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COMPARISON OF ULTRASONOGRAPHY WITH COMPUTED TOMOGRAPHY FINDINGS IN EVALUATION OF ABDOMINAL AORTIC ANEURYSM

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ABSTRACT

Objective: To compare ultrasonography (US) and computed tomography (CT) data for evaluation of abdominal aortic aneurysm.

Study Design: Validation study.

Place and Duration of Study: Radiology Department Combined Military Hospital Rawalpindi, from Apr 2006 to Jan 2008.

Material and Methods: This study involved 67 patients. Both ultrasonography and computed tomography were performed on each patient for evaluation of different variables of abdominal aortic aneurysm. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy and *p*-values were calculated for all qualitative variables separately. Mean and standard deviation (SD) were calculated for the quantitative variables.

Results: Ultrasound measurements of abdominal aortic aneurysm were both accurate and reproducible.

The sensitivity and specificity of ultrasonography for abdominal aortic aneurysm were >90% for all attributes, with minor differences usually resulting from measurement variation rather than failure to distinguish between large aneurysms and normal aortas.

Conclusion: Ultrasound was equally effective in comparison with computed tomography not only in diagnosing abdominal aortic aneurysm but also in assessing its different attributes.

Keywords: Aortic aneurysm, Computed tomography, Ultrasonography.

INTRODUCTION

Abdominal aortic aneurysm (AAA) is an important cause of acute death hence delay in diagnosis may be fatal[1-4]. The true incidence of AAAs is unknown, however studies suggest 5% to 10% prevalence in men older than 60[5-10]. The incidence of atheromatous disease increases with age and affects men more than women[11]. The male to female ratio of incidence is 1.6-4.5:1.12 Worldwide, AAA is more common in white males than in others[12]. AAAs remain asymptomatic for many years and if left untreated, cause death from rupture in about one third of patients[13]. Given the high rate of morbidity and mortality associated with AAAs, accurate diagnosis and preoperative evaluation are essential for improved patient outcomes[14]. Screening for AAAs has been discussed in the literature for nearly half a century[10].

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CT has proved to be the most accurate technique in the detection and estimation of the size of aneurysms[14]. CT is the preferred method for imaging in emergent abdominal vascular conditions[15], because it enables the acquisition of high-spatial-resolution volumetric image data during a single breath hold[1,16]. The shorter scanning time with multi–detector row CT scanners permits better visualization of blood vessels and improved contrast material enhancement of the adjacent organ parenchyma[17]. Furthermore, faster data acquisition makes it possible to perform multiple consecutive CT examinations in the same patient in a short time[17].

US ranks second after CT in its accuracy[15]. US is the preferred method of screening AAA because of its accuracy, low cost, patient acceptance[18], lack of radiation exposure and wide availability[10].

The current surgery literature suggests that there is no significant difference between the size of AAAs depicted by US and CT[19]. One study was conducted to find incidence, clinical presentation and outcome of non traumatic aortic emergencies[4] in a local tertiary care set-up focusing on the growing concern of AAA in geriatric population. Two recent prospective trials indicated that monitoring small (<5.5 cm in diameter) abdominal aortic aneurysms with US is as effective as early surgery in preventing mortality and carries a lower morbidity[20-23]. There is increasing evidence that it is worthwhile and cost effective to screen selected populations for aortic aneurysms with screening US[24-30].

Our study compares different attributes of AAA on US and CT and ascertain effectiveness of the former modality in evaluation of the disease for follow-up and/or surgical planning.

