Review Article

New Modalities for Evaluation and Surveillance of Complex Renal Cysts

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Abbreviations and Acronyms

CEUS = contrast enhanced ultrasound

CT = computerized tomography

DWMRI = diffusion-weighted magnetic resonance imaging

MRI = magnetic resonance imaging

US = ultrasound

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Purpose: The increased use of abdominal imaging has led to more frequent detection of incidental renal cysts. Since the inception of the Bosniak classification system, management of Bosniak I, III and IV cysts has been clearly defined, while evaluation and management of Bosniak II and IIF cysts have remained a clinical dilemma. Discussions of new imaging modalities are becoming increasingly prevalent in the radiological literature. In this context we performed a comprehensive review of the recent literature on complex renal cysts focusing on new imaging modalities, surveillance strategies and biopsy.

Materials and Methods: We performed a comprehensive literature review of articles published from January 1, 1998 through December 31, 2013 via MEDLINE®, EMBASE and the Cochrane Collection using a predetermined search strategy. All studies included were performed in humans older than 18 years, were written in English and had an abstract available for review. We grouped studies into 1 of 5 categories, ie computerized tomography, magnetic resonance imaging, ultrasound, biopsy and surveillance.

Results: While computerized tomography and magnetic resonance imaging with and without contrast enhancement remain the gold standard to evaluate cystic lesions of the kidney, diffusion-weighted magnetic resonance imaging and contrast enhanced ultrasound have surfaced as new tools for assessment of complex cysts. Comparative effectiveness studies on these new imaging modalities are limited. Image guided biopsy has increasingly been shown to be useful for evaluation of intermediate (Bosniak II and IIF) complex cysts. We found few studies providing guidance on the duration and/or intensity of surveillance required for intermediate complex renal cysts.

Conclusions: Although new and enhanced techniques are in development and may be useful in the future management of complex renal cysts, there is a paucity of data regarding the value of these new techniques. Future research should focus on surveillance of intermediate complex renal cysts, particularly on the ideal frequency and type of imaging required.

Key Words: classification; cysts; diagnostic imaging; kidney; kidney diseases, cystic

Due to the growing use of abdominal imaging, there has been an increase in the detection of incidental renal lesions such as renal cysts.[1] Since 1986, evaluation and management of renal cysts have largely centered on use of the Bosniak classification system (see Appendix). Because

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differentiating between Bosniak II and III cysts was particularly challenging, the original classification system was modified to an intermediary group, Bosniak IIF.[2] The Bosniak system groups lesions into 5 categories based on their predicted risk of malignancy. Features such as size, calcification, number of septa, wall thickness and enhancement are used to distinguish benign simple cysts from those with an increased risk of malignancy. At one end of this spectrum simple cysts require no further evaluation because they are known to be common, benign and age related.[3–5] At the other end complex cysts that resemble solid masses are assumed to be malignant and are often managed by surgical resection.

In contrast to simple and solid appearing cysts, those that appear as moderately complex intermediate cysts (Bosniak II and IIF) represent a particular evaluation and management challenge for 2 primary reasons. First, while it is generally accepted that newly diagnosed renal cysts should be categorized using the Bosniak classification system, studies focused on interobserver variation have revealed that current imaging modalities may lead to inaccurate categorization.[1,6,7] Additionally while most intermediate cysts are treated conservatively with surveillance imaging, there is no clear consensus on the type of imaging that should be used or the duration and frequency of followup evaluations.

In the last decade technological advances have enhanced the ability to distinguish between malignant and benign renal lesions. Improved CT methods, use of diffusion-weighted MRI and contrast enhanced ultrasound are a few promising techniques that have been introduced at selected centers to improve the diagnostic yield of renal imaging. In addition, the use of biopsy has resurfaced as a safe and reliable tool in the context of small renal masses. However, its role in the diagnostic evaluation of cystic masses of any size is largely unknown. Broadly speaking, it is unclear whether there is enough evidence to support the use of any of these advancements in the evaluation and surveillance of complex renal cysts. In this context we reviewed all recent scientific investigations pertaining to imaging, biopsy and surveillance of complex renal cysts.

METHODS

We performed a systematic literature review for articles published in the last 15 years (January 1, 1998 to December 31, 2013). We searched MEDLINE, EMBASE and the Cochrane Collection. We used Boolean logic with search terms including "bosniak classification system," "renal cysts," "complex renal cysts," "complex kidney cysts," "kidney cysts" and the controlled vocabulary terms (ie Medical Subject Heading terms) "Kidney Diseases, Cystic*/classification," "Kidney Diseases, Cystic*/diagnosis" and "Kidney Diseases, Cystic*/epidemiology." All studies included were performed in humans older than 18 years, were written in English and had an abstract available for review.

Two authors (CE, KAG) independently established study eligibility, and disagreement was resolved by consensus. For this investigation we included original research studies and excluded commentaries, review articles, case reports and series focusing on interventions for symptomatic renal cysts (eg laparoscopic decortication, sclerotherapy, ablation). We focused on incidentally found complex renal cysts, and, therefore, excluded studies of patients with polycystic kidney disease, genetic disorders (eg tuberous sclerosis, von Hippel-Lindau disease), simple cysts, cystic renal neoplasms and infected cysts. We grouped the remaining studies into 1 of 5 categories, ie computerized tomography, magnetic resonance imaging, ultrasound, biopsy and surveillance.

RESULTS

We retrieved a total 1,418 articles meeting our initial search criteria (fig. 1). After removing 281 duplicates and 1,070 articles that did not meet our inclusion criteria 67 articles were selected for classification into 1 of the 5 categories.

Computerized Tomography

Update on CT of renal cysts. We found more studies (23) focusing on CT than any other imaging modality. CT with and without contrast enhancement remains the gold standard to evaluate cystic lesions of the kidney.[6,8–10] Technical advancements in CT in the last few decades have allowed clinicians to obtain more detailed visualization of fine structures such as hairline thin septa. However, despite advancements in CT, significant interobserver variability exists.[11]

Many studies have focused on identifying predictors of cyst malignancy.[6,9,12–15] Thickened irregular septa, thickened irregular wall, internal heterogeneity and enhancing soft tissue have been demonstrated to be strong predictors of malignant cysts.[6,14] Investigators have found that an enhancement of 42 HU between the corticomedullary phase and pre-contrast phase is independently associated with a substantially increased risk of malignancy (HR 31.5).[9] Septal and nodular enhancements have the highest sensitivity and specificity in predicting malignancy, at 100% and 86%, respectively.[13]

Recent studies have drawn attention to pseudoenhancement, defined as an attenuation increase of 10 HU or more on nephrographic phase compared to unenhanced images, as a diagnostic challenge to clinicans (fig. 2).[16–18] While pseudoenhancement can affect up to 22% of cyst images, it appears to primarily affect cysts smaller than 1.0 cm.