

Value of Immediate Post-Kidney Biopsy Ultrasound in Excluding Late Hemorrhagic Complications

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Abstract

Background Hemorrhage is the most serious potential complication of percutaneous kidney biopsy. Patients are typically observed for at least 6–8 hours after a kidney biopsy, with serial measurements of vital signs and hemoglobin to monitor for major hemorrhage. This study assessed whether an immediate postbiopsy ultrasound can reliably exclude delayed major hemorrhage.

Methods We retrospectively evaluated the clinical outcomes in 147 patients undergoing an outpatient native kidney biopsy with an 18-gauge needle at a large medical center during a 2.5-year period (January 2017 to June 2019). All patients underwent a standardized postbiopsy ultrasound to assess for active extravasation of blood. We extracted from the medical records vital signs and hemoglobin values obtained before the biopsy and at 2, 4, and 6 hours after the procedure. We ascertained whether any patients with a negative postbiopsy ultrasound developed a delayed major hemorrhage.

Results Each patient underwent two or three biopsy passes. The mean patient age was 48 ± 17 years, 49% were female, 37% were black, 53% had hypertension, and 16% had diabetes. Of the 142 patients without evidence of active extravasation on ultrasound, the BP, heart rate, and hemoglobin remained stable during 6 hours of observation. All were discharged after 6 hours, and none had a late bleeding complication.

Conclusions If the immediate postkidney biopsy ultrasound does not show active bleeding, the patient is extremely unlikely to develop a late major hemorrhagic complication (negative predictive value, 100%). Such patients can be discharged home safely after a 2-hour observation, thereby simplifying their management.

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Introduction

Percutaneous kidney biopsy is an essential tool in the management of many kidney diseases. It can help to establish the diagnosis, guide specific therapy, and determine prognosis. One of the most feared complications of kidney biopsy is hemorrhage, which, in severe cases, may require blood transfusion, arterial embolization, or even nephrectomy. The protocol for patient monitoring after an elective renal biopsy is highly variable among medical centers (1–7). Some centers observe patients overnight, others observe as an outpatient for 6–8 hours, and still others observe for shorter periods of time. The optimal duration of observation after a kidney biopsy remains controversial. Multiple studies have demonstrated that use of an automated biopsy gun and real-time ultrasound reduces the frequency of hemorrhagic complications, and this approach has become the standard of care in most centers (8). Given recent improvements in image quality with newer ultrasound machines, it may be possible to identify immediately after a kidney biopsy patients with active extravasation of blood. We evaluated in a retrospective study at a large academic medical center whether an immediate postbiopsy

ultrasound negative for active extravasation can exclude delayed major hemorrhage.

Materials and Methods

Native Kidney Biopsy Management Protocol

All native kidney biopsies were scheduled by two access coordinators, who maintained a prospective, computerized database of the procedures and their complications (9). Patients requiring elective percutaneous kidney biopsy were fasted overnight for 8 hours. The biopsy was performed in an ultrasound suite adjacent to the hospital's interventional radiology suites. Contraindications for elective kidney biopsy included a known bleeding disorder, thrombocytopenia (platelet count $< 50,000/\text{mm}^3$), or morbid obesity (body mass index $> 40 \text{ kg}/\text{m}^2$). If the patient was taking an antiplatelet or anticoagulation agent, it was held for 5 days before the kidney biopsy. The patients arrived about 1 hour before their scheduled biopsy time. A complete blood count, prothrombin time, partial thromboplastin time, and blood type and cross were obtained. Patients with poorly controlled hypertension (systolic BP $> 160 \text{ mm}$

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Table 1. Clinical characteristics of the study population

Characteristic	Value
Patients, <i>n</i>	147
Age, yr (mean±SD)	48±17
Male sex, <i>n</i> (%)	51 (35%)
Black race, <i>n</i> (%)	55 (37%)
Hypertension, <i>n</i> (%)	78 (53%)
Diabetes, <i>n</i> (%)	24 (16%)
Systolic BP, mm Hg (mean±SD)	134±17
Diastolic BP, mm Hg (mean±SD)	81±12
Heart rate/min (mean±SD)	78±15
Prebiopsy hemoglobin, g/dl (mean±SD)	12.3±2.0
Prebiopsy platelet count (× 1000/mm ³)	241±72
eGFR (ml/min per 1.73 m ²)	43±18
Urine protein/creatinine ratio	2.3±3.3
Kidney pathology, <i>n</i> (number of patients)	
Diabetic nephropathy	11
Lupus nephritis	23
Primary GN	55
ATN	10
AIN	2
Thin basement membrane disease	29
Myeloma	3
Fabry disease	5
Other	9

ATN, acute tubular necrosis; AIN, acute interstitial nephritis.

