Peer Reviewed **Article of Interest**

A PICTORIAL PRESENTATION OF CT KIDNEY LESIONS IN ADULTS, PARTICULARLY KIDNEY CANCER: PART 5

Joel Harold Bortz[1] *MB ChB [Cape Town]; DMRD [London]; FRCR [London]; FFRRCS [Ireland]*
Riaan van de Venter[2] *DRad, MTech:Rad (research), PDTE*
Leonie Munro[3] *ND Rad (D), MA, P Grad Dip: Public Admin, Cert for trainers*

[1]LSG Imaging, Los Angeles, California, America
[2]Lecturer, Nelson Mandela University, Port Elizabeth, South Africa
[3]Durban, South Africa

ABSTRACT
There are many pathologies that affect the kidneys. The focus of this paper is computed tomography of kidney cancer. Other imaging modalities for kidney pathologies are briefly discussed. A few examples of benign tumours and masses are presented. The bulk of the paper is a pictorial presentation of kidney cancer and its spread to other organs and bones. A range of unenhanced and enhanced CT images are included for self-assessment.

Keywords: renal cell carcinoma, lymphadenopathy, oncocytoma, imaging modalities

LAY ABSTRACT
Imaging of the kidneys is done to find out whether a mass in a kidney may be a benign tumour, cyst or cancer. If it is a cancer then it is important to check whether there is spread to other organs. Examples of computed tomography (CT) are used to describe the different patterns of benign and cancer lesions.

12. KIDNEY CANCER TREATMENT, FUSION IMAGING AND DUAL ENERGY CT

There are several methods used for kidney cancer treatment. Surgery is used for radical or partial nephrectomy.[43] Minimally invasive surgery includes laparoscopic and robotic surgery.[43] Non-surgical tumour treatment includes radiofrequency ablation, cryoablation, and therapies using medication.[43] Radiation therapy may be used. Drugs (e.g., serofenib, axitinib, pazopanib), which are given by mouth or via the bloodstream, can be used to treat kidney cancer. These drugs are called systemic therapies for use in targeted therapy, immunotherapy, and chemotherapy.[43]

In terms of imaging modalities literature reports the role of US/CT fusion imaging to guide radiofrequency ablation of residual tumour.[44] Dual energy CT (DECT) may be used for grading of clear cell renal cell carcinoma[45] and for imaging of renal masses.[16, 46]

13. KEY POINTS

- There are no available routine tests to detect kidney cancer
- Imaging (e.g., ultrasound, CT, MRI, PET/CT) plays an important role in the visualisation of renal pathology
- There are benign renal tumours (e.g., oncocytoma and angiomyolipoma) and malignant tumours (e.g., renal cell carcinoma)
- Renal pathology may be in one kidney or both
- Multiphase CT of the abdomen is used to visualise lesions in the kidney and spread to adjacent organs
- Mean attenuation values seem to be reliable in terms of determining which renal masses on unenhanced CT need further evaluation
- Enhancement values in a ROI that are more than 10-12 HU above that of pre-contrast measurements are considered significant
- RCC shows significant enhancement above pre-contrast measurements: typically over 100 HU in the corticomedullary phase (also called angionephrographic or late arterial phase) and 60 HU in the delayed phase
- A routine should be followed for CT scans to assess spread of kidney cancer to other organs, lymph nodes and bones
- Important to examine the venous system (e.g., renal veins and IVC) for spread
- Important to examine the adrenals for spread
- The position of both the spleen and the pancreatic tail usually changes to lie in the left renal bed in left post-nephrectomy patients
- The bowel usually occupies the right renal bed in right post-nephrectomy patients

14. CONCLUSION

Early detection of kidney cancer is important in terms of treatment and management of patients. There are no available routine tests to detect kidney cancer. Radiology imaging thus plays an important role to visualise renal pathology. Radiographers, as members of the imaging team, should be able to perform pattern recognition of kidney anatomy in terms of size, shape and anatomical position.

This paper focuses on CT images of

kidney cancer and its spread to other organs, lymph nodes, venous system and bones. A range of examples are presented to highlight the different patterns of benign and malignant masses seen on unenhanced and enhanced CT images.

