CT FEATURES OF ADRENAL MASSES IN SRINAGARIND HOSPITAL

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ABSTRACTS

Abdominal CT findings of 13 adrenal massses in 13 patients who had pathologically proven were reviewed. There were 4 cortical adenomas (3 Cushing's adenomas, 1 primary aldosteronism or Conn's adenoma) and 9 nonadenomas (4 pheochromocytomas, 2 adrenal cysts, 1 macronodular hyperplasia, 2 cortical carcinomas). Adrenalectomy were performed in all cases. All masses of cortical adenomas had smooth contour, size less than 5 cm., homogeneous density (less amount of attenuation number) and enhancement (mild to moderate degree). All pheochromocytomas had the same clinical presentation with smooth contour of masses, size less than 5 cm. and mainly had inhomogeneous density including enhancement pattern (moderate to marked degree). One from 2 cases of adrenal cysts and 1 macronodular hyperplasia could mimic adrenal tumor. All 2 cases of cortical carcinoma had large size masses , more than 5 cm. : 1 case had typical thick irregular rim enhancement and another case similar to benign tumor exceptional for the large size.

INTRODUCTION

The development of cross-sectional imaging technique has dramatically improved ability to examine the adrenal glands. No longer time –consuming or invasive investigations such as arteriography, venography, venous sampling were required, the adrenal glands are readily imaged with CT, sonography and MR imaging.

CT scanning has proved the most useful and most widely accepted imaging techniques, since it provides immediate and accurate diagnosis in all but the tiniest of adrenal masses.

Adrenal mass is an uncommon disease in general. The glands had varied tissue components, then the variety of masses could be occurred. The purpose of this study was to determine the causes of adrenal masses, described CT findings and determined whether there were characteristic features or overlapping findings of each group.

MATERIALS AND METHODS

We retrospectively reviewed the medical records and the available CT scans of 13 adrenal masses in 13 patients who had pathologically proven at Srinagarind Hospital, Khon Kaen University, during 1995-1999. CT examination were performed by using a 9800 GE Medical systems, Milwaukee, Wisconsin was used in 11

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patients, 3 mm. Collimation in 2 patients. All cases underwent CT before and after intravenous administration of contrast medium. The large group of neuroblastoma in pediatric patients were excluded from our study.

The patients were 4 men, 9 women with age range 13 – 67 years (mean age = 33.69 years). There were 4 cortical adrenomas (3 Cushing's and 1 Conn's adenomas) and 9 nonadenomas (4 pheochromocytomas, 2 adrenal cysts, 1 macronodular hyperplasia, 2 cortical carcinomas).

Shape, contour, size, density, enhancement pattern, calcification or necrosis within the masses, involvement adjacent organs were determined and analyzed.

Tissue diagnosis was obtained in all cases. All patients underwent adrenalectomy. (Laparoscopic adrenalectomy in one case)