Hg or diastolic BP >100 mm Hg) were treated with intravenous hydralazine (10 mg) or labetalol (10 mg) to lower their BP before the biopsy.

Two experienced interventional nephrologists (A.A.-B. and A.A.) supervised the kidney biopsies, most of which were performed by one of 12 nephrology fellows. The patients received moderate sedation with fentanyl (50 µg) and midazolam (1 mg) administered by a registered nurse. The patient's BP, cardiac rhythm, and pulse oximetry were monitored continuously throughout the procedure. The skin was cleansed with an antiseptic solution and draped with sterile drapes. A sterile sleeve cover was placed over the ultrasound probe, and the lower pole of the kidney was visualized. The skin and subcutaneous tissue were anesthetized with 1% lidocaine, and a small incision was made in the skin using a scalpel. An automated biopsy gun (Bard 18-gauge 20 cm) was used under real-time ultrasound guidance. Once the needle was visualized at the kidney capsule, the biopsy gun was fired with the patients holding their breath. The biopsy needle was retrieved, and the specimen placed in a media container for surgical pathology. Most patients underwent two or three biopsy passes.

A postbiopsy color Doppler ultrasound imaging was obtained immediately after the biopsy to exclude any active bleeding. The patients were then returned to a postprocedure recovery observation area, where they were fed and kept at bed rest for 6 hours. The BP and heart rate were recorded every 30 minutes. All voided urine samples were inspected for gross hematuria. Hemoglobin values were measured at 2, 4, and 6 hours after the biopsy. If the vital signs and hemoglobin values remained stable, the patient was discharged home after 6 hours of observation. A nurse called the patients 1–

2 days after their biopsy to ask about symptoms or complications.

Patients whose immediate postbiopsy ultrasound revealed active extravasation of blood were hospitalized for observation, regardless of whether there was hemodynamic instability or a substantial decrease in hemoglobin level. In addition, if the nephrologist had any other clinical concerns about the patients, they were also admitted for observation.

Data Collection

We queried the prospective procedure database, and identified all patients who underwent elective outpatient kidney biopsies between January 2017 and June 2019 at the University of Alabama at Birmingham, a large academic medical center. A total of 147 outpatient native kidney biopsies were performed during this time period. Institutional review board approval was obtained before review of the patients' medical records for research purposes. The following clinical data were extracted from the computerized medical records: patient demographics and comorbidities, vital signs, laboratory values, biopsy complications, and diagnostic or therapeutic procedures to manage hemorrhagic complications.

Statistical Analyses

We calculated the mean systolic BP, diastolic BP, heart rate, and hemoglobin of the patients obtained prebiopsy and 2, 4, and 6 hours after the procedure. The changes in these parameters relative to the prebiopsy values were analyzed by paired *t* tests.

Results

The study cohort included 147 patients undergoing elective, outpatient native kidney biopsy. The demographic and clinical characteristics of the patients are summarized in Table 1. The mean patient age was 48±17 years, 49% were female, 37% were black, 53% had hypertension, and 16% had diabetes. The pre- and postkidney biopsy vital signs and hemoglobin values are summarized in Table 2. The systolic BP decreased slightly, but significantly, between the prebiopsy measurement and the 2-hour postbiopsy measurement, but was subsequently stable. The diastolic BP and heart rate remained stable throughout the observation period. The patient's hemoglobin values decreased slightly, but significantly, between the prebiopsy measurement and the 2-hour postbiopsy measurement, but was subsequently stable.

Of the 147 patients included in this study cohort, 142 had no evidence of hemorrhage detected on the immediate postbiopsy ultrasound (*i.e.*, no active extravasation of blood). These patients were discharged home after 6 hours of observation. None were readmitted with a late hemorrhagic complication.

Five patients were admitted for observation. Four of them had active extravasation of blood seen in the immediate postoperative ultrasound (Figure 1). In these four patients, the ultrasound also showed a perinephric hematoma. One patient required blood transfusion, and none required arterial embolization. The fifth patient was admitted because of severe pain at the biopsy site.

Table 2. Pre- and postbiopsy vital signs and hemoglobin values

Vital Sign	Prebiopsy	Postbiopsy		
		2 h	4 h	6 h
Systolic BP (mm Hg)	134±17	127±16 ^a	125±15 ^a	126±16 ^a
Diastolic BP (mm Hg)	81±12	79±13	77±11	77±12
Heart rate (bpm)	78±15	76±14	74±12	76±13
Hemoglobin (g/dl)	12.3±2.0	11.6±2.0 ^a	11.5±2.1 ^a	11.4±2.2 ^a

Values are mean±SD.
^a*P*<0.001 versus prebiopsy values.

