A comparative study of ultrasound and cross-sectional imaging for detection of small renal masses: anatomic factors and radiologist’s experience

Estudo comparativo de ultrassonografia e métodos seccionais para detecção de pequenas lesões renais: fatores anatômicos e experiência do radiologista

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ABSTRACT

Objective: To evaluate anatomic factors and radiologist’s experience in the detection of solid renal masses on ultrasonography. Methods: We searched for solid renal masses diagnosed on cross-sectional imaging from 2007 to 2017 that also had previous ultrasonography from the past 6 months. The following features were evaluated: nodule size, laterality, location and growth pattern, patient body mass index and radiologist’s experience in ultrasound. In surgically resected cases, pathologic reports were evaluated. Unpaired t test and χ² test were used to evaluate differences among subgroups, using R-statistics. Statistical significance was set at p<0.05. Results: The initial search of renal nodules on cross-sectional imaging resulted in 428 lesions and 266 lesions were excluded. Final cohort included 162 lesions and, of those, 108 (67%) were correctly detected on ultrasonography (Group 1) and 54 (33%) were missed (Group 2). Comparison of Groups 1 and 2 were as follows, respectively: body mass index (27.7 versus 27.1; p=0.496), size (2.58cm versus 1.74cm; p=0.003), laterality (54% versus 59% right sided; p=0.832), location (27% versus 22% upper pole; p=0.869), growth pattern (25% versus 28% endophytic; p=0.131) and radiologist’s experience (p=0.300). From surgically resected cases, histology available for Group 1 was clear cell (n=11), papillary (n=15), chromophobe (n=2) renal cell carcinoma, oncocytoma (n=1), and, for Group 2, clear cell (n=7), papillary (n=5) renal cell carcinoma, oncocytoma (n=2), angiomyolipoma, chromophobe renal cell carcinoma, and interstitial pyelonephritis (n=1, each). Conclusion: Size was the only significant parameter related to renal nodule detection on ultrasound.

Keywords: Ultrasonography; Diagnostic imaging; kidney neoplasms/diagnostic, imaging; Multidetector computed tomography

RESUMO

Objetivo: Avaliar os fatores anatômicos e a experiência do radiologista na detecção de massas renais sólidas na ultrassonografia. Métodos: Buscamos massas renais sólidas diagnosticadas em imagens seccionais, de 2007 a 2017, que também tivessem ultrassonografia prévia nos últimos 6 meses. As seguintes características foram avaliadas: tamanho do nóculo, lateralidade, localização e padrão de crescimento, índice de massa corporal do paciente e experiência do radiologista em ultrassonografia. Nos casos com ressecção cirúrgica, os laudos de patologia foram analisados.
Renal cell carcinoma (RCC) ranks ninth as most common type of cancer in males, and the incidence is rising particularly in developing countries, partly due to increase in established risk factors, and also due to widespread use of imaging modalities performed for other abdominal complaints. For those reasons, the majority of RCC are now incidentally diagnosed (over 50%), resulting in size and stage migration towards smaller RCC.

Several screening approaches have been debated, and most of them acknowledge the use of imaging modalities as part of those strategies. Data from other screening programs, such as for aortic aneurisms and colon cancer, using computed tomography (CT), have shown that renal lesions are a very common incidental finding (40% to 70%), but only a small fraction of those lesions are truly malignant renal neoplasms (0.21%). Therefore, although considered as gold standard not only for detection, but also for staging purpose, CT has several limitations for renal mass screening. There is significant burden on patients, with high incidence of indeterminate lesions diagnosed, that might need further investigation or follow-up, resulting in elevated financial resources and concern of using ionizing radiation.

Ultrasound (US) became a potential screening tool for renal masses, given low-cost, wide availability and lack of ionizing radiation. However, US is less sensitive and specific compared to CT for detecting renal masses, particularly in small lesions. The use of modern US equipment with tissue harmonics could further improve detection rate, but some factors, such as obesity, growth pattern, echogenicity and location could interfere in the detection on US.

Several studies evaluated the role of US as screening tool for renal masses, and few studies compared US and CT accuracies, but focusing primarily on tumor size.

### RESULTS

The initial search of renal nodules on CT or MRI resulted in 428 lesions in the period. A total of 266 were excluded due to the following reasons: 256 with...
no previous US, and 10 with missing information on BMI. The final cohort included 162 lesions: 67% were correctly detected on the previous ultrasound (108/162), categorized as Group 1, and 33% were missed (54/162), categorized as Group 2. Comparative analysis of Groups 1 and 2 is summarized on table 1.

We evaluated which clinical and anatomical factors could influence the detection of solid renal masses on US. Several hypotheses have been suggested based on the common sense of radiology ultrasound daily practice: the left kidney is slightly higher than the right and the spleen offers smaller and worse acoustic window on US; smaller and more endophytic nodules are more difficult to detect; BMI could pose additional technical challenges and level of experience performing US could interfere in the detection rate.

However, only tumor size was associated to detection on US in our cohort. Several articles have already demonstrated that US lacks sensitivity in the evaluation of small renal masses. (16,17,19) Interestingly, other tumor features such as laterality, location, growth pattern, BMI and radiology experience did not influence the detection of solid renal nodules on US in our study. We raised the hypothesis that modern US equipment might overcome difficulties in evaluation of intrarrenal lesions, as well as limitations of US performed on obese patients.

