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## PERCUTANEOUS RENAL BIOPSY: OUTPATIENT OBSERVATION WITHOUT HOSPITALIZATION IS SAFE

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### Abstract

**Backgroundy**—Percutaneous renal biopsy (PRB) is a safe and valuable procedure in the diagnosis of renal disease. The optimal duration of observation after a PRB has not been established, and patients are frequently hospitalized for overnight observation. We evaluated prospectively the safety of an outpatient PRB protocol at our institution.

**Methods**—During a 20-month period 100 patients underwent PRB using a standardized outpatient protocol. The biopsy was performed by 8 am by Nephrology Fellows under direct faculty supervision. All biopsies were done under real-time ultrasound with a 16-gauge spring-loaded biopsy gun, and followed immediately by color Doppler ultrasound to exclude active bleeding. Blood pressure and heart rate were monitored frequently. Hematocrit and hemoglobin were measured pre-biopsy, and 4, and 8 hours post-biopsy. If there were no complications, the patients were discharged 9 to 10 hours after the procedure.

**Results**—The patient demographics were as follow: 55% African Americans; 60% female; 17% diabetic; 65% hypertensive; mean BMI  $29.8 \pm 7$  (range, 17 to 51). The depth of the kidney from the skin was  $6.8 \pm 2.3$  cm (range, 3 to 13.5 cm). 53 patients required only 1 biopsy pass and 38 needed 2 passes, 5 needed 3 passes and 4 needed 4 passes, with  $12.7 \pm 9.7$  glomeruli obtained per patient. No major complications were encountered. A small perinephric hematoma ( $< 2 \times 2$  cm) was observed post-biopsy in 13 patients (13%). There was no need for vascular intervention or transfusion in any patient. Four patients (4%) were hospitalized for overnight observation due to a decrease in their hematocrit ( $> 4$  from baseline), but none required a transfusion or intervention. No patient required subsequent hospitalization due to late biopsy-related complications.

**Conclusions**—Outpatient, real-time, ultrasound-guided percutaneous renal biopsy is safe and effective, and minimizes the need for post-biopsy hospitalization. Outpatient PRB can result in significant cost savings without exposing the patients to increased risk of complications.

### Keywords

real-time ultrasound; percutaneous renal biopsy; outpatient; safety

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## Introduction

Percutaneous renal biopsy is a valuable procedure for the diagnosis of renal disease. It is helpful in guiding medical therapy, establishing prognosis and for research purposes. However, a renal biopsy may result in serious hemorrhagic complications, requiring additional diagnostic procedures, blood transfusion, vascular interventions, and prolongation of hospitalization (**Donovan KL, Thomas DM**). The optimal duration of observation after a percutaneous renal biopsy has not been established and patients are frequently hospitalized for overnight observation. When performing a renal biopsy, the operator would like to obtain the tissue required for accurate diagnosis, reduce the risk of major hemorrhagic complications and be able to offer a safe environment to the patient. By offering a safe and quality environment and with the present technology, we can provide an excellent service at a lower cost by minimizing the length of stay in the hospital. In most institutions practitioners perform percutaneous renal biopsies either blind or by ultrasound guided techniques, and admit their patients to the hospital for overnight observation. At our teaching institution, we perform renal biopsies under real-time ultrasound guidance with post-biopsy color Doppler evaluation for major bleedings as an outpatient procedure. Although it is often claimed that the major complications occur within the first 24 hours (**Marwah DS, Korbet SM**) (**Whittier WL, Korbet SM**), we think that if a complication is going to happen it would be within the first 8 hours post-biopsy.

During a twenty-month period at our teaching institution, one hundred (100) consecutive patients underwent a percutaneous renal biopsy using a standardized outpatient protocol. A prospective computerized database was used to enter the data. The goal of the present study was to evaluate if real-time ultrasound guided renal biopsies along with color Doppler surveillance was safe as an outpatient procedure.

