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Characterization of adrenal masses using contrast enhanced CT scan

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Abstract

Background: Abnormalities of the adrenal gland include primary neoplasm, metastases, hemorrhage, or enlargement of the adrenal gland from external hormonal stimulation. Adrenal masses can be divided into two physiologic categories based on whether they hypersecrete a hormone. Hyperfunctioning adrenal masses produce a hormone that results in a chemical imbalance and include pheochromocytomas, aldosteronomas, and cortisol or androgen-producing tumors. **Aim & Objective:1.** Characterization of adrenal masses using contrast enhanced CT scan. **Methods: Study design:** Prospective Observational study. **Study setting:** Department of Radio-diagnosis, **Study population:** Patients with adrenal masses, measuring more than 1cm, with Hounsfield Unit more than 10. **Sample size:** 50. **Results:** The pathological diagnosis was 25 adenomas and 29 non adenomas. Absolute percent washout diagnosed 24 of 25 adenomas and 27 of 29 non adenomas. It had a Sensitivity of 96.00%, Specificity of 93.10%, Positive Predictive Value of 92.31% and Negative Predictive Value of 96.43%. Relative percent washout diagnosed 23 of 25 adenomas and 26 of 29 non adenomas. It had a sensitivity of 92%, specificity of 89.66%, Positive Predictive value of 88.46% and Negative Predictive Value of 92.86%. Both were found to be statistically significant. **Conclusions:** CT contrast washout study is helpful in categorising adenomas and non-adenomas in adrenal masses with high degree of accuracy, sensitivity and specificity and helps guide clinical management

Keywords: Adrenal adenoma, Adrenal nonadenoma,CT contrast washout study,Absolute washout percentage , Relative washout percentage

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Introduction

Abnormalities of the adrenal gland include primary neoplasm, metastases, hemorrhage, or enlargement of the adrenal gland from external hormonal stimulation. Adrenal masses can be divided into two physiologic categories based on whether they hypersecrete a hormone. Hyperfunctioning adrenal masses produce a hormone that results in a chemical imbalance and include pheochromocytomas, aldosteronomas, and cortisol or androgen-producing tumors.[1-5]

Nonfunctioning adrenal masses cause enlargement of the adrenal gland but no significant increased hormone production. Adrenal adenomas and metastases are the most common nonfunctioning adrenal masses.[6-9] The most common lesions, adrenal metastases and

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adenomas cannot be characterized so easily. This is usually because they are small, without specific diagnostic features, and frequently appear similar to each other when detected.
The usual imaging dilemma is therefore to differentiate between these two very different lesions. The diagnosis has profound consequences for the patient. In a patient with an extraadrenal malignancy,[10-12] the determination that an adrenal mass is metastatic often means the primary disease is incurable and palliative therapy is instituted. On the other hand, characterizing a lesion as benign in these circumstances potentially permits curative therapy for the primary disease.

Aim And Objective
Objective:
1. Characterization of adrenal masses using contrast enhanced CT scan

Material And Methods
Type of Study: Prospective Observational study
Place of Study: Department of Radio-diagnosis,
Sample Size: 50
Selection Criteria:
1. Patients with adrenal masses, measuring more than 1cm, with Hounsfield Unit more than 10.
Exclusion Criteria:
1.Pregnant women
2.Severe hypersensitivity or previous allergic reactions
3.Critically ill patients
4.Patients in renal failure
Data Acquisition:
Adrenal masses were evaluated with an adrenal CT imaging protocol. The dedicated adrenal CT protocol consisted of initial densitometry of the mass on unenhanced CT scans. If the mass had an attenuation of 10 HU or less, it was assumed to be benign and the masses were excluded from the study. Thus, twenty masses with HU below 10 were excluded. A diagnosis was established in the final study group of 54 masses when histologic proof was obtained at surgery or percutaneous biopsy.
All patients with adrenal masses that had attenuation values greater than 10 HU at unenhanced imaging underwent enhanced CT imaging 60 seconds after intravenous administration of contrast material and then underwent delayed enhanced CT imaging at 15 minutes.The scans were done with 128 slice CT scanner or 4 slice CT scanner. Enhancement washout percentages were calculated for these masses.
To diagnose an adrenal mass as an adenoma, we used the previously reported thresholds of 60% or higher for absolute percentage washout and 40% or higher for relative enhancement washout. Parameters for the unenhanced and delayed enhanced examinations with the CT scanners were KVp (Peak KV) of 120 kVp, Slice Thickness of 2mm and Slice Interval of 5mm. Enhanced scans were obtained after intravenous injection of 40 mL of iohexol 350
Statistical Analysis
All the collected data was entered in Microsoft Excel sheet and then transferred to SPSS software ver. 17 for statistical analysis. Qualitative data were presented as frequency and percentages while quantitative data were presented as means and standard deviation.

