Distinguishing adrenal adenomas from non-adenomas on dynamic enhanced CT: A comparison of 5 and 10 min delays after intravenous contrast medium injection

Aim: To evaluate the usefulness of several parameters of 5 min compared to 10 min delayed contrast-enhanced CT in distinguishing adenomas from non-adenomas.

Materials and Methods: The study population consisted of 94 patients (52 men and 42 women; mean age 62 years) with 103 adrenal lesions (75 adenomas and 28 non-adenomas). In each patient, unenhanced CT was followed by early, 5 and 10 min enhanced CT. Diagnostic parameters included delayed enhanced attenuation at 5 and 10 min, washout attenuation (WO) at 5 and 10 min, absolute percentage washout (APW) at 5 and 10 min, and relative percentage washout (RPW) at 5 and 10 min. The accuracy of each parameter for diagnosing adenomas from non-adenomas was calculated using receiver operating characteristic (ROC) analysis.

Results: Upon comparison between 5 and 10 min delayed contrast-enhanced CT for differentiating total adenomas or lipid-poor adenomas from non-adenomas, there was no significant difference in the area under the binomial ROC curve (*Az*) values of delayed enhanced attenuation (total adenomas vs. non-adenomas, $p = 0.164$; lipid-poor adenomas vs. non-adenomas, $p = 0.178$), WO (total adenomas vs. non-adenomas, $p = 0.216$; lipid-poor adenomas vs. non-adenomas, $p = 0.230$), APW (total adenomas vs. non-adenomas, $p = 0.401$; lipid-poor adenomas vs. non-adenomas, $p = 0.870$), or RPW (total adenomas vs. non-adenomas, $p = 0.160$; lipid-poor adenomas vs. non-adenomas, $p = 0.780$).

Conclusion: Five minute contrast-enhanced CT was as useful as 10 min contrast-enhanced CT for differentiation of adrenal adenomas from non-adenomas.

Introduction

Adrenal lesions are incidentally discovered at computed tomography (CT) in approximately 5% of patients.[1] It is well known that the majority of adrenal adenomas contain intracellular lipid on a microscopic level, and exhibit low attenuation on unenhanced CT.[2,3] Therefore, unenhanced CT densitometry can be useful for differentiation of some adenomas from non-adenomas, because nearly all non-adenomas are lipid poor. However, 10-40% of all adenomas contains small amounts of lipid and cannot be characterized on the basis of unenhanced CT.[4]

Delayed enhanced CT images can be used to distinguish adrenal adenomas from non-adenomas because adenomas lose enhancement more rapidly than non-adenomas.[5-16] Several studies have measured attenuation at different intervals (delays from 3 min to 1 h) after the injection of contrast material, and evaluated various delayed contrast-enhanced attenuation thresholds in order to distinguish adenomas from non-adenomas.[6,9,13-18] More interest has focused on the usefulness of adrenal washout parameters, such as washout attenuation, absolute percentage washout (APW), and relative percentage washout (RPW), because of the higher accuracy.[6,7,13-19] Although the usefulness of these parameters depends on the timing of the delayed scans, various delay times after contrast material injection have been reported. A 10- 15min delay after administration of contrast material is frequently recommended.[5-15] Kamiyama et al.[10] recently demonstrated the usefulness of a combination of diagnostic parameters of shorter scanning delays (5 min) for diagnosis of adrenal adenomas. A shorter delay contrast-enhanced CT protocol for facilitating the differentiation of these lesions would be desirable in a busy clinical setting. To the authors' knowledge, there have been few reports on the usefulness of <10 min delayed contrast-enhanced CT, or on the comparative accuracy of 5 min enhanced CT with ≥10 min delayed contrast-enhanced CT.[10,14]

Therefore, in the present study, the usefulness of several parameters of 5 min compared to 10 min delayed contrast-enhanced CT was evaluated in distinguishing adenomas from non-adenomas.

Materials and Methods

Patient Population

The protocol used in the present retrospective study was approved by the institutional review board. Informed consents were obtained from all patients. From March 2005 to February 2012, 210 patients were examined with the dedicated CT adrenal protocol with multidetector-row CT (MDCT) for evaluation of suspected adrenal diseases. Their clinical records were reviewed. Patients with the following findings were excluded from the study: normal findings (n=49), adenoma treated by transcatheter arterial embolization (n=6), lesion with expansive necrosis or cystic change (n=4), calcification (n=2), hyperplasia (n=3), myelolipoma (n=5), extra-adrenal lesion (n=3; two cases of Castleman's disease and one paraganglioma), inadequate follow up imaging (n=29), and no established final diagnosis of adrenal lesion (n=15; Fig 1).

