ORIGINAL ARTICLE CODEN: AAJMBG

Prevalence and characterization of adrenal incidentalomas on computed tomography – A hospital-based retrospective study

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Received: 24th July 2020; ***Accepted:*** 15th March 2021; ***Published:*** 01st April 2021

Abstract: *Background:* An adrenal "incidentaloma" is an adrenal mass discovered coincidentally during a radiologic examination and are to be diagnosed to ensure an effective management. *Objective:* To identify the prevalence of Adrenal incidentalomas and to characterize the adrenal incidentalomas into benign and malignant based on Computed Tomography (CT). *Materials and methods:* A total of 7418 CT scans of the abdomen and chest were reviewed Thiswas based on the size, morphology, plain Hounsfield Unit (HU), enhanced HU and delayed HU values, necrosis, fat content, hemorrhages and calcifications along with Absolute and relative percentages washout values. *Results:* A total of 98 adrenal incidentalomas were found in 82 patients (Prevalence- 1.37%). A male (n=58; 70.7%) preponderance was observed. Malignant adrenal incidentalomas were observed predominantly on the right side as estimated by Venous HU (p = 0.0314) and Delayed HU(p = 0.0039) values. The mean Absolute washout (p <0.0001)and Relative washout percentage values(p<0.0001)of benign adrenal incidentalomas on the left side were more when compared to the malignant adrenal incidentalomas on the left side. *Conclusion:* This study reports a tenable evaluation of Adrenal incidentalomas prevalence rates in India and itscharacterization using CT for ensuring timely management and care.
Keywords: Adrenal Incidentaloma, Adrenal Gland Neoplasms, Abdomen, Computed Tomography, X- ray.

Introduction

An adrenal "incidentaloma"is an adrenal mass, which is discovered incidentally during a radiologic examination performed for indications other than for the evaluation of an adrenal disease [1]. The incidental discovery of asymptomatic adrenal masses is seen with an increasing frequency due to the widespread application of non-invasive, high-resolution techniques [2].

This is evidenced by the fact that the prevalence of CT detected adrenal incidentalomas has sharply risen from 0.35%-1.9% in the 1980s to 4.4%-5% in the 21st century [3]. Old age and co-morbidities such as diabetes and hypertension serve as significant risk factors for adrenal incidentaloma, with incidence rates jumping to 10% in individuals aged 70 and above [3]. Due to the lack of sufficient population-based studies on the prevalence of Adrenal incidentalomas its epidemiological profile in the Indian scenario remains esoteric. Adrenal incidentalomas may be secretory or non-secretory, benign or malignant. Benign lesions include adenoma, pheochromocytoma, myelolipoma, hematoma, cyst, hemangioma, ganglioneuroma, and granuloma. Malignant lesions include carcinoma, metastases, lymphoma, neuroblastoma, pheochromocytoma and others [4]. Incidentalomas could be associated with some of the most common clinical syndromes of adrenal hormonal overproduction (hyperaldosteronism, hypercortisolism, or pheochromocytoma); most of them, however, are clinically silent [5].

In the functional state, adrenal incidentalomas may secrete cortisol, aldosterone, catecholamines or androgens. Accordingly, they can present as subclinical Cushing's syndrome (manifest as hypertension, obesity, osteoporosis, and diabetes mellitus), primary hyperaldosteronism (manifest as hypertension, hypokalemia, increased risk of cardiovascular disorders), or clinically silent

pheochromocytoma, abnormal hirsutism or virilization [6-9]. When causing hypo function due to adrenal destruction, the adrenal incidentalomacan lead to Addison's disease [10].

Hence, despite their low prevalence it becomes necessary to identify, manage and study adrenal incidentalomas in greater detail. The two main concerns for a clinician in identifying an adrenal incidentaloma are- first, these lesions must be defined as benign or malignant; second, to detect whether these lesions are hormonally active or hormonally inactive. Therefore, early detection and characterization of adrenal incidentaloma is crucial for improving the prognosis.The modality of choice for characterization of adrenal masses is Computed tomography (CT) [11].

