

Evaluation and optimization of renal biopsy practice in a university hospital: a two-cycle study

Omneya S. Hassan^a, Osama M. Refai^a, Samr Kolkas^b, Habiba Elshabrawi^b, Andrew Tharwat^b, Aya Abdelrahman^b, Basma Ibrahim^b, Lara Abouegla^b, Lobna Gebril^b, Mariam Ahmed^b, Mina Shenouda^b, Salma Elsanhory^b, Sara Hassan^b, Sara T. Ibrahim^a

^aDepartment of Nephrology and Internal Medicine, Faculty of Medicine, Alexandria University, ^bAlexandria University Hospitals, Internal Medicine Department, Alexandria, Egypt

Correspondence to Sara T. Ibrahim, 121 Zakaryeia Ghoneim Street, Ibrahimia, Alexandria, Egypt
Zip code: 21525
Tel: +20 115 065 4036;
E-mail: sarataha_86@yahoo.com

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Introduction

Renal biopsy is one of the most common procedures performed in the Nephrology Department. Therefore, it is crucial to adhere to the standard procedural guidelines to ensure patient safety and reduce the risk of complications. This study was conducted to evaluate current renal biopsy practices in the Nephrology Department in our university hospital and assess the impact of targeted educational interventions on procedural technique and adherence to established protocols.

Patients and methods

Two cycles were conducted to evaluate every aspect of the procedure, including preprocedure, during the procedure, and postprocedure, and to compare them to the guidelines. Improvement measures were implemented between the two cycles, and the degree of practice improvement was measured.

Results

Most of the evaluation items were improved in the second cycle. Items with significant statistical improvement were patient education before the procedure ($P = 0.004$), urinary bladder emptying ($P \leq 0.001$), usage of sterile equipment and patient protective equipment ($P \leq 0.001$, $P = 0.043$, respectively), as well as writing clear instructions on discharge ($P \leq 0.001$).

Conclusion

The study demonstrated meaningful improvement in several critical areas of renal biopsy preparation and follow-up in the second cycle. However, efforts should continue to ensure complete implementation of the guidelines.

Keywords:

audit, guidelines, renal biopsy

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Introduction

Renal biopsy is a procedure that involves obtaining a sample of renal tissue for diagnosis, treatment, and prognostic purposes. It can be done for native kidneys, transplanted kidneys, or renal masses [1]. Examples of renal biopsy indications in adults are nephrotic syndrome, nephritic syndrome, unexplained renal impairment, and urinary abnormalities in the context of systemic diseases, such as systemic lupus erythematosus and vasculitis [2].

Before a renal biopsy, a comprehensive clinical evaluation and laboratory investigations are done to identify patients at risk for complications. Recommended laboratory investigations include complete blood count, renal function tests, prothrombin time, and partial thromboplastin time. The patient's blood pressure should be adequately controlled, and antiplatelet agents and anticoagulants must be withheld for an adequate time before the procedure [3,4].

Contraindications to performing a percutaneous renal biopsy include bleeding diathesis, small kidneys, multiple

cortical cysts, hydronephrosis, urinary tract infection, severe uncontrolled hypertension, significant anemia, an uncooperative patient, and a solitary kidney [3,5].

Bleeding is the most common complication of renal biopsy, which may occur in different areas of the kidney, such as the collecting system, the renal capsule, or the perinephric space. Clinically serious bleeding is usually observed within 12–24 h of the procedure [4,5]. The risk of bleeding could be reduced by adequate blood pressure control, anemia correction, and management of any underlying coagulopathy [6].

Pain is another common complication of renal biopsy. Persistent pain may occur due to occlusion of the ureter by a blood clot or stretching of the renal capsule by a subcapsular hematoma [4]. Other less frequent

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complications include: arteriovenous fistulas [7], chronic hypertension due to the “Page kidney” phenomenon, which occurs when there is a large subcapsular hematoma causing continuous activation of the renin–angiotensin system [8]. Rarely, injury to adjacent organs such as the liver, spleen, or pancreas may occur.

Renal biopsy is a commonly performed procedure in the Nephrology Department. Therefore, it is crucial to adhere to standard procedural guidelines to ensure patient safety, diagnostic accuracy, and reduce the risk of complications. This study was conducted to evaluate current renal biopsy practices in the Nephrology Department in our university hospital and assess the impact of targeted educational interventions on procedural technique and adherence to established protocols.