RESULTS

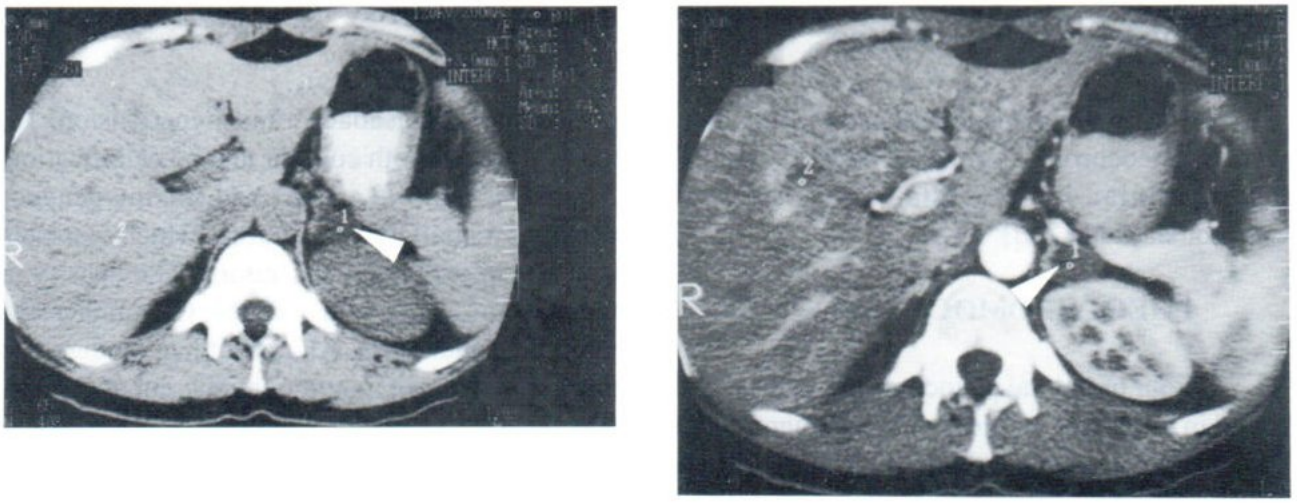
CORTICAL ADENOMA

Four unilateral cortical adenomas were encountered in 4 patients. All patients had biochemical and/or clinical evidence of adrenal hyperfunction and were females. (table 1) All masses had smooth contours, homogeneous density and no calcification. Their diameter measured 2 – 4.5 cm. (average 2.78 cm.) The density of the masses was less than or equal to muscles. The available CT number of 2 cases was 5 H.U. and 17 H.U. respectively which is similar to fluid attenuation. (fig. 1, 2) Mild to moderate degree of homogeneous enhancement was evident

TABLE 1. Patient Data & CT features of cortical adenomas

Patient			Lesions					
Age (yr)	Sex	Clinical	Unenhanced CT				Enhanced CT	
			Size cm.	Contour	Homogeneity	Density	Homogeneity	Degree
25	F	Conn's	2	Smooth	Homogeneous	5 H.U.	Homogeneous	Mild
31	F	Cushing	3	"	"	= muscle	"	Mod.
31	F	"	2	"	"	= muscle	"	"
33	F	"	4.5	"	"	17 H.U.	"	"

● No calcification in all cases

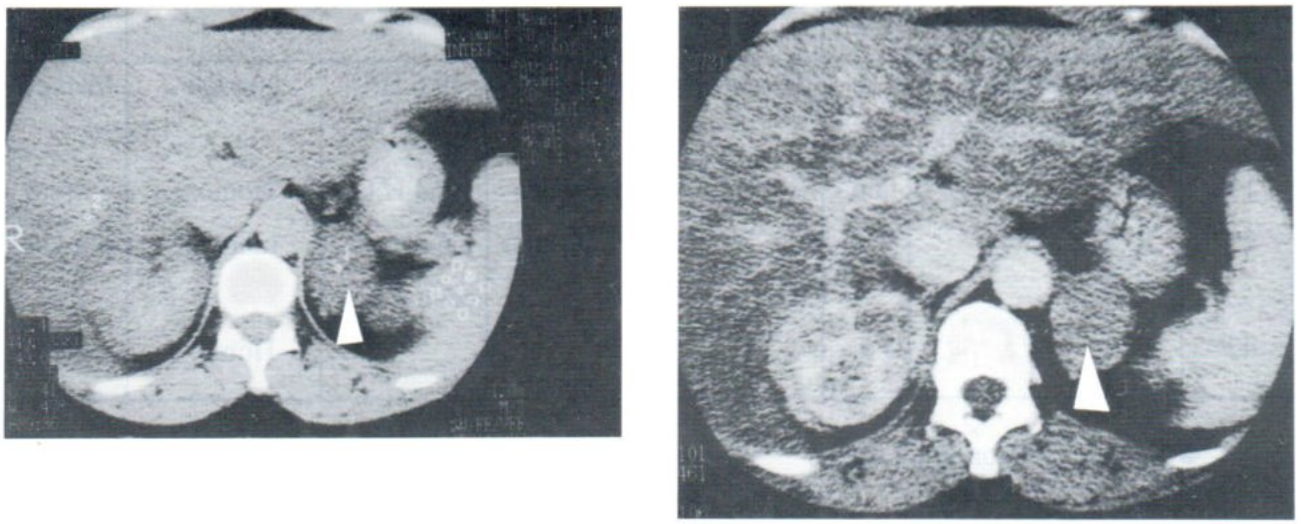


1A 1B

Fig. 1 Cortical Adenomas (Conn's adenoma) in a 25 – year – old woman with hypertension and an biochemical evidence of primary aldosteronism

A. Very small homogeneous hypodense LT.adrenal mass with smooth contour. Attenuation of mass is about 5 H.U. (arrow)

B. Moderate degree of homogeneous enhancement on post – contrast image (arrow)



2A 2B

Fig. 2 Cortical Adenomas (Cushing's adenoma) in a 33 – year – old woman

A. LT.adrenal mass with smooth contour ,density is slightly less than muscles about 17 H.U. (arrow)

B. Moderate degree of enhancement on post contrast image (arrow)

NONADENOMATOUS MASSES

Of the 9 nonadenomatous patients, there were 4 pheochromocytoma, 2 adrenal cysts, 1 macronodular hyperplasia, and 2 cortical carcinoma. (table 2, 3)