The final study group comprised 94 patients (52 men and 42 women; age range 33-81 years; mean age 62 years) with 103 lesions consisting of 75 adenomas and 28 non-adenomas. A total of 72 patients had 75 adenomas that were diagnosed by surgical pathologic examination (n = 11) or by size stability on CT examinations for at least 6 months (n=64; 29±14 [standard deviation] months; range, 6-136 months). Three patients had an adenoma in each of adrenal glands. Based on the criterion used in a previous report [5-6, 13, 15-16, 19], these 75 adenomas were divided into lipid-rich (≤10 HU) and lipid-poor (>10 HU) adenoma groups. Table 1 shows the clinical data of individual adenoma and non-adenoma groups. Twenty-two patients had 28 non-adenomas including 15 metastases, four phaeochromocytomas, two cortical carcinomas, five malignant lymphomas and two neurofibromas. Twelve of 28 non-adenomas were diagnosed by histopathological examinations following surgical resection (n=10) or percutaneous ultrasonography-guided needle biopsy (n=2). Thirteen metastases and three malignant lymphomas were diagnosed by other clinical examinations or by a change of the lesion seen in follow-up CT examinations within 6 months after chemotherapy.

CT Protocols

All CT examinations were performed with a MDCT machine (Aquilion, Toshiba Medical Systems, Tokyo, Japan). The CT parameters were as follows: 120 kVp tube voltage, 200-440 mA tube current, detector row configuration of 16 x 1 mm, gantry rotation speed of 0.5 s, and table increment of 15 mm/rotation in the cephalocaudal direction. The reconstruction section and interval thickness was 3mm. The dose of 2 mL/kg body weight of non-ionic contrast material with an iodine concentration of 300 mg iodine/mL was injected over a fixed duration of 30 s, and 20 mL saline was injected at the same rate immediately after the end of the contrast material injection through a 20 G plastic intravenous catheter sited in an upper extremity vein. Unenhanced CT and three-phase enhanced CT scans were successively performed. The early phase was initiated automatically 20 s after a bolus-tracking program detected the threshold enhancement of 50 HU in the aorta at the level of the celiac axis. The scan delays of delayed phases after administration of contrast material was fixed at 5 and 10 min.

Data Analysis

The diagnostic parameter measurements were retrospectively performed on a workstation (SYNAPSE; Fujifilm, Tokyo, Japan) by one radiologist (Y.K., with 10 years of experience in abdominal radiology), who was blinded to all clinical and histopathological information, and other imaging findings. The size of the adrenal lesion was recorded with the CT distance cursor to measure the largest diameter in the axial plane on unenhanced CT. A circular or ovoid region-of-interest (ROI) cursor was used to measure CT attenuation on unenhanced, early, and delayed (5 and 10 min) contrast-enhanced CT. The ROI was placed as large as possible within the lesion, while attempting to exclude cystic, calcified, or necrotic regions. To reduce partial volume effects, the cursor was placed to avoid the edge of the lesion (Fig 2). Standard deviation ranges or cut-off values for measurements of radiodensity of the lesions were not used. From the data acquired, the following diagnostic parameters were calculated: wash-in attenuation (WI) (early enhanced attenuation - unenhanced attenuation); washout attenuation (WO) at 5 min (WO5) and 10 min (WO10) (early enhanced attenuation - delayed enhanced attenuation); absolute percentage washout (APW) of 5 min (APW5) and 10 min (APW10) ([WO / WI] x 100); and relative percentage washout (RPW) of 5 min (RPW5) and 10 min (RPW10) ([WO / early enhanced attenuation] x 100).