15. SELF-ASSESSMENT

When assessing images it is important to remember that an image's pattern may be normal including normal variants and congenital abnormalities or abnormal indicating pathology. Figures 15a to 15w are a range of examples covered in the text and the figures in the different sections.

Kindly email sorsaoffice@gmail.com to request a copy of the self-assessment answers (for members only).

16. ACKNOWLEDGEMENTS

Professor PJ Pickhardt from Wisconsin University is thanked for providing the oncocytoma CT images. Professor D Kim from Wisconsin University is thanked for providing the lymphoma CT images.

17. CONFLICT OF INTEREST

The authors declare no conflict of interest.

18. CONTRIBUTIONS OF THE AUTHORS

JHB (LSG), RvdV (NMU) and LM (Dbn) contributed to the draft manuscript. LM edited the manuscript. Annotation of the images (figures) was done by LM. JHB wrote the legends for all the figures.

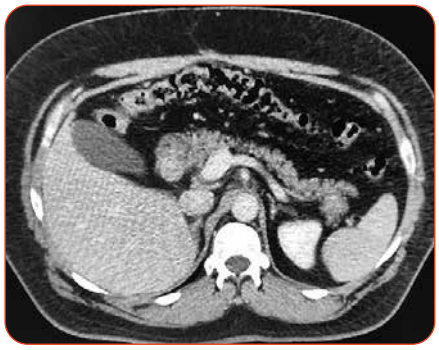

Figure 15a

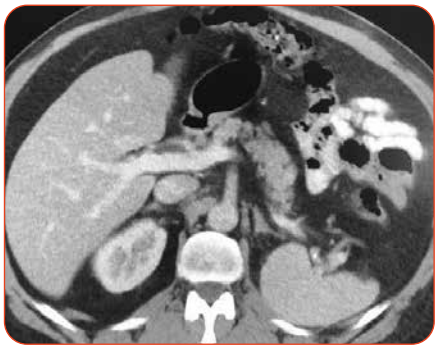

Figure 15b

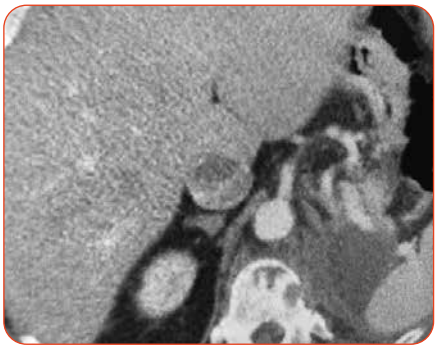

Figure 15c

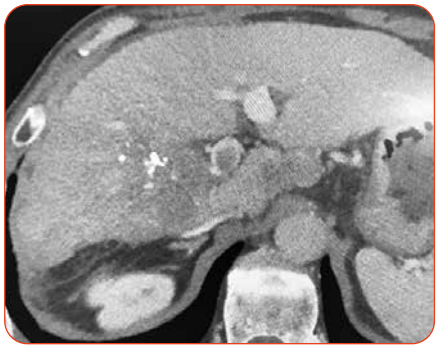

Figure 15d

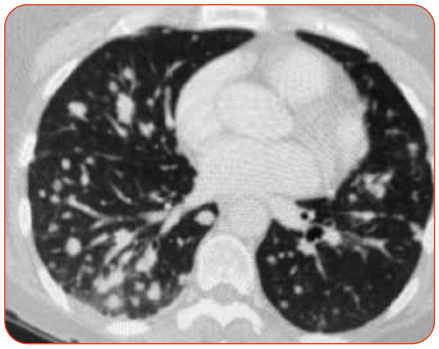

Figure 15e

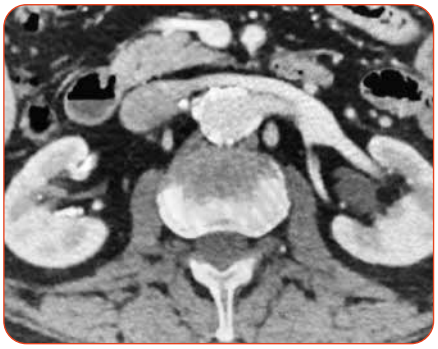

Figure 15f

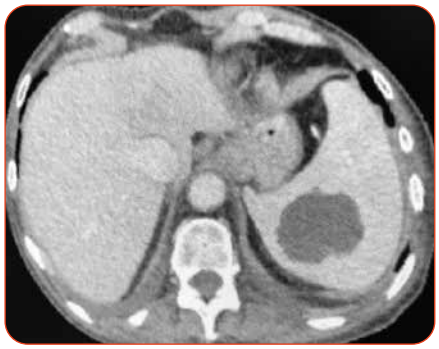

Figure 15g

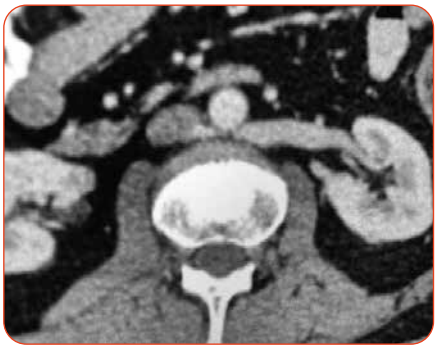

Figure 15h

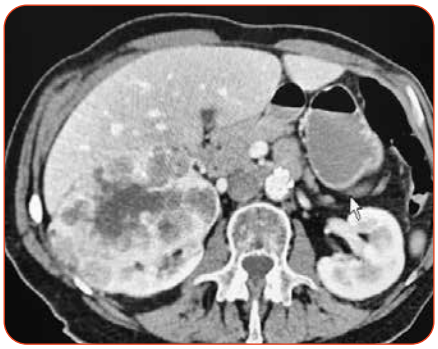

Figure 15i

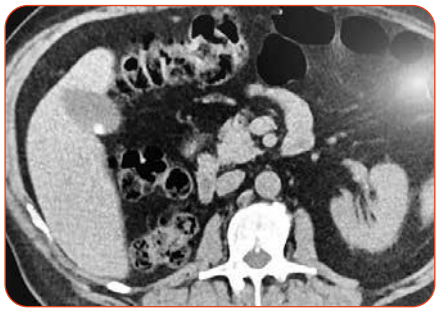

Figure 15j

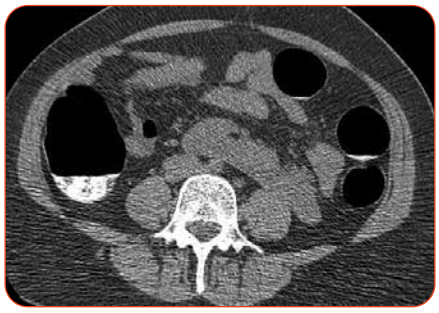

Figure 15k

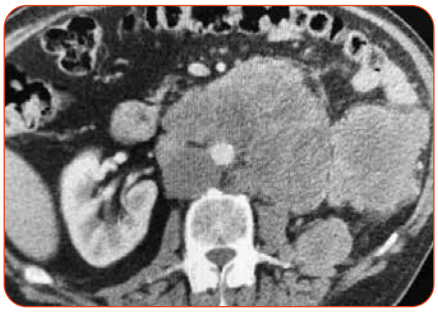

Figure 15l

Figure 15m

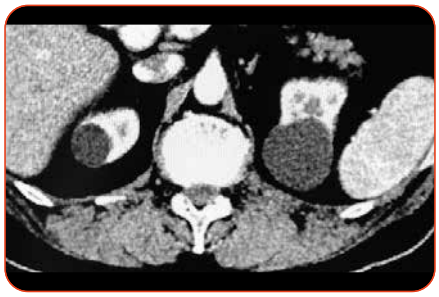