However, there is a dearth of literature pertaining to the prevalence of adrenal incidentaloma in India. Hence this study has strived to fill these lacunae by determining the prevalence rate of adrenal incidentaloma among the local populace and evaluating the scope of CT in the characterization of detected adrenal incidentaloma that can affect a targeted and timely management of such elusive adrenal masses.

Material and Methods

This retrospective study was conducted on all the cases that were evaluated for the CT of the abdomen &/or thorax during the period of January 2016 to December 2016, at the Department of Radio-diagnosis. Therefore, a sample size of 7418 was obtained. The study was approved by the Institutional Ethics Committee and a written informed consent was obtained from the study subjects before enrolment.

Patients undergoing CT abdomen and/or thorax without symptoms and signs denoting an adrenal pathology were included for the study. Whereas, the exclusion criteria consisted of patients presenting with an adrenal gland pathology or a known adrenal mass, adrenal hemorrhagedue to traumatic injury to the abdomen, having undergone unilateral adrenalectomy and those unwilling to participate in the study. Demographic characteristics and risk factors such as age, gender, habits of beedi, cigarette smoking, and alcohol consumption of the study patients were obtained from the patient's data file.

Technique

Scan Protocol for multi-detector row CT [12-13]: CT imaging was performed using 64-slice single source CT scanner (Siemens Medical Solutions, Germany). Axial plain sections of the thorax or abdomen (depending on the requisition from the referring consultant) were taken using 5.0 mm sections and multiplanar reconstruction was done in 1.5 mm slice thickness. The examination area extended from the lung apex to upper abdomen in CT chest and from the lower chest to the inferior margin of pubic rami in CT abdomen; i.e., the CT thorax studies were done in such a way as to include sections of the upper abdomen including the bilateral adrenal glands.

Depending on the need for further evaluation, plain study was followed by intravenous (I.V.) contrast study using non-ionic water-soluble contrast medium i.e. Iomeron 350 mg% in a dose of 1 ml/kg body weight. Images were taken in the arterial and venous phases. Delayed scans were taken with special emphasis made on delayed scans at 15 min of the start of contrast bolus. Once an Adrenal incidentaloma was seen on the CT, the characterization was done based on size of mass, absolute percentage washout (APW), relative percentage washout (RPW), presence or absence of necrosis, presence or absence of calcification, and presence or absence of hemorrhage.

Based on the size, masses were categorized into three types i.e. <2 cm, 2-4 cm, >4 cm, where malignancy was considered to linearly increase with size. Depending on attenuation on baseline, enhanced (70seconds) and delayed (15 minutes) scans, absolute percentage washout (APW) and relative percentage washout (RPW) were calculated using the formulae

$$\text{Absolute percentage washout} = \frac{\text{Contrast-enhanced HU} - \text{Delayed HU}}{\text{Contrast-enhanced HU} - \text{Unenhanced HU}}$$

$$\text{Relative percentage washout} = \frac{\text{Contrast-enhanced HU} - \text{Delayed HU}}{\text{Contrast-enhanced HU}}$$

For all adrenal masses detected on CT, the attenuation was measured by using circular-region of interest placed over the area of

disease avoiding lesion margins to preclude partial volume effects. If baseline attenuation value (region of interest > two thirds or half of adrenal gland, excluding area of necrosis, calcification, and hemorrhage) was less than or equal to 10HU, no further study was required and the mass was assigned as a benign adenoma.

Necrosis was defined as a region (within the mass) with an attenuation value similar to that of water (20 HU) at 70 seconds contrast enhanced CT. Calcification was defined as a region with an attenuation value > 100 HU at non enhanced CT. If the plain attenuation of the Adrenal incidentaloma was >10 HU, contrast study with delayed study at 15 min were performed. If APW>60%or RPW>40%, the incidentaloma was assigned a benign phenotype and if APW<60%or RPW<40%, the incidentaloma was assigned a malignant phenotype. Scans were reviewed in appropriate window settings.

