

Nephrology and the Percutaneous Renal Biopsy: A Procedure in Jeopardy of Being Lost Along the Way

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The percutaneous renal biopsy (PRB) of native kidneys was introduced by Iversen and Brun (1) in 1951. Prior to this time, insight into clinicopathologic correlation was limited to information obtained through surgically obtained specimens or from evaluation at autopsy. The development of the PRB evolved from their experience with percutaneous liver biopsy using an aspiration-needle technique. Intravenous pyelography was used for localization of the right kidney (to avoid large vessels and the spleen), and the patient was biopsied in the sitting position. Unfortunately, the success of their technique was limited, with adequate tissue obtained in only 53% of biopsies (1). Concerned with the poor technical success using this technique, Drs. Robert Kark and Robert Muehrcke (2), my predecessors at Rush University Medical Center, made important modifications to the procedure (2–5). First, they performed the biopsy with the patient in the prone position and placed a sandbag under the abdomen, because they felt this would reduce the “mobility” of the kidney. Second, instead of an aspiration biopsy needle, they used a Franklin-modified Vim-Silverman needle, a precursor to the needle currently used today, which trapped the tissue in the needle and then sheared it off. In 1954, Kark and Muehrcke (2,3,5) published their experience with this “new technique,” reporting a success rate of 96% and no major complications.

Kark and Muehrcke realized the value of the renal biopsy would be to provide the nephrologist with information that would be critical in diagnosis, prognosis, and guiding therapy. In their initial study, they found that the biopsy findings changed the initial clinical diagnosis in more than 50% of cases (2). Additionally, they felt that renal biopsy would provide nephrologists with the ability to follow the natural history of renal disease through repeated biopsies, define new renal diseases, and assess the effects of therapy on renal disease. Almost 60 years later, these predictions have proven true. The renal biopsy, developed by nephrologists, has become an integral part of the clinical practice of nephrology and in the research of renal disease. In fact, the development of the PRB has been considered one of the major technological advancements that led to the establishment of nephrology as a subspecialty in 1960 (6).

The success of the PRB is defined not only by the ability to attain adequate tissue for diagnosis but, equally

important, the safety profile of the procedure. Throughout the years, improvements in imaging techniques and biopsy needles have resulted in the ability to obtain adequate renal tissue for diagnosis in >95% of renal biopsies (7–11). Additionally, these technical improvements have led to increased safety of the procedure: the rate of complications resulting in death decreased from 0.12% to 0.02% during the last 50 years (7,12). In fact, during the last 20 years, death resulting from PRB of native kidneys has been an extremely rare event, with no deaths reported in a number of recent studies (13–20). Nonetheless, despite the improved safety of the procedure, clinically significant bleeding complications do occur in 4%–7% of biopsies on average (7,12), and rates as high as 25% to >30% have been reported in a number of recent studies despite the use of newer technologies (8,14,19,21). Although the majority of complications resolve spontaneously without the need for further intervention, in up to 9% of biopsies, the complication can be more severe and potentially life threatening, resulting in the need for intervention (7,11,12,22). In most cases, this may be simply the transfusion of blood products, but the need for more invasive intervention such as surgery or angiography and embolization, although uncommon, still occurs in up to 0.8% of biopsies even in recent reports (7,8,11,12,21).

Differences in complication rates among studies can vary substantially and can be difficult to interpret because of confounding issues such as the nature of the study (prospective or retrospective), the type of imaging used (real-time ultrasound, computerized tomography, or blind biopsies after ultrasound localization), the needle type or gauge used (manual versus automated and 14, 16, or 18 gauge), and who is performing the biopsy (a few “experienced” nephrologists, many nephrologists, renal fellows, or radiologists) (7,12). Additionally, the reason for biopsy and patient mix can be important because studies that comprise high-risk patients, those with renal insufficiency, poorly controlled hypertension, or a prolonged bleeding time/coagulopathy, are more likely to report increased complication rates (11,14,20,21,23–27).

In this issue of *CJASN*, Tondel *et al.* (28) report on the 22-year experience (from 1988 to 2010) with PRB of native kidneys from the Norwegian Kidney Biopsy Registry, which includes 26 hospitals. The 9288 percutaneous biopsies in the study represented 96% of all

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biopsies performed during that time period. Adults comprised 92% of biopsies, and 98% were performed under ultrasound guidance (it is not clear whether this was real-time ultrasound). Although the primary reason for biopsy was proteinuria (81%), a large proportion of biopsies were done in patients with renal insufficiency with an estimated GFR (eGFR) of <60 ml/min per 1.73 m² in 63% of the patients and <30 ml/min per 1.73 m² in 37% of patients.