Result and observation
Number: The final clinical diagnosis was adrenal adenoma for 25 masses and nonadenoma for 29 masses, confirmed at pathologic examination. Size The average maximal diameter of

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the adenomas was 3.5 cm (range, 2.5ñ5.1 cm, with Standard deviation of 0.6). Nonadenomas were larger (mean size, 4.2 cm; range, 2.7ñ 6.3 cm, with Standard deviation of 1.0). It was found to be statistically significant with a p value of 0.005. The mean attenuation values of adenomas and nonadenomas on unenhanced, enhanced, and delayed enhanced CT scans are shown in Table 1.

Table 1: Mean attenuation values of Adrenal Masses

	Unenhanced	**Enhanced**	**Delayed**
Adenoma	23.5	75.3	41.6
Non adenoma	27.2	66.2	45.9

The nonadenomas included 26 metastases, two pheochromocytomas, one adrenal cortical carcinoma. The primary malignancies in the 26 patients who had adrenal metastases were the following lung cancer (n =17), esophageal cancer (n = 2), renal cancer (n = 2), tongue cancer (n = 1), rectal cancer (n = 1) and breast cancer (n =3).

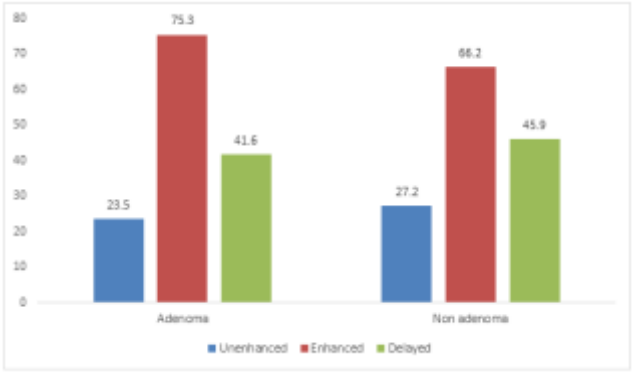

Figure 1

Absolute percent washout The use of a threshold of 60% in the differentiation of adenomas from nonadenomas resulted in a sensitivity of 96% (24 of 25 masses) and a specificity of 93% (27 of 29 masses)

Table 2: APW Outcome vs Pathological Result

	Adenoma	**Non adenoma**
Test + ve	24	2
Test - ve	1	27

There was 1 adenoma that did not meet the 60% threshold. The percentage enhancement washout measurements for this mass was 57.4% Two nonadenomas had absolute percentage enhancement washout measurements above the 60% threshold. These washout measurements were 99.2% and 65.1%. Both were metastases.

Relative percent washout The use of a relative percentage enhancement washout threshold value of 40% in the differentiation of the adenomas resulted in a sensitivity of 92% (23 of 25 masses) and a specificity of 89.66% (26 of 29 masses).

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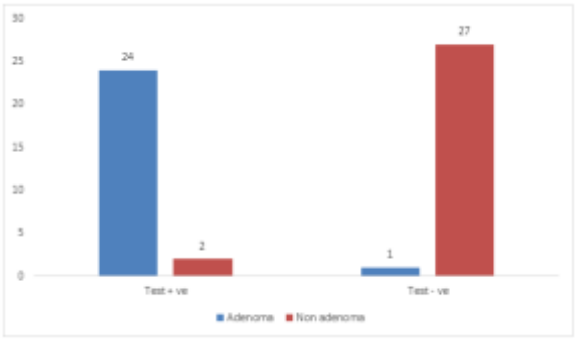

Figure 2

Table 3: RPW Outcome vs Pathological Result

	Adenoma	**Non adenoma**
Test + ve	23	3
Test - ve	2	26

The relative percentage enhancement washout measurements for the 2 adenomas that did not meet the 40% relative percentage enhancement threshold were 37.7%, 34.9%.1adenoma did not meet either threshold criteria. 3 Non adenomas were wrongly characterized with relative percent washout. The relative percentage enhancement washout measurements for these masses were 41.5%, 42.4% and 47% respectively.