## Methods

### Study Population

A computerized database was used to prospectively enter date on all outpatient native kidney biopsies performed by the Division of Nephrology at University of Alabama at Birmingham during the twenty-month period from February 1<sup>st</sup>, 2007 to September 30<sup>th</sup>, 2008. Biopsies of transplant kidneys and from the acute renal service were excluded from the analysis. Seven first-year nephrology fellows under the direct supervision of two nephrology faculty members performed all renal biopsies. A total of 100 renal biopsies were performed during the study period. All renal biopsy were performed under real-time ultrasound guidance along with post-biopsy color Doppler surveillance vs. blind procedure) was at the discretion of the faculty member, and was based on their past experience performing a given biopsy.

Renal biopsies were performed after verifying adequate blood pressure control and acceptable coagulation tests. Absolute contraindications to performing a percutaneous renal biopsy included a bleeding disorder, thrombocytopenia (platelet count < 50,000/mm<sup>3</sup>) or polycystic kidney disease. Uncontrolled hypertension (systolic blood pressure > 160 mm Hg or diastolic blood pressure > 100) was treated initially with clonidine 0.1 mgs by mouth and

in severe cases with hydralazine 10 mgs IV prior to the biopsy. Finally, aspirin and anti-platelet agents were withheld 7 days before the procedure.

### **Standardized outpatient protocol**

Nephrologists from either the UAB faculty or from surrounding facilities call the vascular access coordinator to schedule a renal biopsy. Patients are scheduled within 3 to 7 days from the day of call. They are instructed to come to the outpatient setting of interventional radiology/nephrology facility at the hospital by 6 am. Once there, they are admitted as outpatients to private rooms. A cell blood count (CBC), renal function panel, prothrombin time, partial thromboplastin time and a type and cross are obtained. Patients are taken to the nephrology ultrasound suite in the same pre-operative area at around 7:30 am. Their blood pressure, EKG and pulse-oximetry are monitored throughout the procedure. Patients are placed in a prone position on the table.

### **Real-time ultrasound-guided renal biopsy**

Patients are placed in a prone position on the table. The nephrology fellow supervised by a nephrology attending performs an initial diagnostic bilateral renal ultrasound with and without color Doppler. Length and depth are measured and any abnormalities are dictated.

The skin is prepped with antiseptic solution and draped in the customary fashion. A sterile cover is placed over the ultrasound probe and the lower pole of the kidney visualized. The skin and subcutaneous tissue are anesthetized with lidocaine, and a small incision is made in the skin. A Nephrology Fellow performs the biopsy while the attending nephrologist holds the ultrasound probe for real-time guidance. The automated biopsy gun (Bard, 16 or 18 gauge (10, 16 or 20 cm)) with a sampling length of 22 mm is selected. The 16-gauge, 16 cm with 22 mm sample length is used most frequently. Under real-time ultrasound guidance the biopsy needle gun is advanced. Once it is close to the renal capsule, the gun is fired with the patient holding his or her breath (**Figure 1**). The biopsy needle is retrieved and the specimen placed in a media container and sent to surgical pathology. An average of one to two passes are performed per patient.

### **Post-renal biopsy monitoring**

A post-biopsy color Doppler ultrasound imaging is obtained immediately following for the biopsy to exclude active bleeding and at 5 minutes. Patients are taken and monitored in the pre-operative area and kept at bed rest for 8 hours, with blood pressure and heart rate recorded every 30 minutes. All voided urine samples are saved and inspected for gross hematuria. Hematocrit and hemoglobin values are measured at 4 and 8 hours following the biopsy. A second ultrasound or CT scan is obtained if the patient developed hypotension, gross hematuria or abdominal pain. If active bleeding is visualized, the patient undergoes selective renal artery embolization by Interventional Radiology. Blood transfusions were provided when clinically indicated. Patients are discharged after 8 hours of close monitoring and if their hematocrit and hemoglobin levels are stable. They are admitted for observation if a complication occurs. All of them are followed within 2 to 4 weeks by their nephrologists in the outpatient clinic.