Data was analyzed using statistical software R version 3.6.0 and Excel. Continuous variables were represented in the form of mean± standard deviation. Categorical variables were represented as frequency. Comparison of the mean values was done with t-test. A p-value less than 0.05 was considered as significant.

Results

A total of 7418 participants (4143 males and 3275 females (M: F ratio of 2.5:1)), with an age range of 5-86 years were enrolled for the study. CT scans of the abdomen and chest were reviewed over a period of 1 year and a total of 98 adrenal incidentalomas were found in 82 patients (Prevalence- 1.37%).

The indications for imaging procedure were abdominal pain, including either ill-defined discomfort or biliary & renal colic, acute abdomen, post-surgery follow-up, fever under evaluation, vomiting under evaluation, nonspecific abdominal symptoms, chest complaints and others. No significant difference in the indications by gender was apparent. The age of the patients with adrenal incidentalomas ranged from 22-86 years. The mean age of the patients who had adrenal incidentalomas was 55.72 ± 14.0 years.

Out of the 82 patients detected with Adrenal incidentalomas, the masses were on the right side in 32 patients, on the left side in 34 patients and were bilateral in 16 patients. Among the bilateral masses detected, 9 were benign tumors and 7 were malignant tumors. The diameter of the adrenal incidentalomas estimated on CT ranged from 0.9 to 9 cm.

The mean diameter of benign adrenal incidentalomas on the right side was 1.9 ± 0.84 cm. and on left side was 2.02 ± 1.0 cm. The mean diameter of malignant adrenal incidentalomas on the right side was 3.2 ± 1.5 cm and on left side was 2.9 ± 2.1 cm. A total of 65 benign adrenal incidentalomas; 34 (40.2%) on the right side and 31 (37.8%) on the left side were diagnosed. A total of 33 malignant adrenal incidentalomas; 14 (17.1%) on the right and 19 (23.1%) on the left side were diagnosed.

The various types of adrenal incidentalomas that were diagnosed were lipid poor adenoma (n = 29), lipid rich adenoma (n = 6), adrenal lipoma (n = 4), myelolipoma (n = 4), adrenal calcification (n = 4), adrenal cyst (n = 1), adrenal carcinoma (n = 1), ganglioneuroma (n = 1), hematoma (n = 5), metastasis (n = 26) and pheochromocytoma (n = 1)(where n is the number of patients).

Adrenal adenomas (lipid poor and lipid rich) were seen in 22 males and 13 females. Lipomas were seen in 4 males and no females; Hematomas were seen only in 5 males and metastases were seen in 20 males and 6 females (Figures1 & 2).