Figure 15n

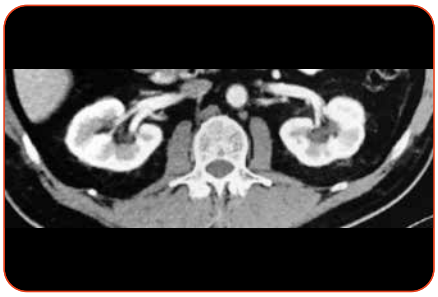

Figure 15o

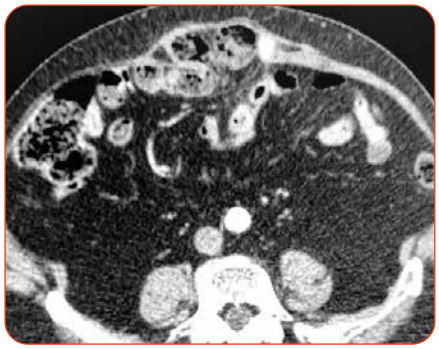

Figure 15p

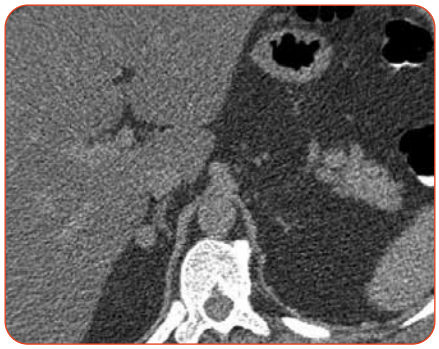

Figure 15q

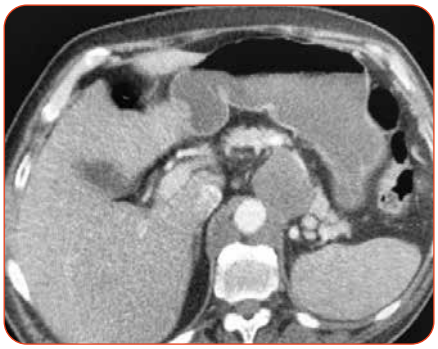

Figure 15r

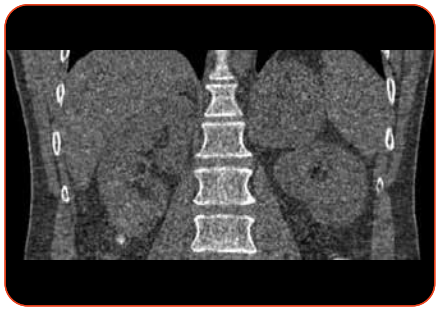

Figure 15s

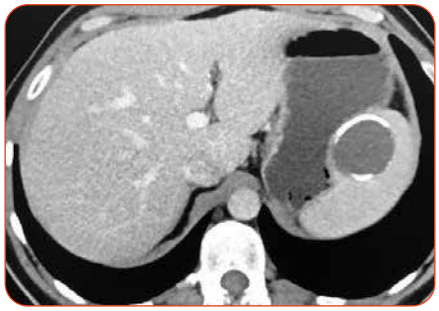

Figure 15t

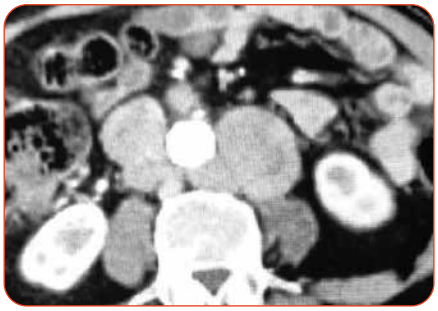

Figure 15u

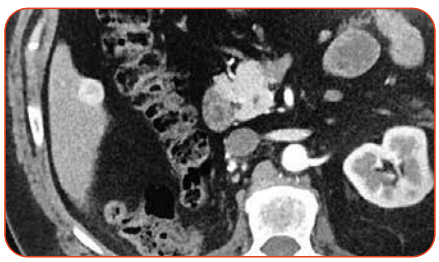

Figure 15v

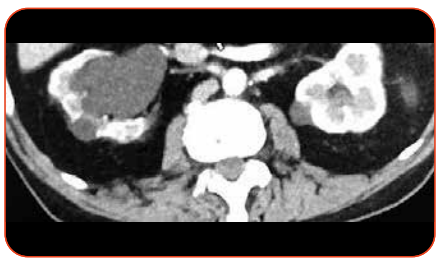

Figure 15w

19. REFERENCES

1. Muttarak M, Corr P, Peh WCG. Urinary tract imaging. In: Pattern recognition in diagnostic imaging. Geneva: WHO, 2011: pp 183-191
2. https://www.cancer.org/cancer/kidney-cancer/about/key-statistics.html
3. https://www.cancer.net/cancer-types/kidney-cancer/statistics

