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Low Rate of Adequacy of Percutaneous Kidney Biopsy Associated with Lack of On-site Microscopic Examination

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Abstract

Background and objectives: Renal biopsy is an essential diagnostic tool used by nephrologists to establish the diagnosis of many glomerular diseases. The absence of an adequate biopsy sample may affect the course of management of patients who may suffer from a serious underlying disease requiring an early initiation of therapy. We conducted a quality improvement project aiming to assess the rate of adequate percutaneous native kidney biopsy samples in the absence of on-site microscopic examination of samples. Furthermore, the project also aimed to study the effect of some variables on the adequacy rate.

Methods: We included all percutaneous native kidney biopsies performed between January 1, 2017, and December 31, 2020. We excluded allograft renal biopsies from this study. Data were retrospectively collected; and included: patient-related data, procedure-related data, and biopsy results-related data. The sample was labeled as adequate if at least ten glomeruli were seen on light microscopy, and at least one glomerulus on immunofluorescence and one glomerulus on electron microscopy. Biopsies not fulfilling the aforementioned criteria were labeled as inadequate.

Results: Out of 82 percutaneous native kidney biopsies, 35 biopsies (43%) were adequate and the remaining 47 biopsies (57%) were inadequate. When comparing the adequate versus the inadequate group we found that the age, gender, weight, BMI, operator, needle size, number of passes, and the number of cores were the same in both groups.

Conclusion: Our study demonstrates the high rate of inadequate renal biopsy samples associated with the lack of on-site microscopic examination of samples. Age, gender, weight, BMI, operator, needle size, number of passes, and number of cores did not affect the rate of the adequacy. The small sample size represents a limitation of this study.

Keywords

Kidney biopsy • Adequacy of renal biopsy • On-site microscopic examination • Inadequate samples • Glomerular diseases

Introduction

A percutaneous renal biopsy is an essential tool used for diagnosis, prognosis, and guiding the management of many glomerular diseases. For a thorough evaluation of native renal biopsy samples, it must be examined by light microscopy looking at the overall tissue architecture including the four renal components (glomeruli, tubules, interstitium, and blood vessels), immunofluorescence looking for the composition of immune deposits and electron microscopy looking at the ultrastructure of deposits. Therefore, an adequate biopsy sample is required for the provision of accurate diagnosis by the reporting pathologist. Different studies have used different criteria to define the adequacy of the native renal biopsy sample and look at factors that may improve the yield of the biopsy while maintaining a low rate of complications. We carried out a quality improvement project to assess the percentage of adequate percutaneous native kidney biopsy performed at our hospital where on-site microscopic examination of samples is not available, and to examine the relationship between the adequacy of the sample and that of the specific variables.

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Subjects and Methods

We collected data about all native kidney biopsies performed between January 1, 2017, and December 31, 2020. Allograft renal biopsies and native renal biopsies ordered by departments other than nephrology were excluded (i.e., biopsies ordered by urology for diagnosis of a renal mass). From the electronic database, we abstracted data about all identified patients including: patient-related data (age, gender, weight, and Body Mass Index (MBI)), procedure-related data (date of procedure, needle size used, operator and number of passes), and biopsy results-related data (number of cores, comments about sample fixation, number of glomeruli seen on light microscopy, immunofluorescence and electron microscopy). Additionally, we collected data about post-procedure complications and assessed whether repeat procedures were required or not. We labeled a biopsy sample as adequate if at least ten glomeruli were seen on light microscopy, at least one glomerulus on immunofluorescence and one glomerulus on electron microscopy. Biopsies not fulfilling the aforementioned criteria were labeled as inadequate. At our hospital, the interventional radiologist performs the percutaneous renal biopsy under ultrasound guidance. On-site microscopic examination of samples to check for the presence of glomeruli is unavailable. The sample is then kept in a fixative solution and sent to the pathology department at another specialized hospital for processing and reporting.

Statistical analysis

The data were imported from Excel into SPSS version 22 and saved in an SPSS system file to which variable labels and value labels were added. The univariate distribution of each variable was examined for anomalies, and errors were corrected. Discrete variables were reported using counts and percentages, while continuous variables using the median and quartiles. Comparative analysis was conducted between the study outcome (adequate vs. inadequate) using the Mann-Whitney U test for continuous variables, and the $\chi 2$ test or Fisher exact test for categorical variables.

Results

Eighty-two percutaneous native kidney biopsies were performed between January 1, 2017, and December 31, 2020. Six out of the 82 were repeat biopsies (7.3%). Thirty-five biopsies (43%) fulfilled our criteria for an adequate biopsy, and the remaining 47 biopsies (57%) were inadequate. When comparing the adequate versus the inadequate group we found that the age, gender, weight, BMI, operator, needle size, number of passes, and the number of cores were the same in both groups (Table 1).