Fig-1: Distribution of CT diagnosis of adrenal incidentalomas by gender

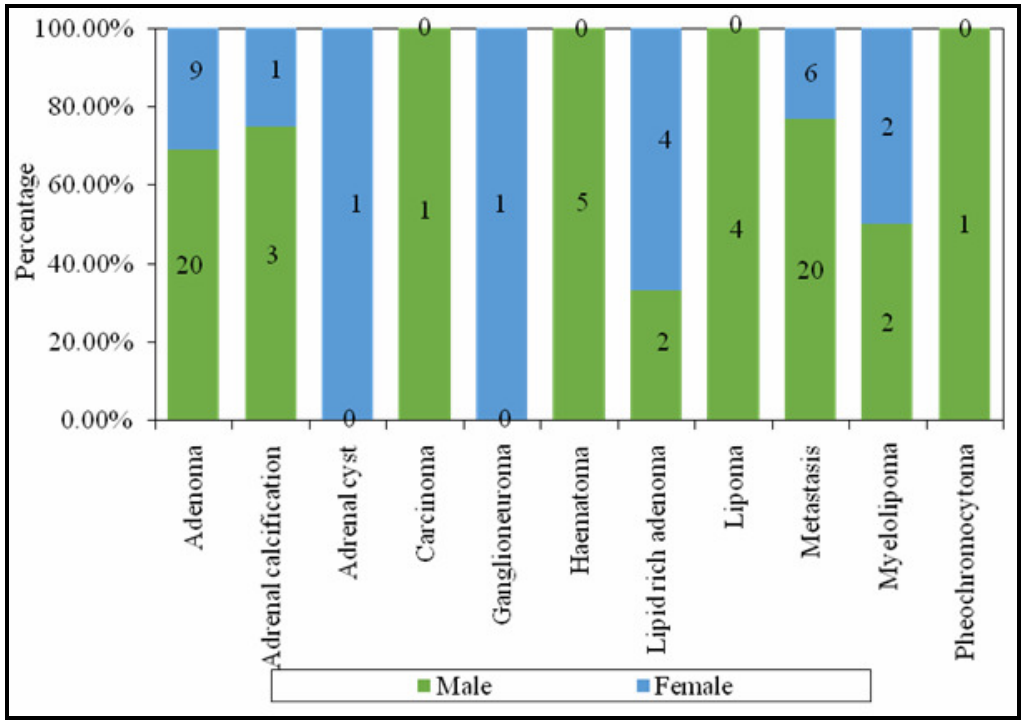

Fig-2: CT scans of adrenal incidentalomas (A) Lipid poor Adrenal adenoma: Enhancing mass lesion is seen on the right adrenal gland showing attenuation value of 63.6 HU (indicative of malignancy) in 70s contrast enhanced CT (B) Lipid rich Adrenal adenoma: Left adrenal mass with attenuation of 8.8 HU is seen on non-enhanced CT suggestive of lipid rich adrenal adenoma(C) Adrenal hematoma: Right adrenal gland is diffusely bulky with increased attenuation suggestive of adrenal hematoma on plain CT (D) Adrenal metastasis: A heterogeneously enhancing mass seen on the right adrenal gland showing attenuation value 34.7 on delayed scan consistent with metastasis.