PATIENTS AND METHODS

This validation study was carried out in Radiology Department of Combined Military Hospital Rawalpindi. The study duration was one year and nine months, from April 2006 to January 2008. Sixty seven cases were included in the study fulfilling the inclusion criteria of

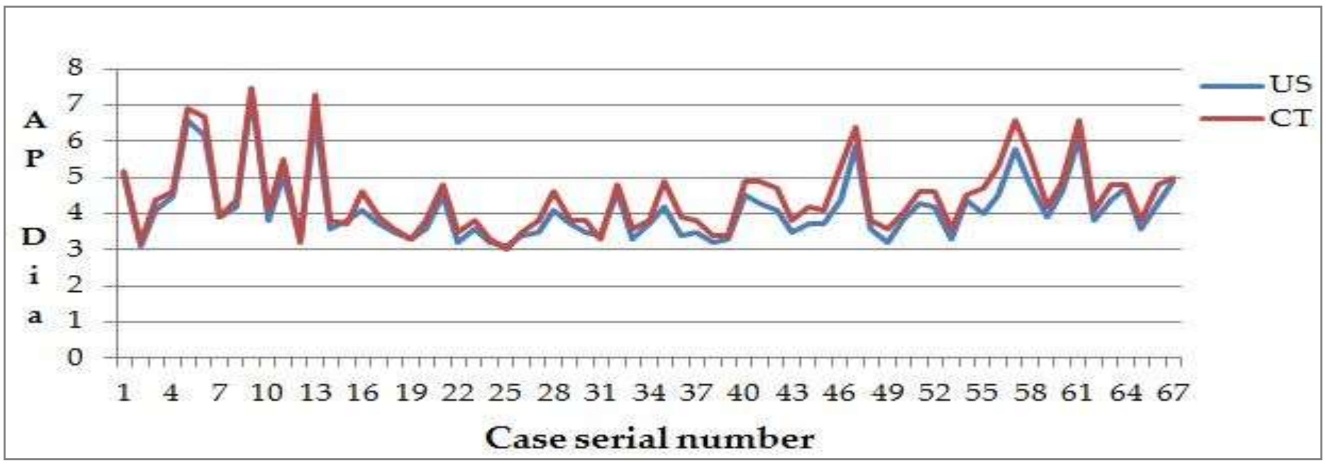

Figure-1: Comparison of antero-posterior diameter of abdominal aortic aneurysm by ultrasonography and computed tomography (n=67).

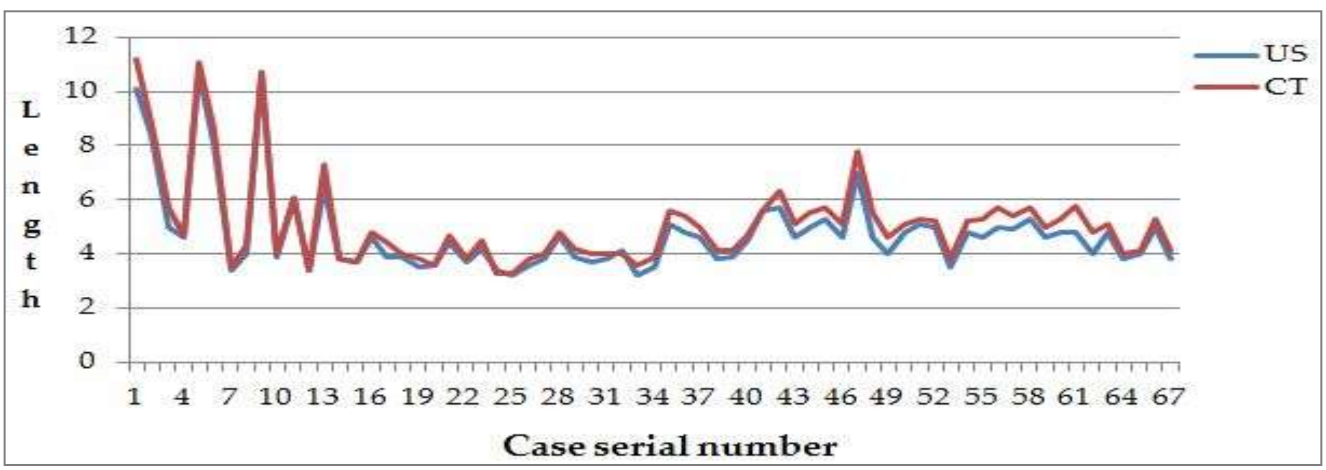

Figure-2: Comparison of length of abdominal aortic aneurysm by ultrasonography and computed tomography (n=67).

