Histopathological and Immunohistochemical Studies on the Adrenal Cortical Tumors of Egyptian Patients

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Abstract: The presnet study provides guidelines for the diagnosis of adrenal cortical tumors in Egyptian patients. This retrospective study included 40 patients of adrenal cortical tumors (28 adenoma and 12 carcinoma). They were admitted to Mansoura Urology and Nephrology Center between 1985-2002. All patients were surgically treated by adrenalectomy. Patients with adenoma were followed for a period ranging from 24-67 months. Clinical and laboratory improvement of adenoma was observed. Nine patients of carcinoma died of distant metastasis after 8 months and the other 3 patients were still alive 24 months after surgery. Hyaline globules which are PAS positive were detected in adrenal cortical adenoma and carcinoma and both types were positive for reticulin stain. Immunohistochemically; cytokeratin was expressed in 22/28 cases of adenoma and all cases 12/12 of carcinoma. Vimentin was expressed in 20/23 cases of adenoma and 8/12 cases of carcinoma. The present study concluded that: (1)- Reticulin staining is useful for the diagnostic differentiation of adrenal cortical carcinoma from adrenal cortical adenoma. (2)- The expression of cytokeratin and vimentin is helpful in diagnosis, but the histopathological examination of paraffin sections remains the basic method. (3)- No significant correlation between immunohistochemical pattern of adrenocortical tumors and survival was observed.
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Key words: Histopathology, Immunohistochemistry, Adrenal cortical tumors, Cytokeratin, Vimentin

Introduction

Tumors in the adrenals originate from the adrenal cortex and medulla or as metastases from-extra adrenal primaries (Tatic *et al.,* 2002). Differentiation between these three groups is the first task a pathologist to tackle when dealing with specimens from the adrenal region. The second great problem is the dignity of adrenal tumors, which cannot be determined in many adrenomedullary and some adrenocortical tumors. Immunostaining is helpful but the histopathological examination of paraffin sections remains the basic method (Saeger, 2000).

Adrenocortical cancer is a rare cancer with a very poor prognosis (Tissier *et al.,* 2005)**.** According to Barzon *et al*. (2005), adrenocrotical tumors may originate from the zona glomerulosa, zona fasiculata or zona retecularis and be associated with syndromes due to overproduction of mineralocorticoids, glucocorticoids or androgens respectivley. During the past decade, many monoclonal antibodies have been developed, some of which have been assessed in adrenocortical neoplasmas using various methods. Antibodies directed against cytokeratin and vimentin can help in diagnosis (Saeger *et al.,* 2003).

The present study has been carried out on some of the adrenal cortical tumors obtained from patients in the Urology and Nephrology Center, Mansoura University, Egypt. The study was conducted to:

1- Threw light on the origin of the different tumors of the adrenal cortex.
2- Study the clinical approachs of the patients with these tumors.
3- Differentiate between the different types of adrenal tumors using the histological and immunohistochemical methods.
4- Examine the diagnostic usefulness of the co expression of cytokeratin and vimentin in adrenal cortical tumors.

2. Patients and Methods

This retrospective study was carried out on 40 cases of adrenal cortical tumors (28 Adenoma and 12 carcinoma). These cases were obtained from the Urology and Nephrology Center belonging to Mansoura University during the period from 1985-2002. All patients were routinely investigated after hospitalization to evaluate the extent of the tumor. The study included clinical examination, conventional laboratory investigation, intravenous urography, abdominal ultrasonography, chest x-ray to rule out pulmonary metastases and radio isotopic bone scan to exclude skeletal metastases. Also, computerized axial and tomography and radical

adrenalectomy in all patients were performed. Clinical data which are recorded in the present study were obtained from surgical requests. These data included patients' age, sex and size of each tumor.

