Percutaneous biopsy for risk stratification of renal masses

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***Abstract*:** The increased use of abdominal imaging has led to identification of more patients with incidental renal masses, and renal mass biopsy (RMB) has become a popular method to evaluate unknown renal masses prior to definitive treatment. Pathologic data obtained from biopsy may be used to guide decisions for treatment and may include the presence or absence of malignant tumor, renal cell cancer subtype, tumor grade and the presence of other aggressive pathologic features. However, prior to using RMB for risk stratification, it is important to understand whether RMB findings are equivalent to pathologic analysis of surgical specimens and to identify any potential limitations of this approach. This review outlines the advantages and limitations of the current studies that evaluate RMB as a guide for treatment decision in patients with unknown renal masses.

In multiple series, RMB has demonstrated low morbidity and a theoretical reduction in cost, if patients with benign tumors are identified from biopsy and can avoid subsequent treatment. However, when considering the routine use of RMB for risk stratification, it is important to note that biopsy may underestimate risk in some patients by undergrading, understaging or failing to identify aggressive tumor features. Future studies should focus on developing treatment algorithms that integrate RMB to identify the optimal use in risk stratification of patients with unknown renal masses.

Keywords: renal cell carcinoma, renal mass biopsy, risk stratification, small renal mass

Introduction

The incidence and detection of renal cell carcinoma (RCC) has increased significantly over the past 50 years [Pantuck *et al.* 2001]. Improvements in cross-sectional imaging techniques have facilitated detection of asymptomatic small renal masses (SRMs) while causing a stage migration in RCC [Hollingsworth *et al.* 2006] with masses up to 4 cm constituting 48–66% of new diagnoses [Nguyen *et al.* 2006]. The etiology of unknown renal masses falls into three categories: aggressive cancers, slow-growing cancers and benign tumors [Frank *et al.* 2003] and treatment of renal tumors may include surgery, ablation or active surveillance. However, deciding among treatments is not always straightforward, especially for patients with major comorbidities or advanced age [Patel *et al.* 2012]. Many small RCCs are indolent with less than 5% of patients with nonmetastatic SRMs progressing to metastatic RCCs (mRCCs) within the first 5 years after treatment [Abel *et al.* 2010b; Umbreit *et al.* 2012]. However, while the probability of developing mRCC is small, the consequences are significant because the prognosis for patients with RCC with metastases is dismal despite treatment with newer systemic agents [Heng *et al.* 2009]. Therefore, identifying aggressive tumors is critical to proper treatment, while the identification of more indolent tumors is also useful for selecting patients who may benefit from alternative approaches to treatment such as surveillance regimens.

Renal mass biopsy (RMB) has become a popular diagnostic tool to evaluate renal masses and may provide important information prior to treatment [Volpe *et al.* 2007]. However, RMB should be compared with the gold standard for risk assessment in patients with nonmetastatic disease, which is based on pathologic evaluation of renal tumor specimens after surgery. Multiple pathologic predictors for metastatic recurrence and

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Table 1. Advantages and disadvantages of performing renal mass biopsy (RMB).

Advantages of RMB	Disadvantages of RMB
By avoiding treatment in patients with benign tumors: Improved overall renal function Decreased treatment-related morbidity Decreased cost of treatment	Complications related to biopsy procedure
Improves informed consent for patients considering treatment	Additional cost of procedure
Allows pathologic diagnosis for patients treated with ablation or surveillance	Theoretical risk of tumor spreading

cancer-specific survival have been described and validated, including nuclear grade, T stage and the presence of poor prognostic features such as sarcomatoid differentiation [Zisman *et al.* 2002; Sorbellini *et al.* 2005; Thompson *et al.* 2007; Abel *et al.* 2010b]. While percutaneous biopsy and three-dimensional imaging provide predictive data, it is unclear if information gained prior to surgery is equivalent to the pathologic assessment after surgery. The purpose of this review is to outline the data supporting and limiting the use of RMB for risk stratification in patients with renal masses.

