**Original Research Article**

**RENAL LESIONS: DIFFERENTIATION OF MALIGNANT AND BENIGN TUMORS, SEX AND AGE DISTRIBUTION AND VARIABLES ASSOCIATED WITH RENAL CELL CARCINOMA**

ABSTRACT

Background:   In Yemen there are only some special epidemiological studies dedicated to malignancy, and for this motivation it is necessary to strengthen, update, construct and continue to afford studies on tumor comportments with the plan of achieving better influence on public health, with early diagnosis and suitable treatment with the plan of enhance survival of living and reducing the possible subsequent consequences of malignancy. Aims:. This study aimed to describe the different types of kidney cancer, the age and sex distribution of the cancer, and to identify the different types of them and their association with gradation and invasion; and its association with age groups and gender. Materials and methods: An observational descriptive study was performed on renal masses patients who were subsequently diagnosed selectively by histopathological study in the Department of Pathology at the National Center for Public Health Laboratories (NCPHL) and the Department of Pathology in Al-Thorah university hospital, Sana'a, Yemen, over a period of 18 years from January 1, 2004 to December 31, 2021. The study variables were lesions histological types, benign, malignancy, non-neoplastic lesions**,** sex, grades and age. Results: Malignant tumors accounted for 177/282 (62.8%) of the total kidney lesions, renal cell carcinoma (RCC) was the most common type of cancer with 126/282 (44.7%), followed by Wilms tumors 47/282 (16.7%), while non-Hodgkin’s lymphoma reported 3 cases (1.1%) and mucinous carcinoma one case (0.35%). Benign tumors accounted for 14/282 (5%) , and non-neoplastic lesions accounted for 91/282 (32.3%). Concerning RCC , the average diameter of RCC is 8.9 cm. GI 40/126 (31.7%) with mean tumor diameter equal to 5.8 cm, GII was the most frequent grade 63/126 (50%) . Female cases were 71/126 (56.3%) more than male cases 55/126 (44%). The mean age of RCC patients was 49.9 years with SD equal to 13.5 years and ages ranged from 12 years to 85 years. There was a highly significant association of RCC with the ≥46-year-old group (73.8% with OR = 7.2, CI = 4.2–12.5, p < 0.001) and with the 31-45 year (43% with OR = 2.7, CI = 1.5–4.7, p < 0.001). Conclusion: Renal cell carcinoma in Yemeni adults presents at an early age with an increased incidence among the female sex with a relatively larger tumor size. It appears that there has been a slight improvement in the diagnosis of kidney cancer in Yemen over the past 18 years.

Keywords: benign tumors, grades, malignant renal tumors, Non-neoplastic lesions, renal cell carcinoma (RCC) renal masses, Wilms’ tumor (WT),

INTRODUCTION

In Yemen there are only some special epidemiological studies dedicated to malignancy1-7, and for this motivation it is necessary to strengthen, update, construct and continue to afford studies on tumor comportments with the plan of achieving better influence on public health, with early diagnosis and suitable treatment with the plan of enhance survival of living and reducing the possible subsequent consequences of malignancy. The renal mass is defined as an abnormal growth in the kidneys, and it has been found that the majority of renal masses are benign. However, a large number of them require further diagnosis and therapeutic interventions. It is known that retroperitoneal dissection, signs or symptoms, or physical examination are insufficient to detect renal masses. At present, imaging methods such as magnetic resonance imaging, computed tomography, or ultrasound are used to diagnose these masses, and classified them into solid or cystic8-10.

Kidney masses have generally increased in the last two decades due to enhanced sensitivity and common use of advanced imaging methods. This is why this renal mass is more commonly diagnosed in healthy individuals today than it was 30 years ago. Alternatively, the ratio of recent malignant renal mass cases continued stable from 2008 to 2016, with the five-year survival rate steadily improving due to advances in detection and early intervention10. Kidney cancer begins in the kidneys with symptoms including blood in the urine, back pain and abdominal flatulence. Fever, weight loss, and fatigue are also common. A complication of these tumors is its spread to the lungs or the brain10-12. The most important types of kidney cancer are renal cell carcinoma (RCC), and Wilms carcinoma. Renal cell carcinoma accounts for approximately 80% of renal carcinomas11. Smoking, being overweight, high blood pressure, certain pain medications as [non-steroidal anti-inflammatory drugs](https://en.wikipedia.org/wiki/Non-steroidal_anti-inflammatory_drugs) (NSAIDS), previous bladder cancer, certain chemicals, and family history are potential risk factors for RCC 11-13. Genetic factors have little effect on an individual's susceptibility to infection with immediate relatives of people with RCC having a 2 to 4 folds increased risk of developing RCC14. Other genetically related conditions increase the risk of renal cell carcinoma, including [hyperparathyroidism-jaw tumor syndrome](https://en.wikipedia.org/w/index.php?title=Hyperparathyroidism-jaw_tumor_syndrome&action=edit&redlink=1), hereditary papillary renal carcinoma, hereditary [leiomyomatosis](https://en.wikipedia.org/wiki/Leiomyomatosis), Birt-Hogg-Dube syndrome, von Hippel-Lindau disease, familial papillary thyroid carcinoma, and [sickle cell disease](https://en.wikipedia.org/wiki/Sickle_cell_disease) 15.