Histopathological examination:

After adrenalectomy, the resected tumor was fixed in 10% buffered formalin for 24 hours and processed as usual for the preparation of paraffin wax blocks. These blocks were sectioned at 4-6 µm and were stained by the following methods:

1. Routine hematoxylin and eosin stain for general histological examination (Harris, 1900).
2. Periodic acid-Schiff's (PAS) reaction for detection of intracytoplasmic hyaline globules (Hotchkiss, 1948).
3. Reticulin stain by Gordon method for revealing the distribution of reticular fibers in the tumor tissues (Gordon and Sweets, 1936).
4. Moreover, immunohistochemical stainings were performed using different monoclonal and polyclonal primary antibodies.

Immunohistochemical examination:

Immunohistochemical staining of 4-6 µm paraffin sections was performed on the Dako Autostainer (Dako corporation, Carpentaria, Calif) using streptavidin-biotin peroxidase method of Hsu *et al.,* (1981). Histostain plus Kits (Zymed USA) which contain 10% non-immune serum, biotinylated secondary antibody and streptavidin-perxidase for antibodies against pan-cytokeratin (NCL-PAN-CK, 1:25; Novo castra Vector, Burlingame, Calif) and vimentin (Dako Carpentaria Calif, USA) for adrenal cortical tumors were used.

1- Pan cytokeratin (NCL-PAN-CK):

Pan Cytokeratin (NCL) is a mouse monoclonal antibody that reacts with human cytokeratins 5,6,8 and 18 (58 Kd, 56 Kds, 52 Kd & 45Kd), respectively. It is designed to recognize almost epithelial tissues and their tumors. NCL-PAN-CK labels all carcinomas of simple and squamous epithelial origin. The positive control for cytokeratin is the skin **(Angus *et al.*, 1988).**

2- Vimentin:

This vimentin **(57 Kd)** is a mouse monoclonal antibody that reacts with human vimentin intermediate filament subunit. In normal tissues, cell types which vimentin includes are endothelial cells, fibroblasts, smooth muscle cells and lymphoid cells. A number of tumors co-express vimentin and cytokeratin e.g. thyroid carcinomas, pleomorphic adenomas of the salivary glands and renal carcinoma.

Immunohistochemical procedure (Elias *et al.*, 1989):

Serial sections were cut at 4-6 µm and deparaffinized with xylene, rehydrated with descending grades of alcohols and immersed in deionized water.

Prior to immunohistochemistry, selected tissue sections were pretreated twice in an 1100- W microwave oven at 70% power for 4 minutes in 1% citrate buffer at PH 6.0 (Lab. vision corporation, Fremont, Calif) for vimentin. Sections for pan-cytokeratin immunostaining were pre-treated with 0.01% pepsin solution for 30 minutes at 37◦C.

Deparaffinized sections were incubated with 0.3% hydrogen peroxide in methyl alcohol to block the endogenous peroxidase activity for 30 minutes. Then, washed in phosphate-buffered saline (PBS) at pH 7.4 and incubated with non-immune serum. After application of the primary antibody, a biotinylated secondary antibody was added followed by the avidin-biotin-peroxidase complex. After each immunostaining procedure, sections were incubated with 3, 3′ diaminobenzidine-hydrogen peroxide substrate and counterstained with hematoxylin. Appropriate positive and negative control sections were also used.

Result of stain:

Immunohistochemical reactions revealed cytoplasmic brown stain in positive cases with the used antibodies. Accumulation of cytokeratin and vimentin was observed in tumor cells which take a brown color.

Follow up of patients:

The patients were followed postoperatively in the outpatient clinic for available period (mean = 47.46 month). This included, clinical examination, body weight and hypertensive state. Moreover, radiological follow up for local recurrence and distant metastasis in malignant cases was carried out.

3. Results

In the presnet study 40 patients represented the cortical tumors. These tumors were subdivided into two subdivisions, adenoma and carcinoma with a percentage of 24.7% and 10.6%, respectively.

I-Clinical findings:

1- Adrenal cortical adenoma (ACA):

In this study, 28 patients had cortical adenoma with a percentage of (24.7%). The clinical data of these patients is outlined in Table (1).

Age distribution:

Age distributions in patients with ACA are shown in table (1a). Most of the cases were in the 6th decades of life, while, in the first and second decades, no patients were recorded. The age of patients ranged from 22-60 years (the average was 46.8 years).