Rationale for renal mass biopsy

Historically, patients diagnosed with renal masses would be treated with surgery and pathologic diagnosis would be made afterward from nephrectomy specimens. The rationale for surgery was the presumptive diagnosis of RCC since it is found in the majority of patients with incidental renal masses in surgical series [Frank *et al.* 2003]. However, the increased use of imaging has led to more frequent diagnosis of small incidental renal masses in patients who are often being treated for other cancers or serious medical comorbidities [Umbreit *et al.* 2012]. Deciding the best treatment for patients with renal masses can be especially difficult when considering possible competing causes of mortality for many patients [Kutikov *et al.* 2010]. In addition, alternatives to surgery such as thermal ablation [Choueiri *et al.* 2011] and active surveillance protocols [Smaldone *et al.* 2013] have been developed and may be more appropriate treatments for patients with serious comorbidities. As a result, RMB has become popular method for identifying renal malignancies prior to treatment [Leppert *et al.* 2014].

The optimal use of RMB for patients with incidental renal masses is debated and the proper role of biopsy for the evaluation of patients with typical renal mass remains unclear. Although there are theoretical advantages and disadvantages with the use of RMB (Table 1), the choice to obtain a biopsy should be made individually based on the perceived risks and benefits for each patient. Similar to any diagnostic test, a thorough understanding of the ability and limitations of RMB is essential for physicians treating patients with renal masses. Risk stratification for treatment planning should be comprehensive considering patient comorbidities, data from RMB and imaging, as well the potential for inaccuracy when using these techniques. Depending on the institutional practice, pathological information reported from biopsy specimens may include the presence of neoplasm, tumor grade, histologic subtype, and the presence of aggressive features, for example, sarcomatoid or rhabdoid features. The ability of RMB to accurately diagnose these features will be examined individually.

Renal mass biopsy: safety and cost

It is appropriate to first consider the safety and cost of RMB prior to assessing its clinical utility. Potential complications of RMB include retroperitoneal hemorrhage, vascular complications, pneumothorax or biopsy tract seeding. However, the overall rates of post biopsy complications are low [Lane *et al.* 2008; Volpe *et al.* 2012] and complications requiring intervention are seen in less than 1% of patients from large modern series [Prince *et al.* 2014]. The most common complication following biopsy is bleeding from nearby vascular structures, the kidney parenchyma or the tumor itself. As biopsy techniques have evolved, the risk of significant hemorrhage has decreased [Caoili *et al.* 2002; Rybicki *et al.* 2003]. Similarly, the development of arteriovenous fistula or pneumothorax occurs in less than 1% of patients following biopsy [Leveridge *et al.* 2011]. One exceptionally rare complication which receives disproportionate attention is the possibility of

biopsy tumor tract seeding. This complication has been reported in the literature twice in the last 20 years [Leveridge *et al.* 2011; Mullins and Rodriguez, 2013], despite a significant increase in the utilization of RMB over the same time period [Leppert *et al.* 2014].

Another concern when integrating biopsy into patient management of renal masses is the additional cost of undergoing a biopsy when surgery achieves both diagnosis and treatment objectives. However, if patients with benign tumors are spared the cost of treatment, biopsy may be cost effective. To address the cost effectiveness of RMB, Pandharipande and colleagues used a decision-analytic Markhov model to compare cost effectiveness of using RMB to triage patient management to surveillance or empiric surgery for SRMs [Pandharipande *et al.* 2010]. They found that a biopsy strategy yielded a minimally improved quality-adjusted life expectancy of 4 days compared with surgery at a lower lifetime cost of $3466. In similar fashion, while again using a Markhov model, a more recent report compared immediate surgery with biopsy or surveillance in a hypothetical 60-year-old man with a SRM. When adjusting for quality of life, biopsy outperformed immediate surgery as a more cost-effective diagnostic strategy at $33,840 per quality-adjusted life year gained [Heilbrun *et al.* 2012]. Although biopsy did not yield the best survival, this study highlights that low-risk patients may be treated with surveillance for a T1a renal mass while benefiting from a cost-effective strategy.