Wilms' tumor, and identified as nephroblastoma, is a kidney cancer that usually occurs in children, and seldom in adults. Wilms' tumor has numerous causes, which can be generally classify as syndromic and non-syndromic. Syndromic causes of Wilms' tumor are caused by changes in genes such as the Wilms tumor 1 (WT1) or Wilms tumor 2 (WT2) genes, and the tumor appears with a range of other signs and symptoms. Non-syndromic Wilms' tumor is not connected with additional symptoms or pathologies. Numerous cases of Wilms' tumor develop from the nephrogenic rests. The nephrogenic rests are fragments of tissue in or around the kidney which they developed before birth and turn into cancerous masses after birth. Cases of bilateral Wilms tumor, as well as cases of Wilms tumor derived from certain genetic syndromes such as Dennis-Drash syndrome, generally are strictly associated with nephrogenic rests. In cases of [metastasis](https://en.wikipedia.org/wiki/Metastasis), it is usually spread to the lung. Rupture of a Wilms’ tumor places the patient at risk of bleeding and peritoneal spread of the tumor cells. In such cases, surgical intervention by an experienced surgeon in removing such a fragile tumor is necessary16.

Yemen lacks a unified National Cancer Registration Center (NCRC) to date. Thus there is a lack of cancer information and reliable data. For this reason, this study aimed to describe the different types of kidney cancer, the age and sex distribution of the cancer, and to identify the different types of them and their association with gradation and invasion; and its association with age groups and gender, during the past eighteen years, based on data from two main pathology examination centers in Sana'a city, Yemen.

**PATIENTS AND METHOD**

**Study designed**: Retrospective descriptive study.

**Study site**: The Departments of Pathology at the National Center for Public Health Laboratories (NCPHL) and the unit of cancer in Al-Thorah University hospital in Sana'a city which serve the major government hospitals and private hospitals in the city of Sana'a and act as a reference laboratories for the entire country.

**Study population**: Study was conducted on renal lesion patients (Patients are usually referred from hospitals for histological diagnosis) who were subsequently diagnosed selectively by histopathological study in the Department of Pathology at the National Center for Public Health Laboratories (NCPHL) and the unit of cancer in Al-Thorah University hospital Sana'a, Yemen, over a period of about 18 years from January 1, 2004 to December 31, 2021.

**Study variables and cancer classification**: Study variables were the histological type of cancer, sex, grades, and age. Types, grades, and histological diagnoses were formed in line with the World Health Organization17 and “Kidney Cancer, Version 2.2017, NCCN Clinical Practice Guidelines in Oncology” 18.

**Inclusion criteria**: Inclusion criteria for patients included the following: Complete renal histopathological findings. Patients of any age and gender. Availability of clinical data, and histological slides that confirm the diagnosis of kidney lesions and cancers.

**Exclusion criteria:** Exclusion criteria included patients with no histopathological slides and insufficient clinical data in our record.

STATISTICAL ANALYSIS

Data were reported using appropriate descriptive statistics (including frequency, mean, standard deviation, *OR*, *CI*, *X*2 and *P*-value). First data were entered using the SPSS software to minimize errors. All statistical analyzes of the data were performed using the Statistical Package for Social Sciences (SPSS) version 24 and Excel 2007.

ETHICAL APPROVAL

From the Medical Research and Ethics Committee at the Faculty of Medicine and Health Sciences at Sana'a University with a reference number (811) dated 10-01-2022, the ethical approval was obtained. Also, all data, including patient identification, have been kept confidential.