PHEOCHROMOCYTOMA

Four unilateral pheochromocytomas were found in 4 patients. (table 2) Three patients were females. All patients had the same clinical presentation of headache and hypertension. All masses had smooth contour and no calcification. Almost of them (3 cases) had inhomogeneous density by small low dense areas which represent necrosis in pathological sections. The density of the mass in 2 cases with available CT number was more than adenomas. Almost all had moderate to marked degree of inhomogenous enhancement. (fig. 3, 4)

TABLE 2. Pheochromocytoma (4 cases)

Patient			Lesion					
Age (yr)	Sex	Clinical	Unenhanced CT				Enhanced CT	
			Size (cm.)	Contour	Homogeneity	Density	Homogeneity	Degree
13	M	Headache, hypertension	4	Smooth	Inhomogeneous	39.6 H.U.	Inhomo.	Marked
19	F	"	3.6	"	Homogeneous	48.4 H.U.	Homo.	Mod.
25	F	"	4.4	"	Inhomogeneous	= munscle central low	Inhomo.	Marked
42	F	"	4.5	"	"	"	Homo.	Mod.

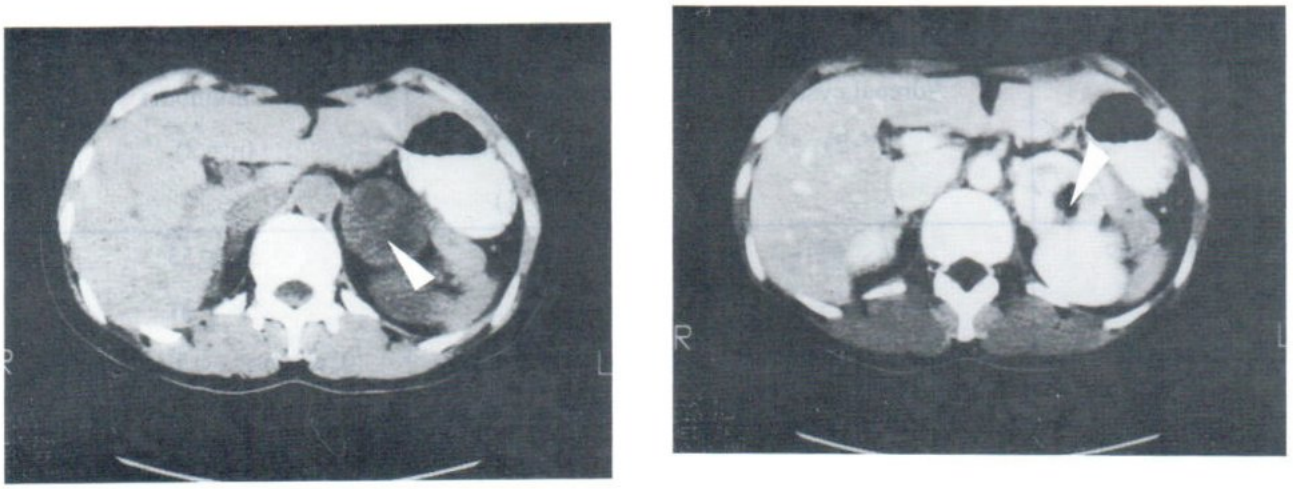
● No calcification in all cases

ADRENAL CYSTS

They were encountered in 2 patients. One of them presented with RUQ abdominal pain, another one was asymptomatic. Both of them were reported as tumor, particularly primary malignancy or metastases because of her old ages. But the pathological sections were proven as adrenal cysts. One of them had well defined density mass without enhancement. (fig. 5) Another one had heterogeneous soft tissue density mass with lobulated contour, calcification and mild degree inhomogeneous enhancement. (fig. 6)