4. https://www.cancer.net/cancer-types/kidney-cancer/screening
5. Mitreski G, Sutherland T. Radiological diagnosis of perinephric pathology: pictorial essay 2015. Insights Imaging. 2017; 8:155-167
6. Perez JA, Torres FG, Torribio AM, Fernandez LK, Hayoun C, Naranjo ID. Angio CT assessment of anatomical variants in renal vasculature: importance in the living donor. Insights Imaging. 2013; 4:199-211
7. Johnson J. What is adenopathy? 2018 [Cited 2020 August 12]. Available from: https://www.medicalnewstoday.com/articles/320660
8. Merriam-Webster.com Medical Dictionary, Merriam-Webster [Cited 2020 August 12]. Available from: https://www.merriam-webster.com/medical/angiomyolipoma
9. MedlinePlus, National Library of Medicine. Benign, n.d. [Cited 2020 August 12]. Available from https://medlineplus.gov/ency/article/002236.htm
10. Shiel WC. Medical definition of renal cancer. [Cited 2020 August 13]. Available from: https://www.medicinenet.com/script/main/art.asp?articlekey=5299
11. Yang R-H, Ting C-H, Chu, Y-K. Cannonball lung metastases as a presenting feature of ectopic hCG expression. Journal of Oncological Science. 2016; 2(2-3):58-62. [Cited 2020 August 13]. Available from: https://doi.org/10.1016/j.jons.2016.07.003
12. Leveridge MJ, Bostrom PJ, Koulouris G, Finelli A, Lawrentschuk N. Imaging renal cell carcinoma with ultrasonography, CT, and MRI. Nat Rev Urol. 2010; 7: 311-325. [Cited 2020 August 14]. Available at: doi.10.1038/nrurol.2010.63
13. Watson S. Kidney cyst. Healthline. 2017. [Cited 2020 August 14]. Available from: https://www.healthline.com/health/kidney-cyst
14. Vosper M. Principles of CT. In: Bortz JH, Ramlaul A, Munro L , editors. CT colonography for radiographers: a guide for performance and image interpretation. Geneva: Springer, 2016: 30.
15. Dorland's Pocket Medical Dictionary 29th ed. London: Saunders, 2012.
16. de Leon AD, Pedrosa I. Imaging and screening of kidney cancer. Radiol Clin North Am. 2017; 55 (6):1235-1250.
17. Balaji AR, Prakash JVS, Darlington D. Cystic renal oncocytoma mimicking renal cell carcinoma. Urol Ann. 2019; 11:98-101.
18. Chan O. ABC of emergency radiology. 3rd ed. Wiley-Blackwell: Chichester, West Sussex, pg. 123.
19. Raby N, Berman L, Morley S, de Lacey G. Accident & emergency radiology. A survival guide. 3rd ed. 2015. Saunders Elsevier: Edinburgh, pgs. 330, 338.
20. Eisenberg RL, Johnson NM. Comprehensive radiographic pathology. 6th ed. 2016. Elsevier: St Louis, Missouri, pgs. 18-19, 217.
21. Chowdhury R, Wilson IDC, Rofe CJ, Lloyd-Jones G. Radiology at a glance. 2nd ed. Wiley-Blackwell: Chichester, West Sussex, pgs. 67, 69, 73, 85, 127.
22. Van Oostenbrugge TJ, Fütterer JJ, Mulders FA. Diagnostic imaging for solid renal tumors: a pictorial review. Kidney Cancer. 2018; 2(2):79–93. [Cited 2020 August 19]. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6364093/
23. Mathen A, Brahmbhatt B, Rajesh R, Kunian G, Unni VN. Page kidney. Indian J Nephrol. 2009; 19 (4): 170-171.
24. Martino P, Lucarelli G, Palazzo S, Tedeschi M, Impedovo SV, Di Lorenzo V, Ditonno P, Battaglia M, Selvaggi FP. Surgical complications of renal transplantation: ultrasound diagnosis. Arch Ital Urol Androl. 2010;82(4):221-5. [Cited 2020 August 19]. Available at: https://europepmc.org/article/med/21341568.
25. Petjova N, Martinek A. Renal cell carcinoma: review of etiology, pathophysiology and risk factors. Biomed Pap Med Fac Univ Palacky Homoue Czech Repub. 2016; 160 (2): 183-194.