**RESULTS**

Table 1 shows the sex and age distribution of patients with kidney lesions in Sana'a, Yemen. The distribution of female cases increased by 56% than that of males (44%). The mean age of the study group was 36.4 years with SD equal to 21.3 years and ages ranged from 9 months to 85 years. Most of the lesions were in the age group ≥ 46 years (36.5%) followed by 31-45 years (24.1%), 1-15 years (20.6%) and 16-30 years (18.1%), while in less than 1 year there were only two cases. Table 2 shows the distribution of different renal lesions diagnosed between 2004-2021 in two centers in Sana'a, Yemen. Malignant tumors accounted for 177/282 (62.8%) of the total kidney lesions, renal cell carcinoma (RCC) was the most common type of cancer with 126/282 (44.7%), followed by Wilms tumors 47/282 (16.7%), while non-Hodgkin’s lymphoma reported 3 cases (1.1%) and mucinous carcinoma one case (0.35%). Benign tumors accounted for 14/282 (5%) which included angiomyolipoma (2.1%), ganglioneuroblastoma (0.35%), mesoblastic nephroma (0.7%), neurofibroma (0.35%) and oncocytoma (1.4%) . Non-neoplastic lesions accounted for 91/282 (32.3%), and they included chronic pyelonephritis (27.3%), cystic kidney disease (0.35%), end-stage renal failure (1.8%), tubulo-intestinal-nephritis (0.7%), Polycystic kidney disease (0.7%), simple benign cyst (1.1%), and renal atrophy (0.35%).

Table 3 shows distribution of different malignant tumors among 282 patients in Sana'a, Yemen. Malignant tumors accounted for 177/282 (62.8%) of the total kidney lesions, renal cell carcinoma (RCC) was the most common type of cancer with 126/177 (71.2%), followed by Wilms tumors 47/177 (26.6%), while non-Hodgkin’s lymphoma reported 3 cases (5.3%) and mucinous carcinoma one case (0.6%) (Table 3). Table 4 shows the side of the kidney with renal lesions among 282 patients in Sana'a, Yemen. Right kidney lesions were 140/282 (49.6%) and left kidney lesions were 142/282 (50.4%), and no cases of lesions on both sides. Table 5 shows the distribution of renal cell carcinoma according to the grade, among 126 renal cell carcinoma patients. The average diameter of RCC is 8.9 cm. GI was 40/126 (31.7%) with mean tumor diameter equal to 5.8 cm, GII was the most frequent grade 63/126 (50%) with mean tumor diameter equal to 10 cm, GIII was 19/126 (15.1 %) and had a mean tumor diameter of 11 cm, while the GIV was only 4/126 (3.2%) with a mean tumor diameter of 12.4 cm. Table 6 shows the sex and age distribution of the 126 renal cell carcinoma patients. Female cases were 71/126 (56.3%) more than male cases 55/126 (44%). The mean age of RCC patients was 49.9 years with SD equal to 13.5 years and ages ranged from 12 years to 85 years. Most of the renal cell carcinoma patients were in the age group **≥** 46 years (60.3%), followed by 31-45 years (34.1%), 16-30 years old had 6 cases (4.8%), while 1-15 years only had 1 case (0.8%). Table 7 shows the relationship between renal cell carcinoma, sex and ages among 282 patients with renal lesions in Sana'a city, Yemen. There was no significant association between RCC and gender as equal rates were found in both sexes. Considering the age groups, there was a highly significant association of RCC with the ≥46-year-old group as the rate was 73.8% with OR = 7.2, CI = 4.2–12.5, p < 0.001. There was a highly significant association of RCC also with the 31-45-year group where the rate was 43% with OR = 2.7, CI = 1.5–4.7, p < 0.001. There was no significant association between renal cell carcinomas with other age groups. Also, there was no significant correlation between renal cell carcinoma and the renal side, where approximately equal rates were found for both sides.

DISCUSSION

A renal mass is an unusual growth in the kidney. The preponderance of renal masses are benign. In spite of this, a large number of them need more intervention. Retroperitoneal dissection, signs, symptoms, or physical inspection are inadequate to detect renal masses. Imaging modalities such as computed tomography, magnetic resonance imaging, or ultrasound are used to diagnose these masses, and histopathology usually confirms the diagnosis8. In the current study, the distribution of female cases increased by 56% than that of males (44%). This result is different from that reported elsewhere in which males are more infected with renal masses 8. Also, most of the lesions in the current study were in the age group **≥** 46 years (36.5%) followed by 31-45 years (24.1%), 1-15 years (20.6%) and 16-30 years (18.1%), while in less than 1 year there were only two cases. These findings are similar to those reported elsewhere in the world where advanced age is a validating factor for benign tumors, malignancies, and/or non-neoplastic lesions 8,10, 19, 20. Also, most regions of the world have seen increases in age-standardized incidence rates (rate of increase with age), with South Asia, tropical Latin America, and high-income Asia Pacific region reporting the largest increases. In contrast, the Caribbean and southern Latin America showed lower standard incidence rates for older adults19.