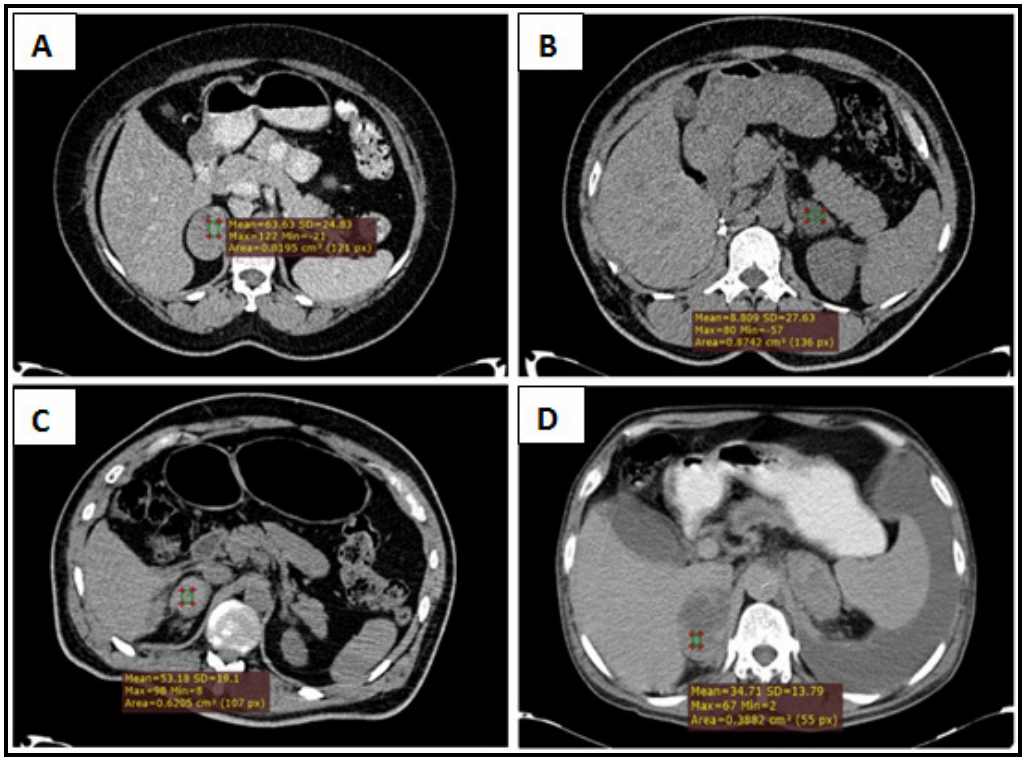

Table-1: Comparison of the diagnosis with different parameters on the right and left sides												
Diagnosis	Plain HU				Venous HU				Delayed HU			
	Right		Left		Right		Left		Right		Left	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Adenoma	21.18 (17)	18.33	18.33 (18)	13.37	61.78 (9)	23.43	57.50 (10)	23.33	37.22 (9)	18.30	29.70 (10)	12.22
Adrenal calcification	198.33 (3)	50.08	224.5 (2)	48.79	--	--	--	--	--	--	--	--
Adrenal cyst	--	--	--	--	--	--	--	--	--	--	--	--
Carcinoma	--	--	37 (1)	--	--	--	47.00 (1)	--	--	--	43.00 (1)	--
Ganglioneuroma	--	--	31.00 (1)	--	--	--	34.00 (1)	--	--	--	41.00 (1)	--
Hematoma	60.50 (4)	7.14	40.00 (1)	--	60.00 (3)	8.19	40.00 (1)	--	58.67 (3)	8.50	40.00 (1)	--
Lipid rich adenoma	14.00 (3)	18.19	8.50 (4)	11.21	55.67 (3)	14.50	56.50 (2)	17.68	25.67 (3)	12.66	19.50 (2)	3.54
Lipoma	-99.00 (3)	12.12	-91.00 (1)	--	-93.00 (3)	13.08	-88.00 (1)	--	-94.67 (3)	5.03	-86.00 (1)	--
Metastasis	31.07 (15)	10.53	32.43 (19)	14.2	66.00 (14)	19.82	70.94 (18)	15.08	51.29 (14)	14.33	56.06 (18)	12.24
Myelolipoma	-39.00 (2)	36.77	-25.00 (2)	62.23	-16.00 (2)	43.84	-48.00 (1)	--	-18.00 (2)	35.36	-46.00 (1)	--
Pheochromocytoma	48.00 (2)	--	--	--	118.00 (1)	--	--	--	59.00 (1)	--	--	--
Total	**28.71**	**59.24**	**27.96**	**48.43**	**46.69**	**51.97**	**55.71**	**36.58**	**29.86**	**44.89**	**38.20**	**31.44**

The benign and malignant adrenal incidentalomas on the right side of the body axis were assessed in terms of plain HU, venous HU and delayed HU. The mean plain HU of the benign and malignant adrenal incidentalomas were found to be 27.470 and 31.71 respectively. In regards to the venous HU, the mean values of benign and malignant adrenal incidentalomas were 33.82 and 68.46 respectively. Whereas, the mean delayed HU of the benign and malignant adrenal incidentalomas was 16.14 and 53.08 respectively (Table 1). The Mann-Whitney test highlighted a significant difference in the distribution of venous HU (p = 0.0314) and delayed HU (p = 0.0039) between the benign and malignant cases. However, plain HU did not show any significant variation across the two types (p = 0.1999).