## Data Analysis

Approval was obtained from the UAB Institutional Review Board to review the patients' medical records for research purposes. The prospective database included demographic and clinical features, laboratory values, biopsy complications, and diagnostic or therapeutic procedures to manage hemorrhagic complications. In addition, the surgical pathology reports were used to ascertain the adequacy of renal tissue and pathologic diagnosis.

## Statistical analysis

Clinical characteristics and outcomes were recorded.

## Results

The clinical and laboratory characteristics of the patients are in **Table 1**. The patient demographics were as follow: 55% African Americans; 60% female; 17% diabetic; 65% hypertensive; mean BMI  $29.8 \pm 7$  (range, 17 to 51). The outcomes are summarized in **Table 2**. The depth of the kidney from the skin was  $6.8 \pm 2.3$  cm (range, 3 to 13.5 cm). Fifty-three (53) patients required only 1 biopsy pass and 38 needed 2 passes, 5 needed 3 passes and 4 needed 4 passes, with  $12.7 \pm 9.7$  glomeruli obtained per patient, the tissue specimen was adequate in all patients undergoing a real-time ultrasound-guided renal biopsy. No major complications were encountered. A small perinephric hematoma ( $< 2 \times 2$  cm) was observed post-biopsy in 13 patients (13%), which goes along with the literature. There was no need for vascular intervention or transfusion in any patient. Four patients (4%) were hospitalized for overnight observation due to a decrease in their hematocrit ( $> 4$  from baseline), but none required a transfusion or intervention. No patient required subsequent hospitalization due to late biopsy-related complications.

Hematocrits were measured prior to each biopsy and at 4 and 8 hours post-biopsy. There was a drop in hematocrit from the baseline value from  $36 \pm 6.3$  to  $34.2 \pm 5.8$  at 4 hours but remained stable at  $34.3 \pm 5.9$  at 8 hours. The hemoglobin value dropped by 0.6 g/dL from  $12.2 \pm 2.1$  to  $11.6 \pm 2.0$  (**Tables 3 and 4**).

## Discussion

The present study evaluates the outcomes of renal biopsies performed at a single institution under a strict standardized outpatient protocol. We found that real-time ultrasound-guided renal biopsies with a proper and rigorous outpatient protocol can be safely performed. Although the study was not randomized, it was performed prospectively with a proper follow-up of the patients.

The main reason for overnight stay in the hospital is basically as a safety net in case there is a major complication (**Marwah DS, Korbet SM**). The major complication, which one could encounter, is severe bleeding causing a large retroperitoneal hematoma. This complication can be catastrophic and should be addressed immediately by performing a selective renal arteriogram with embolization of the bleeding arteriole, which will infarct a small portion of the kidney. This complication is in the order of 0 to 6 % depending on the author (Marwah DS, Korbet SM) and (Whittier WL, Korbet SM) and (Maya ID Allon M) and (Doyle AJ,

Gregory MC) and (Cozens NJ, Murchison JT) and (Hergessel O, Felten H) and (Burstein DM, Korbet SM); the reasons for these differences are not cleared but may be related to the technique used (blind vs. ultrasound guided biopsy), operator experience, gauge of the biopsy needle and the number of passes. We demonstrated lower frequency of hemorrhagic complications with real-time ultrasound-guided biopsies, as compared with blind biopsies (**Maya ID, Allon M**). Some authors believe that patients are still at risk for type complication beyond the 8 hours observation post-biopsy; we hypothesize that under a controlled environment (see standardized protocol) and a proper technique (real-time ultrasound) we can minimize this risk and be able to have the renal biopsy performed as an outpatient procedure. Also, the use of color Doppler post-biopsy surveillance enhances one's confidence that there is no major bleeding. In our institution, first-year fellows perform all renal biopsies (relatively inexperienced operators). Thus, one might expect a higher frequency of complications. However, that is not the case and it has been demonstrated not only on this study, but also in our prior study (**Maya ID, Allon M**). The use of the real-time ultrasound-guided technique minimizes the risk of major complications even in the hands of inexperienced operators. We documented that the lower risk of hemorrhagic complications with the ultrasound-guided technique may be attributable to the use of smaller biopsy needles (18-gauge), but in the present study the majority of the biopsies were performed with a 16-gauge needles with similar results.