In this study, malignancies accounted for 177/282 (62.8%) of the total kidney lesions (Table 2). This result differs from that reported in developed countries where benign masses are predominant8,19. I think that the decline in the benign masses in our study is due to the small size of the benign masses that lead to be unrecognized by the doctors in Sana'a. Active surveillance is suggested in various situations, in particular in tiny masses with benign characteristics. Once the tumor is less than 1 cm by a regular growth rate, more imaging and biopsy are not helpful because of the minimal risk of malignant transformation. These patients should be to have active surveillance as an alternative. Monitoring should also be offered to patients who are not candidates for surgery. A suitable candidate for active surveillance is elderly patient with a short life expectancy with a tumor size of less than 4 cm. Even though there are no standardized guidelines for the rate of active monitoring, the consensus is that renal ultrasound, CT scan, or MRI may be used to monitor renal mass every 3 to 6 months for the first year. They can be diverged depending on the kidney pathology and its progression21,22.

In the current study, malignancies accounted for 177/282 (62.8%) of the total kidney lesions with renal cell carcinoma (RCC) being the most common carcinoma with 126/282 (44.7%) (Table 2). There are a number of potential reasons for the high burden of kidney cancer. First, the prevalence of risk factors, such as smoking, high body mass index, low physical activity and high blood pressure, may be as high in Yemen as it is in developed countries and some developing regions23. Second, increases in the incidence of kidney cancer can also be partly due to improvements in early detection of cancer using imaging procedures, such as ultrasound, CT, and MRI. Also, increases in the incidence of kidney cancer may be due to exposure to occupational and environmental risk factors, such as arsenic, radon, trichlorethylene, cadmium, and nitrates. Although we know that exposure to these risk factors has decreased in the developed world, there is no evidence to suggest that this same pattern of pollution will be repeated in the developing world as Yemen19, 23, 24. Renal cell carcinoma (RCC) is cancer of kidney that initiates in the lining of the proximal convoluted tubule, the part of the very small tubes in the kidneys that transport primary urine. RCC was the most common type of carcinoma with 126/177 (71.2%) (Table 3) of the malignancies in the current study. This result is slightly lower than the prevalence of this type in other countries where RCC is the most common type of kidney cancer in adults, where it is responsible for about 90-95% of the cases25. Female cases were 71/126 (56.3%) more than male cases 55/126 (44%) with sex ratio M:F = 1.0:1.3 in the current study. This result is different from that reported by Luciani *et al.*26 where the male to female ratio was 1.5:1 but similar to that reported by Talek and Al-Faqih in Saudi Arabia on a group of 43 Saudi patients with renal cell carcinoma; where the ratio of M:F was 1.3:127. However, the result of our study differs from that reported by Al-Falahi *et al.*7 previously in Yemen where they observed a 1:1 ratio7. The current study indicates a higher rate of exposure of Yemeni females to risk factors than males. The mean age of RCC patients was 49.9 ±13.5 years and ages ranged from 12 years to 85 years and most of the renal cell carcinoma patients were in the 3rd and 5th decades and there was a highly significant association of RCC with the ≥46-year-old group as the rate was 73.8% with OR = 7.2, CI = 4.2–12.5, p < 0.001 and with the 31-45 year group where the rate was 43% with OR = 2.7, CI = 1.5–4.7, p < 0.001 (Table 6). Thus, the peak incidence of RCC occurs about two to three decades lower than the peak incidence of 50-70 years reported among Caucasians28, but is almost similar to that previously reported in Yemen where the mean age was 50.3 ± 13.3 (range 22–80), with a peak incidence in the fourth and fifth decades of life7. About 40% of our patients are under 40 years of age, and this finding is about eight times greater than that reported by Jae Hee Suh *et al.* in a cohort of 838 RCC cases29, only 5.2% of their patients had ≤4029. This indicates a higher incidence of renal cell carcinoma in younger adults (40 years old) in Yemen.

