Histomorphological Spectrum of Nephrectomy Specimens with Special Reference to Renal Cell Carcinoma: A ten year Institutional Study from Central India

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Abstract

Background: Nephrectomy is done in various non-neoplastic lesions such as chronic pyelonephritis (CPN) and in neoplastic lesions such as renal cell carcinoma (RCC) and Wilm's tumor. Renal cell carcinoma has many prognostic factors like tumor size, venous invasion, perinephric fat invasion, adrenal involvement, tumor grade, RCC subtype, tumor necrosis, and lymph node and distant metastasis which can easily be assessed by detailed morphologic examination of nephrectomy specimens.

Objectives: To study the demographic and clinico-histopathological features of nephrectomy specimens.

Materials and methods: This was a cross-sectional observational study done for a period of ten years. It included all nephrectomy specimens except autolyzed specimens and renal biopsy. The clinical and demographic data with detailed gross and microscopic features of all specimens were noted and analyzed.

Results: Out of a total of 100 nephrectomy specimens 45 % were non-neoplastic and 55% were neoplastic. Left nephrectomy specimens were 74 %. Male to female ratio was 1.2:1. Age range was 11 months to 80 yrs. RCC was the most common neoplastic lesion with the clear cell variant as the commonest subtype. The mean size of RCC was 14.3 cm. The capsular invasion, vascular invasion, and extension to perinephric fat were observed in 10/55 (18%), 8/55 (14.5%), and 6/55 cases (10.9%) respectively.

Conclusion: Nephrectomy is indicated in a wide variety of lesions. A detailed morphological examination is necessary for each specimen for accurate diagnosis, staging, and grading of tumor which helps in the proper management of patient.

Keywords: Nephrectomy; Chronic pyelonephritis; Renal cell carcinoma.

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Introduction

Kidney similar to the other organ, also involved by various pathological conditions, some of which may require surgical removal. Nephrectomy can be either simple, partial, radical or extended radical depending upon the indication and other patient parameters. The indications for nephrectomy depend on the type of disease, extent of renal damage, status of the second kidney and the patient's general condition. Nephrectomy being a common procedure is indicated in almost all malignant tumors and few benign tumors **(Ghalayini, 2002).**

Simple nephrectomy is indicated in patient with non-neoplastic conditions such as irreversibly damaged non-functional kidney due to severe obstructive nephropathy, hydronephrosis, pyonephrosis, and chronic pyelonephritis. It may also be indicated in uncorrectable renovascular hypertension, congenital dysplasias and in severe traumatic injury. Partial nephrectomy is indicated in benign tumor such as angiomyolipoma or oncocytoma and in patient with localized pathology of kidney. Radical nephrectomy implies resection of Gerota fascia and its contents including the kidney and adrenal gland. It is most effective treatment of primary malignant renal tumors **(Thakur et al., 2019).**

A detailed histopathological examination is necessary for each nephrectomy specimen of tumors for accurate diagnosis of histological subtype, to know the extent of tumor involvement, and to study the various prognostic factors like capsular/vascular invasion and nuclear grading. The present study was conducted for evaluation of demographic and histomorphological features of nephrectomy specimens in a tertiary care center.

Materials and methods

This cross sectional study was conducted in the Department of Surgical Pathology in a tertiary care teaching hospital over a period of 10 years from July 2008 to June 2017. Ethical approval was taken from Institutional Ethical Committee.

All nephrectomy specimens were received in the histopathology laboratory during this period were included and autolysed and biopsy sample were excluded. Along with the demographic data (age, gender, laterality), size of the specimen, location , size and appearance of the lesion, secondary changes like areas of hemorrhage, necrosis and calcification were noted in all specimens.

Microscopic slides of all nephrectomy specimens were reviewed and numerous histological features such as diagnosis, inflammatory response, capsular and vascular invasion and perinephric fat invasion by tumor were recorded.

Statistical analysis

All collected data was entered into Microsoft Excel 2007. All the qualitative data were expressed as numbers and percentages. The student t test was applied to know the significance of the age, and chi square test was applied to know the significance of gender to compare the neoplastic and non-neoplastic lesions.