Among the adrenal incidentalomas of the left side of the body axis, the mean plain HU of 24.61 and 33.42, mean venous HU of 39.06 and 72 and mean delayed HU of 18.47 and 56.83 were observed for the benign and malignant forms respectively (Table 1).On comparing the benign and malignant adrenal incidentalomas on the left side of the body axis with respect to the mean venous HU(p = 0.0037) and delayed HU(p < 0.0001) values by the two sample t-test, the malignant masses were found to be significantly larger than the benign forms.

There were no significant associations between the mean of plain HU between the left and right side for adenoma (p-value =0.602). No significant variance in the mean of venous HU between sides for adenoma (p = 0.654) and metastasis (p =0.4287) diagnosis were noticed as analyzed by the two sample t-test. Similarly, the difference in the mean of delayed HU between left and right side for adenoma and metastasis diagnosis was insignificantas depictedby the p-values of 0.3021 and 0.3183 respectively.

Table-2: Comparison of the diagnosis with Absolute washout and Relative washout scores on the right and left sides

Diagnosis	Absolute washout %				Relative washout %			
	Right		Left		Right		Left	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Adenoma	71.16 (9)	18.04	80.13 (9)	9.19	39.80 (9)	15.04	50.93 (9)	10.10
Adrenal calcification	--	--	--	--	--	--	--	--
Adrenal cyst	--	--	--	--	--	--	--	--
Carcinoma	--	--	40.00 (1)	--	--	--	8.50 (1)	--
Ganglioneuroma	--	--	--	--	--	--	--	--
Hematoma	--	--	--	--	--	--	--	--
Lipid rich adenoma	71.33 (3)	15.82	66.00 (2)	5.66	53.90 (3)	15.18	64.50 (2)	4.95
Lipoma	--	--	--	--	--	--	--	--
Metastasis	40.48 (15)	16.18	34.64 (17)	25.52	21.27 (15)	8.76	18.53 (17)	12.03
Myelolipoma	--	--	--	--	--	--	--	--
Pheochromocytoma	84.00 (1)	--	--	--	50.00 (1)	--	--	--
Total	**55.20**	**22.71**	**51.1**	**29.21**	**31.75**	**16.53**	**31.41**	**20.81**

Table 2 depicts the comparison of benign and malignant incidentalomas with respect to the absolute washout and relative washout percentage values on the right and left sides of the body axis. The mean absolute percentage washout time of benign and malignant adrenal incidentalomas on right side were 70.6±16.9 and 38.51±16.50.While the mean relative percentage washout time of benign and malignantadrenal incidentalomas situated on the right side were 41.96±16.17 and 21.18±9.29. Hence, the mean of absolute (p <0.0001) and relative (p <0.0002) washout of benign mass was deduced to be significantly higher than that of the malignant cases.

In reference to the adrenal incidentalomas of the left, the mean absolute percentage washout time of benign masses was 75.27±12.54 and that of the malignant masses was 34.05± 25.26 (p <0.0001). While the mean relative percentage washout time of benign andmalignant adrenal incidentalomas situated on the left side of the body axiswas 50.92±13.33 and 17.64±12.19 respectively (Table 2). As determined by the two sample t-test, the mean of absolute (p <0.0001) and relative washout of benign mass significantly larger compared to malignant cases (p <0.0001).

There was no significant difference in the mean of absolute washout between the two sides for adenoma and metastasis diagnosis, p-values were 0.2021, and 0.4524 for two sample t-test respectively. Similarly, the difference in the mean of relative washout between two sides for adenoma and metastasis diagnosis was determined to be insignificant as depicted by the p-values of 0.0838 and 0.4718respectively (Table 2).

As per Mann-Whitney test results, the distribution of the plain HU was significantly different across necrosis (p = 0.02145), calcification (p = 0.0115) and fat (p <0.0001) categories while venous HU distribution was significantly different across necrosis (p = 0.03786) and fat (p <0.0001) categories. Distribution of delayed HU significantly differed across hemorrhage (p = 0.03558), necrosis (p = 0.001) and fat (p <0.0001) categories and are tabulated in Table 3.