The renal cell carcinoma grading is the majority important factor in predict the prognosis, and the prognosis for a renal mass depends on the tumor identifying. Renal cell carcinoma causes about 15,000 deaths or 80% of all renal and pelvic cancers. As with most other types of cancer, survival improves with early diagnosis and treatment. According to the American Cancer Society, the survival rate for localized disease in grades 1 and 2 is over 90%, while the survival rate for distant metastasis, as in stage 4, is 13% for 5 years. In the third stage, the survival rate for patients who underwent nephrectomy reaches 70%. However, invasion into the renal vein indicates a poor prognosis30,31. Presentation by grade is compared with other series in (Table 5) 81.7% of our patients presented in GI and GII and 18.3% in GIII and GIV.

These results are consistent with other reports and indicate that there is no delay in the diagnosis and management of renal cell carcinoma patients in Yemen. The average size of the surgically removed tumor mass in this series was 8.9 cm (ranged 3–18 cm); for the GI was 5.8 cm, the GII was 10 cm, the GIII was 11 cm, and the GIV was 12.4 cm (Table 5). The tumor size ranged from 5 to 8 cm in most of the series, and the average size reported in the literature was 5.3 cm7,8,19,20, 32. This finding in Yemeni patients indicates that in our community RCC is relatively larger at presentation. This finding also reflects late presentation in most of our patients in contrast to early detection in developed societies8,19,21.

**CONCLUSION**

Renal cell carcinoma in Yemeni adults presents at an early age with an increased incidence among the female sex with a relatively larger tumor size. It appears that there has been a slight improvement in the diagnosis of kidney cancer in Yemen over the past 28 years. Our study has provided much needed information about the burden of kidney cancer in Yemen, to enable Yemen to better plan to address the burden and to allocate its limited resources more appropriately. Our results highlight the need for renewed efforts to improve early detection of this disease.

AUTHOR CONTRIBUTION

This study was completed by Amin Abdulkarem Okbah, Professor of Histopathology at Sana'a University, and

the National Center of Public Health Laboratories (NCPHL) Sana'a, Yemen; and Prof. Dr. Hassan Abdul-Wahab Al-Shamahy, Faculty of Medicine, Sana'a University. All authors analyzed the data, wrote the manuscript, and reviewed it.

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CONFLICT OF INTEREST

"No conflict of interest associated with this work”.

REFERENCES

1-Al-Samawi AS, Aulaqi SM. Urinary bladder cancer in Yemen. Oman Med J. 2013;28(5):337-340. doi:10.5001/omj.2013.97. doi: 10.5001/omj.2013.97.

2-Okbah AA, Al-Ankoshy AAM, Al-Shamahy HA. Bladder cancer: Bladder cancer: differentiation of types, age, sex distribution and associated variants with gradation. Universal Journal of Pharmaceutical Research 2021; 6(6):57-64. DOI: https://doi.org/10.22270/ujpr.v6i6.701

3-El-Zine MAY, Alhadi YA, Ishak AA, Al-Shamahy HA. Prevalence of Different Types of Leukemia and Associated Factors among Children with Leukemia in Children’s Cancer Units at Al-Kuwait Hospital, Sana’a City: A Cross- Sectional Study. Glob J of Ped & Neonatol Car. 3(4): 2021. GJPNC.MS.ID.000569. DOI: 10.33552/GJPNC.2021.03.000569.

4-Alhadi AM, El-Zine MAY, IshaK AA, Al-Shamahy HA. “Childhood Leukemia in Yemen: The Main Types of Childhood Leukemia, its Signs and Clinical Outcomes”. EC Paediatrics 2021; 10.6 (2021): 75-82.

5-Al-Maktari L AS, Al-Nuzaili MAK, Al-Shamahy HA, Al-Hadi AA, Ishak AA, et al., Distribution of Hematological Parameters Counts for Children with Leukemia in Children’s Cancer Units at Al-Kuwait Hospital, Sana’a City: A Cross-Sectional Study. Adv Can Res & Clinical Imag. 3(2): 2021. ACRCI.MS.ID.000560. DOI: 10.33552/ACRCI.2021.02.000560.

6-El-Zine M AY, Ali MAA, Al-Shamahy HA. “Prevalence of CNS tumors and histological recognition in the operated patients: 10 years experience in Yemen”. Universal Journal of Pharmaceutical Research 2021; 6, (2): 20-27. doi:https://doi.org/10.22270/ujpr.v6i2.563.