Sex distribution:

Sex distribution in patients with ACA is shown in table (1b). 28 patients had cortical adenoma with a

percentage of 24.7%. They were 12 males and 16 females. The male to female ratio was 1:1.3.

Tumor Size:

The tumor size in patients with ACA is recorded in table (1c). The size ranged from 2 to 10 cm. with an average 6.65 cm. More than 60 % of the tumors have sizes ranging from 6-10 cm, while less than 40 % of them possessed sizes ranged from 0-5 cm.

2-Adrenal cortical carcinoma:

12 patients had cortical carcinoma with a percentage of 10.6%. The clinical data of patients with cortical carcinoma is outlined in table (2).

Age distribution

The age of the patients ranged from 10 up to 53 years with an average age of 42 years. Nine cases were equal to or above 42 years and three cases were below the age of 42 year. Most cases were in the 5th decade of life.

Sex distribution:

Sex distributon in patients with ACC is shown in table (2). 12 patients had cortical carcinoma with a percentage of 10.6%. They were 5 males and 7 females. The male to female ratio was 1:1.4.

Tumor size:

Tumor sizes which were recorded in all cases of ACC are shown in table (2). The tumor size ranged from 10 to 18 cm. The average diameter was 12.8 cm. A male patient with an age of 24 year represented the largest ACC tumor size, while three patients represented the smallest one. Their age ranged from 42-53 years. One patient was female and the other two patients were males.

II- Histopathological Observations:

1- Adrenal cortical adenoma (ACA):

The most common architectural patterns of ACA are cells grouped in a nesting or alveolar pattern. These cells have compact eosinophilic cytoplasm. Their nuclei are deeply stained and vesicular with central to eccentric nucleoli (Fig. 1). In addition, an organoid architectural was observed in most of the studied ACA (Fig. 2). In all cases of ACA, neither mitotic figures nor tumor necrosis were observed.

In the present study, the tumor tissues of all cases were stained by PAS reaction and by Gordon technique to demonstrate the total hyaline globules and Reticulin fibers, respectively. The results of staining are recorded in table (3). This table shows that, the PAS Positive intracytoplasmic hyaline globules (Fig. 3) were detected in 13 cases only from the studied ACA 28 cases. The other 15 cases revealed negative reactivity to the PAS reaction.

Moreover, most of the ACA, (23/28) stained by Gordon technique were highly rich in the reticular fibers (Fig. 4). Moderately staining reactivity for reticular fibers was observed in 5 cases only. The reticular fibers surround the individual cells.

2- Adrenal cortical carcinoma (ACC):

The tumor has a diffuse or solid pattern of irregular-pleomorphic cells. Most tumor cells have moderate to abundant eosinophillic compact cytoplasm. Mitotic figures were numerous with many atypical forms (Fig. 5). Sections of tumors were stained with PAS and Gordon technique for reticulin stain. The result of staining is recorded in table (3). From this table, it can be observed that, the PAS positive intracytoplasmic hyaline globules were detected in eight cases of ACC (Fig. 6), while the other four cases showed negative staining. Most of the ACC tumors studied (10/12) showed a relative deficiency of the reticular fibers (Fig. 7). Two cases only of ACC gave negative results with reticulin stain.

III- Immunohistochemical observations:

The immunohistochemical reactions appeared as granular brown deposits precipitated in the cytoplasm of tumor cells. Meanwhile, the expression of cytokeratin and vimentin in the ACA and ACC are summarized in Table (4).

Expression of cytokeratin in the adrenal cortical tumors (ACT):

1- Adrenal cortical adenoma (ACA):

From table (4), it can be noticed that, most of the studied ACA cases (21/28) showed relative expression of cytokeratin with different grades of intensity. However, a wide range of expression was noticed. The staining was observed to be focal and the nuclei were stained blue with prominent nucleoli (Fig. 8). Seven cases showed a strong staining pattern and five cases showed a weak staining pattern. Moreover, the last seven cases of ACA gave negative immunoreactive staining pattern for cytokeratin.