Statistical Analysis

Statistical analysis was performed using SPSS version 14.0 software for Windows (SPSS, Chicago, IL, USA). The differences in the mean values of 12 parameters (size, unenhanced attenuation, early enhanced attenuation, 5 min and 10 min delayed enhanced attenuation, WI, WO5, WO10, APW5, APW10, RPW5, and RPW10) between total adenomas and non-adenomas and between lipid-poor adenomas and non-adenomas were examined using the Mann-Whitney *U* test. Values of $P<0.05$ were considered to indicate significant differences. Receiver operating characteristic (ROC) curves was generated using the MedCalc Statistical Software (MedCalc Software, Mariakerke, Belgium) in order to assess the ability of the 12 parameters to discriminate between total adenomas and non-adenomas, and lipid-poor adenomas and non-adenomas. Diagnostic accuracy was measured by using the area under the binomial ROC curve (*Az*) value by using Student's *t* test.[20] In addition, the optimal cut-off points for the best accuracy for diagnosis of total adenomas and lipid-poor adenomas were determined for all parameters. The accuracy of delayed enhanced attenuation, WO, APW, and RPW were compared between 5 min and 10 min delayed contrast-enhanced CT using the McNemar test and Cohen's agreement value κ. The κ values were interpreted as follows: a κ value greater than 0.81 indicated very good agreement; a κ value of 0.80-0.61, good agreement; a κ value of 0.60-0.41, moderate agreement; and a κ value of less than 0.41, poor agreement.[21]

Results

Table 2 shows the mean values of size, unenhanced attenuation, early enhanced attenuation, WI, 5 min and 10 min delayed enhanced attenuation, WO5, WO10, APW5, APW10, RPW5, and RPW10 in lipid-rich adenomas, lipid-poor adenomas, total adenomas and non-adenomas. There were statistically significant differences between the total adenomas and non-adenomas, and between lipid-poor adenomas and non-adenomas in all parameters ($P<0.001$), except for early enhanced attenuation between total adenomas and non-adenomas ($P=0.813$).

There were no significant differences between 5 min and 10 min in *Az* values of delayed enhanced attenuation (0.916 vs. 0.938; *P*=0.164), WO (0.812 vs. 0.796; *P*=0.216), APW (0.854 vs. 0.861; *P*=0.401), or RPW (0.877 vs. 0.891; *P*=0.160) for total adenomas. No significant differences were obtained in *Az* values of delayed contrast-enhanced attenuation (0.845 vs. 0.884; *P*=0.178), WO (0.851 vs. 0.830; *P*=0.230), APW (0.881 vs. 0.883; *P*=0.870), or RPW (0.879 vs. 0.875; *P*=0.780) for lipid-poor adenomas (Figs 3 and 4).

The sensitivity, specificity, and accuracy values at the cut-off point of the CT parameters for diagnosis of total adenomas and lipid-poor adenomas are given in Tables 3 and 4. In comparison of accuracy at the cut-off point between 5 min and 10 min, there was no significant difference with regard to delayed enhanced attenuation (*P*=0.289), WO (*P*=0.688), APW (*P*=1.000), or RPW (*P*=0.500) for diagnosing total adenomas. No significant difference was obtained with regard to delayed enhanced attenuation (*P*=0.109), WO (*P*=0.625), APW (*P*=1.000), or RPW (*P*=1.000) for lipid-poor adenomas. The concordances of 5 min and 10 min CT parameters were good to very good and detailed in Table 5.

Discussion

The fact that many adrenal adenomas have low attenuation on unenhanced CT has led to speculation that the amount of lipid present in many adenomas may account for the CT features. Boland et al.[4] critically analyzed prior reported attenuation values of adenomas and non-adenomas in 10 published series of adrenal lesions and concluded that a threshold of 10 HU on unenhanced CT images corresponded to a sensitivity of 71% and a specificity of 98% in the diagnosis of adrenal adenoma. With such a high specificity, it is very likely that a lesion that is 10 HU or less on unenhanced CT is an adenoma, and this technique is supported by the American College of Radiology appropriateness criteria.[8] Therefore, considering all prior evidences, it was concluded that all lesions of 10 HU or less on unenhanced CT images in the present study were lipid-rich adenomas and included this assumption in the calculations of the accuracy of the dedicated CT protocol.