TABLE 3. Other nonadenomatous masses

	Adrenal cysts (n = 2)	Macronodular hyperplasia (n = 1)	Carcinoma (n = 2)
● Patient age	49 , 67	13	37 , 53
● Sex	F , F	M	F , M
● Presentation	RUQ pain , Asymptom	Precoccious Puberty and hypertension	Cushing 's , RUQ pain
Lesion size (cm.)	6 , 4 cm.	3 cm.	6 , 21 cm.
Unenhanced CT			
- Contour	smooth , lobulated	smooth	smooth , smooth
- Homogeneity	Homo , Inhomo.	Homo.	Homo. , Inhomo.
- Attenuation	= GB fluid , 37.9 H.U.	= muscle	= muscle , 28.57 H.U.
Enhanced CT			
- Homogeneity	no enhance , Inhomo.	Homo.	Thin septal & rim, thick irregular rim
- Degree	——— , Mild	Mild	Mild , Mod.
Calcification	None , septal Ca+	None	None , punctate
Involved adj. Organ	None , None	None	None , kidney

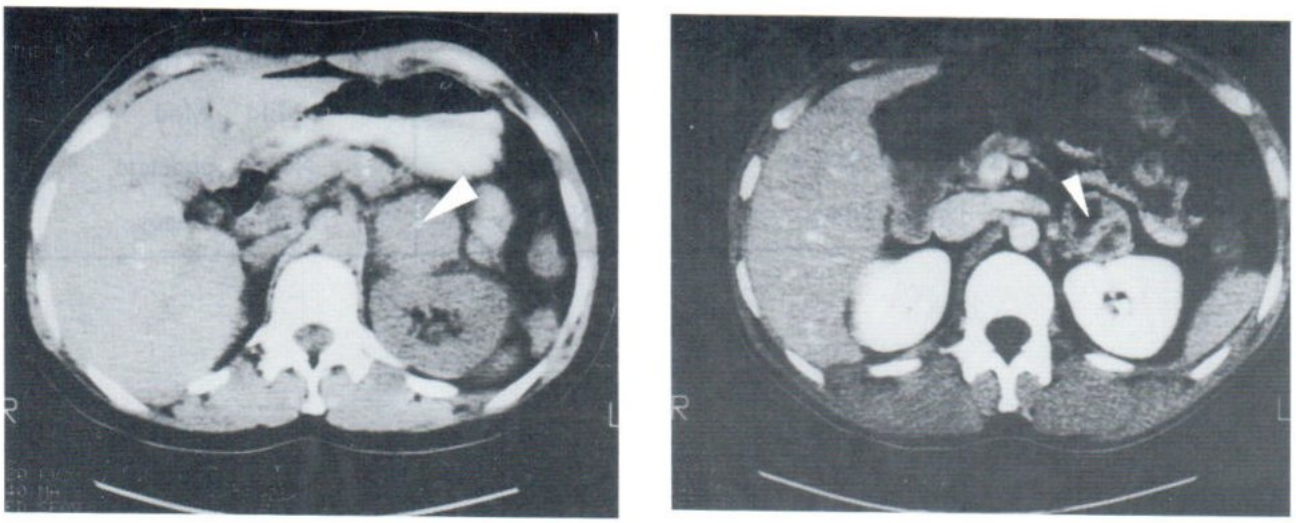


3A 3B

Fig. 3 Pheochromocytoma

A. Inhomogeneous hypodense mass of LT.adrenal gland with smooth contour (arrow)

B. Post contrast image show markedly enhancement of mass with more delineation of focal necrosis. (arrow)

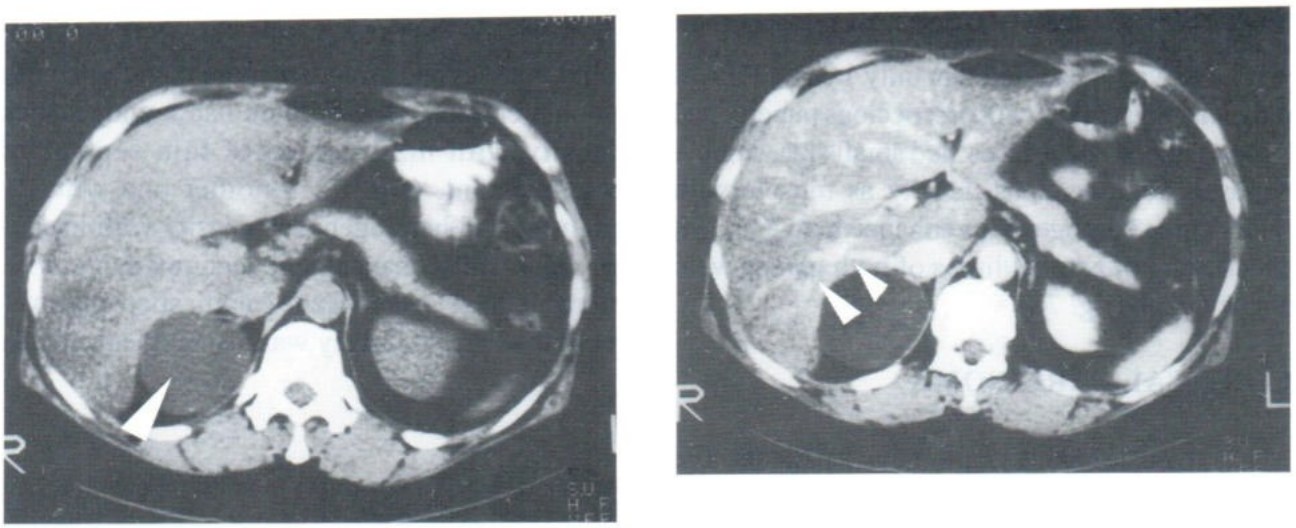


4A 4B

Fig. 4 Pheochromocytoma

A. Only one case of homogeneous density of LT.adrenal mass on pre – contrast image (arrow)

B. Heterogeneous moderate enhancement of the mass with small areas of necrosis (arrow)

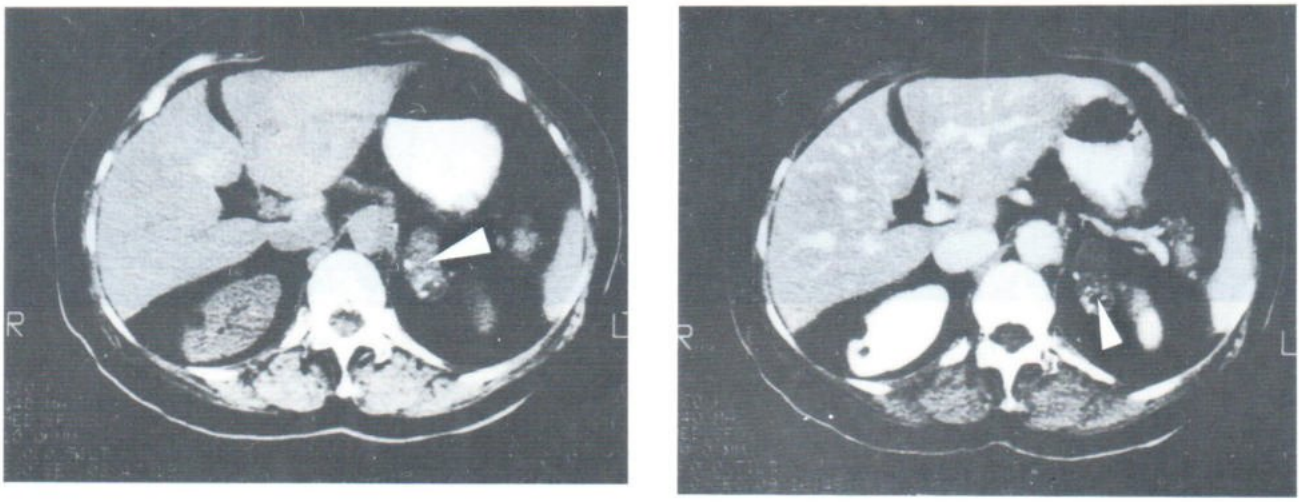


5A 5B

Fig. 5 Uncomplicated adrenal cyst

A Globular shape of hypodense mass (equal to GB fluid) with smooth contour at RT. adrenal gland (arrow)