2- Adrenal corticar carcinoma (ACC):

In the adrenal cortical carcinoma (ACC), cytokeratin expression was seen in all cases of tumors. However, a wide range of expression was noticed, 3 cases demonstrated a strong staining pattern and 9 cases showed a moderate staining pattern (Fig. 9).

Expression of vimentin in the adrenal cortical tumors (ACT):

1- Adrenal cortical adenoma (ACA):

ACA exhibited a wide range of expression with vimentin. Some tumors showed immunostaining reactivity mainly in stromal elements, while others showed strong expression of vimentin in the neoplastic cells (Fig. 10). Vimentin expression was observed in 20 cases of adrenal cortical adenomas. The staining was generally strong in eight cases, moderately also in eight cases and four cases gave weakly staining, while the other 8 cases of the tumor

showed negative results for the staining reactivity (Table 4).

2- Adrenal cortical carcinoma ACC:

In ACC, vimentin was seen in the cytoplasm of the tumor cells and its expression was observed in (10/12) ACC cases (Fig. 11). The staining was generally strong in three cases, moderately in five cases and weak immunoreactive in two cases. The last two cases were negative for immunoreactivity staining.

Table (1): Clinical data of the patients with adrenal cortical adenoma.

Case No.	Sex	Age (Year)	Size (cm.)	Follow up (month)	Status
1	F	30	7	168	S
2	M	22	7	120	S
3	F	53	8	124	S
4	F	56	5	84	S
5	F	30	8	120	S
6	M	53	8	82	S
7	F	35	5	78	S
8	M	46	4	72	S
9	F	58	8	68	S
10	M	59	7	60	S
11	F	54	7	62	S
12	M	56	5	48	S
13	F	51	8	36	S
14	M	43	3	35	S
15	M	53	6	32	S
16	F	27	4	28	S
17	F	60	7	26	S
18	F	53	5	24	S
19	M	58	8	20	S
20	F	57	6	12	S
21	F	35	10	26	S
22	F	54	9	32	S
23	F	37	8	48	S
24	M	34	4	32	S
25	M	50	6	24	S
26	M	52	3	30	S
27	F	37	5	27	S
28	M	60	2	18	S

S = Survival M = Male F = Female

Table (1a): Age distribution in patients with adrenal cortical adenoma.

Age group	No. of patients	Percentages %
First decade (1-10)	0	0%
Second decade (11-20)	0	0%
Third decade (21-30)	4	14.2%
Fourth decade (31-40)	5	17.8%
Fifth decade (41-50)	3	10.7%
Sixth decade (51-60)	16	57.1%
Total	28	100.0 %

Table (1b): Sex distribution in patients with adrenal cortical adenoma.

Sex	No. of patients	Percentages %
Male	12	42.8%
female	16	57.2%
Total	28	100.0%

Table (1c): Tumor size in patients with adrenal cortical adenoma.

Size group (cm)	No. of patients	%
0-5	11	39.28%
6-10	17	60.72%
Total	28	100.0

Table (2): The clinical presentation of Adrenal Cortical Carcinoma.

Case	sex	Age (years)	Size (cm)	Followup (months)	Status
1	M	45	12	36	D
2	M	42	10	11	D
3	F	46	10	16	D
4	M	10	13	24	D
5	F	46	15	24	D
6	M	43	11	37	D
7	F	32	16	38	D
8	F	24	18	27	D
9	F	36	13	24	S
10	M	53	10	39	D
11	F	44	11	36	S
12	F	42	14	23	S

D = Died, S = Survival, M = Male, F = Female.

Table (3): The results of PAS and Reticulin stain for adrenal cortical tumors (ACA & ACC).

Stain / Tumor	PAS		Reticulin stain		
	+ve	-ve	High +2	Low +1	-ve
ACA	13/28	15/28	23/28	5/28	-
ACC	8/12	4/12	-	10/12	2/12

+ve Positive -ve Negative

Table (4): Immunohistochemical expression of cytokeratin and vimentin in adrenal cortical tumors (ACA & ACC).