Previous researchers have reported that lipid-poor adenomas containing insufficient concentrations of lipid and non-adenomas have similar unenhanced CT attenuations.[5,14,18] Much interest has been focused on use of delayed contrast-enhanced CT to accurately distinguish adrenal adenomas and non-adenomas.[9-16,18] The WO parameter is the absolute loss of attenuation between early and delayed enhancement. Previous researchers have demonstrated that WO is much larger in adenomas than in non-adenomas.[5,10] Recently, several reports have suggested that calculation of the percent washout (APW and RPW) can provide a reproducible means of measuring contrast enhancement on delayed images in order to distinguish adenomas from non-adenomas.[5-7,9,10,14,15,18,19] There are two ways to measure percent washout: APW (which incorporates unenhanced attenuation) and RPW (which can be calculated by using the early and delayed enhanced images). With regards to the percent washout parameters, the APW of an adrenal lesion may at first seem to be a more accurate calculation of enhancement washout because the unenhanced attenuation value is included in the calculation of APW.[7] On the other hand, RPW can be useful when the unenhanced attenuation of an adrenal lesion is unknown.[5-7,10,14,15,18] Several researchers reported that mean APW and RPW of total adenomas and lipid-poor adenomas were significantly higher than those of non-adenomas,[4,6,7] similar to the results of the present study.

Korobkin et al.[14] reported that attenuation of adrenal adenomas (n=52) showed a much more rapid decrease enhancement than that of the non-adenomas (n=24), and this difference was evident as early as the first delayed scan 5 min after contrast material injection. They generated ROC curves to assess the ability of the 5 to 45 min delayed enhanced attenuations to discriminate between adenomas and non-adenomas. The shapes of the ROC curves were nearly identical (*Az* values were as follows: 5 min=0.98, 10 min=0.99, 15 min=0.97, 30 min=0.96, and 45 min=0.96), and the areas under the five curves were not significantly different from each other. In the present study, 5 min and 10 min enhanced attenuations were significantly larger in the non-adenoma group (n=28) than in the total adenoma group (n=75). There were no significant differences between 5 min and 10 min delayed enhanced attenuation in *Az* values for diagnosis of total adenoma, in concordance with the results of Korobkin et al.[14]. Moreover, the accuracy of the delayed enhanced attenuation at the cut-off point for diagnosing total adrenal adenomas was not significantly different between 5 min and 10 min enhanced CT. However, the *Az* values (5 min, *Az*=0.916; 10 min, *Az*=0.938) of delayed enhanced attenuation in the present study were lower than the results of Korobkin et al. The delayed enhancement criteria are accurate for differentiation of lipid-rich adenomas from non-adenomas, but they yield lower sensitivity for lipid-poor adenomas[5,10-16]. Therefore, the lower *Az* values in the present study could be attributed to the high proportion of lipid-poor adenomas (53%). Previous reports have not shown that *Az* values of delayed enhanced attenuation have been used for diagnosis of lipid-poor adenomas. In the present study, there were no significant differences between 5 min and 10 min delayed enhanced attenuations in either *Az* values or in accuracy at the cut-off point for the diagnosis of lipid-poor adenomas.

In the present study, the WO5 criterion yielded an 80% accuracy, APW5 criterion yielded an 83% accuracy, and RPW5 criterion yielded an 85% accuracy for differentiation of total adenomas (n=75) from non-adenomas (n=28). For differentiation of lipid-poor adenomas (n=40) from non-adenomas (n=28), the WO5 criterion yielded an 85% accuracy, APW5 criterion yielded an 84% accuracy, and RPW5 criterion yielded an 85% accuracy at the cut-off point to produce the best accuracy. Kamiyama et al.[10] reported that WO5 criterion yielded an 82% accuracy, APW5 criterion yielded an 84% accuracy, RPW5 criterion yielded an 87% accuracy for differentiation of total adenomas (n=53) from non-adenomas (n=15), and the WO5 criterion yielded an 82% accuracy, APW5 criterion yielded 87% accuracy, RPW5 criterion yielded an 84% accuracy for differentiation of lipid-poor adenomas (n=23) from non-adenomas (n=15) when they set the cut-off point to produce the best accuracy. They recommended that a combination of diagnostic parameters of the 5 min delayed enhanced CT protocol yields diagnostic results comparable with those of longer scanning delays. Accuracies of WO5, APW5 and RPW5 in the present results were also similar to those reported by Kamiyama et al.[10]

Sangwaiya et al.[19] reported that the accuracies of APW10 (cut-off point, 50%) and RPW10 (cut-off point, 35%) to distinguish total adenomas (n=307) from non-adenomas (n=16) were 72% and 82%. In the present study, accuracies of both APW10 (82%) (cut-off point, 50%) and RPW10 (87%) (cut-off point, 36 %) were better to those of Sangwaiya et al.[19] Blake et al.[7] assessed the ability of APW10 and RPW10 to discriminate adenomas (n=92) from non-adenomas (n=14), and reported that the *Az* values were 0.892 for APW10, and 0.985 for RPW10. The present *Az* values of APW10

(*Az*=0.861) and REW10 (*Az*=0.891) were lower than the results of Blake et al.[7] They excluded phaeochromocytomas from their group analyses. In general, phaeochromocytomas and hypervascular metastases sometimes exhibit rapid enhancement and contrast medium washout. Therefore, the low *Az* values of the present study could be attributed to the high proportion of phaeochromocytomas (n=4) and hypervascular metastases, such as hepatocellular carcinoma (n=1), renal cell carcinoma (n=1) and cortical carcinoma (n=2).