smoking, hypertensive males age more than 60 years who were found to have aortic diameter of more than 3 cm on US examination. Toshiba Asteion Super 4 (multi-slice CT) and 3.5 MHz curvilinear probe on Toshiba Aplio Doppler US Machine (Model: SSA- 700 A) were used in the study. Patient age, antero-posterior (AP) abdominal aortic diameter and longitudinal diameter (length) were quantitative variables while aneurysmal sac form, wall calcification, involvement of renal artery and peri-aortic haematoma were qualitative variables. Antero-posterior diameter and length of AAA were measured by use of electronic calipers of the US machine and multi-slice CT scanner while qualitative variables were assessed by gray-scale differentials in the two imaging modalities. depicted on Multi-slice CT. The results on each imaging modality were gathered by a common observer which was substantiated by the findings of a consultant radiologist.

Medcalc Software version 16.4 was used for computation and data analysis. Mean and SD were calculated on two independent samples in US and CT for continuous variables. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated for qualitative variables in the two groups.

RESULTS

The quantitative variable of AP diameter of AAA in the two modalities showed a mean of 4.152 cm on US and 4.457 cm on CT with SD of 0.927 and 1.036 respectively (fig-1).

Table–I: Comprarison of presence/absence of renal artery involvement on US and CT.

	CT (Gold Standard)		
US (New Test)	**Renal artery involved**	**Renal artery spared**	**Total**
Renal artery involved	7	0	7
Renal artery spared	1	59	60
	8	59	67

Sensitivity: 87.5%, Specificity: 100%, Positive Predictive Value: 100%, Negative Predictive Value: 98.33%, Accuracy: 98.5%

Table–II: Comparison of presence / absence of peri-aortic haematoma on US and CT.

	CT (Gold Standard)		
US (New test)	**Peri-aortic haematoma**	**Absence of peri-aortic haematoma**	**Total**
Peri-aortic haematoma	3	3	6
Absence of peri-aortic haematoma	1	60	61
	4	63	67

Sensitivity: 75%, Specificity: 95.24%, Positive Predictive Value: 50%, Negative Predictive Value: 98.36%, Accuracy: 94%

Aneurysmal sac form was classified as either saccular or fusiform. Wall calcification was recorded for its presence as intensely echogenic rim surrounding aneurysm on US and curvilinear calcific density on CT. Presence or absence of renal artery involvement and peri-aortic haematoma were also recorded.

After taking necessary personal information and informed consent on patients reporting to the department, the size of abdominal aorta were measured on US. A focused US was carried out in patients fulfilling the latter criteria to measure variables of AAA followed by the measurements

The quantitative variable of the length of AAA in the two modalities showed a mean of 4.785 cm on US and 5.129 cm on CT with SD of 1.6 and 1.706 respectively (fig-2).

The qualitative variable of forms of AAA, that are fusiform and saccular are 100% correctly picked up by US as compared to CT.

Regarding qualitative variable of calcification, US revealed 38 positive cases while 29 negative cases. On CT, positive cases were 45 while 22 cases were negative. This entails slightly low sensitivity of US in detecting calcification as compared to CT.

Qualitative variable of involvement of renal artery by AAA was picked up by US remarkably well. US depicted 7 out of 67 (10.44%) cases while CT detected 8 out of 67 (11.94%) cases (table-I). US was equally good in depicting involvement of renal artery/arteries when compared to CT. US depicted 3 out of 67 (4.47%) cases while CT depicted 4 out of 67 (5.97%) cases of peri-aortic haematoma (table-II, fig-III). Again US was found to be equally effective as CT in the presence of peri-aortic haematoma.

US detected equal number of patients regarding form of AAA as compared to the CT data. Other qualitative variables of presence or absence of wall calcification, involvement of renal artery and peri-aortic haematoma were also picked up well by US. The quantitative variables of AP diameter and length of AAA as depicted by US in comparison with CT revealed 3mm and 3.4 mm difference respectively.