7-Alfalahi S, Baadani THA, Babakri M, *et al.* Renal cell carcinoma in Yemeni patients: a review of 67 cases. Urol Nephrol Open Access J. 2016;3(2):67-71. DOI: [10.15406/unoaj.2016.03.00075](https://doi.org/10.15406/unoaj.2016.03.00075)

8-Ballard BD, Guzman N. Renal Mass. [Updated 2022 Jan 5]. In: StatPearls [Internet]. Treasure Island (FL): Stat-Pearls Publishing; 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK567761/>

9-Snyder M.E., Bach A. Kattan M.W.*et al*. Incidence of benign lesions for clinically localized renal masses smaller than 7 cm in radiological diameter: influence of sex. J Urol. 2006; 176  2395-6): 2391-2395. doi: 10.1016/j.juro.2006.08.013.

10-Bray F., Ferlay J., Soerjomataram I., Siegel R.L., Torre L.A., Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J. Clin. 2018;68:394–424. doi: 10.3322/caac.21492.

11- National Cancer Institute ["Renal Cell Cancer Treatment"](https://www.cancer.gov/types/kidney/patient/kidney-treatment-pdq). Retrieved 11 April  2022.

12- National Cancer Institute ["Transitional Cell Cancer (Kidney/Ureter) Treatment"](https://www.cancer.gov/types/kidney/patient/transitional-cell-treatment-pdq). 2019. Retrieved 11 April  2022.

13- Cho, Eunyoung; Curhan, G; Hankinson, SE; et al. ["Prospective Evaluation of Analgesic Use and Risk of Renal Cell Cancer"](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3691864). Archives of Internal Medicine 2011; 171 (16): 1487–93.  [doi](https://en.wikipedia.org/wiki/Doi_(identifier)):[10.1001/archinternmed. 2011 .356](https://doi.org/10.1001%2Farchinternmed.2011.356).  [PMC](https://en.wikipedia.org/wiki/PMC_(identifier)) [3691864](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3691864). [PMID](https://en.wikipedia.org/wiki/PMID_(identifier)) [21911634](https://pubmed.ncbi.nlm.nih.gov/21911634).

14- Pavlovich, Christian P.; Schmidt, Laura S. "Searching for the hereditary causes of renal-cell carcinoma". Nature Reviews Cancer 2004; 4 (5): 381–93. [doi](https://en.wikipedia.org/wiki/Doi_(identifier)):[10.1038/nrc1364](https://doi.org/10.1038%2Fnrc1364).

15-Rini, Brian I; Campbell, Steven C; Escudier, Bernard. "Renal cell carcinoma". The Lancet 2009; 373 (9669): 1119–1132. [doi](https://en.wikipedia.org/wiki/Doi_(identifier)):[10.1016/S0140-6736(09)60229-4](https://doi.org/10.1016%2FS0140-6736%2809%2960229-4).

16-Erginel B, Vural S, Akın M, Karadağ CA, Sever N, Yıldız A. *et al*. Wilms' tumor: a 24-year retrospective study from a single center. Pediatr Hematol Oncol 2014; 31: 409–414. doi: 10.3109/08880018.2014.930767.

17-Lopez-Beltran, Antonio; Scarpelli, Marina; Montironi, Rodolfo; Kirkali, Ziya. "2004 WHO classification of the renal tumors of the adults". European Urology 2006; 49 (5): 798–805.  [doi](https://en.wikipedia.org/wiki/Doi_(identifier)):[10.1016/j.eururo.2005.11.035](https://doi.org/10.1016%2Fj.eururo.2005.11.035).

18- Motzer, Robert J.; Jonasch, Eric; Agarwal, Neeraj; *et al.*  ["Kidney Cancer, Version 2.2017, NCCN Clinical Practice Guidelines in Oncology"](https://jnccn.org/view/journals/jnccn/15/6/article-p804.xml). Journal of the National Comprehensive Cancer Network 2017; 15 (6): 804–834. [doi](https://en.wikipedia.org/wiki/Doi_(identifier)):[10.6004/jnccn.2017.0100](https://doi.org/10.6004%2Fjnccn.2017.0100).