Few published studies have addressed the important issue of safety and length of stay after a percutaneous renal biopsy. Some authors documented this procedure to be safe in the outpatient setting and some authors disagree. Marwak and Korbet reported on 394 patients and concluded that less than 8-hour period observation can miss up to 20% of complications (**Marwah DS, Korbet SM**). In this study all complications (minor and major) were accounted together, only 42% of the patients had the biopsy performed with an automated gun, the rest were performed with a manual biopsy device and all biopsies were performed with 14-gauge needles and there was no report on how many passes were performed. They timed the major complications, which accounted for 24 out of a total of 394 biopsies (6.6%), and reported that 19 of them were observed before the 8-hour mark. Thus, only 5 major complications were captured after 8 hours of observation. Whittier and Korbet re-evaluated the data and reported a series of 750 patients, in which they added the patients from the prior study (**Whittier WL, Korbet SM**). This time, they concluded that less than 8-hour period of observation was not optimal and they reported that it could miss up to 33% of complications. Again, all complications (minor and major) were placed in the same category. Out of 750 biopsies, 45 had a major complication (6.6%). Thirty of them were diagnosed before 8-hours of observation, the other 15 were diagnosed between 9 to 24 hours. On the contrary, there at least four studies showing different results. Farazier and Fairley reported only minor complications in a series of 118 patients (only 2 patients) (**Fraser IR, Fairley KF**). Oviasu E and ugdodaga P, from Nigeria reported in no complications in a series of 20 patients (**Oviasu E, Ugbodaga P**). Murphy BF et al, had similar data (**Murphy BF, MacIsaac A**). Bairy M et al, reported on 178 outpatient renal biopsies and reported no major complications with only 13.2% of minor complications to include 4 patients with gross hematuria, 16 patients with small perinephric hematomas and 3

with both hematuria and hematoma (**Bairy M AJKD 2008**). No interventions were needed and only two patients stayed over night. The current study shows similar results.

Minor complications including small perinephric hematomas and transient gross hematuria are more frequent. Most perinephric hematomas resolve within weeks, they produce no symptomatology and they do not need any intervention. The present study shows that 13% of the patients developed a small hematoma (< 2 by 2 cm) at the time of the biopsy, none of them had transient gross hematuria. The hematomas were observed almost immediately or at the time of the color Doppler ultrasound surveillance exam. None of them required further intervention.

It is a fact that the more passes on the average, the higher the risk for active bleeding. We averaged  $1.6 \pm 0.8$  passes with good adequate renal tissue yield and 100% accuracy. Renal adequate tissue by real-time ultrasound runs between 93 to 100% as compared with a 79% frequency with the blind technique. In our study we obtain 100% adequate tissue. The findings of the current study are consistent with those reported by other investigators. It has been reported that smaller gauge needle sizes (16 or 18) and the use of automated biopsy guns decrease the rate of major complications.

In conclusion, outpatient, real-time, ultrasound-guided percutaneous renal biopsy is safe and effective, and minimizes the need for post-biopsy hospitalization. Outpatient percutaneous renal biopsy can result in significant cost savings without exposing the patients to increased risk of complications.