Patients and methods

This study was done in sequential phases

Phase 1

Establishment of evaluation standards: a comprehensive literature search was carried out to identify suitable guidelines for the renal biopsy procedure. The Kidney Health Australia-Caring for Australians with Renal Impairment (KHA-CARI) guidelines [9] were selected as it encompasses all the important steps in the renal biopsy procedure, starting from patient education till the final follow-up of the patient after the procedure. To facilitate the evaluation process, the guidelines were adapted into a structured evaluation form to be used by the evaluating house officers. The evaluation form was divided into three main domains: preprocedural preparation, including patient education, informed consent, blood pressure measurement, bladder emptying, management of anticoagulant and antiplatelet therapy, as well as assessment of coagulation profile and platelet count.

Then during the procedure itself, including availability of sterile equipment and doctor protective equipment, patient positioning, administration of local anesthesia, execution of procedural steps with aseptic technique (proper skin and ultrasound probe sterilization) and performance of follow-up ultrasound, application of adequate postbiopsy compression, and appropriate handling and transport of biopsy specimens to the pathology laboratory. Finally, postprocedural care and monitoring, including duration of bed rest, timing of discharge, blood pressure monitoring, and provision of clear written discharge instructions. Furthermore, data on biopsy indications and any procedure-related complications were collected. The detailed evaluation form is provided in the supplementary materials.

Phase 2

Assessment of current practice in relation to the standard (evaluation cycle 1): a group of dedicated house officers attended every renal biopsy performed in our Nephrology Department over 2 months and completed an evaluation form for each procedure. To minimize observer-related bias and ensure accurate assessment of routine practice, the physicians performing the renal biopsy were not informed about this evaluation, and the house officers participated as nonintrusive observers.

Phase 3

Implementation of improvement interventions: based on the findings from evaluation cycle 1, areas of nonadherence to guidelines were identified, and the following measures were implemented to address them. Educational sessions on renal biopsy technique were delivered to the doctors during weekly departmental meetings. Trainees received leaflets summarizing the guidelines. All procedures in the study were conducted in accordance with the ethical standards of the Faculty of Medicine, Alexandria University research committee (IRB approval number 00012098), and the 1975 Declaration of Helsinki and its later amendments, or comparable ethical standards. A written consent form was developed and printed for patients to sign before the procedure. Leaflets outlining prebiopsy and postbiopsy care, written in simple language, were prepared for distribution to patients before the procedure. Finally, the administration was notified about equipment and material shortages to ensure regular restocking.

Phase 4

Reassessment of practice (evaluation cycle 2): after 2 months of implementing the improvement interventions, the house officers conducted a second evaluation cycle for a subsequent cohort of 21 consecutive patients.

Statistical analysis

Data was analyzed using SPSS, version 26 (IBM Corp., New York 10504, United States). Results from the first and second evaluations are expressed as frequencies and percentages. For comparison between the two groups, the χ^2 test or Fisher's exact test was used as appropriate. A *P* value less than 0.05 was considered statistically significant in all.

Results

Twenty-one evaluation forms were collected from the first evaluation cycle, and another 21 were collected from the second evaluation cycle. The main indication for renal biopsies from both cycles was lupus nephritis (70%), followed by nephrotic syndrome (15%), nonlupus glomerulonephritis (10%), and undiagnosed renal impairment (5%).

First evaluation cycle's results

Adequately performed items included preprocedure blood pressure measurement, which was done in 90% ($n = 19/21$) of biopsies and cases with high blood pressure were postponed. Platelet and coagulation profiles were done adequately within 48 h to 1 week before the biopsy in 85% ($n = 18/21$) of cases and considered in adequate in the remaining 15% ($n = 3/21$) as the results were from 10 days before the biopsy day. Withholding anticoagulation before the procedure for patients who were receiving it, patient positioning, local anesthesia, and procedural steps (from ultrasound examination to needle removal) were all done in 100% ($n = 21/21$) of biopsies.

Areas requiring improvement included patient education (14.3%; $n = 3/21$), incomplete or absent written consent (81%; $n = 17/21$ signed; others oral only), and lack of bladder emptying instructions. Full sterile equipment was available in only 52% ($n = 11/21$) of procedures as in the rest of the cases, the sterile cover for the ultrasound probe was not available; a sterile glove was used instead, and the sterile surgical drape used to cover the patient was not available in all cases; a sterile towel was used instead. Adequate postbiopsy compression was achieved in 67% ($n = 14/21$). Although all specimens were sent to pathology, only 62% ($n = 13/21$) included detailed clinical information. Postbiopsy blood pressure monitoring was suboptimal (19%, $n = 4/21$ hourly), and no patients received written discharge instructions.

Four (19%) patients had minor complications such as pain and temporary hematuria after the biopsy, and two (9.5%) had a perinephric hematoma that resolved with rest and follow-up without any intervention.