Results

A total of 100 nephrectomy specimens were received during the study period, out of which left nephrectomy specimens were 74 %. Male to female (M:F) ratio was 1.2:1. The youngest patient was 11 months old and the oldest was 80 years in the present study, with the highest number of nephrectomy specimens (26%) being from the 5th decade (**Table.1**). The neoplastic lesions constituted 55% in contrast to non-neoplastic lesion (45%) and clear cell renal cell carcinoma was commonest (72.2%) neoplastic lesion. The mean age for neoplastic lesions and non-neoplastic lesions was 48.13 years and 45.84 years respectively (p=0.51).

Table.1.Age and gender wise distribution of nephrectomy specimens

Age (Years)	Non- Neoplastic		Neoplastic		Total
	Male	Female	Male	Female	
0-10	00	00	03	00	03
11-20	01	00	02	00	03
21-30	02	06	02	01	11
31-40	03	07	03	02	15
41-50	04	07	10	05	26
51-60	04	08	08	02	22
>60	01	02	12	05	20
Total	15	30	40	15	100

Neoplastic lesions were more common in males (40/55 cases, 72.72%) in contrast to non- neoplastic which were more common in females (30/45 cases, 66.6%). This gender variation was statistically significant ($p<0.05$) among neoplastic and non-neoplastic lesions. Loin pain was the commonest manifestation in both types of nephrectomy specimens. The second common clinical presentation was fever with dysuria and abdominal mass for non-neoplastic lesion and neoplastic lesion respectively. Histomorphological frequency of each lesion is represented in (**Table.2**).

Table.2. Frequency of various renal lesions in nephrectomy specimens

S.NO	Histopathological diagnosis	No. of cases	% of cases	Overal l %
A.	**NON- NEOPLASTIC (M:F=1:2)**	**45**	**100**	**45**
1	Chronic non specific pyelonephritis	39	86.6	39
2	Xanthogranulomatous pyelonephritis	4	8.8	4
3	Renal abscess	1	2.2	1
4	Tuberculous nephritis	1	2.2	1
B.	**NEOPLASTIC (M:F=2.6:1)**	**55**	**100**	**55**
1	Clear cell RCC	40	72.7	40
2	Papillary RCC	6	10.9	6
3	Chromophobe RCC	3	5.4	3
4	Wilms'Tumour	2	3.6	2
5	Mesoblastic nephroma	3	5.4	3
6	Angiomyolipoma	1	1.8	1

Neoplastic lesions: In neoplastic lesions highest number of cases (15 cases, 27.27%) were observed in the 41-50 years age group. One case of Wilm's tumor and two cases of mesoblastic nephroma were seen in less than one year old boys. There was none neoplastic case in females in first and second decade. An interesting case of angiomyolipoma was observed, which has a similar variegated gross

appearance with RCC because of the admixture of yellow and hemorrhagic areas

RCC: The age range for RCC was 29 - 80 years with male predominance. Among 49 cases of RCC, left sided kidney (28/49 cases, 57.1%) was more commonly involved. Tumor was located most commonly in the entire kidney in 22/49 cases (44.9 %) followed by involvement of upper pole and lower pole in 18/49 cases (36.7%) and 9/49 cases (18.3%) respectively. The mean size of RCC was 14.3 cm with range of 4 cm to 19 cm.

Grossly, the classic clear cell RCC cases have golden yellow color due to abundant intracytoplasmic lipid. Higher grade tumors contain less lipid and glycogen and show a more variegated appearance including areas of hemorrhage and necrosis (**Fig.1**).

Fig.1.Cut surface shows variegated appearance with marked haemorrhage & necrosis. The growth involving almost whole of the kidney

In microscopic examination most of the tumor showed solid acinar structures or nests of tumor cells, separated by delicate fibrovascular septa (**Fig.2**). Mitotic rate was variable. The nuclei was central and nearly spherical, ranging from small hyperchromatic ones lacking visible nucleoli, to large and pleomorphic ones with macronucleoli. Capsular invasion, vascular invasion and extension to perinephric fat was observed in 10/55 cases (18.2%), 8/55 cases (14.5%) and 6/55 cases (10.9%) respectively. Extensive involvement of capsule, vessels & perinephric fat was seen in 3/55 cases (5.45%). Lymph node metastasis was not seen in any case of RCC.