There have been no previous reports that have compared the accuracy of WO, APW and RPW at several delay times for distinguishing between adenomas and non-adenomas. In the present study, there were no significant differences between 5 and 10 min parameters (delayed enhanced attenuation, WO, APW or RPW) in *Az* values, or in the accuracy at the cut-off point for diagnosis of lipid-poor adenomas and total adenomas. These facts suggest that 10 min delayed enhanced CT protocol could not improve the accuracy to distinguish adenomas or lipid-poor adenomas from non-adenomas. Therefore, 5 min enhanced CT protocol would be useful for differentiation of adrenal adenomas from non-adenomas.

The present study had several limitations. First, the diagnoses of adrenal lesions were not histologically verified in many patients. Size stability at the ≥6 month follow-up was used to confirm adenomas and growth or shrinkage of the mass within 6 months after chemotherapy to confirm metastases. The size stability at 6 months follow-up has been an accepted criterion for classifying a lesion as benign in several previous studies.[5,6,8,9,12,13] Second, although the number of adenomas in the present series was substantial, the number of non-adenomas was small. Because cancer patients did not usually follow the present adrenal CT protocol, only 15 adrenal metastases were found in the present study.

In conclusion, the present results suggested that 5 min delayed contrast-enhanced CT might be as useful for differentiation of adrenal adenomas and non-adenomas as 10 min delayed contrast-enhanced CT. The 5 min delayed contrast-enhanced CT is a more convenient method for adrenal lesion characterization because of the shorter examination time. This time advantage is even more important with MDCT technology, which permits dramatic increases in patient throughput.

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Figure and Table Legends

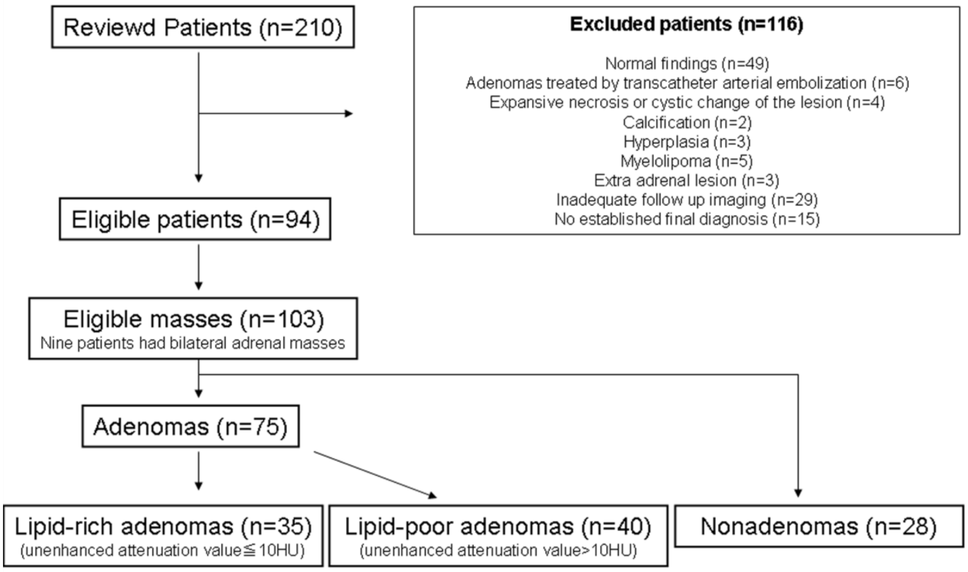

Figure 1 A flow diagram of the 94 patients with adrenal tumors who were eligible for participation in the study, selected from 210 patients who underwent adrenal MDCT