## Acknowledgments

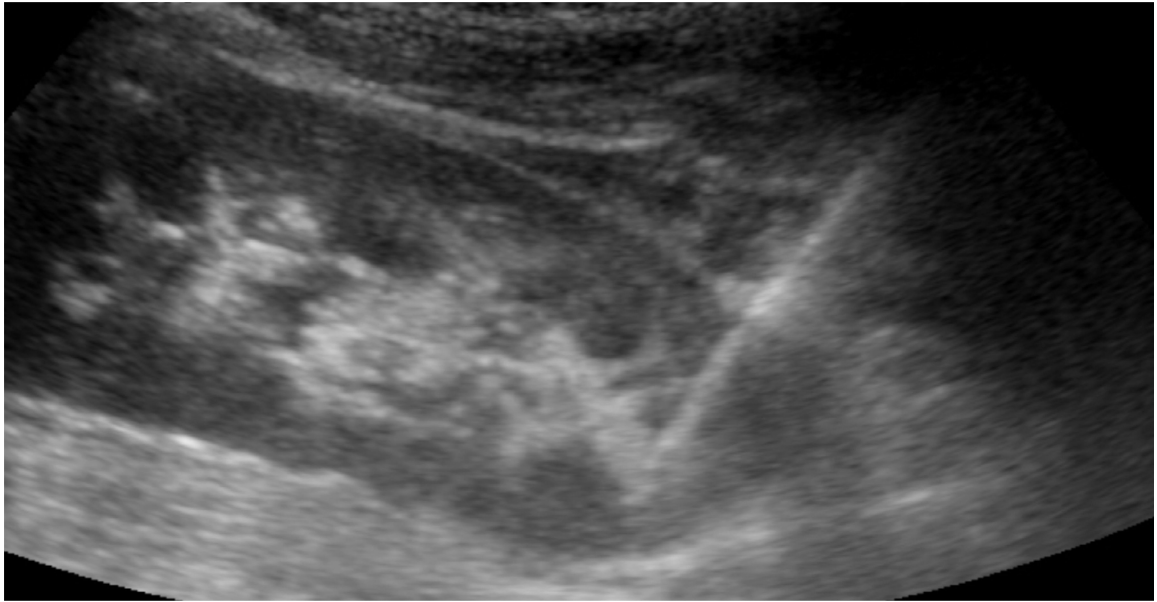
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**Figure 1.**  
Ultrasound image shows the biopsy needle going into the lower pole of the kidney.



**Table 1**

## Clinical features

N pts	100
Age, years	41.93±15.37
Sex, N (%) male	40 (40%)
Race, N (%) white	45 (45%)
Diabetes, N (%)	17 (17%)
Hypertension, N (%)	65 (65%)
Peripheral Vascular Disease, N (%)	8 (8%)
Coronary Artery Disease, N (%)	4 (4%)
Systolic BP (mmHg)	132±15
Diastolic BP (mmHg)	85±10
BMI (kg/m <sup>2</sup> )	29.8 ±7
Obesity (BMI >30 kg/ m <sup>2</sup> ), N (%)	43 (43%)
International normalized ratio (INR)	0.99±0.08
Pre-biopsy Platelets	262,700±83,270
Pre-biopsy hematocrit (%)	36.02±6.3
Pre-biopsy hemoglobin (g/dl)	12.19±2.11
Pre-biopsy serum creatinine (mg/dl)	1.55±1.093

**Table 2**

## Outcomes

N pts	100
Depth of kidney	6.83±2.3 cm
Number of passes	1.6±0.8
Number of pieces	1.24±0.5
Number of glomeruli	12.7±9.7
Was tissue obtained in all patients?	100 %
Patients admitted for observation	4 (4%) Decrease in hct
Small perinephric hematomas	13 (13%)
Large hematoma	0 (0%)
Vascular intervention	0 (0%)
Transfusion TX	0 (0%)
Death	0 (0%)

**Table 3**

Hematocrit and hemoglobin follow-ups

	<b>US-guided biopsy</b>
N pts	100
Pre-biopsy Hct	36.02±6.31
4 hours post-biopsy	34.21±5.82
8 hours post-biopsy	34.34±5.94
Pre-biopsy Hg	12.19±2.11
Final Hg	11.65±1.96

**Table 4**

Hematocrit and hemoglobin follow-ups

<b>Pre-biopsy Hct</b>	<b>8 hours post-biopsy</b>	<b>P value</b>
36.02±6.31	34.34±5.94	0.054
Pre-biopsy Hg	Final Hg	
12.19±2.11	11.65±1.96	0.063