

The Risks Associated With Percutaneous Native Kidney Biopsies (NKBs) in a Tertiary Care Hospital

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Abstract: Percutaneous native kidney biopsy (NKB) remains a cornerstone for the histopathological diagnosis of renal diseases. While it is generally considered a safe and effective procedure, the risk of complications—particularly bleeding—necessitates a careful evaluation of its safety profile in local healthcare settings. **Objective:** To assess the frequency and types of complications associated with percutaneous native kidney biopsies performed under real-time ultrasound guidance in a tertiary care center. **Methods:** This prospective observational study was conducted at a tertiary care hospital from September 2024 to March 2025. A total of 209 patients scheduled for percutaneous NKB were enrolled using non-probability consecutive sampling. Biopsies were performed under real-time ultrasound guidance using automated biopsy devices. Patients were monitored for complications up to 24 hours post-procedure. Complications were categorized as major (e.g., requirement for blood transfusion, angioembolization, prolonged hospitalization >24 hours, surgical intervention, or procedure-related death) or minor (e.g., self-limiting hematuria or small hematomas). Data were analyzed using SPSS Version 25, with descriptive statistics reported as frequencies and percentages. **Results:** The mean age of participants was 43.2 ± 16.5 years, and 119 (56.9%) were male. Minor complications were noted in 15 patients (7.1%), including small hematomas in 8 (3.8%) and transient hematuria in 7 (3.3%). Major complications occurred in 12 patients (5.7%). Of these, 5 (2.4%) required blood transfusion, 2 (0.9%) developed major hematomas, 2 (0.9%) experienced prolonged hospitalization, and 1 (0.5%) each required repeat biopsy or intervention due to inadequate specimens. No deaths were reported. **Conclusion:** Percutaneous NKB is a reliable and generally safe diagnostic procedure for renal pathology. Although minor complications such as transient bleeding are relatively common, serious adverse events remain infrequent. Continued adherence to real-time imaging and post-procedural monitoring protocols is recommended to further minimize risk.

Keywords: Native kidney biopsy, complications, hematoma, blood transfusion

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Introduction

The technique of native kidney biopsy (NKB) for native kidneys was established in the 1950s by Iversen and Brun, with subsequent modifications by Kark and Muehrcke (1). Renal biopsies have been a crucial element in clinical practice and nephrology research for over six decades. This procedure provides critical diagnostic and prognostic insights that are essential for developing effective treatment plans (2). Since its introduction, numerous technological advancements have enhanced the process of renal biopsies, leading to improved diagnostic accuracy and increased safety. Today, many medical institutions utilize real-time ultrasound guidance and automated devices to conduct these biopsies effectively (3, 4).

Advancements in imaging technology and the design of biopsy needles have made it possible to obtain sufficient renal tissue for diagnostic purposes in more than 99% of kidney biopsy procedures. These enhancements have also contributed to the overall safety of the process, with the incidence of severe complications leading to death significantly declining from 0.12% to just 0.02% over the last six decades (5, 6). Moreover, in the past two decades, fatalities associated with percutaneous renal biopsies of native kidneys have become exceedingly uncommon (7-9).

Even with the implementation of modern technology and better safety measures, clinically significant bleeding complications remain a concern. Some studies have reported that the incidence can soar as high as 25% to more than 30% (5).

Most complications typically resolve on their own and do not require additional treatment. However, in some cases—approximately 9% of

biopsies—complications can be more severe and may pose a serious threat to life, thereby requiring medical intervention (10, 11).

Variation in complication rates across different studies can be significant and challenging to interpret due to various confounding factors. These factors may include the study design (whether it's retrospective or prospective), the demographics of the patient population, the imaging techniques employed, the type or gauge of the needle used, as well as the qualifications of the individual performing the biopsy. In order to deepen our understanding of the success rates and complications related to the preservation of renal function in native kidneys, we undertook this research to assess the complications associated with native kidney biopsy within a tertiary care setting.