Table 1. Effect of certain variables on adequacy of native renal biopsy.

Variable	Adequate (n=35)	Inadequate (n=47)	P-value
Age (years)			
Median (Quartiles)	42 (26-55)	36 (25-44)	0.223
Mean rank	45.2	38.7	
Gender			
Male	21 (60%)	20 (42.6%)	0.118
Female	14 (40 %)	27 (57.4%)	
Weight			
Median (Quartiles)	74 (55-83)	72 (58-87)	0.455
Mean rank	38.3	42.2	
BMI			
Median (Quartiles)	27 (23-31)	26.5 (24-31.7)	0.641
Mean rank	39.1	41.5	
Operator			
1	15 (42.9%)	14 (29.8%)	
2	3 (8.6%)	3 (6.4%)	
3	9 (25.7%)	12 (25.5%)	0.452
4	7 (20%)	12 (25%)	
5	1 (2.9%)	6 (12.8%)	
Needle size (Gauge)			
16	1 (2.9%)	4 (8.5%)	0.57
18	31 (88.6%)	39 (83%)	
20	3 (8.6%)	4 (8.5%)	
Number of passes			
1 or 2 passes	24 (68.6%)	30 (63.8%)	0.658
3 passes	11 (31.4%)	17 (36.2%)	
Number of cores			
1 or 2 cores	26 (74.3%)	31 (66%)	0.905
3 or 4 cores	9 (25.7%)	16 (34%)	

Note: N: number

Five biopsy reports received comments on poor fixation of the received samples. Three patients developed asymptomatic small hematoma that did not require any medical intervention. Yet, one patient developed significant bleeding that required a blood transfusion but the CT angiogram did not show any active bleeding and did not require embolization.

Discussion

In general, there are clear criteria to define an adequate sample for allograft renal biopsies using the Banff Classification System (BCS) [1]. However, the definition of an adequate sample for native kidney biopsy is variable and depends on the underlying pathology. For example, while ten glomeruli are often enough to provide a diagnosis for most renal pathologies [2], more than 15 glomeruli is ordinarily required to confidently exclude the diagnosis of Focal Segmental Glomerulonephritis (FSGS). The inadequate sample may result in delaying the initiation of appropriate therapy and if a repeat biopsy is required, it may lead to patient's dissatisfaction, expose the patient to another invasive procedure with its potential risks and complications, and increase the healthcare cost. Many studies have looked at potential factors that may play a role in the adequacy and diagnostic value of a renal biopsy [3-9]. For example, when considering the needle size used at the time of the procedure, some data suggest there is no difference in the adequacy of samples or the rate of complications between 16 and 18 gauge needles [6]. However, a retrospective study involving a larger number of patients demonstrated that 16 gauge needles provide more glomeruli, more diagnostically adequate renal tissue, with the added benefit of fewer cores without a significant increase in complications compared with 18 gauge needles [7]. This observation was also demonstrated in other studies [8,9]. Therefore, KHA-CARI guideline recommendations for a renal biopsy suggest using a 16-gauge needle for native renal biopsies as it provides the best balance between sample adequacy and risk of bleeding [10]. The number of passes represents another critical factor to be taken into consideration. In most cases, it is believed that even if the first pass provides a good number of glomeruli, a second pass is typically performed to ensure sampling another area of the kidney. This is because pathological changes are not always uniformly distributed. Some studies have shown that taking at least two samples and limiting the number of radiologists performing renal biopsies were associated with a high number of glomeruli seen on a biopsy [3,5]. Renal biopsy samples must be instantly assessed at the time of the procedure by direct microscopic examination to allow for visualization and differentiation of the renal cortex and medulla and therefore ensuring the sample contains glomeruli. The impact of on-site microscopic examination of renal biopsy samples was observed in two previous studies [3,4]. A retrospective study to evaluate the adequacy of a renal biopsy with or without using this on-site microscopic evaluation found that the likelihood of getting an inadequate specimen is almost four times greater when the on-site evaluation was not used [4]. Additionally, the introduction of on-site microscopic assessment of biopsy samples was a successful intervention to improve the adequacy rate of native renal biopsies in a center with a high rate of inadequate samples [3].

Conclusion

Our study re-demonstrates the high rate of inadequate renal biopsy samples associated with a lack of on-site microscopic examination of samples. Variables like age, gender, weight, BMI, operator, needle size, number of passes, and the number of cores were indifferent between the adequate and inadequate group in our study. However, the small sample size of our study population may have influenced the effect of the studied variables. We conclude that on-site microscopic examination of renal biopsy samples is of paramount importance and should be part of any protocol for native kidney biopsy procedures.

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