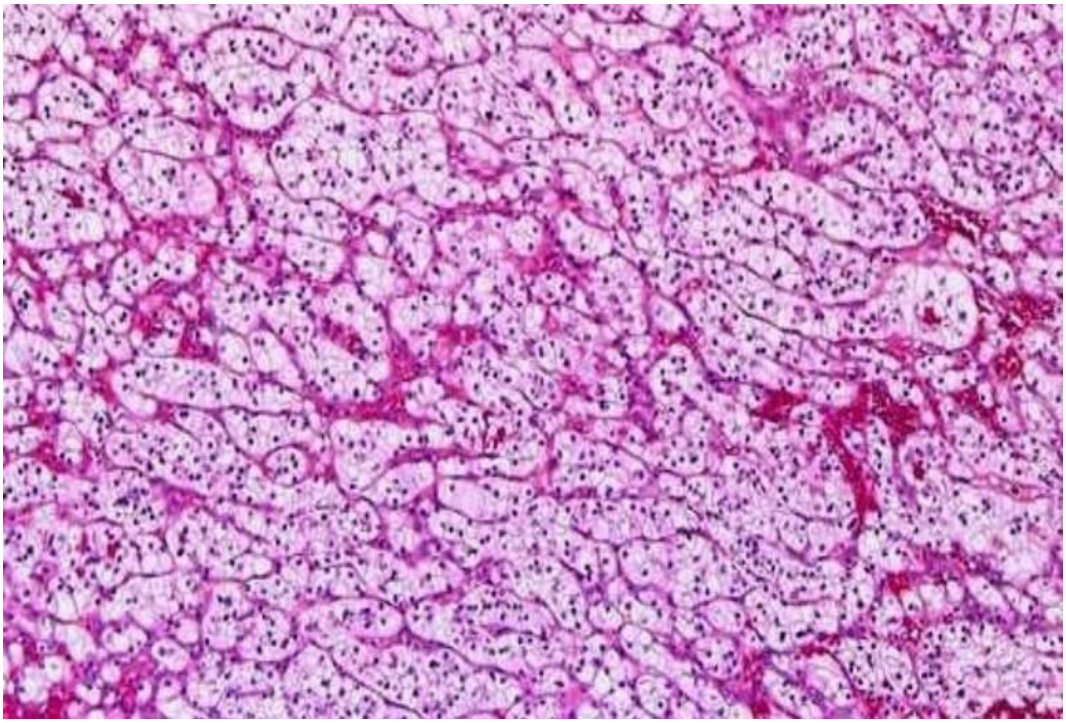

Fig.2. Clear cell RCC –shows cells in nests separated by fibrovascular septa. Cells having clear cytoplasm with round to oval nucleus. (H&E, 100X)

Among 40 cases of clear cell RCC, the majority were of Fuhrman's nuclear grade 2 (20/40 cases, 50%) followed by grade 3 and grade 1 with frequency of 11/40 cases (27.5 %) and 6/40 cases (15%). The least cases were observed in grade 4 (3/40 cases,7.5%).

Papillary RCC cases were grossly, well circumscribed and surrounded by a fibrous pseudocapsule. Cut surface had variegated appearance with areas of hemorrhage and necrosis. Microscopically tumor cells were arranged in papillae lined by neoplastic epithelial cells and containing a central fibrovascular core. The cells showed abundant eosinophilic cytoplasm (**Fig.3**).