Methodology

This study was thoughtfully designed as a prospective investigation and was carried out at the renowned Armed Forces Institute of Urology (AFIU) Rawalpindi. The research spanned from September 2024 to March 2025 and involved a cohort of 209 patients who met the inclusion criteria for participation. Prior to the study, all patients were provided with comprehensive information regarding the biopsy procedure and its implications. Each participant willingly provided their written consent, ensuring that ethical standards were upheld throughout the study.

The procedures were carried out utilizing real-time ultrasound guidance along with automated percutaneous instruments, conducted by a consultant Urologist. A 16-gauge or 18-gauge needle was employed to collect two tissue samples, which were then processed independently for both light microscopy and immunofluorescence analysis. Following the



procedure, patients were monitored for 24 hours to ensure their well-being.

Complications from the procedure were classified into two categories: major and minor. Major complications encompassed several serious issues, including the necessity for blood transfusions, the requirement for angiembolization, prolonged hospitalization exceeding 24 hours, the need for additional surgical procedures, and any fatalities directly associated with the procedure. On the other hand, minor complications were characterized by less severe events, such as temporary episodes of gross hematuria or small hematomas that resolved on their own without the need for transfusions or medical intervention, and which did not result in hospitalization lasting more than 24 hours.

All data were inputted and analyzed using SPSS version 27. Continuous variables were presented as means with their corresponding standard deviations, while qualitative variables were reported as numbers along with their corresponding percentages.

Results

In this study, the baseline characteristics of the participants included an average age of 43.2 (± 16.5) years. The gender distribution showed that 119 (56.9%) were male. The mean weight was 71.3 kg (± 14.8), and hemoglobin levels averaged 11.2 g/dL (± 2.3). The platelet count stood at $261 \times 10^3/\mu\text{L}$ (± 45), while serum creatinine levels averaged 2.6 mg/dL (± 0.83). For coagulation parameters, the activated partial thromboplastin time (aPTT) had an average of 29.1 seconds (± 4.3), and the prothrombin time (PT) averaged 11.2 seconds (± 1.7) Table 1

on the complications of NKB, minor complications occurred in 15 cases (7.1%), with small hematomas reported in 8 instances (3.8%) and hematuria in 7 instances (3.3%). Major complications were less frequent,

Discussion

In our investigation, we evaluated a total of 209 patients of NKBs, the overall complication rate observed was 12.9%. Among these complications, major issues arose in 5.7% of the patients, while minor complications were noted in 7.1% of cases.

In a comprehensive study conducted by Azhar and colleagues in Peshawar, Pakistan, researchers examined a total of 200 percutaneous kidney biopsies (PKBs) to assess the rates of complications associated with this procedure. Their findings revealed that 10% of the patients experienced complications following the biopsy. These complications were categorized as minor in 8% of the cases, while major complications were observed in 2% of patients, indicating that while such procedures are generally safe, there is a notable risk involved (12).

Similarly, another significant study was performed in India, where researchers reviewed data from 320 renal biopsies conducted on 305 patients over a span of five years. This study aimed to evaluate the efficacy and safety of renal biopsies in obtaining sufficient tissue for pathological evaluation. The results indicated that adequate tissue samples for accurate pathological diagnosis were successfully obtained in approximately 79% of the biopsies performed. Moreover, the overall complication rate was found to be 6.8%, which demonstrates that while renal biopsies often yield valuable diagnostic information, there is still a measurable risk of adverse events associated with the procedure (13).

In a comprehensive systematic review conducted by Corapi and colleagues, the authors analyzed data from a total of 34 studies, both retrospective and prospective, involving 9,474 adults who underwent native kidney biopsies guided by real-time ultrasound. This thorough investigation aimed to assess the safety and complication rates associated with this commonly utilized diagnostic procedure. The findings revealed the incidence of various bleeding complications that can arise following kidney biopsy, providing valuable insights into the risks involved. According to their results, approximately 3.5% of patients experienced transient macroscopic hematuria. The study indicated that about 0.9% of the patients required blood transfusions to manage significant blood loss.