Immunostaining / Tumor	Expression of cytokeratin				Expression of vimentin			
	+3	+2	+1	0	+3	+2	+1	0
ACA	7/28	9/28	5/28	7/28	8/28	8/28	4/28	8/28
ACC	3/12	9/12	-	-	3/12	5/12	2/12	2/12

+3 intense immunoreactivity. +2 moderate immunoreactivity +1 weak immunoreactivity. -ve negative immunoreactivity.

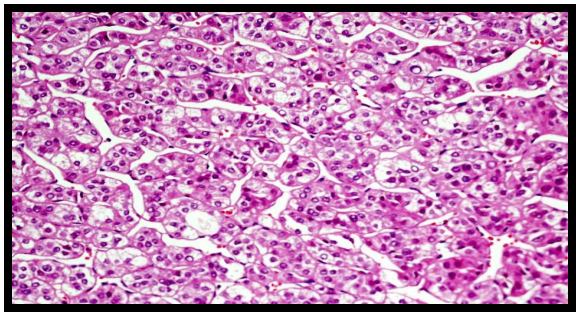

Fig. (1): Photomicrograph of adrenal cortical adenoma showing alveolar or nesting pattern. Cells have compact eosinophilic cytoplasm. (H & E x 200)

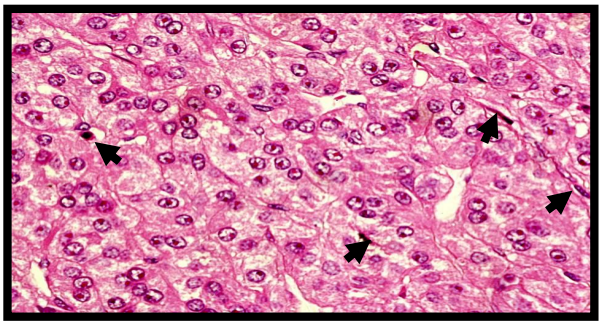

Fig. (2): Photomicrograph of adrenal cortical adenoma showing organoid arcitecture (arrows). No mitotic figures are observed, nuclei are vesicular with central to eccentric nucleoli. (H & E x 400)

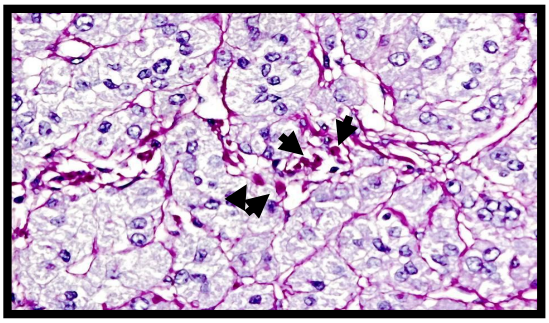

Fig.(3): Photomicrograph of adrenal cortical adenoma showing intra-cytoplasmic hyaline PAS positive globules, (arrows). (PAS X 400)

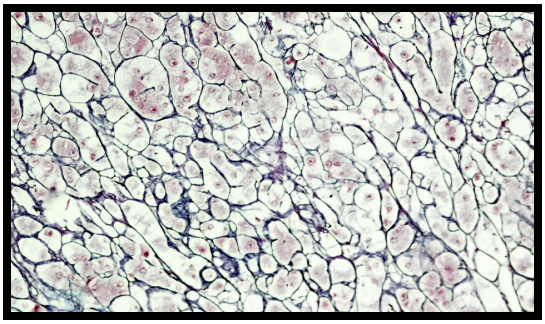

Fig. (4): Photomicrograph of adrenal cortical adenoma showing abundant reticular fibers. (Gordon stain X 200)