Second evaluation cycle's results compared to first cycle's results

A detailed comparison between the first and second cycles' results is shown in Table 1.

Preprocedural domain

Patient education before the procedure showed significant improvement to 62% ($n = 13/21$) of biopsies in the second cycle compared to 14% ($n = 3/21$) in the first cycle, with a P value of 0.004. Bladder emptying before the procedure showed significant improvement to 73% ($n = 11/15$) of noncatheterized patients compared to 0% in the first cycle, with a P value of 0.001. Although consent form clarity improved with fewer missing or invalid consents [only 10% ($n = 2/21$) compared to 19% ($n = 4/21$) in first cycle], also measuring blood pressure before the procedure and assessment of platelet count and international normalization ratio were done adequately for all patients [100% ($n = 21/21$) compared to 90% ($n = 19/21$) and 86% ($n = 18/21$), respectively

in first cycle], there were no statistical significance differences between first and second cycles regarding these items with P values of 0.663, 0.488, and 0.231, respectively. Anticoagulation management remained optimal [both cycles was 100% ($n = 21/21$)].

Procedural domain: availability of sterile equipment and operator protective equipment improved significantly [100% ($n = 21/21$) and 86% ($n = 18/21$) vs. 52% ($n = 11/21$); $P < 0.001$ and 0.043, respectively]. Postbiopsy compression (71%; $n = 15/21$ vs. 67%; $n = 14/21$) and pathology reporting (81%; $n = 17/21$ vs. 62%; $n = 13/21$) improved without statistical significance ($P = 0.738$ and 0.305, respectively). All other procedural steps remained optimal (100%; $n = 21/21$).

Postprocedural care

Monitoring blood pressure hourly postbiopsy showed a little, nonsignificant improvement in the second cycle (33%; $n = 7/21$) compared to the first cycle (19%; $n = 4/21$) with a P value of 0.484. However, delivery of clear written instructions to patients on discharge showed significant improvement in the second cycle (86%, $n = 18/21$) compared to the first one (0%) with a P value of less than 0.001.

As regards biopsy complications, there was no statistically significant difference between the second cycle and the first cycle regarding minor (14.3%; $n = 3/21$ and 19%; $n = 4/21$, respectively) and major complications (4.8%; $n = 1/21$ and 9.5%; $n = 2/21$, respectively), with a P value of 1 for both, where minor complications were defined as pain or hematuria not requiring blood transfusion and major complications were defined as perinephric hematoma or hematuria requiring blood transfusion, angiographic intervention, or surgery (Fig. 1).

Discussion

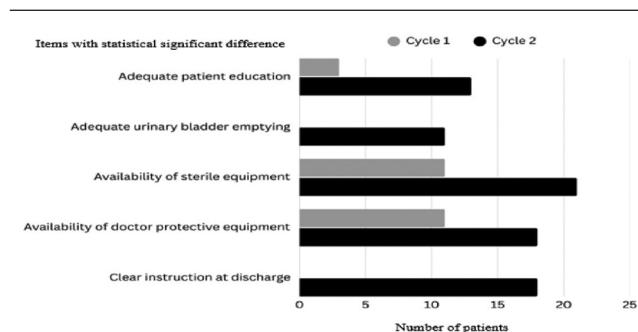
This study evaluated renal biopsy practices in a tertiary university hospital using a structured two-cycle audit design [10] and demonstrated that targeted educational and system-based interventions can significantly improve adherence to procedural guidelines. The most notable improvements were observed in patient education, preprocedural bladder emptying, availability of sterile equipment, and provision of written discharge instructions. However, other domains, particularly postprocedural monitoring, showed limited or nonsignificant improvement, highlighting persistent gaps in practice.

The significant improvement in patient education (14–62%) reflects the direct impact of structured educational interventions, including lectures and patient-directed leaflets. This finding is consistent with quality improvement literature, where simple