Table-3: Comparison of Plain HU, Venous HU, and Delayed HU over Haemorrhage, Necrosis, Fat and calcification							
Variable		**Plain HU**	**p-value**	**Venous HU**	**p-value**	**Delayed HU**	**p-value**
Hemorrhage	Yes	36.54±18.95	0.06598	64.8±13.51	0.7261	55.5±9.05	0.03558*
	No	27.07±57.17		55±38.18		36.55±32.71	
Necrosis	Yes	31.61±12.78	0.02145*	70.33±20.48	0.03786*	52.48±12.53	0.00105*
	No	26.81±64.49		48.87±41.82		30.11±34.94	
Calcification	Yes	18.94±57.21	0.0115*	33	--	30	--
	No	138.17±95.47		70±55.71		38.2±31.21	
Fat	Yes	-0.56±39.35	<0.0001*	18.94±57.21	<0.0001*	2.19±48.95	<0.0001*
	No	42.33±54.38		60.24±34.12		42.88±28.76	
Abbreviations: p-values were determined by Mann-Whitney test, *p-value< 0.05 considered significant							

Table-4: Comparison of diagnosis with Absolute washout and Relative washout scores over Hemorrhage, Necrosis, Fat and calcification					
Variable		**Absolute Washout %**	**p-value**	**Relative Washout %**	**p-value**
Hemorrhage	Yes	28.87±20.49	0.00754*#^{Wt}	19.63±7.44	0.001202*#^{Wt}
	No	54.63±28.22		33.47±20.86	
Necrosis	Yes	41.66±18.99	0.001086*#^{t}	23.54±10.78	0.0002201*#^{Wt}
	No	62.67±26.63		39.53±21.28	
Calcification	Yes	37.5	--	9	--
	No	58±51.1		31.41±20.62	
Fat	Yes	61.71±14.75	0.07696 ^{t}	42.16±21.31	0.01514*#^{t}
	No	48.49±30.68		28.22±18.98	
Abbreviations: Wt: Welch's two sample t-test, t: Two sample t-test, #: one tailed t-test.*p-value< 0.05 considered significant					

Table 4 tabulates the results of two sample t-test comparing the mean values of absolute and relative washout in the presence or absence of hemorrhage, necrosis, fat and calcification. Absolute washout and relative washout mean scores were found to be significantly greater in the absence of corollary factors like hemorrhage (p = 0.001202), necrosis (p = 0.0002201), and fat (p = 0.01514).

Discussion

A total of 7418 (4143 males and 3275 females, age range 5-86 years) CT scans of the abdomen and chest were reviewed over a period of 1 year and a total of 98 adrenal incidentalomas were found in 82 patients (Prevalence- 1.37%). The prevalence of incidentalomas in CT examinations has varied from 0.35 to 5%, [12, 14-16] and in the autopsy series adrenal adenomas are found in 1.4 to 8.7%, but these series also include small adenomas that cannot be found in radiologic examinations [17-18]. Davenport *et al.* reported a prevalence of approximately 1%. They performed a retrospective study of 3,705 CT scans of the chest and abdomen and identified 37 incidentalomas [19].

Out of the 82 patients with adrenal incidentalomas, 58 (70.7%) patients were male and 24 (29.3%) patients were female. A study by Terzolo *et al.* states that the prevalence of adrenal incidentalomas increases with age with no difference in sex and in obese, diabetic, and hypertensive patients [9].

Similarly, in this study the number of patients with adrenal incidentalomas in the age group

less than 30 years was 5 (6.1%), which was less in comparison with the age group in the range of 51 to 60 and 61 to 70 years, which had the most cases with 26 (31.7%) patients in either of the groups.

Of the 35 patients with adrenal adenomas, most of them had adrenal incidentalomas with plain HU value< 10. The remaining adenomas were diagnosed on delayed studies with the help of the absolute and relative percentage washout values. Hamrahain *et al.*performed a study of 299 adrenal incidentalomas in which they reported a sensitivity of 40.5% and specificity of 100% for a cut-off value of 10 HU for the diagnosis of adrenal adenoma [20].