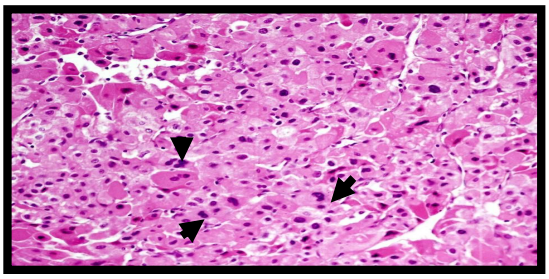

Fig. (5): Photomicrograph of adrenal cortical carcinoma showing diffuse pattern of irregular pleomorphic tumour cells. Most tumour cells have moderate to abundant eosinophilic compact cytoplasm. Mitotic figures are numerous with many atypical forms (arrows). (H & E X 200)

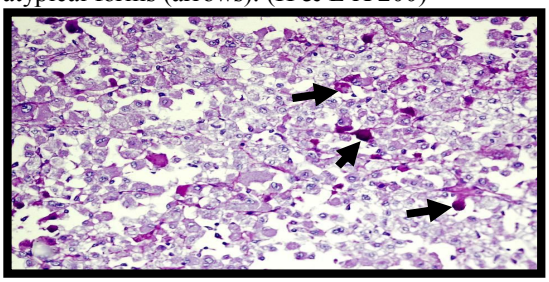

Fig. (6): Photomicrograph of adrenal cortical carcinoma showing intracytoplamic hyaline globules (arrows). (PAS X100)

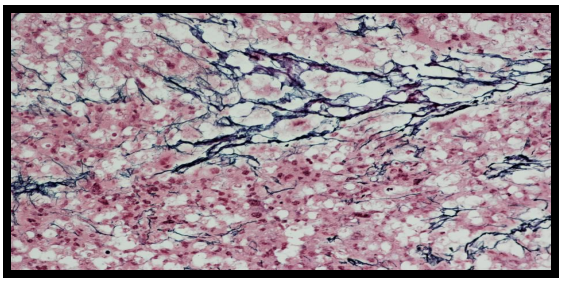

Fig. (7): Photomicrograph of adrenal cortical carcinoma showing deficient reticular fibers. (Gordon stain X 200)

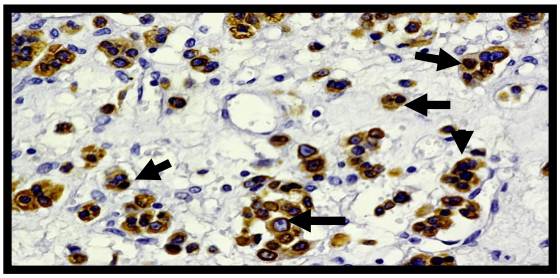

Fig. (8): Photomicrograph of adrenal cortical adenoma showing intense cytoplasmic immunoreactivity for Cytokeratin. (Immunoperoxidase X 400)

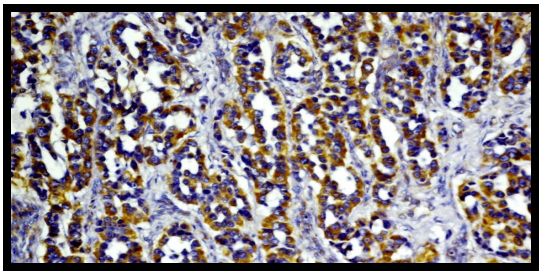

Fig. (9): Photomicrograph of adrenal cortical carcinoma showing intense cytoplasmic immunoreactivity for Cytokeratin in a brown colour. (Immunoperoxidase X 200)

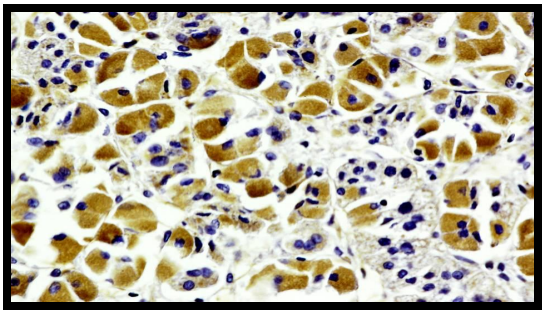

Fig. (10): Photomicrograph of adrenal cortical adenoma showing intense cytoplasmic immunoreactivity for Vimentin in a brown colour. (Immunoperoxidase X 400)