There are some limitations in this study. First, potential false negative US scans were missed due to selection bias (since patients included needed US and cross-sectional images). A prospective study could further confirm our hypothesis. Second, US was performed in our organization with highly trained radiologists, using modern US equipment, which may not reflect the daily practice in other facilities. Perhaps different results could be obtained in places where a technologist performs US, regarding experience, patient's BMI and tumor features. Third, clinical indication for US was not evaluated, and could potentially interfere with nodule detection (such as the evaluation of hematuria), since radiologists were aware of clinical information during the US examination. Forth, half of the lesions did not have a final diagnosis.

**CONCLUSION**

Size is the only significant parameter related to renal nodule detection on ultrasound. Other features related to patient’s body mass index, to the lesion (laterality, location and growth pattern) and to radiologist’s experience were not associated to lesion detection.
REFERENCES

1. Znaor A, Lortet-Tieulent J, Laversanne M, Jemal A, Bray F. International variations and trends in renal cell carcinoma incidence and mortality. Eur Urol. 2015;67(3):519-30. Review.

2. Hock LM, Lynch J, Balaji KC. Increasing incidence of all stages of kidney cancer in the last 2 decades in the United States: an analysis of surveillance, epidemiology and end results program data. J Urol. 2002;167(1):57-60.

3. Lightfoot N, Conlon M, Kreiger N, Bissett R, Desai M, Warde P, et al. Impact of noninvasive imaging on increased incidental detection of renal cell carcinoma. Eur Urol. 2000;37(5):521-7.

4. Beinfeld MT, Wittenberg E, Gazelle GS. Cost-effectiveness of whole-body CT screening. Radiology. 2005;234(2):415-22.

5. Filipas D, Spix C, Schulz-Lampel D, Michaelis J, Hohenfellner R, Roth S, et al. Screening for renal cell carcinoma using ultrasonography: a feasibility study. BJU Int. 2003;91(7):595-9.

6. Fujii Y, Ajima J, Oka K, Tosaka A, Takehara Y. Benign renal tumors detected among healthy adults by abdominal ultrasonography. Eur Urol. 1995;27(2):124-7.

7. Malaeb BS, Martin DJ, Littooy FN, Lotan Y, Waters WB, Flanigan RC, et al. The utility of screening renal ultrasonography: identifying renal cell carcinoma in an elderly asymptomatic population. BJU Int. 2005;95(7):977-81.

8. Mihara S, Kuroda K, Yoshioka R, Kayama W. Early detection of renal cell carcinoma by ultrasonographic screening-based on the results of 13 years screening in Japan. Ultrasound Med Biol. 1999;25(7):1033-9.

9. Shea MW. A proposal for a targeted screening program for renal cancer. Front Oncol. 2013;3:207.

10. Fenton JJ, Weiss NS. Screening computed tomography: will it result in overdiagnosis of renal carcinoma? Cancer. 2004;100(5):986-90.

11. Ishikawa S, Aoki J, Ohwada S, Takahashi T, Morishita Y, Ueda K. Mass screening of multiple abdominal solid organs using mobile helical computed tomography scanner—a preliminary report. Asian J Surg. 2007;30(2):118-21.

12. Schmidt T, Hohl C, Haage P, Blaum M, Honnef D, Weiβeta C, et al. Diagnostic accuracy of phase-inversion tissue harmonic imaging versus fundamental B-mode sonography in the evaluation of focal lesions of the kidney. AJR Am J Roentgenol. 2003;180(6):1639-47.

13. Dashe JS, McIntire DD, Twickler DM. Maternal obesity limits the ultrasound evaluation of fetal anatomy. J Ultrasound Med. 2009;28(8):1025-30.

14. Keller C, Wang NE, Imler DL, Vasanawala SS, Bruzoni M, Quinn JV. Predictors of nondiagnostic ultrasound for appendicitis. J Emerg Med. 2017;52(3):318-23.

15. Spouge AR, Wilson SR, Wooley B. Abdominal sonography in asymptomatic executives: prevalence of pathologic findings, potential benefits, and problems. J Ultrasound Med. 1996;15(11):763-7; quiz 769-70.

16. Dachille G, Erinnio M, Cardo G, Maselli FP, Vestita G, Ludovicó GM. Detection rate of ultrasound vs CT scan in clinical staging accuracy of renal tumors pT1NxMx. Arch Ital Urol Androl. 2005;77(3):149-50.

17. Jamis-Dow CA, Choyke PL, Jennings SB, Linehan WM, Thakore KN, Walther MM. Small (< or = 3-cm) renal masses: detection with CT versus US and pathologic correlation. Radiology. 1996;198(3):765-7; quiz 769-70.

18. Silverman SG, Israel GM, Trinh QD. Incompletely characterized incidental renal masses: emerging data support conservative management. Radiology. 2015;275(1):28-42. Review.

19. Kathrins M, Caesar S, Mucksavage G, Guzzo T. Renal mass size: concordance between pathology and radiology. Curr Opin Urol. 2013;23(5):389-93. Review.