Boland *et al* critically analyzed the reported attenuation values of adenomas and non-adenomas in 10 published series of adrenal masses 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 high specificity, it is very likely that a mass that is 10 HU or less on unenhanced CT images is an adenoma [21].

Alternative imaging techniques like ultrasonography fare poorly in comparison to CT, with detection rates pegged at 65% in adrenal incidentalomas less than 3 cm in size as reported by Suzuki *et al*. The same study also demonstrated the ability of CT and Magnetic Resonance Imaging (MRI) techniques todetect all adrenal tumors irrespective of the size [22].

Some studies on adenomas place delayed contrast-enhanced CT above chemical shift MRI in terms of diagnostic efficiency due to shortcomings such as mild contrast enhancement, low signal intensity and homogeneity of masses in MRI scans [23-24].

The mean diameter of the benign adrenal incidentaloma on the right side was 1.9 ± 0.84 cm. and on left side was 2.02 ± 1.0 cm. And the mean diameter of the malignant adrenal incidentaloma on the right side was 3.2 ± 1.5 cm and on left side was 2.9 ± 2.1 cm. Angeli *et al*. reported in a study involving 887 patients who had adrenal incidentalomas, a diameter greater than 4 cm was shown to have 90% sensitivity for the detection of adrenocortical carcinoma but a low specificity; only 24% of lesions greater than 4 cm in diameter were malignant [25]. Mantero *et al.* performed a retrospective study of 1004 adrenal incidentalomas from 1980 to 1995. They reported that the cut off of 4 cm had 93% sensitivity in differentiating benign from malignant Al [26].

Of the 82 patients with Al, 35 (43%) were adenomas and 47 (57%) were non-adenomas. Non-adenomas included benign lesions like myelolipoma, cyst,hematoma,pheochromocyt oma and malignant lesions like adrenocortical carcinoma and metastases. Pheochromocytomas can be benign or malignant depending on the histological characteristics, and it cannot be differentiated on imaging (unless they metastasize).

All of the various types of Adrenal incidenatlomas were more common in males. Caoili *et al.*evaluated 166 adrenal masses using the adrenal protocol. They found 127 adenomas and 39 non-adenomas. They reported a mean diameter of 2.3 cm for adenomas and 4 cm for non-adenomas [27].

The results of the present study indicated that at non-enhanced CT, both adrenocortical carcinomas and pheochromocytomas have mean attenuation values similar to those of metastases but significantly higher than those of adenomas.

By using both non-enhanced and contrast-enhanced CT scan attenuation measurements and calculation of relative percentage washout on dynamic and delayed enhanced CT scans most adrenal lesions can be characterized by CT, thereby obviating the need for additional imaging, follow-up, or biopsy. The study did not include the correlation of adrenal incidentalomas detected on CT with the hormonal levels, histopathological findings, and clinical features which was the main limitation of the present study.

Conclusion

Despite its small size, the adrenal gland can harbor numerous abnormalities ranging from hormonal dysfunction, primary and secondary neoplasms, to infiltrative diseases. In this

study, with the help of non-enhanced and contrast-enhanced CT scan attenuation measurements, and calculation of relative percentage washout on dynamic and delayed enhanced CT scans, the authors characterized most adrenal lesions, thereby obviating the need for additional imaging, follow-up, or biopsy. Hence, characterization of adrenal incidentalomas using CT is a pre-requisite for the delineation of pertinent management plans that forestall progression of malignancies.

Financial Support and sponsorship: Nil

Conflicts of interest: There are no conflicts of interest.

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Cite this article as: Shivapur AA, Patil AS, Goudar PS , Patil SD and Hattiholi VV. Prevalence and characterization of adrenal incidentalomas on computed tomography – A hospital-based retrospective study. *Al Ameen J Med Sci* 2021; 14(2):159-168.

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