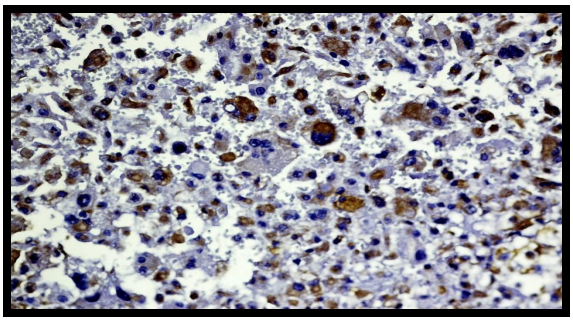

Fig. (11): Photomicrograph of adrenal cortical carcinoma showing intense cytoplasmic immunoreactivity for Vimentin in a brown colour. (Immunoperoxidase X 200)

4. Discussion

In the present study, forty cases of adrenal cortical tumors with a nearly mean of 5 years follow-up were investigated. They were 28 adenoma (ACA) and 12 carcinoma (ACC).

The studied patients were between 22-60 years of age, average age 46.8 years. Most patients were in 6th decade of life and they were 16 female and 12 male. The size of the tumor ranged from 2 to 6 cm with mean diameter of 3.8 cm. No patients with adenoma had recurrence of tumor after excision. Lack *et al*. (1990) reported that, there is a distinct predilection for female patients and most tumors are diagnosed in the third to fifth decades of life. The tumor measures 2-3 cm in diameter. Neville *et al.* (1985) showed that, 92% of tumors were less than 2 cm in diameter, while Conn *et al.* (1964) reported that 72% of tumors were less than 3 cm.

In the present study, the most common architectural patterns are cells in a nesting or alveolar arrangement. Adenomas typically had a compact eosinophilic cytoplasm. ACA tumor cell nuclei are usually single and their shapes are round to oval. Margination of chromatin along the nuclear membrane produces a vesicular appearance. Most nuclei contain a single dot-like nucleolus which is central or eccentric in location. Organoid architecture is seen, no mitotic figures are present, predominantly clear or foamy cytoplasm and no tumor necrosis in all cases is present. In addition, the intracytoplasmic hyaline globules were detected in 13/28 adrenal cortical adenoma. These globules are round to oval and are identified positive by periodic-acid Schiff's reaction (PAS). Lack *et al.* (1997) observed also the same result. They reported the presence of intracytoplasmic hyaline globules in a few number of adrenal cortical tumors both benign and malignant. Moreover, Handler (2003) showed that, intracytoplasmic hyaline globules have also been observed in about 10% of adrenal cortical tumors; both benign and malignant. The present study revealed that most cases of adrenal cortical adenoma were rich in reticular fibers by staining tissues with reticulin stain.

In the present investigation, twelve cases of adrenal cortical carcinoma were studied. The patients were between 24-53 years of age; average age was 42 years. Most patients were in the 4th and 5th decade of life and they were seven females and five males. Size of the tumor ranged from 10-18 cm with mean 12.8cm of diameter. Four patients were survival and the other eight patients of carcinomas had died with disease. Wooten and King, (1993) reported that, individuals in the 4th and 5th decades of life are most frequently affected, although adrenal cortical carcinoma can occur at any age. Weiss *et al.* (1989) showed that, most large clinical series indicate a predilection for female patients, with a ratio of 1.5 to 1 (over 900 patients studied). However, there was a predilection for male patients including one that reviewed all non-hormonal tumors (Lack *et al.,* 1999). The average size of tumors recorded in several documented studies was 12.0cm (Card *et al.,* 1992), 12.4cm (Henley *et al.,* 1983), 14.0 cm (*Weiss et al.,* 1989) and 16.6 cm (Cohn *et al.,* 1986), but the range wide was from 3 to 40 cm (Lewinsky *et al.,* 1974). Scheingar *et al*., (2005) reported that ACC, were highly malignant tumors that accounts only 0.2% of death due to cancer, and were usually resistant to chemotheraby.