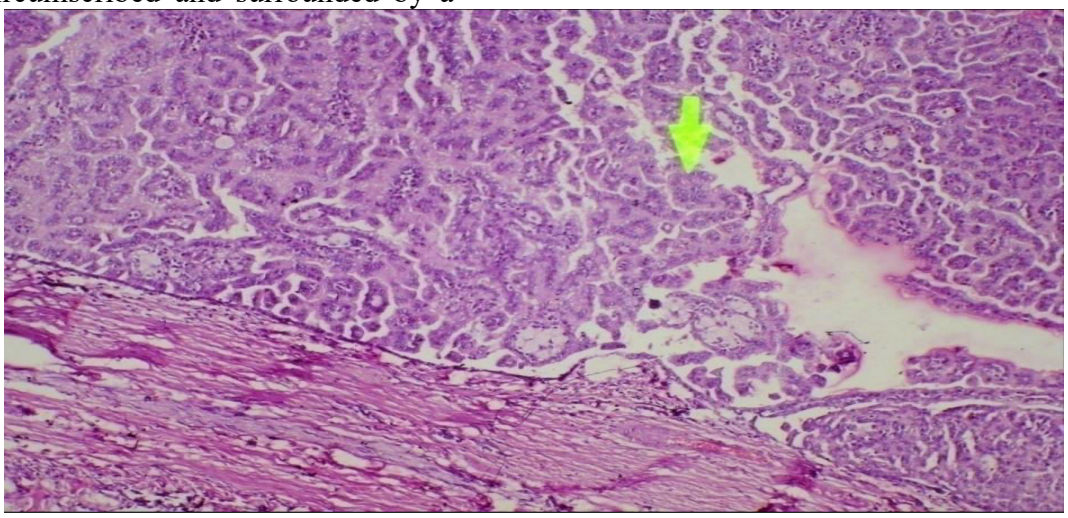

Fig.3. Papillary RCC – tumor cells arranged in papillae with fibrovascular core. (H&E, 400X)

All three cases of chromophobe RCC were presented with typical clinical triad of loin pain, hematuria and abdominal mass. Grossly they were non capsulated but well circumscribed, with a homogeneous brown to tan cut surface without areas of hemorrhage and necrosis. Microscopically, tumor cells were arranged in the alveolar pattern, having well defined cell borders, abundant cytoplasm and a clear perinuclear zone (**Fig.4**). None of the case of chromophobe RCC invaded into capsule, vessels or perinephric fat in the present study.

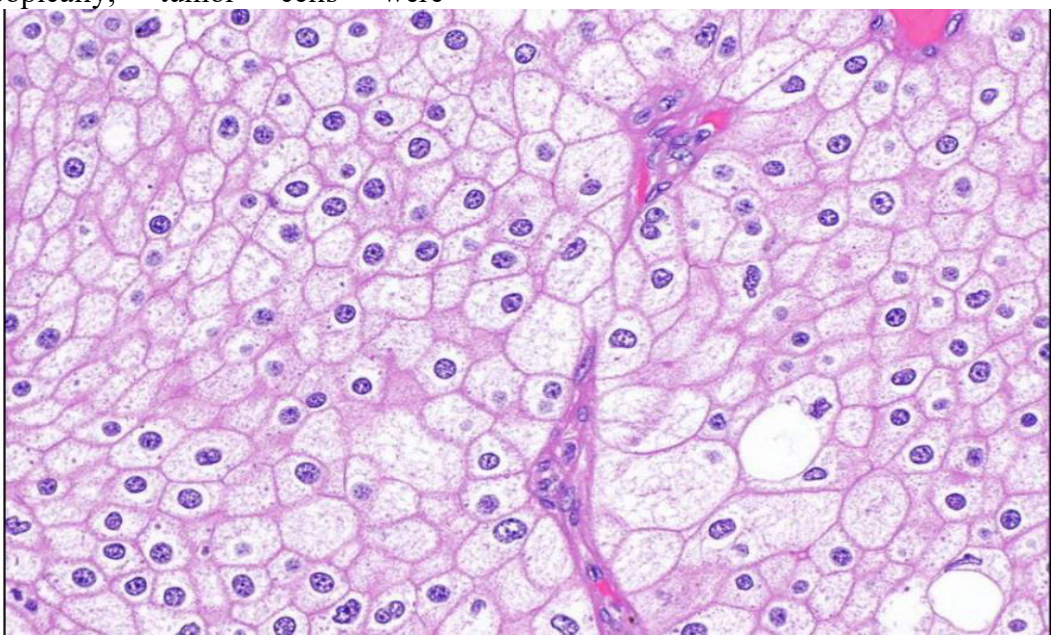

Fig. 4. Chromophobe RCC- alveolar arrangement of the tumor cells with sharply defined borders , abundant cytoplasm and a clear perinuclear zone (H&E,400X)