Ability of renal mass biopsy to diagnose the presence of malignancy

The accuracy of RMB to diagnose malignancy depends on multiple factors, including the ability to target small tumors using imaging guidance, the ability to diagnose malignancy from small pathologic specimens, and the inherent sampling error when evaluating heterogeneous tumors. Although no prospective studies have evaluated fine needle aspiration (FNA) *versus* core biopsy techniques for accuracy, it should be noted that diagnoses from FNA sampling are considerably dependent on the experience of the cytopathologist, who may be present at the biopsy to confirm the adequacy of sampling [Volpe *et al.* 2007]. Nondiagnostic findings from RMB are present in 15–22% of large contemporary series [Shannon *et al.* 2008; Leveridge *et al.* 2011; Prince *et al.* 2014] (Table 2). Some of the variation in incidence among series stems from the lack of a standardized definition for nondiagnostic RMB. Many series report only fibrosis or necrosis as nondiagnostic findings while other series include RMB with benign renal parenchyma when the tumor was 'missed'. Nondiagnostic findings appear to be more common in patients with smaller tumors [Wang *et al.* 2009; Leveridge *et al.* 2011; Prince *et al.* 2014] and cystic features [Leveridge *et al.* 2011; Prince *et al.* 2014]. In addition, a longer distance from the skin to the tumor and a lack of enhancement with contrast imaging may also be associated with higher nondiagnostic rates [Prince *et al.* 2014]. Patient and tumor characteristics should be considered when deciding to obtain RMB, and lower overall nondiagnostic rates may be possible when selecting only patients with larger solid enhancing masses and shorter skin to tumor distance. When RMB is not diagnostic for either infection or a neoplasm, physicians should still suspect the presence of malignancy and consider repeating biopsy or proceeding with surgery or observation as indicated. However, there is minimal impact on risk stratification when physicians understand the continued risk of malignancy in patients with incidental renal masses and nondiagnostic RMB.

Ability of renal mass biopsy to diagnose renal cell cancer subtypes

Prior studies evaluating the concordance between biopsy specimens and surgical pathology for RCC subtype have ranged between 86% and 100% (Table 3) [Shannon *et al.* 2008; Wang *et al.* 2009; Millet *et al.* 2012]. High levels of concordance between biopsy and surgical pathology are especially noted in clear cell or conventional RCC [Shannon *et al.* 2008], which is the most common subtype of RCC [Lane *et al.* 2008]. Recent studies of non-clear cell RCC subtypes have also demonstrated high rates of concordance [Millet *et al.* 2012], with immunohistochemical staining facilitating diagnosis in some patients [Lane *et al.* 2008].

One important diagnostic consideration is the ability to differentiate between chromophobe RCC and oncocytoma, which may be achieved using a panel of tissue markers [Huang *et al.* 2009]. Historically, there was significant concern over the ability to distinguish oncocytoma from RCC both histologically and radiographically [Gakis *et al.* 2011] and surgical resection remained the only modality to diagnose and treat oncocytoma.

Table 2. Renal mass biopsy series and nondiagnostic rate.

Study	Biopsies	Nondiagnostic biopsy rate	Nondiagnostic definition
Maturen *et al.* [2007]	152	6 (3.9%)	Insufficient tissue
Volpe *et al.* [2008]	100	16 (16%)	Insufficient tissue 1 RCC of 2 repeat biopsies
Prince *et al.* [2014]	565	83 (14.7%)	Necrosis/fibrosis Insufficient tissue
Leveridge *et al.* [2011]	345	67 (19.4%)	Nonrenal tissue Insufficient tissue 12 repeat biopsies revealed 8 RCCs
Lebret *et al.* [2007]	119	25 (21%)	Necrosis Inflammation 13 repeat biopsies revealed 11 RCCs
Shannon *et al.* [2008]	235	51 (21.7%)	Inflammation/necrosis Connective tissue
Vasudevan *et al.* [2006]	100	30 (30%)	Fat tissue
Wang *et al.* [2009]	110	10 (9%)	Insufficient tissue 2 nondiagnostic biopsies were renal cell cancer after nephrectomy

Table 3. Studies comparing renal mass biopsy to surgical pathology.

Study	Biopsy (*n*)	Subtype cancer diagnosis (%)	Grade concordance (%)	Grade concordance (%) (high or low)
Maturen *et al.* [2007]	59	98	70	Not shown
Volpe *et al.* [2008]	100	66	68	75
Schmidbauer *et al.* [2008]	60	96	76	Not shown
Leveridge *et al.* [2011]	100	88	64	Not shown
Lebret *et al.* [2007]	52	86	46	74
Blumenfeld *et al.* [2010]	67	82	43	64
Millet *et al.* [2012]	61	100	75	93

Concern for hybrid tumors consisting of oncocytoma juxtaposed with malignant tissue [Waldert *et al.* 2010] caused many surgeons to recommend treatment for all patients despite a biopsy diagnosis of oncocytoma. However, recent series have suggested that hybrid tumors are exceptionally rare. Ginzburg and colleagues identified 147 solitary sporadic tumors that contained any element of oncocytoma or angiomyolipoma following nephrectomy [Ginzburg *et al.* 2014] and found less than 3% of tumors included coexistent malignant tissue, with no tumors having any high-grade components. Importantly, at a median follow up of 44 months, no patient with a hybrid tumor experienced local, regional or metastatic progression. These results are encouraging and support less aggressive approaches for renal oncocytoma management.