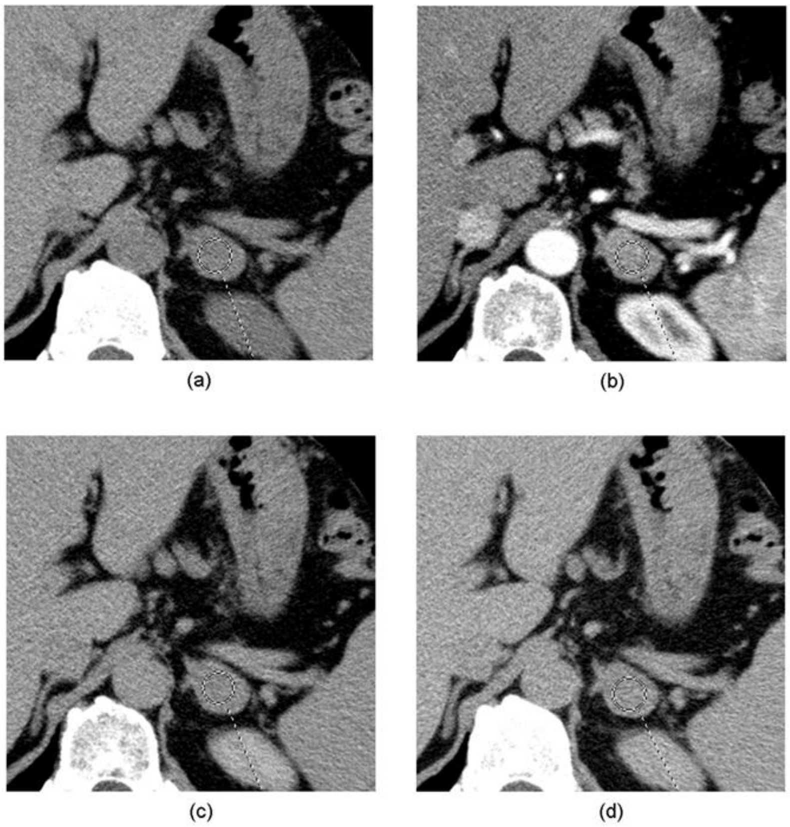

Figure 2 A 58-year-old man with lipid-poor adrenal adenoma.

(a) Unenhanced CT image shows left adrenal mass that measured 40HU. (b) Early enhanced CT image shows left adrenal mass with enhanced attenuation of 96HU and WI of 56HU. (c) The 5 min enhanced CT image shows left adrenal mass that measured 60HU. The WO, APW, and RPW are 36HU, 64% and 38%, respectively. (d) The 10 min enhanced CT image shows left adrenal mass that measured 54HU. The WO, APW, and RPW are 42HU, 75% and 44%, respectively.

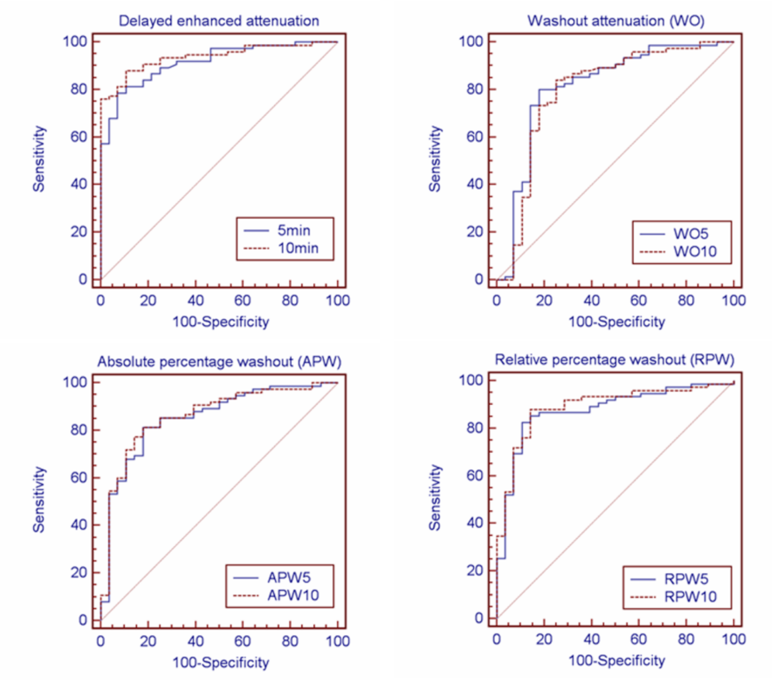

Figure 3 ROC curves of CT parameters for diagnosis of total adenomas (n=75). There were no significant differences in *Az* values of delayed enhanced attenuation (*P*=0.164), WO (*P*=0.216), APW (*P*=0.401), or RPW (*P*=0.160) between 5 and 10 min enhanced CT.