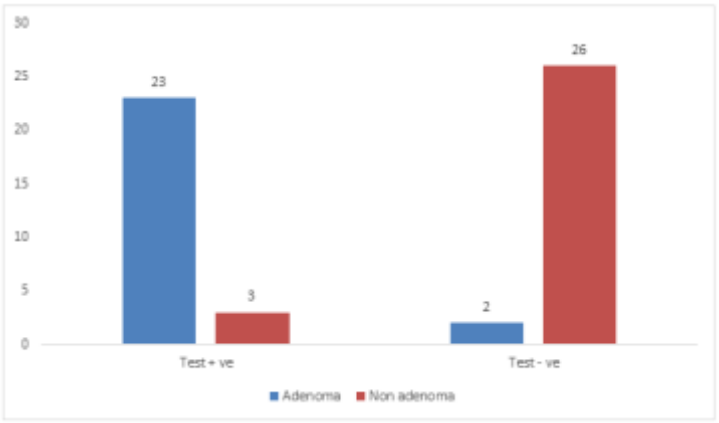

Figure 3

Table 4: APW & RPW

	Sensitivity	Specificity
APW	96.00 %	93.1 %
RPW	92.00 %	89.66 %

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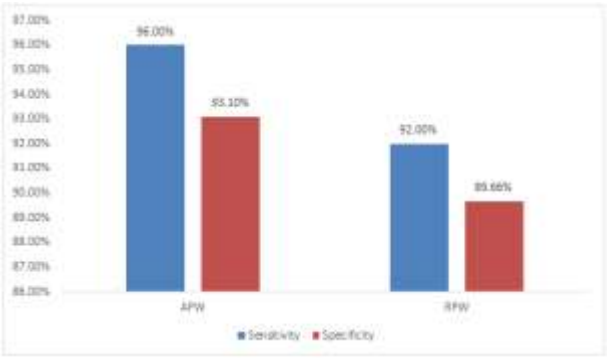

Figure

Discussion

There are two independent properties of adrenal adenomas that can be exploited in characterizing them at CT. First, most adenomas contain large amounts of intracellular lipid, resulting in lower attenuation values at unenhanced CT than nonadenomas.Second, all adenomas, including those without substantial lipid content, tend to have a more rapid loss of attenuation value soon after enhancement with intravenous contrast material.

The purpose of this study was to assess the accuracy, sensitivity and specificity of this method. Absolute percentage enhancement washout threshold of 60% correctly diagnosed 24 of 25 adenomas. This was with a sensitivity of 96%, specificity of 93.1%. The positive and negative predictive values were 92.3% and 96.4% respectively.

Absolute percentage washout failed to correctly characterise two non adenomas. These included a metastasis from lung cancer and an incidentally detected metastasis. The values were 99.2% and 65.1% respectively.It also failed to characterise 1 adenoma. This was in a patient with a lung primary, which it ruled as non adenoma. The value was 57.4% Relative percent washout correctly characterised 23 of 25 adenomas and 26 of 29 non adenomas.

The sensitivity and specificity were 92% and 89.7% respectively. The positive and negative predictive values were 88.5% and 92.7% respectively. Relative percentage washout failed to correctly characterise three non adenomas. These included a metastasis from lung cancer and two incidentally detected metastases. The values were 41.5%, 47% and 42.4% respectively. It also failed to characterise 2 adenomas.

These included patients with an incidentally detected adenoma and a case of Cushingís syndrome which was also pathologically proven to be an adenoma. Both of them were characterised as non adenomas. The value was 34.9% and 37.7% respectively. The results of this study confirms those of prior studies and demonstrates that the mean attenuation values at unenhanced CT adrenal adenomas and those of nonadenomas are nearly identical.

Although the two groups have significantly different mean attenuation values at both enhanced and delayed enhanced CT, the considerable overlap between the two groups is too large to permit sufficiently accurate differentiation between them for any individual case. The distribution of the enhancement washout calculations for the two groups, however, was significantly different to allow accurate differentiation of individual cases.

Absolute percent washout correctly characterised 51 of 54 adrenal masses with an accuracy of 94.44% Relative percent washout correctly characterised 49 of 54 adrenal masses with an accuracy of 90.74% Absolute enhancement washout values were more accurate than use of the relative enhancement washout value in the differentiation of adenomas from nonadenomas.

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Conclusion

Adenomas can be differentiated from nonadenomas at delayed enhanced CT examinations with absolute and relative percentage enhancement washout calculations.

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