Ability of renal mass biopsy to evaluate tumor grade in renal cell carcinoma

Tumor grade is often a reliable determinant of tumor behavior [Ficarra *et al.* 2010]. However, with recent studies demonstrating considerable tumor heterogeneity within RCC tumors, biopsy grade may be less accurate due to sampling error [Gerlinger *et al.* 2012]. To evaluate the possibility that tumor heterogeneity can lead to misrepresentation of biopsy grade, Ball and colleagues reevaluated 32 pT1a RCC surgical specimens for grade heterogeneity. Specimens consisted of either clear cell or papillary RCC with high- and low-grade features. The authors showed that 26 samples (81.3%) were heterogeneous and 15 of 16 high-grade tumors also exhibited significant low-grade components [Ball *et al.* 2015]. With significant grade heterogeneity demonstrated among high-grade

cancers, it is obvious how biopsy sampling may miss a component of high-grade disease and underestimate RCC risk. Previous series substantiate the inaccuracy of predicting tumor grade from biopsy specimens [Neuzillet *et al.* 2004; Lebret *et al.* 2007; Millet *et al.* 2012], which has implications for reporting and interpreting RMB results. A recent report identified grade heterogeneity in single tumors in up to 25% of cases [Halverson *et al.* 2013]. Undergrading biopsy specimens could be significant clinically for some patients if they choose to defer treatment based on risk assessment from an erroneous tumor grade. The accuracy of tumor grading on RMB specimens varies considerably among series (43–75%) [Tomaszewski *et al.* 2014], and no studies included more than 100 patients. Although high-grade tumors are rare in small localized tumors [Abel *et al.* 2010b], the limited ability to predict tumor grade must be considered when making treatment decisions.

Ability of preoperative imaging to evaluate tumor stage in small renal cell carcinoma

Radiologic imaging may be used to evaluate the clinical T stage of the primary tumor, which is an important predictor of RCC recurrence and survival [Zisman *et al.* 2002; Sorbellini *et al.* 2005; Thompson *et al.* 2007], although clinical staging is not equivalent to pathologic staging in RCC. Renal masses equal to or less than 7 cm are staged as T1 or T3a when tumors invade into perinephric fat. However, imaging does not reliably identify perinephric fat invasion [Hedgire *et al.* 2013], which is an important predictor of poor outcomes in RCC. In a recent study of 860 patients with RCC stage T1–3 [Yoo *et al.* 2008], the authors showed a significant difference in disease-free survival [hazard ratio 2.21, 95% confidence interval (CI) 1.01–4.84; $p = 0.05$] among patients with fat invasion compared with lower stage disease. Furthermore, 85% of patients with recurrence of T3a tumors greater than 7 cm died of RCC compared with 33% of patients who had recurrence with tumors less than 7 cm ($p = 0.001$). When evaluating patients with tumors less than 7 cm specifically, metastatic recurrence was 14.6% compared with 6.0% in patients with fat invasion and without fat invasion, respectively [Ginzburg *et al.* 2014]. Siddiqui and colleagues also evaluated the significance of T3a disease across a spectrum of tumor size and found risk ratios of death for RCC fat invasion to be 6.15 (1.84–20.50, $p = 0.003$), 4.12 (2.50–6.78, $p < 0.001$) and 2.13 (1.53–2.97, $p < 0.001$) for tumors 4 cm or smaller, 4–7 cm, and more than 7 cm, respectively [Siddiqui *et al.* 2007]. The association of death with fat invasion remained significant on multivariate analysis. Attempts to identify T3a tumors based on preoperative imaging have demonstrated poor accuracy [Sokhi *et al.* 2015]. A recent study compared a combined approach of computed tomography/magnetic resonance imaging with nephrectomy assessment for perinephric fat invasion in renal masses with median diameter of 4.5 cm. Of 55 patients who were diagnosed with fat invasion, 26 (47.2%) did not have pathological fat invasion [Huang *et al.* 2009]. Likewise, detection of renal sinus fat invasion may carry equal importance as these tumors have been shown to be more aggressive than tumors with perinephric fat involvement [Thompson *et al.* 2005]. Unless more reliable methods for detecting perinephric fat and renal sinus fat invasion [Kim *et al.* 2014] are developed, understaging will likely remain a persistent limitation for approximately 5–10% of patients with clinically localized tumors that are pathologically T3a [Siddiqui *et al.* 2007; Gorin *et al.* 2013].