19- Safiri Saeid , Kolahi AA, Mansournia MA *et al.* The burden of kidney cancer and its attributable risk factors in 195 countries and territories,1990–2017. Scientific Reports 2020;10:13862. https://doi.org/10.1038/s41598-020-70840-2

20- Chukwubuike KE. Nephroblastoma: Profile and Management Outcome in a Tertiary Hospital in a Developing Country. Int J Nephrol Ther. 2021;7(1): 004-009. doi: 10.37871/ijnt.id30

21-Gordetsky J, Eich ML, Garapati M, *et al.* Active Surveillance of Small Renal Masses. Urology. 2019 Jan;123:157-166. doi: 10.1016/j.urology.2018.09.017

22-Anderson CB, Clark PE, Morgan TM, *et al.* Urinary collecting system invasion is a predictor for overall and disease-specific survival in locally invasive renal cell carcinoma. Urology. 2011 Jul;78(1):99-104. doi: 10.1016/j.urology.2011.02.039

23- Wong MCS, Goggins WB, Yip BHK, *et al.* Incidence and mortality of kidney cancer: temporal patterns and global trends in 39 countries. *Sci Rep*. 2017;7(1):15698.doi:10.1038/s41598-017-15922-4

24- Scelo G, Larose TL. Epidemiology and Risk Factors for Kidney Cancer. *J Clin Oncol*. 2018;36(36): JCO2018791905. doi:10.1200/JCO.2018.79.1905

25-Curti, B; Jana, BRP; Javeed, M; Makhoul, I; Sachdeva, K; Hu, W; Perry, M; Talavera, F. Harris, JE (ed.). ["Renal Cell Carcinoma"](http://emedicine.medscape.com/article/281340-overview#showall). Medscape Reference. WebMD. [Archived](https://web.archive.org/web/20140307024450/http:/emedicine.medscape.com/article/281340-overview#showall) from the original on 7 March 2014. Retrieved 7 April 2022.

26-Luciani LG, Cestari R, Tallarigo C. Incidental Renal Cell Carcinoma- Age and Stage Characterization and Clinical Implications: Study of 1092 Patients (1982–1997). Urology 2000; 56(1): 58-62. doi: 10.1016/s0090-4295(00)00534-3.

27- Talic RF, El Faqih SR. Renal Tumors in Adult Saudi patients: A review of 43 cases. Ann Saudi Med 1996; 16(5): 517-520. doi: 10.5144/0256-4947.1996.517.

28-Amsellem-Ouazana D, Allory Y, Viellefond A. Survival and Prognostic Factors of Papillary Renal Cell Carcinoma (Rcc): Long Term Follow-up of 43 Patients. J Urol 2002; 167: 192. PMID: **11743277**

29- Suh JH, Oak T, Ro JY, Truong LD, Ayala AG, Shen SS. Clinicopathologic features of renal cell carcinoma in young adults: a comparison study with renal cell carcinoma in older patients. Int J Clin Exp Pathol. 2009;2(5):489-93. PMID: 19294008; PMCID: PMC2655150.

30- [Kidney Cancer / General Information](http://www.cornellurology.com/kidney/gi/rcc.shtml) [Archived](https://web.archive.org/web/20111101172045/http:/www.cornellurology.com/kidney/gi/rcc.shtml) 2011-11-01 at the [Wayback Machine](https://en.wikipedia.org/wiki/Wayback_Machine) at Weill Cornell Medical College, James Buchanan Brady Foundation, Department of Urology. Retrieved 11 April  2022.

31-Guinan PD, Vogelzang NJ, Fremgen AM. Renal cell carcinoma: tumor size, stage and survival. J Urol 1995; (153): 901-903. PMID: 7853570.

Table 1: Gender and age distribution of kidney lesion patients in Sana’a, Yemen

|  |  |  |
| --- | --- | --- |
| **Characters** | **Number** | **%** |
| **Gender** | | |
| Male | 124 | 44 |
| Female | 158 | 56 |
| **Age groups** | | |
| Less than 1 year | 2 | 0.7 |
| 1-15 years | 58 | 20.6 |
| 16-30 years | 51 | 18.1 |
| 31-45 years | 68 | 24.1 |
| ≥46 | 103 | 36.5 |
| **Total** | **282** | **100** |
| Mean age | 36.4 years |  |
| SD | 21.3 years |  |
| Min | 9 months |  |
| Max | 85 years |  |
| Mode | 50 years |  |
| Median | 40 years |  |