Discussion

Major postkidney biopsy hemorrhage may be life threatening, and occasionally requires blood transfusion or selective embolization of the bleeding artery (8). This concern justifies routine postbiopsy observation; however, the optimal duration of such monitoring remains unclear. Previous studies suggested that an observation time of 8 hours was sufficient, thereby avoiding the requirement for routine overnight hospitalization (1–4). However, none of these studies addressed the potential role of an immediate postkidney biopsy ultrasound in excluding late onset hemorrhage. Accordingly, this study assessed the value of an immediate postkidney biopsy ultrasound in excluding late major hemorrhagic complications. In our cohort, among the 142 patients without evidence of active extravasation of blood on the postbiopsy ultrasound, none developed late major hemorrhage (100% negative

predictive value). Thus, such patients could be discharged home after a 2-hour observation, thereby simplifying their postbiopsy management.

Notably, there was an initial mild drop in systolic BP, which stabilized after 2 hours of observation. This initial decrease was likely related to the prebiopsy sedation, rather than to hemorrhage, consistent with the stabilization of the BP in the ensuing 4 hours. Furthermore, there was an initial mild (0.7 gm/dl) drop in hemoglobin between the prebiopsy value and the 2-hour measurement, but the hemoglobin stabilized during the subsequent 4 hours of observation.

The current study has several strengths. First, all patients were treated with a standardized pre- and postbiopsy protocol. Second, all vital signs, hemoglobin values, postbiopsy ultrasounds and clinical outcomes were recorded prospectively in the electronic medical record, thereby ensuring completeness of the data. Third, because the majority of biopsies were performed by nephrology trainees under the supervision of an interventional nephrologist, our findings would likely apply to less experienced operators.

Our study also has some limitations. First, it was restricted to elective outpatient kidney biopsies, and the findings may not apply to inpatient kidney biopsies. Second, our study was restricted to native kidney biopsies, and the results may not generalize to patients undergoing transplant kidney biopsies. Third, we excluded high-risk patients, such as those with morbid obesity and bleeding diatheses, in whom the bleeding risk after a biopsy may be greater. Finally, the findings from this single-center study may not generalize to some practice settings.

If the immediate postkidney biopsy ultrasound does not show active bleeding, the patient is extremely unlikely to develop a delayed major hemorrhagic complication. Such patients can be discharged home safely after a 2-hour observation, thereby simplifying their postbiopsy management.

Disclosures

All authors have nothing to disclose.

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Author Contributions

A. Al-Balas was responsible for data curation, methodology, and wrote the original draft; A. Almeheem and M. Allon were responsible

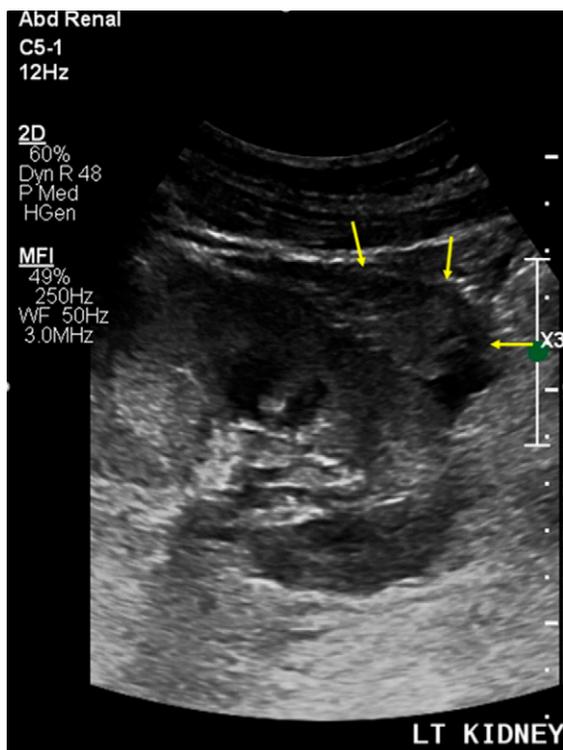


Figure 1. | Postbiopsy ultrasound showing a perinephric hematoma (arrows). 2D, two dimensional; Abd, abdominal; MFI, mean fluorescence intensity.

for validation; A. Al-Balas, A. Almekhi, and M. Allon conceptualized the study and reviewed and edited the manuscript; and M. Allon was responsible for formal analysis.

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