Ability of biopsy to identify aggressive pathologic features in small renal masses

Sarcomatoid dedifferentiation is an aggressive pathologic feature that may be present with any RCC subtype [Lane *et al.* 2008] and is associated with poor outcomes [Zhang *et al.* 2014]. However, the ability of percutaneous biopsy to identify sarcomatoid features may be limited by sampling error. In patients with mRCC, sarcomatoid dedifferentiation was identified preoperatively in only 11.8% and 9.2% of primary tumors and metastatic tumors, respectively [Chao *et al.* 2001; Crispen *et al.* 2011]. As seen with high tumor grade [Ball *et al.* 2015], sarcomatoid dedifferentiation may only be present in a minority of tissue and percutaneous biopsy is therefore prone to sampling error. However, sarcomatoid pathology is rare in lower stage tumors, with one study of 925 patients with pT1 and pT2 tumors demonstrating less than 1% incidence of sarcomatoid features in the surgical specimens [Abel *et al.* 2010b]. Given the rarity in low-stage tumors, the inability to identify sarcomatoid features from biopsy is likely less significant for this population.

Should the limitations of biopsy limit its use for risk stratification of incidental renal masses?

There are notable limitations (Table 4) when using RMB that may result in underestimation of risk in patients with nonmetastatic disease and incidental renal masses. These limitations should

Table 4. Potential limitations when using renal mass biopsy for estimating risk from incidental renal masses.

Nondiagnostic findings in approximately 15% of patients
Underestimation of grade in approximately 25% of patients
Underestimation of stage in approximately 5–10% of patients
Failure to identify aggressive pathology, that is sarcomatoid or rhabdoid features

be considered when ordering RMB for healthy patients considering surgical treatment, because of the risk of mRCC. However, the potential benefits of RMB for many patients should not be dismissed regardless of RMB limitations. Biopsy is safe and likely cost efficient when used judiciously and has demonstrated the ability to reliably identify malignant and benign tumors in patients with incidental renal masses. For many patients with incidental renal masses, RMB can provide information that is helpful for management.

Patient selection for renal mass biopsy

Selecting appropriate patients for RMB is important to improve the evaluation of incidental renal masses and maximize the percentage of patients who benefit from this procedure. Patients who are considering active surveillance or thermal ablation should receive RMB in order to plan appropriate follow-up protocols [Volpe *et al.* 2012]. When benign masses are identified, patients may receive minimal follow up as appropriate. Similarly, in patients who are borderline candidates for surgery, the identification of benign masses allows surgery to be deferred. However, in patients with comorbidities that significantly limit a patient's life expectancy, RMB should only be ordered when the information gained from RMB may change the patient's further treatment.

Patients with atypical renal masses that are concerning for infection or metastatic lesions are ideal patients for RMB. In addition, very young patients or those with masses that are suspicious for non-RCC lesions may benefit from identification of malignancy, as treatment for some tumors such as renal lymphomas [Cyriac *et al.* 2010] or sarcomas [De Visschere *et al.* 2013] may involve upfront chemotherapy or radiation therapy. Deciding which patients should receive RMB among patients who are otherwise acceptable surgical candidates is less clear. However, RMB does improve informed consent for patients who are considering surgical treatment for their renal masses. When patients are given the diagnosis of cancer from RMB, they may be more willing to be treated with surgical therapy. Conversely, patients with benign masses identified from RMB may be more willing to undergo observation.