B. No enhancement of this mass on post – contrast image, minimal pressure effect to adjacent liver is shown. (arrow)



6A 6B

Fig. 6 Complicated adrenal cyst

A. Heterogeneous solid appearance of LT. adrenal mass (arrow) with calcification and lobulated contour which mimic tumor

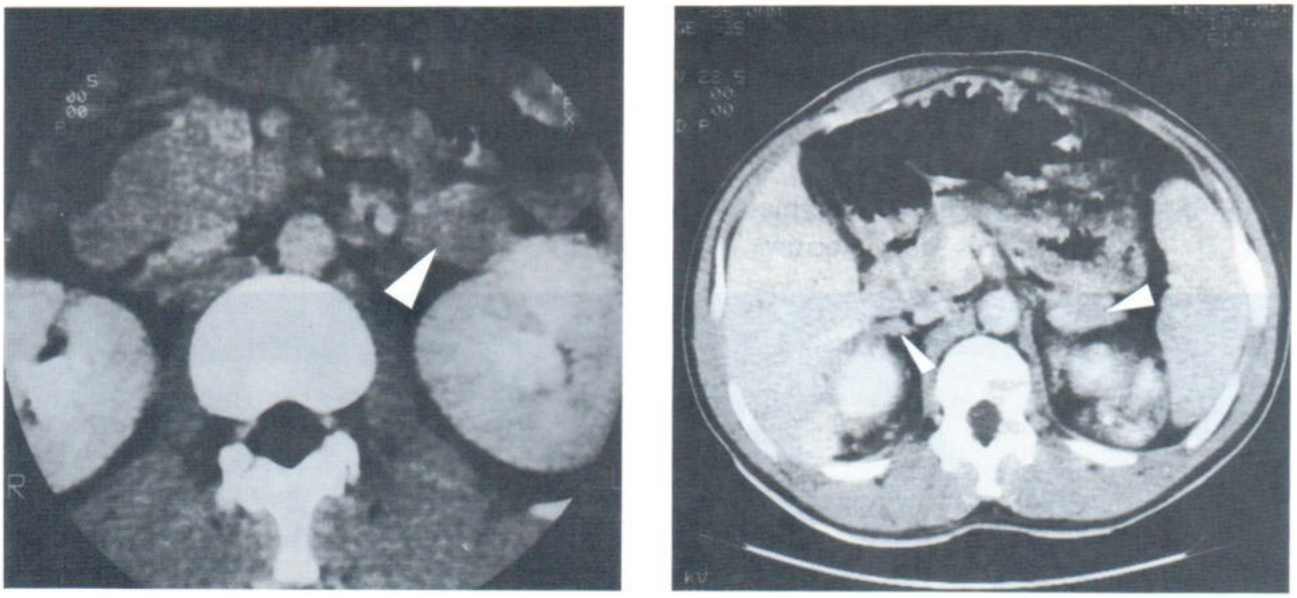
B. Post contrast image show mild degree septal enhancement (arrow)

MACRONODULAR HYPERPLASIA

It was encountered in only 1 case, 13 year old male, presenting with precoccious puberty and hypertension. The masses had small size, smooth contour, homogeneous density as muscle with mild degree homogeneous enhancement. (fig. 7a) Thickening of adrenal limbs of both glands were also evident. (fig. 7b)

CORTICAL CARCINOMA

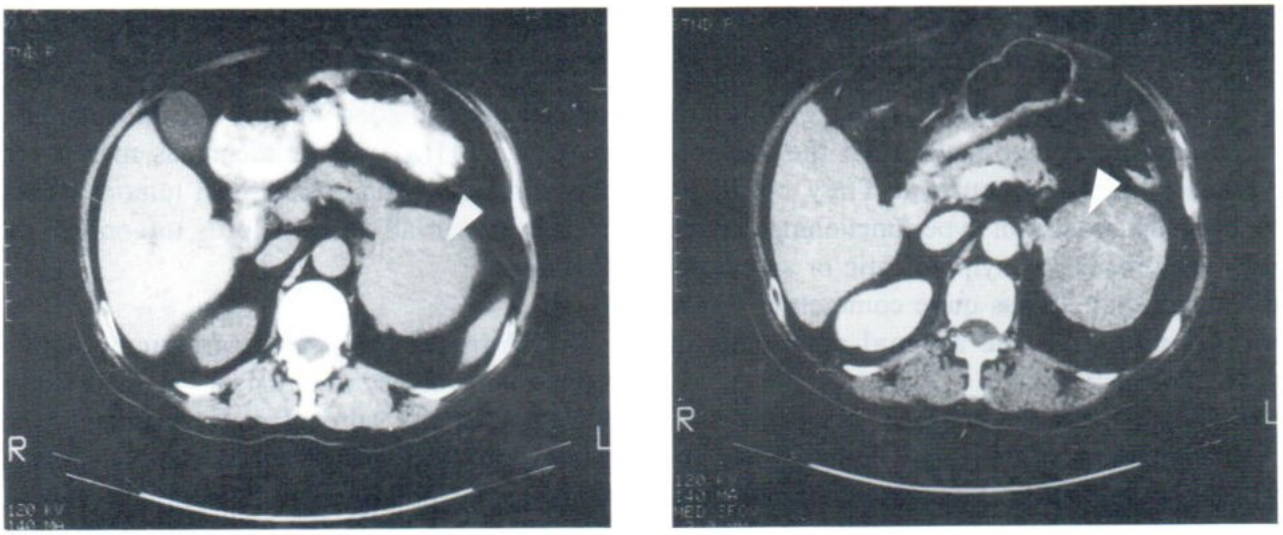
It occurred in symptomatic 2 patients. The tumor masses had large size more than 5 cm. with smooth contour. One of them had homogeneous density with mild degree of thin septal-rim enhancement. (fig. 8) Another one with 21 cm.mass had heterogeneous density with irregular thick rim enhancement,accompanying with mural nodules and punctate calcification. Involvement to adjacent kidney was also evident. (fig.9)