Discussion

The present study of 100 nephrectomy cases showed 74% of cases with left laterality. Similar to the our study, **Datta et al. (2012)** and **Shaila et al. (2015)** reported left laterality in 69.3% and 58.49% of cases respectively in their studies. However, **Ngairangbam et al. (2016)** found right laterality in 57.14% nephrectomy cases. There was slight male preponderance in nephrectomy cases with M:F ratio of 1.2:1 which was found closer to study done by T**hakur et al. (2019)** and **Vinay and Sujatha (2018)**. However, **Meena et al. (2017)** and **Suryawanshi et al. (2017)** in their study showed more male predominance with M:F ratio of 3:1 and 2:1. This variation may be due to difference in sample size and geographic distribution.

In the present study, the frequency of non-neoplastic and neoplastic lesions were 45% and 55% respectively. These findings were comparable with studies by **Narang et al. (2016)** and **Gupta et al. (2020).** While some studies (**Vinay and Sujatha 2018; Suryawanshi et al.,2017; Gupta et al.,2020)** showed much higher frequency of non-neoplastic lesions in their studies. The higher frequency of neoplastic lesions in present study may be due to better availability of oncosurgical facilities in our institute and also due to geographical variation. The present study showed male preponderance in neoplastic and female preponderance in

non- neoplastic lesions. **Narang et al. (2016)** and **Kruthi et al. (2022)** also found male dominance in neoplastic and female dominance in non-neoplastic lesions.

The frequency of RCC among neoplastic lesion was 49/55 cases (89%) in the present study. This observation was similar with other studies **(Narang et al. 2016; Suryawanshi et al. 2017; Shah et al. 2019)**. In present study the peak age range for occurrence of RCC was 41-60 years (25/49 cases, 51%). The finding was in consensus with **Suryawanshi et al. (2017)** and **Gupta et al. (2020).** The left kidney was more commonly involved by RCC in the present study (28/49 cases, 57.1%). Parallel results were obtained by **Thakur et al. (2019)** and **Datta et al. (2012),** who reported RCC in the left kidney at a frequency of 70% and 72.7%, respectively. **Narang et al. (2016)** and **Amin et al. (2015)** showed higher right-side kidney involvement by RCC in their study.

Grossly size of RCC was ranged from 4-19 cm similar to **Narang et al. (2016).** In the present study whole kidney (44.8%) was more frequently involved by RCC than upper pole (18/49 cases, 36.7%) and lower polar (9/49 cases,18.3%) which is in contrast with findings by **Suryawanshi et al. (2017)** who observed more upper pole involvement by RCC in 44.4% cases (4/9 cases) than lower pole and whole kidney.

In the present study 72.7% of RCC was clear cell type. The results were in concordance with most of the studies **(Narang et al., 2016; Shah and Goyal. 2019, Gupta et al., 2020).** The other histomorphological features of RCC were similar to the other studies (**Shah and Goyal. 2019; Gupta et al., 2020).** The present study showed that Fuhrman's nuclear Grade 2 was the most common nuclear grade present in 50% of cases and in concordance with studies of **Latif et al. (2011), Shah and Goyal (2019), and Gupta et al. (2020)** who reported that Fuhrman's nuclear grade 2 in frequency of 45.5%, 62.5% and 63.3% respectively.

Conclusion

A wide histopathological spectrum of lesions comprising both neoplastic and non-neoplastic lesions was encountered in nephrectomy specimens. Highest number of nephrectomy specimens received were of left side (74%). In males, neoplastic cases were more common and in females non neoplastic cases were more common. It is concluded from this study that chronic pyelonephritis was the most frequent lesion encountered among non-neoplastic cases and renal cell carcinoma clear cell type was the most common among the neoplastic cases. Most of the neoplastic lesions were seen in 6th decade of life.

The present study provides a fair insight on the morphological spectrum of nephrectomy specimens, especially of RCC. Thus proper and detailed examination of gross and microscopic features of RCC is mandatory for proper management.

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