Patients who are suspected of having metastatic renal masses may also obtain RMB for diagnosis, especially as the majority of patients with mRCC are not treated with cytoreductive nephrectomy [Tsao *et al.* 2012; Minnillo *et al.* 2014], but need a pathologic diagnosis prior to treatment. Despite the development of multiple new therapies, patients with mRCC continue to have a poor prognosis [Heng *et al.* 2009]. Aggressive features such as sarcomatoid dedifferentiation are associated with short overall survival and may not benefit from cytoreductive surgery [Mian *et al.* 2002; Molina *et al.* 2011; Przybycin *et al.* 2014]. An analysis of 417 patients undergoing cytoreductive nephrectomy for mRCC compared those with sarcomatoid histology with conventional RCC [Shuch *et al.* 2009]. Median survival in patients with sarcomatoid features was just 4.9 months compared with 17.7 months for conventional clear cell RCC ($p < 0.001$). However, sarcomatoid features are difficult to identify because of sampling error in large tumors or metastases using standard biopsy techniques [Abel *et al.* 2010a, 2012]. Similarly, distinguishing non-clear cell tumor subtypes may be helpful as targeted therapy appear to be less effective [Vera-Badillo *et al.* 2014]. In a meta-analysis consisting of 49 studies and 7771 patients treated with targeted therapy for mRCC, the median progression-free survival and overall survival for non-clear cell RCC was 7.4 and 13.4 months, respectively, compared with 10.5 and 15.7 months for clear cell RCC, respectively ($p < 0.001$). While cytoreductive nephrectomy may provide a survival benefit in metastatic non-clear cell RCC [Aizer *et al.* 2014], preoperative identification of non-clear cell RCC from RMB may allow enrollment in clinical trials of presurgical therapy.

Clinical protocols for decision making using renal mass biopsy for incidental renal masses

Information gained from biopsy may allow improved patient selection for surgery and other

treatments. Several studies have critically analyzed the ability of RMB to impact decision making, although the optimal use remains debated. Halverson and colleagues evaluated 133 patients with SRMs and assigned patients to surgery or surveillance based on RMB findings [Halverson *et al.* 2013]. Of the 97 tumors that were assigned to surgery, agreement between biopsy and final pathology was 100% for identifying malignancy and 94% for distinguishing histology. According to their model, biopsy correctly assigned all 97 patients (90% sensitivity) to surgery while 11 of 36 patients were incorrectly assigned to surveillance based on final pathology. For the entire cohort, agreement between biopsy and final pathology was 92% (95% CI 0.64–0.90). Similarly, Tan *et al.* analyzed the role of RMB for SRMs to guide decision making [Tan *et al.* 2012]. The authors determined indications for RMB in 78 (38%) of 204 patients with T1 tumors and identified body mass index greater than 25, juxtahilar tumor location, and high R.E.N.A.L. (it is an acronym for Radius, Exophytic/endophytic properties, Nearness of tumor to hilum, Anterio/posterior, Location) nephrometry score as factors associated with use of RMB on multivariate analysis. The authors conclude that RMB was able to direct treatment-related decision making, with surveillance planned more often for patients with favorable and benign histology and surgical management reserved for aggressive tumors ($p < 0.001$). The approaches in these two studies highlight the potential for RMB to improve clinical decision making as more asymptomatic renal tumors are diagnosed by cross-sectional imaging. However, the limitations of RMB (Table 4) should be discussed with patients who are risk stratified using these approaches, given the risks with this approach.

Biopsy for evaluation of incidental renal masses: potential impact on patient care

Approximately 20–30% of renal masses are benign following surgical resection [Frank *et al.* 2003; Gill *et al.* 2003]. If RMB could reliably identify these patients prior to surgery, a significant proportion of patients with benign tumors could be spared surgery. Despite noted RMB limitations (Table 4), the majority of series have demonstrated accuracy to distinguish between benign and malignant tumors, when biopsy findings are diagnostic. Avoiding treatment in patients with benign tumors would improve overall renal function, as fewer patients would have treatment-related loss of renal function. In addition, patients with benign tumors could be spared the risk of treatment-related complications and the cost of treatment.

Another potential impact of routine RMB that is difficult to measure empirically is the improved ability for informed consent after RMB in patients considering definitive management. Patient awareness of biopsy-proven malignancy may lead to a more informed and assertive decision for management, which appears reasonable given the low procedural morbidity. When atypical renal masses are diagnosed from imaging [Leveridge *et al.* 2010], RMB also allows for distinguishing between rare tumors and uncommon presentations of common tumors, which may also impact management for tumors when nonsurgical treatment is indicated.

Conclusion

Risk stratifying patients with unknown renal masses is important when choosing an acceptable treatment. RMB is associated with a low incidence of complications and may provide valuable information to help patients and physicians decide among treatments. It is important to recognize that RMB may underestimate risk and has limited accuracy when evaluating tumor grade, aggressive pathologic features or T stage. Future studies are necessary to evaluate the optimal use of biopsy in the evaluation and management of incidental renal masses.

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Conflict of interest statement

The authors declare that there is no conflict of interest.

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