with the ultrasound scan being done prior to the CT Scan. The value of each technique and the complimentary roles of the two imaging modalities in the assessment of the pathological states in the abdomen are the highlights of this report.

Materials and methods

The population of our study is made up of 70 consecutive patients who had both ultrasonographic and computed tomographic studies of the abdomen done, in a 4-year period, (January, 1994 – December, 1998). Patients were referred for abdominal ultrasound scans as a result of the clinical features relating to the abdomen (Table 3). Abdominal ultrasound scans were done in the transverse and longitudinal planes using a Siemen scanner with a 3.5mHz sector transducer.

The CT scans were requested, for further evaluation of equivocal cases. They were also done in cases with persistent abdominal symptoms even with normal ultrasound scans. Even though the timing of CT scans post-abdominal ultrasonography was variable, all CT scans were done within one week of ultrasonic examination. The CT scans were obtained using a General Electric 9,000 CT/T3 Sec scanner.

Scans were done supine and slices obtained at 10mm contiguous sections, before and after oral and intravenous contrast administration. Thinner slices were obtained whenever it was necessary. Patients with acute trauma of the abdomen were not included in the study.

Results

There were 46 males and 23 females, giving a 2:1 male/female ratio. One patient's sex was not recorded. Patients' ages ranged from 23 to 73 years. The mean duration time between the two examinations was 48.02 hours.

Table 1 shows age group distribution in the study. Two patients did not have their ages recorded. This table also

Table 1: Age group and frequency

Age group	Frequency	Percent	Cum %
20 - 29	8	11.8%	11.8%
30 - 39	11	16.2%	28.0%
40 - 49	17	25.0%	53.0%
50 - 59	14	20.6%	73.6%
60 - 69	14	20.6%	94.2%
70 - 79	4	5.9%	100.0%
Total	68	100%	

2 patients did not have their ages recorded.

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indicates that (25%) of the patients studied were in the 5th decade. This was followed by an incidence of 20.6% each in the 6th and 7th decades. Only 4 (5.9%) cases were above 70 years.

Table 2: Clinical features and frequency of occurence

Clinical features	Frequency	%
1. Abdominal pain	22	20.75
2. Jaundice	18	16.98
3. Abdominal swelling	13	12.26
4. Weight loss	12	11.32
5. HT (Phaeochromocytoma)	9	8.49
6. Hepatomegaly	8	7.54
7. Ascites	4	3.77
8. Pruritus	3	2.88
9. Fever	3	2.83
10. Vomiting	2	1.89
11. Aneamia	2	1.89
12. Hypoglycemic seizures	1	1.89
13. Renial mass	1	0.94
14. Haematuria	1	0.94

HT is Hypertension

Table 2 shows patients' presenting clinical features and their frequencies. A total of 14 different clinical features were reported, the commonest was abdominal pain with a frequency of 22 (20.75%) followed by jaundice with a frequency of 18 (16.98%). Thirteen patients (12.26%) were scanned for abdominal swelling .

Table 3: Comparative table of ultrasound and computed tomographic findings and their incidence in the same set of patients.

Findings	USS frequency	%	CT frequency	%
1. Normal	8	4.88	4	2.44
2. Hepatomegaly	20	12.20	23	14.02
3. Liver-tumoral mass	15	9.15	18	10.98
4. Pancreatic masses	7	4.27	14	8.54
5. Paraaortic nodes	7	4.27	18	9.76
6. Dilated gallbladder	6	3.66	6	3.66
7. Dilated intrahepatic ducts	6	3.66	5	3-05
8. Renal cysts	6	3.66	6	3.66
9. Calculi (gallbladder)	6	3,66	4	2.44
10. Splenomegaly	5	8.05	42	2.44
11. Thickwalled GB	4	2.44	-	-
12. Ascites	4	2.44	4	4.44
13. Hydronephrosis	4	2.44	5	3.05
14. Liver-Cystic Mass	3	2.44	-	-
15. Renal Mass	2	1.83	5	3.05
16. Adrenal mass	2	1.22	2	1.22
17. Uterine cervical mass	2	1.22	2	1.22
18. Splenic masses	1	0.61	-	0
19. Pleural effusion	-	-	1	0.61
20. Bowel displacement	-	-	30	18.29
21. Vertebral osteophytosis	-	-	5	3.05
22. Vertebral mass	-	-	5	3.05
23. Aortic calcification	-	-	3	1.83
24. Pelvic mass	-	-	1	0.61
25. Appendicular mass	-	-	1	0.61
Total	110	67.1%	164	100%