Note: WO5 and WO10, washout attenuation at 5 and 10 min; APW5 and APW10, absolute percentage washout at 5 and 10 min; RPW5 and RPW10, relative percentage washout at 5 and 10 min.

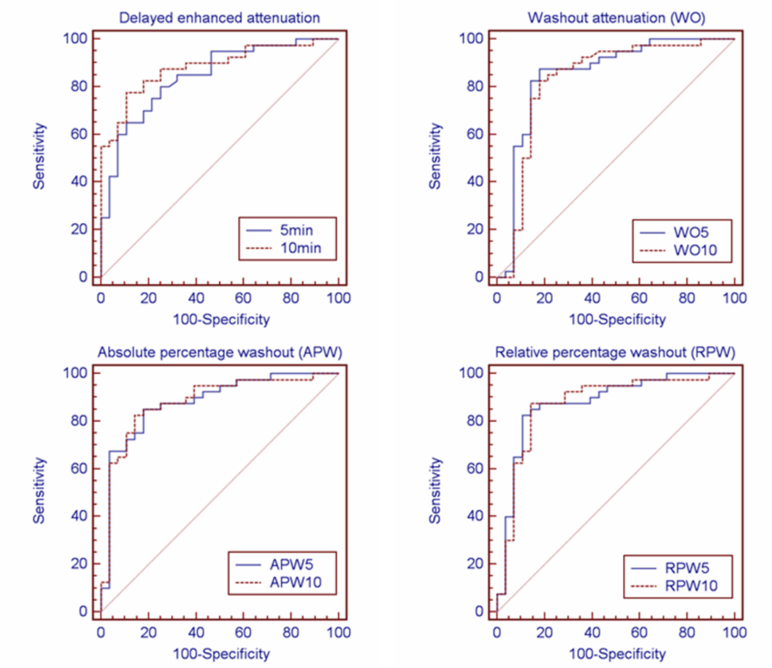

Figure 4 ROC curves of CT parameters for diagnosis of lipid-poor adenomas (n=40). There were no significant differences in *Az* values of delayed enhanced attenuation (*P*=0.178), WO (*P*=0.230), APW (*P*=0.870), or RPW (*P*=0.780) between 5 and 10 min enhanced CT.

Note: WO5 and WO10, washout attenuation at 5 and 10 min; APW5 and APW10, absolute percentage washout at 5 and 10 min; RPW5 and RPW10, relative percentage washout at 5 and 10 min.

Table 1 Clinical data for adrenal adenoma and non-adenoma

Characteristic	Lipid-rich adenoma	Lipid-poor adenoma	Total adenoma	Nonadenoma	Overall
Number of patients	33	39	72	22	94
Age (years)					
Range	45 - 78	37 - 79	37 - 79	33 - 81	33 - 81
Mean	62 ± 10	61 ± 10	62 ± 9	65 ± 11	62 ± 10
Gender (male : female)	20:13	17:22	37:35	15:7	52:42
Number of lesions	35	40	75	28	103
Location (right : left)	14:21	19:21	33:42	13:15	46:57
Diagnosis					
Non-functioning adenoma	32	36	68		68
Aldosteronoma	3	2	5		5
Cushing		2	2		2
Metastasis				15	15
Phaeochromocytoma				4	4
Cortical carcinoma				2	2
Malignant lymphoma				5	5
Neurofibroma				2	2
Pathologic confirmation	3	8	11	12	23
Clinical confirmation (size change)	32	32	64	16	80