7A 7B

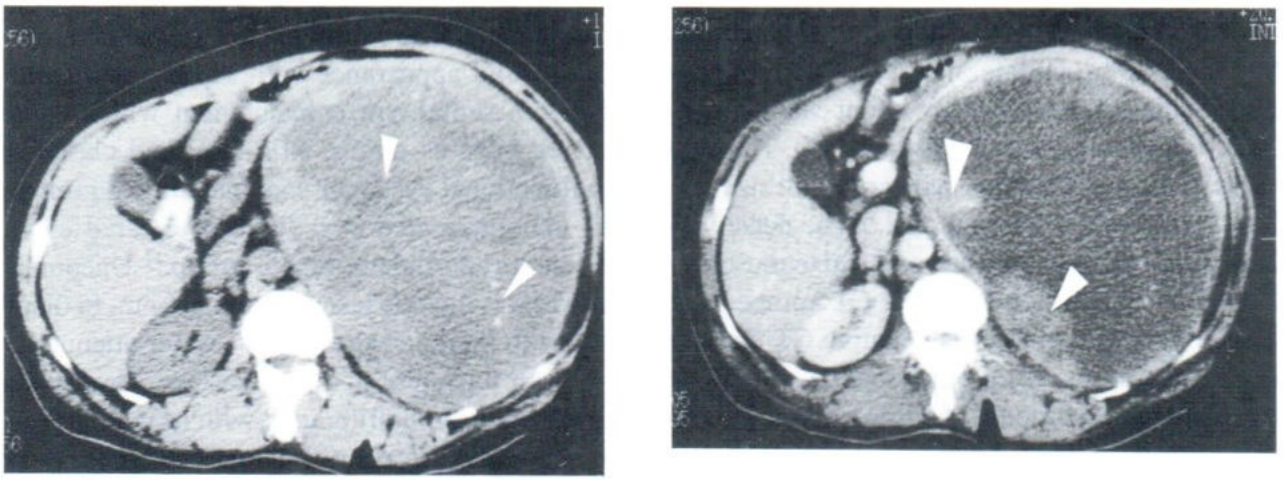
Fig. 7 Macronodular Hyperplasia

A. Magnification of LT.adrenal mass with slightly enhancement (arrow)
B. Thickening of adrenal limbs of both glands were shown. (arrow) More thickening on the LT. side is evident.



8A 8B

Fig. 8 Cortical Carcinoma
A. 6 cm. LT.adrenal mass with smooth contour, homogeneous density (arrow)
B. Post contrast image reveal mild degree of thin septal rim enhancement (arrow)



9A 9B

Fig. 9 Cortical Carcinoma
A. Huge LT.adrenal mass with heterogeneous density, punctate calcification (arrow)
B. Thick irregular rim enhancement with nodules (arrow) was shown on post – contrast images

DISCUSSION

As we know that adrenal glands had varied tissue components, then the variable masses could be occurred. They could be nonhyperfunctioning or hyperfunctioning masses. They may result in asymptomatic or symptomatic condition.[10] It was quite common to divide adrenal masses to be adrenal adenomas or nonadenomas.[13]

Although recently, MR imaging has improved the evaluation of masses of adrenal gland and several methods have been proposed. CT scan is still useful and widely accepted imaging techniques without longer time consuming or more expensive cost. It can detect the only tiny masses.