Table 3: is a comparative table of the incidence of detection of the various findings in both methods of imaging. A total of 19 different ultrasonic findings were documented, while CT reported 26.Although hepatomegaly was the commonest finding at ultrasound scans, bowel displacement was the most frequently reported finding on CT Scans. In the thirteen patients with abdominal swelling, both CT and ultrasonography showed the particular organ responsible for the swelling. Hepatomegaly topped the list in both techniques. The same table shows comparable incidences in both imaging techniques for the following: renal cysts, uterine cervical mass, ascites, hepatomegaly, adrenal mass and hydronephrosis. Interestingly, six additional findings were recorded by computed tomograhic imaging, namely: pleural effusion,bowel displacement, vertebral osteophytes and mass, aortic calcification, pelvic and appendicular masses.

Table 4: Correlation of CT and ultrasonic finding in the same patients and frequency.

Groups	Frequency
1. No correlation between CT and USS	11 (15.7%)
2. Correlation between CT and USS	15 (21.4%)
3. Correlation between CT USS + New CT findings	38 (54.3%)
4. Entirely new CT findings	6 (8.6%)

Table 4 shows the degree of correlation of CT and ultrasound findings. In group 1, there was no correlation between ultrasound and computed tomographic findings; 11 cases were reported in this category. In group 2, 15 (21.4%) cases showed correlation between CT and USS findings. In group 3, apart from the correlative findings of the two techniques, there were additional CT findings in 38 (54.3%) of the cases. Group 4 recorded positive CT findings in 6 cases who had normal ultrasound scans.

Table 5: Kappa and P-values in the radiological findings diagnosed by sonography and CT

USS + CT findings	Kappa value	P -value
Normal	96.2%	0.00
Hepatomegaly	97.1%	0.00
Liver tumoral mass	97.1%	0.00
Pancreatic masses	92.4%	0.00
Paraaortic nodes	89.6%	0.00
Dilated intrahepatic ducts	99.0%	0.00
Gall bladder calculi	98.1%	0.00
Splenomegaly	99.0%	0.00
Hydronephrosis	99.9%	0.00
Renal mass	98.1%	0.00
Dilated gallbladder	100%	0.00
Renal cycts	100%	0.00
Ascites	100%	0.00
Adrenal mass	100%	0.00
Uterine cervical mass	100%	0.00

In 106 findings, USS and CT demonstrated positive findings at the same or at different frequencies. The Kappa statistical test was applied to these findings in order to measure the level of agreement of the result obtained from the two modalities.

Table 5 shows the Kappa and P –values for positive radiological findings in both CT and sonography. The Kappa statistical test was used to measure the level of agreement of these findings. The Table shows a 100% agreement for 5 radiological findings namely: dilated gall bladder, renal cysts, ascites and adrenal and uterine cervical mass. The Kappa values of the other findings range from 89.6% to 99% with P-values = 0.005 which is statistically significant.

Discussion

USS and CT imaging of the abdomen have undergone diverse use as well as tremendous improvement over the year [6]. Both techniques have been found useful in the evaluation of abdominal pathologies.

With the use of an adequate contrast agent, CT allows accurate differentiation of bowel from other structures in the abdomen. This was confirmed in our study where the axial images easily demonstrated intestinal displacement in 30 (18.29%) cases (Table 3).

From Table 3, both techniques aided the localization of masses within the abdomen in addition to demonstrating the precise intrinsic nature of these masses. Intrahepatic tumoral masses, were reported in 9.15% and 10.98% percent in US and CT scans, respectively. This increased sensitivity of CT in detecting intrahepatic masses is in agreement with the reports by Alfidi *et al* [7], Stephens *et al* [8], Yeh and Wolf [9] and Alfidi *et al* [10]. This is so because all intrahepatic masses are of diminished density when compared to normal hepatic parenchyma, their detection is further accentuated with the appropriate use of contrast agents. This is an acknowledged edge of CT over sonography especially in instances where fat-free areas in the latter scans can be misinterpreted for intrahepatic masses [11]. Of the hepatic masses diagnosed, 2.4% were reported by sonography as hepatic cysts while none was reported by CT. The dangers of imaging misinterpretation, as a result of over reliance of CT on attenuation value may be responsible for this [2]. On the other hand sonography is superior in the detection of a cyst in any organ due to the through and through transmission of sound waves by the cyst [4]. It may however be difficult by ultrasonography alone to distinguish a cavitatory neoplasm from a benign hepatic cyst or abscess [3].