US was equally effective in detecting different quantitative and qualitative variables of AAA in comparison with CT in our sample data of 67 patients. Fifty eight out of total number of 67 (86.56%) patients were found to have abdominal aortic diameter between 3 cm and 5.5 cm. Forty-six out of 67 patients (68.65%) were over the age of 65 years.

DISCUSSION

Fifty-eight out of total number of 67 (86.56%) patients were found to have abdominal aortic diameter between 3 cm and 5.5 cm. Forty-six out of 67 patients (68.65%) were over the age of 65 years. This is close to the findings in international studies i.e.; incidence of AAA is highest in elderly men with between 70% and 90% of AAAs occurring in men older than 65[31]. Mildly reduced incidence observed in this study is likely due to reduced longevity in Pakistan as compared to that in the West. US has shown to be a successful imaging modality not only in screening of geriatric patients for AAA but also in its measurements which has shown to be consistently correct[32] as well as repeatable[30]. When an AAA was detected and analyzed on US, the patient was followed-up by CT for quantitative as well as qualitative characterization of AAA. Insignificant variation was observed in the AP diameter of AAA in the two modalities. AP diameter of AAA as characterized by US and CT has a mean difference of 3 mm with the former modality just perceptibly underestimating the attribute. The difference is likely due to gas shadows obscuring the abdominal aorta on US and oblique sections across AAA on CT. Length of AAA as characterized on US and CT was also in conformity, with only minor variation (3.4 mm mean difference) arising from observer error and gas shadows resulting in slightly reduced length

Figure-3: Hypoechoeic region postero-lateral to abdominal aortic aneurysm signifying para-aortic hematoma on ultrasonography.

measurements on US. Qualitative variables were assessed by gray-scale differentials in the two imaging modalities of US and CT. In characterization of form of AAA, US and CT detected 65 cases each of fusiform shape while 2 cases each of saccular form of AAA. US findings exactly matched with the findings on CT. The findings are in concordance with other international studies[30,32]. The attribute of calcification is seen as highly echogenic line or focus at the rim of AAA on US and dense line or focus with Hounsfield unit of 230 and above on MSCT. Calcification in the wall of AAA as depicted on US, revealed 38 positive cases while

29 negative cases. On CT, positive cases were 45 while 22 cases were negative. This entails slightly low sensitivity of US in detecting calcification as compared to CT. The observed difference is likely due to proximity of bowel gas and aneurysmal wall calcification. In the assessment of renal artery involvement by AAA which was picked up both on US and CT by the continuation of abdominal aortic dilatation in its branches of renal artery/arteries, US depicted 7 out of 67 (10.44%) cases while CT detected 8 out of 67 (11.94%) cases. Our findings for incidence of infra-renal type of AAA among all subtypes is 89.56% on US and 88.06% on CT which is close to another study[33], which observed 95% frequency for infra-renal type of AAA[33]. Presence of peri-aortic haematoma was depicted by loss of continuity of rim calcification in the aneurysm wall, on US. While the same attribute was picked up on CT by well defined soft tissue density. US depicted 3 out of 67 (4.47%) cases while CT depicted 4 out of 67 (5.97%) cases of peri-aortic haematoma. Again US was found to be equally effective as CT in detecting peri-aortic haematoma. CT is the gold standard investigation but can lead to a delay in definitive diagnosis and treatment (especially out of normal working hours) and transfer to scan may be associated with further risks or deterioration. An early ultrasound scan in the resuscitation phase may be the primary investigation of choice. One international study suggested protocol to scan larger aneurysms at 6-month intervals and smaller ones at 12-month interval. Ultrasound measurements of AAA are both accurate and reproducible. The sensitivity and specificity of US for AAA are nearly 100% with inaccuracies usually resulting from minor measurement variation rather than failure to distinguish between large aneurysms and normal aortas.

CONCLUSION

Ultrasound has been found to be equally effective in diagnosis of abdominal aortic aneurysm as compared to CT. Insignificant differences in quantification and characterization of aneurysm by US and CT were due to intra-abdominal gas shadows and inter-observer variation.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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