Carcinomas were characterized by mitotic figures in the most active area. All cases were lack of significant nest growth pattern components. Nine cases were solid or trabecullar growth was more common and a considerable proportion of cells showed eosinophillic cytoplasm. Tumor necrosis was found in 10 cases. In the present study, the intracytoplasmic hyaline globules were detected in eight cases of adrenal cortical carcinomas. Most of the cases of adrenal cortical carcinomas were deficient in reticular fibers.

It can be concluded that, carcinomas were usually larger than adenomas. The average size of adrenal cortical adenoma and adrenal cortical carcinoma are about 3.8cm and 12.8cm, respectively. The patients with adenomas were older in the average than those with carcinoma (average 46.8 years versus average 42 years). No patients with adenoma had recurrence of tumor after excision, whereas 8 carcinomas patients were dead of tumor. These data are in accordance with Evans *et al.* (1996) who reported in their study of 56 cases of adrenal tumors that, carcinomas were usually larger than adenomas and the patients of adenomas were older in the average than those with carcinoma. In addition, these results are in agreement with Wieneke *et al.* (2003) who revealed that, all patients with tumor classified

adenomas were alive, without evidence of disease, whereas 21 patients of carcinomas had died with diseases.

Concerning the immunohistochemical results, 21 of 28 cases of adrenal cortical adenoma (ACA) showed cytokeratin positive cells while all 12 cases of adrenal carcinoma (ACC) showed immunoreactivity for cytokeratin. Lack *et al.* (1999) reported that, at present there is no pathogenomonic immunohistochemical profile for adrenal cortical carcinoma, but even negative results can sometimes aid in a difficult differential diagnosis. Cote *et al.* (1990) reported positive results in cortical cells and adrenal cortical adenoma, but none of the adrenal cortical carcinoma cells expressed cytokeratin. Our findings are in agreement with those observed by Nakano (1988) who reported that, 24 of 62 adrenal cortical carcinomas were cytokeratin positive, while all of the 42 adrenal cortical adenomas were negative. In a study reported by Haak *et al.* (1995), nine of 18 adrenal cortical carcinomas were positive for cytokeratin and in most cases, less than 25% of cells were relatively immunoreactive. None of the adrenal cortical adenomas was immunoreactive for cytokeratin. Our results are in accordance with Hoang *et al.* (2002) who reported that, all tumors studied (four adrenal cortical carcinomas) were immunoreactive for cytokeratin.

In the present study, 20 of 28 cases of adrenal cortical adenoma showed scattered vimentin-positive cells considering the fact that, the adrenal cortex is of mesodermal origin. Vimentin positive tumor cells were detected in 8 out of 12 cases of adrenal cortical carcinoma. This finding may suggest differentiation of the tumor to fetal tissue. Vimentin has been reported to be positive in tumor cells of adrenal cortical carcinoma. Nevertheless, the frequency reported in the literature varies considerably; 65% of the adrenal cortical carcinoma (Gaffey *et al.,* 1992), 73% of adrenal carcinoma versus only 14% of adrenal adenomas (Nakano, 1988) and 100% of adrenal cortical carcinomas (Diman *et al.,* 1992) were positively immunoreactive for vimentin. Meanwhile, Song *et al.,* (2004) observed also that, all the studied adrenocortical carcinomas were immunoreactive for vimentin. Generally, despite the variable results reported in the literature, a tumor that has the typical morphology of adrenal cortical carcinomas would statistically be expected to be vimentin positive and cytokeratin negative. Raikhlin *et al.,* (2002) revealed in their study that, adrenocortical tumors were associated with positive reaction to vimentin and a negative one to cytokeratin. These characteristics were used to differentiate adrenocortical tumors from adenomas that were reactive for cytokeratin and hardly to vimentin. On the contrary, our results revealed that adrenal cortical tumors were positive immunoreactive for cytokeratin and vimentin in most studied cases.

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