USS and not CT is the primary imaging modality for the gallbladder because of its shape, echo pattern and location. However, significant gallbladder pathology may be diagnosed by CT. The above reasons account for the increased frequency recorded by sonography (3.66%) over CT (2.44%) in demonstrating gallbladder stones. The reasons can be further explained, in some CT images where gallstones may appear isodense with bile or are too small to be demonstrated. Also, contrast in the adjacent bowel loops may obscure or mimic gallstones in the gallbladder. These same explanations are responsible for the detection of gallbladder wall thickening by sonography alone. This is a known short fall of computed tomography [12].

However in the investigation of jaundice both techniques can evaluate the biliary tree and the status of the adjacent hepatic parenchyma. Six (3.66%) cases with intrahepatic duct dilatation were diagnosed by ultrasonography, as their sonolucent appearance with the adjacent echogenic wall facilitate their detection. Computed tomography has been reported to be about 95% accurate in determining the presence, level and cause of biliary obstruction [10]. This has been attributed to the low intensity of bile within the biliary tract that make it easily apparent on CT images, especially when they are dilated [6,13].

Computed tomography demonstrated 14 (8.54%) pancreatic masses (Table 3), half of which were found in the tail. Ultrasonography was positive for only half of the above number. Reports [14,15] have shown that the pancreas can be routinely visualized in both the normal and pathological states by CT. This is however not true for sonographic images, as bowel gas and fatty changes of the pancreas can degrade the quality of the images, making pancreatic scans sometimes impossible. In such patients , a gastric window is recommended for improved ultrasound imaging. Both CT and USS demonstrate reasonably renal masses (Table 3), but in gross hydronephrosis ultrasonography may be necessary for confirmation.

In our study, associated vertebral lesions were reported by CT in 5 (3.05%) of our cases, this is because bony abnormalities are clearly demonstrated in CT scans unlike ultrasonography where calcific densities result in almost total absorption of sound waves with resultant difficulty in imaging.Both techniques are useful in the identification and localization of enlarged lymph nodes [16]. Our study shows that CT scan identified more nodes but only the paraaortic group of nodes were demonstrated by both examinations.The nodes were of varying sizes. Previous reports show that small-sized lymph nodes are mostly associated with reactive or inflammatory lymphadenopathy including the Human Immunodeficiency Virus (HIV) infection, while malignant nodes tend to be large [17]. Apart from size, the characteristic imaging appearance of these nodes are also helpful criteria in their differentiation. Sonography in particular is known to highlight these differences and the following associations have been described namely:(i)hyperechoic nodes in metastatic disease, (ii) hypoechoic or nearly cystic nodes in lymphoma and (iii) central necrosis and cystic changes in inflammatory nodes as suppuration occurs [17]. The authors believe that these findings could be the subject for a future paper.

Conclusion

In the agreed radiological diagnosis of each of these 70 cases, there was no correlation between US and CT findings in 11 cases while correlation was found in 53 (75.7%) (Table 4) despite the mean duration time between the two studies which expectedly could alter radiological findings. Analysis of our data in table 5 show that the level of agreement between CT and USS findings is statistically significant . The authors therefore, agree that abdominal ultrasonography gives a high yield of diagnostic accuracy, while CT offers more diagnostic details (Table 3).This study also reiterates that computed tomography and ultrasonographic examination of the abdomen is not restricted to a single organ but to every structure demonstrated on the particular plane of interest. Despite the advantages of CT in examining the abdomen, its limited availability, cumbersome technique and the use of ionizing radiation are all factors to be considered before it is requested. Fortunately, the diagnostic yield of both techniques is complimentary. The authors therefore conclude that ultrasonography in trained hands can be reliably and accurately utilized.

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