Table 2

CT parameters for each group and statistical results of multiple comparisons

CT parameter	Lipid-rich adenoma	Lipid-poor adenoma	Total adenoma	Nonadenoma
Size[a] (mm)	20 ± 9	21 ± 9	20 ± 9	49 ± 35
Unenhanced attenuation (HU)	-1.9 ± 8	27 ± 9	13 ± 17	36 ± 6
Early enhanced attenuation (HU)	52 ± 24	100 ± 27	78 ± 35	80 ± 35
Wash-in attenuation (HU)	54 ± 22	73 ± 25	64 ± 25	44 ± 36
Delayed enhanced attenuation				
5 min (HU)	23 ± 13	55 ± 12	40 ± 20	71 ± 11
10 min (HU)	16 ± 10	48 ± 11	33 ± 19	64 ± 8
WO				
5 min (HU)	29 ± 20	45 ± 24	37 ± 23	11 ± 31
10 min (HU)	36 ± 22	52 ± 24	45 ± 24	18 ± 35
APW				
5 min (%)	43 ± 42	55 ± 27	50 ± 35	-13 ± 70
10 min (%)	59 ± 34	65 ± 29	62 ± 31	5 ± 64
RPW				
5 min (%)	46 ± 55	41 ± 19	43 ± 40	2 ± 29
10 min (%)	64 ± 43	49 ± 19	56 ± 33	11 ± 30

Data are the mean ± standard deviation.

WO, washout attenuation; APW, absolute percentage washout; RPW, relative percentage washout.

[a]Size is maximum diameter of the lesion.

Table 3 Total adenoma versus non-adenoma: sensitivity, specificity, and accuracy of cut-off points of CT parameters

CT parameter	Value criterion	Sensitivity (%)	Specificity (%)	Accuracy (%)
Size	≦ 28 mm	87	68	82
Unenhanced attenuation	≦ 30 HU	84	86	84
Early enhanced attenuation	≧ 54 HU	76	25	62
Wash-in attenuation	≧ 41 HU	85	61	79
Delayed enhanced attenuation [a]				
5 min	≦ 65 HU	87	79	84
10 min	≦ 56 HU	88	89	88
WO [b]				
5 min	≧ 22 HU	79	82	80
10 min	≧ 25 HU	84	75	82
APW [c]				
5 min	≧ 31 %	85	75	83
10 min	≧ 50 %	84	75	82
RPW [d]				
5 min	≧ 27 %	85	86	85
10 min	≧ 36 %	88	86	87

WO, washout attenuation; APW, absolute percentage washout; RPW, relative percentage washout.

The cut-off point was determined as the best accuracy of diagnostic values for each CT parameters. In comparison of accuracy at the cut-off point between 5- and 10-min, there was no significant difference with regard to delayed enhanced attenuation (^{a}p=0.289), WO (^{b}p=0.688), APW (^{c}p=1.000), or RPW (^{d}p=0.500).

Table 4. Lipid-poor adenoma vs. non-adenoma: sensitivity, specificity, and accuracy of cut-off points of CT parameters

CT parameter	Value criterion	Sensitivity (%)	Specificity (%)	Accuracy (%)
Size	≦ 28 mm	85	68	78
Unenhanced attenuation	≦ 30 HU	70	86	76
Early enhanced attenuation	≧ 84 HU	75	71	74
Wash-in attenuation	≧ 45 HU	88	71	81
Delayed enhanced attenuation [a]				
5 min	≦ 65 HU	75	79	76
10 min	≦ 57 HU	78	89	82
WO [b]				
5 min	≧ 22 HU	88	82	85
10 min	≧ 32 HU	83	82	82
APW [c]				
5 min	≧ 41 %	85	82	84
10 min	≧ 60 %	83	86	84
RPW [d]				
5 min	≧ 27 %	85	86	85
10 min	≧ 36 %	88	86	87

WO, washout attenuation; APW, absolute percentage washout; RPW, relative percentage washout. The cut-off point was determined as the best accuracy of diagnostic values for each CT parameters. In comparison of accuracy at the cut-off point between 5- and 10-min, there was no significant difference with regard to delayed enhanced attenuation ([a]p=0.109), WO ([b]p=0.625), APW ([c]p=1.000), or RPW ([d]p=1.000).

Table 5. Cohen's agreement value (κ) of accuracy of 5 min and 10 min CT parameters

CT parameter	κ value	95% CI
Total adenoma versus non-adenoma		
Delayed enhanced attenuation	0.822	0.703-0.940
WO	0.872	0.773-0.971
APW	0.978	0.934-1.021
RPW	0.956	0.896-1.016
Lipid-poor adenoma versus non-adenoma		
Delayed enhanced attenuation	0.706	0.538-0.874
WO	0.880	0.766-0.994
APW	0.881	0.767-0.994
RPW	0.970	0.912-1.028

WO, washout attenuation; APW, absolute percentage washout; RPW, relative percentage washout.