Our series had 13 adrenal masses in 13 patients who had pathologically proven from adrenalectomy in all cases.We found 4 cases of cortical adrenomas with all hyperfunction tumors. All masses were unilateral and had smooth contours, homogeneous density without calcification. Their diameter measured less than 5 cm. The only 1 case of Conn's adenoma had very small size,less than 2 cm.,as in previous report.[10] The density of adenomas was low (less than or equal to muscles), about 5 and 17 H.U.in available CT number of 2 cases. But no any mass has negative CT number of attenuation as many other reports, it may be explained by less amount of adipose tissue in both 2 cases of available CT number. Mild to moderate homogeneous enhancement are shown. For 4 cases of pheochromocytoma, all tumor masses are unilateral, smooth contour, size less than 5 cm. Without calcification. Almost of them (3 cases) had heterogeneous density due to small areas of necrosis. Moderate to marked inhomogeneous enhancement are shown. The remaining one case has homogeneous density mass which could mimic cortical adenoma except the attenuation number is higher. As H.Miyake et al had reported that adrenal mass with less attenuation (< 20 H.U.) indicate cortical adenomas, if the attenuation is more than 20 H.U. may be adenomas, metastases, pheochromocytoma, periadrenal tumor.[8] Rising urine VMA in all cases help us to confirm the diagnosis.

Adrenal cysts are infrequent, with a reported prevalence of 0.064 % - o.180% But in one recent study, adrenal cysts constitued 5.7% The apparent increasing frequency is likely related to incidental radiographic detection of adrenal masses[12] which like one case in our series.

Two cases of adrenal cysts in our series, one had round shape, homogeneous hypodensity mass but there's no enhancement at all which indicate the simple cyst and could distinguish from adenomas. Another one had no symptom and came to our hospital for check up.Ultrasound show an echoic mass. The following CT reveal heterogeneous solid appearance with septal calcification and thin septal rim enhancement which cause misdiagnose as tumor. Alla et al had classified nonfunctional cystic adrenal mass into 3 groups ; (a) uncomplicated cyst (b) complicated cystic lesions (c) an indeterminate group.[12] Uncomplicated cysts include lesions up to 5-6 cm. In diameter with homogeneous near – water attenuation and wall thickness of 3 mm. or less. These cysts may be uni- or multilocular, with or without wall or septal calcification. Lesions that meet these criteria can be safely observed as one case in our series. Complicated cystic lesions have at least one of the following features ; high attenuation value, nonhomogeneous texture, stippled central or thick peripheral calcification, or a thick wall (>, = 5 mm.). Such findings are likely caused by acute or chronic hemorrhage as in our case. Such lesions should be surgically explored, although most of them will prove to be hemorrhagic cysts. A short observation period with documentation of the evolution of intracystic hemorrhage may be

appropriate in some cases. Radiologically indetermine lesions include uncomplicated cysts larger than 5-6 cm.,with slightly higher-than-water attenuation (up to 30 HU), or with borderline wall thickness. Patients with these cysts may benefit from percutaneous cyst aspiration and otherwise conservative management.

Two types of adrenal hyperplasia have been described ; the common smooth hyperplasia and the less common nodular type, also known as cortical nodular hyperplasia. Nodular hyperplasia can be of (a) the micronodular variety in which the glands may appear normal and possess nodules of varying sizes (b) the macronodular variety, in which the gland are thickened and posesses nodules of varying size. The macronodular variety can at times be difficult to diagnose, as it can easily misdiagnosed as a hyperfunctioning cortical adenomas. Macronodular hyperplasia produce solitary mass with slightly enhancement. Our patient present with hypertension, precoccious puberty. Ultrasound and CT shows left adrenal mass .Then patient underwent unneccesary Lt. adrenalectomy after it was reported as adrenal tumor. If carefully evaluate, there's helpful finding to document adrenal hyperplasia by visible thickening of adrenal limbs of both glands. Finally, the patient is proven for congenital adrenal hyperplasia with salt retention by 11-? hydroxylase deficiency in adrenogenital syndrome.

ADRENAL CARCINOMA

Typical features are large mass bigger than 5 cm. with heterogeneous density and thick irregular rim enhancement accompanying with involvement to adjacent organs.[1,6,11] One of our 2 cases had these features as well. Another one had homogeneous density with slightly thin septal rim enhancement but there was large size,bigger than 5 cm.

CONCLUSION

Small homogeneous adrenal masses with less amount of attenuation number are likely to be cortical adrenomas. Heterogeneous masses with necrotic areas, moderate to marked enhancement indicate pheochromocytomas. Adrenal cysts had to be evaluated as uncomplicated or complicated cysts. Macronodular hyperplasia can mimic tumor, but carefully pay attention to the morphological features of the adrenal glands whether there are hyperplasia will allow radiologists to distinguish this condition from adrenal tumor and unnecessary adrenalectomy may be avoided. Then large size masses (more than 5 cm.) with thick irregular rim enhancement and invasion to adjacent organ are definitely to be adrenal carcinoma .

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