affecting 12 cases (5.7%). Among these, blood transfusions were needed in 5 patients (2.4%), while major hematomas were observed in 2 patients (0.9%). Additionally, there were cases of inadequate biopsy specimens and a need for reintervention, each occurring in 1 patient (0.5%). Prolonged hospitalization was also noted in 2 patients (0.9%) Table 2

Table 1. Baseline Study Characteristics

Age (Y)	43.2 \pm 16.5
Male Gender	119 (56.9%)
Weight (Kg)	71.3 \pm 14.8
Hemoglobin (g/dL)	11.2 \pm 2.3
Platelets ($\times 10^3/\mu\text{L}$)	261 \pm 45
Serum Creatinine (mg/dL)	2.6 \pm 0.83
aPTT (sec)	29.1 \pm 4.3
PT (sec)	11.2 \pm 1.7

PT=Prothrombin time, aPTT=activated partial thromboplastin time

Table 2. Complications of Native Kidney Biopsy

Minor Complications (%)	15 (7.1%)
Small Hematoma	08 (3.8%)
Hematuria	07 (3.3%)
Major Complications (%)	12 (5.7%)
Blood Transfusion	05 (2.4%)
Major Hematoma	02 (0.9%)
Inadequate Biopsy specimen	01 (0.5%)
Need for reintervention	01 (0.5%)
Prolonged Hospitalization	02 (0.9%)

In an even smaller subset, approximately 0.6% of individuals needed angiographic intervention. The statistics also highlighted exceedingly rare, yet serious, outcomes; for instance, nephrectomy, or surgical removal of the kidney, was required in 0.01% of cases. The mortality rate associated with these procedures was recorded at just 0.02% (14).

Mishra and colleagues noted that complications occurred in 5.8% of cases, with the majority being minor in nature (15). In a separate study conducted by Jiang and his team, which examined 475 biopsy procedures, the overall complication rate was found to be 8.2%. This included 6.9% classified as minor complications and 1.3% considered major (16). In a comprehensive study conducted by Whittier and colleagues, a total of 750 percutaneous kidney biopsies (PKBs) were performed on patients with native kidneys over a span of two decades. Within this extensive cohort, complications were observed in approximately 13% of the cases. Notably, among these complications, 6.4% were classified as major events, underscoring the potential risks associated with the procedure (17). In contrast, a different study led by Toledo and his team reported a significantly lower incidence of major complications, with their findings indicating that such severe adverse events occurred in less than 1% of their patient population (18).

A comprehensive systematic review and meta-analysis conducted by Poggio et al. examined 87 studies with a total of 118,064 biopsies. The findings revealed that pain at the biopsy site was reported in 4.3% of patients, while 1.6% experienced bleeding that necessitated blood transfusions. Additionally, 0.3% of the cases required interventions to control bleeding. Importantly, the analysis indicated that mortality linked to native kidney biopsies was rare, occurring in only about 0.06% of all procedures, and even lower at 0.03% for outpatient biopsies (5).

In a detailed meta-analysis by Kajawo et al., researchers evaluated 39 studies that encompassed 19,500 kidney biopsies performed in low and middle-income countries. The analysis revealed an overall complication rate of 14.9%. Among the significant complications, the study found that macroscopic hematuria occurred in 1.48% of cases, while nephrectomy was needed in 0.04%. Additionally, 0.24% of patients experienced blood loss that required a red cell transfusion, and 0.22% needed angiographic

intervention. Tragically, the analysis recorded a mortality rate of 0.01% (11).

Collectively, these studies highlight the varying complication rates associated with NKB procedures, suggesting that continual assessment, technological advancement, and refined techniques are pivotal in enhancing patient safety and outcomes. This emphasis on understanding both major and minor complications allows for a more nuanced approach to patient care, where risks can be strategically managed, thus fostering a safer environment for NKBs.

Conclusion

NKB is a trustworthy technique for diagnosing kidney diseases through histological examination, boasting a strong success rate. Although it is mostly a safe procedure, the main risk it carries pertains to bleeding. Fortunately, serious complications are infrequent.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-TCAD-0348-24)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Manuscript drafting, Study Design,

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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