Table 2: Distribution of different renal lesions diagnosed between 2004-2021 in two oncology screening centers in Sana'a, Yemen

|  |  |  |
| --- | --- | --- |
| **Renal Lesions** | **Number** | **%** |
| **Malignant tumors** | **177** | **62.8** |
| * Renal cell carcinoma | 126 | 44.7 |
| * Wilms tumor | 47 | 16.7 |
| * Non-Hodgkin’s lymphoma | 3 | 1.1 |
| * Mucinous carcinoma | 1 | 0.35 |
|  | | |
| **Benign tumors** | **14** | **5** |
| * Angiomyolipoma | 6 | 2.1 |
| * Ganglioneuroblastoma | 1 | 0.35 |
| * Mesoblastic nephroma | 2 | 0.7 |
| * Neurofibroma | 1 | 0.35 |
| * Oncocytoma | 4 | 1.4 |
|  | | |
| **Non-neoplastic lesions** | **91** | **32.3** |
| * Chronic pyelonephritis | 77 | 27.3 |
| * Cystic renal disease | 1 | 0.35 |
| * End stage kidney | 5 | 1.8 |
| * Tubulo-intestinal-nephritis | 2 | 0.7 |
| * Polycystic kidney disease | 2 | 0.7 |
| * Simple benign cyst | 3 | 1.1 |
| * Renal atrophy | 1 | 0.35 |
|  | | |
| **Total** | **282** | **100** |

Table 3: Distribution of different malignant tumors in two oncology screening centers in Sana'a, Yemen

|  |  |  |
| --- | --- | --- |
| **Malignant tumors** | **Number** | **%** |
| **Total** | **177** | **100** |
| * Renal cell carcinoma | 126 | 71.2 |
| * Wilms tumor | 47 | 26.6 |
| * Non-Hodgkin’s lymphoma | 3 | 5.3 |
| * Mucinous carcinoma | 1 | 0.6 |

Table 4: Side of the kidney with renal lesions in 282 patients in Sana'a, Yemen

|  |  |  |
| --- | --- | --- |
| **Side** | **Number** | **%** |
| Right kidney | 140 | 49.6 |
| Left kidney | 142 | 50.4 |
| Total | 282 | 100 |

Table 5: Distribution of renal cell carcinoma according to the grade, among 126 renal cell carcinoma patients in Sana'a, Yemen

|  |  |  |  |
| --- | --- | --- | --- |
| **Staging** | **Number** | **%** | Mean Diameter of the Tumor (cm.) |
| GI | 40 | 31.7 | 5.8 |
| GII | 63 | 50 | 10 |
| GIII | 19 | 15.1 | 11 |
| GIV | 4 | 3.2 | 12.4 |
| Total | 126 | 100 | 8.9 |

Table 6: Sex and age distribution of 126 RCC patients in Sana’a, Yemen

|  |  |  |
| --- | --- | --- |
| **Characters** | **Number** | **%** |
| **Gender M:F ratio = 1.0: 1.3** | | |
| Male | 55 | 43.7 |
| Female | 71 | 56.3 |
| **Age groups** | | |
| 1-15 years | 1 | 0.8 |
| 16-30 years | 6 | 4.8 |
| 31-45 years | 43 | 34.1 |
| ≥46 | 76 | 60.3 |
| **Total** | **126** | **100** |
| Mean age | 49.9 years |  |
| SD | 13.5 years |  |
| Min | 12 years |  |
| Max | 85 years |  |
| Mode | 50 years |  |
| Median | 50 years |  |

### Table 7: Association between RCC sex and ages among 282 patients with renal lesions **in Sana’a city, Yemen**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Characters** | **RCC n=126** | ***OR*** | ***CI 95%*** | ***X2*** | ***p*** |
| **No (%)** |
| **Gender** |  |  |  |  |  |
| Male n=124 | 55 (44.4) | 0.92 | 0.57-1.4 | 0.11 | 0.73 |
| Female n=158 | 71 (44.9) | 1.02 | 0.77-1.3 | 0.009 | 0.92 |
| **Age groups** |  |  |  |  |  |
| Less than 1 year n=2 | 0 (0.0) | 0.0 | undefined | 1.6 | 0.2 |
| 1-15 years n=58 | 1 (1.7) | 0.02 | 0.004-0.2 | 57 | <0.001 |
| 16-30 years n=51 | 6 (11.8) | 0.12 | 0.05-0.3 | 27.2 | <0.001 |
| 31-45 years n=68 | 43(63.2) | 2.7 | 1.5-4.7 | 12.4 | <0.001 |
| ≥46 n=103 | 76 (73.8) | 7.2 | 4.2-12.5 | 55.6 | <0.001 |
| **Kidney side** |  |  |  |  |  |
| Right n=140 | 61 (43.6) | 0.91 | 0.57-1.4 | 0.13 | 0.7 |
| Left n=142 | 65 (45.8) | 1.1 | 0.7-1.8 | 0.22 | 0.63 |
| **Total n=282** | **126 (43.8)** |  |  |  |  |

*OR* = odd’s ratio, *CI* 95% = confidence interval 95%, *X2* = Chi square, *p*= p value