26. Rossi SH, Klatte T, Usher-Smith J, Stewardt GD. Epidemiology and screening for renal cancer. World J of Urology. 2018; 36: 1341-1353.
27. Pascual D, Borque A. Epidemiology of kidney cancer. Advances in Urology. 2008 [Cited 2020 August 19]. Doi:10.1155/2008/782381
28. Woo S, Cho JY. Imaging findings of common benign renal tumour in the era of small renal masses: differential diagnosis from small renal cell carcinoma – current status and future perspectives. Korean J of Radiology. 2015; 16 (1): 99-113.
29. Balaji AR, Prakash JVS, Darlington D. Cystic renal oncocytoma mimicking renal cell carcinoma. Urol Ann. 2019; 11: 98-101.
30. Kang SK, Huang WC, Pandharipande FV, Chandaram H. Solid renal masses: what the numbers tell us. AJR. 2014; 202: 1196-1206.
31. O'Connor SD, Pickhardt PJ, Kim D, Oliva MR, Silverman SG. Incidental findings of renal masses on unenhanced CT: prevalence and analysis for guiding management. AJR. 2011; 197: 139-145.
32. Pooler BD, Pickhardt PJ, O'Connor SD, Bruce RJ, Patel SR, Nakada SY. Renal cell carcinoma: attenuation values on unenhanced CT. AJR. 2012: 195 (5): 1115-1120.
33. Bortz Joel H. Extracolonic findings. In: Bortz JH, Ramlaul A, Munro L , editors. CT colonography for radiographers: a guide for performance and image interpretation. Geneva: Springer, 2016: 239-266.
34. Eble JN. Angiomyolipoma of kidney. Semin Diagn Pathol. 1998; 15 (1): 21-40
35. Silverman SG, Israel GM, Herts BR, Richie JP. Management of the incidental renal mass. Radiology, 2008; 249 (1): 16-31.
36. Seth S, Fishman EK. CT in kidney cancer. In: Guermazi A editor. Imaging of kidney cancer. Berlin: Springer, 2006; pp 29-50.
37. Barker DW, Zagoria. Renal cell carcinoma. In: Guermazi A editor. Imaging of kidney cancer. Berlin: Springer, 2006; pp 103-123.
38. Browne RF, Torreggiani WG. Transitional cell carcinoma. In: Guermazi A editor. Imaging of kidney cancer. Berlin: Springer, 2006; pp 125-143.
39. Urban BA, Fishman EK. Renal lymphoma: CT pattern with emphasis in helical CT. RadioGraphics. 2000; 20: 197-212.
40. Hackworth J, Rowe SP, Kawamoto S, Fishman EK, Johnson PT. 4,3,2,1 … How many phases are needed? Balancing diagnostic efficacy and radiation modulation for MDCT imaging of renal cell carcinoma. Educational exhibit, RSNA November 27 to 2 December 2016, Chicago.
41. Songib N, Nazri M, Yaakup NA, Nor HM, Sun Z. Multiphase renal CT in the evaluation of renal masses: is the nephrographic phase necessary? Clinical Imaging. 2013; 37 (6): 1037 -1042. https://doi.org/10.1016/j.clinimag.2013.08.005
42. Bortz JH. 'Zebra spleen': a normal incidental finding. SAR. 2020;58 (2):29-31.
43. Kidney cancer: types of treatment. Cancer.Net. 2019. [Cited 2020 December 27]. Available from: https://www.cancer.net/cancer-types/kidney-cancer/types-treatment
44. Camisassi N, Mauti G, Vigna PD, Bonomo G, Varano GM, Maltettini D, Orsi F. Local occurrence of renal cell carcinoma successfully treated with fusion imaging-guided percutaneous thermal ablation. eCancermedicalscience. 2020; 14:1070. [Cited 2020 December 27]. Available from: https://doi.org/103332/ecancer.2020.1070
45. Wei J, Zhao J, Zhang X, Wang D, Zhang W, Wang Z, Zhou J. Analysis of dual energy spectral CT and pathological grading of clear cell renal cell carcinoma (ccRCC). PloS ONE. 2018;13 (5):e0195699.
46. Mileto A, Nelson RC, Paulson EK, Marin D. Dual-energy MDCT for imaging the renal mass. AJR. 2015; 204:W640-W647.