Table 1 Summary of the evaluation cycles' results and comparison between them

Evaluation criteria	Evaluation cycle 1 (n=21) [n (%)]	Evaluation cycle 2 (n=21) [n (%)]	P
Preprocedure			
Adequate patient education	3 (14.3)	13 (62)	0.004
Written consent before the procedure, done adequately	17 (81)	19 (90)	0.663
BP measured preprocedure, done adequately	19 (90)	21 (100)	0.488
Urinary bladder emptying before procedure, done adequately	0 ^a	11 (73) ^b	<0.001
Anticoagulants stopped adequately before the procedure	21 (100)	21 (100)	1.000
Platelet count $\geq 50\ 000$ & INR <1.5, done adequately	18 (86)	21 (100)	0.231
During procedure			
Sterile equipment (table cover, sponges, gauze pads, surgical scalpel blade, syringe), done adequately	11 (52)	21 (100)	<0.001
Doctor equipment (sterile gloves, eye protection, surgical caps, and surgical masks), done adequately	11 (52)	18 (86)	0.043
Patient positioning, done adequately	21 (100)	21 (100)	1.000
Local anesthesia, done adequately	21 (100)	21 (100)	1.000
Procedure steps, done adequately	21 (100)	21 (100)	1.000
Postbiopsy compression, done adequately	14 (67)	15 (71)	0.738*
Sample preservation and delivery to pathology department with report, done adequately	13 (62)	17 (81)	0.305
Postprocedure			
Follow-up BP hourly for 6 h, done adequately	4 (19)	7 (33)	0.484
Discharge with clear written instruction, done adequately	0	18 (86)	<0.001
Complications			
Minor complications (pain, temporary hematuria)	4 (19)	3 (14.3)	1.000
Major complications (perinephric hematoma)	2 (9.5)	1 (4.8)	1.000

BP, blood pressure; INR, international normalization ratio. ^aZero out of 14 noncatheterized patients. ^bEleven out of 15 noncatheterized patients. *P* value by Fisher's exact test. **P* value by χ^2 test, *P* value of less than 0.05 was considered statistically significant.

Figure 1

Comparison of items that showed statistical significant difference between the first and second cycles.

educational tools have been shown to enhance compliance with procedural standards. Improved patient education is clinically relevant, as it contributes to informed consent, reduces patient anxiety, and may indirectly improve cooperation during and after the procedure [11].

Similarly, the marked improvement in preprocedural bladder emptying (0–73%) suggests that checklist-based or protocol-driven interventions are effective in modifying simple but frequently overlooked practices. Bladder emptying is an important safety step, as it reduces patient discomfort and facilitates optimal positioning during the procedure.

The availability and use of sterile equipment and operator protective measures improved significantly

following administrative intervention and restocking efforts. This highlights the importance of system-level factors in procedural quality. Unlike educational interventions, which target individual behavior, ensuring consistent availability of equipment addresses structural barriers to compliance [12]. These findings underscore that adherence to biopsy guidelines is multifactorial and requires both behavioral and organizational modifications.

In contrast, postprocedural practices, particularly hourly blood pressure monitoring, showed only modest, nonsignificant improvement. This likely reflects workflow and staffing constraints rather than a lack of awareness. Postbiopsy monitoring is critical, as most clinically significant bleeding complications occur within the first 12–24 h, as described in previous studies [13,14]. Suboptimal monitoring may therefore represent a clinically important gap despite improvements in other domains. This finding suggests that interventions targeting postprocedural care require more robust system redesign, such as standardized observation charts or nursing protocols, rather than relying solely on physician education.

The provision of written discharge instructions showed one of the most substantial improvements (0–86%), reflecting the effectiveness of introducing standardized patient materials. Clear postbiopsy instructions are essential for early detection of delayed complications

and appropriate patient behavior after discharge. This improvement demonstrates that relatively simple, low-cost interventions can significantly enhance patient safety, continuity of care and reduce readmission rates [15].

Importantly, the rates of minor and major complications did not differ significantly between the two cycles. This is likely attributable to the limited sample size rather than the absence of clinical impact. Reported complication rates in this study fall within the range described in the literature, where major complications typically occur in ~1–10% of cases [16].

When compared to established guidelines, first cycle results showed that baseline adherence in several domains was suboptimal. The improvements observed after intervention support the concept that guideline dissemination alone is insufficient, and that active implementation strategies, including education, reminders, and system support are necessary to achieve meaningful change.

This study is limited by a relatively small sample size, which limits generalizability and prevents us from reporting significant differences in the rate of complications and patient outcomes.

Despite these limitations, the study demonstrates that a structured audit cycle is an effective tool for identifying deficiencies and driving improvement in procedural practice. The interventions implemented were low-cost, feasible, and reproducible in similar healthcare settings, particularly in resource-limited environments.

Future efforts should focus on sustaining improvements through continuous monitoring, integrating checklist-based protocols into routine practice, and addressing system-level barriers to postprocedural care. Repeated audit cycles and expansion to multicenter settings would further strengthen the evidence and support broader implementation.

In conclusion, this study highlights that adherence to renal biopsy guidelines can be significantly improved through targeted interventions, and achieving comprehensive compliance requires ongoing efforts that address both individual practice and healthcare system factors.

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Conflicts of interest

There are no conflicts of interest.

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