Despite this relatively high-risk patient population, there were no biopsy-related deaths, and only 2.6% of biopsies were associated with a complication. A major complication (defined by the need for a blood transfusion, surgery, or radiologic intervention) was reported in only 0.9% of biopsies. Blood transfusions were required in 0.9% of cases, and surgical or radiographic intervention (angiography with or without embolization) was required in 0.2% of cases. By multivariate analysis, only the eGFR at the time of biopsy and the number of biopsies performed by a center per year were predictive of complication rate. Patients with an eGFR of 59–30 ml/min per 1.73 m² had five times the risk of a complication, and patients with an eGFR of <30 ml/min per 1.73 m² had an almost 16-fold greater risk for a complication compared with patients with an eGFR of ≥60 ml/min per 1.73 m². Additionally, centers that performed <30 biopsies per year had a 1.6-fold greater likelihood of complication than centers performing >30 biopsies per year.

Although there was no difference in the complication rate based on who performed the biopsy (nephrologist or radiologist) or the needle size (14, 16, or 18 gauge), it is of interest that radiologists performed the biopsy in 54% of cases, with nephrologists performing only 33% of biopsies. Also, 62% of biopsies were done using an 18-gauge needle, and only 14% were done with a 14-gauge needle. Adequate tissue for diagnosis was obtained in 94% of cases overall, and there was no difference based on who performed the biopsy or needle size. Nonetheless, 3% of biopsies had no glomeruli, and the sample size was significantly smaller in biopsies done with 18-gauge needles (a median of 9 glomeruli per biopsy) compared with 12 glomeruli with either the 16- or 14-gauge needles. Over the 22-year period, there was a decrease in both the number of biopsies done by nephrologists (actual proportion not provided) and the proportion of biopsies done using 14-gauge needles (22% to ≤1%). This important study by Tondel *et al.* (28) reconfirms that the PRB is a safe and successful procedure in a nationwide experience. However, it also serves as a wake-up call for the nephrology community that smaller biopsy needles are being used, and biopsies are increasingly being performed by radiologists rather than nephrologists.

Since the introduction of the automated needles, there has been a tendency to use smaller 18-gauge needles rather than the larger 14-gauge needles, which had been the common practice with manual needles (7,12). The rationale for this is not clear but may be linked to the increasing number of biopsies being done by radiologists as suggested by the study of Tondel *et al.* (28) and as reported by Gupta and Balogun (29), who found that an 18-gauge needle was used in 69% of biopsies performed by radiologists compared with only 14% of biopsies performed by nephrologists. Additionally, the study by Tondel *et al.* (28) and other studies (7,29–32) continue to demonstrate that when using an 18-gauge needle, the sample size is significantly smaller (9 versus >12 glomeruli), and often, the quality of the sample (the number

of intact glomeruli) is poorer. In the only study assessing the differences between 14-, 16-, and 18-gauge automated needles, Nicholson *et al.* (32) demonstrated that using an 18-gauge needle resulted not only in a significantly smaller sample size (9 versus 11 versus 15 glomeruli) but was also associated with less diagnostic success (53% versus 76% versus 85%), despite no significant differences in complication rates. The importance of sample size cannot be underestimated when evaluating glomerular lesions that are focal in nature and whose prognosis depends on the degree of involvement (*i.e.*, focal segmental glomerulosclerosis, lupus nephritis, vasculitis, and crescentic GN) (33,34). A biopsy containing only 10 glomeruli has a 35% probability of missing the lesion if the prevalence of diseased glomeruli in the kidney is 10%, but the probability decreases to 12% if 20 glomeruli are contained in the biopsy. Thus, the trend toward an increasing use of 18-gauge needles stands to jeopardize the diagnostic accuracy of the PRB.

There has also been a shift in who is performing the biopsy during the last 20 years. In 1990, Tape *et al.* (35) published a survey of 516 practicing nephrologists trained from 1964 to 1974 and found that 95% of certified nephrologists performed PRB. Five years after this report, a memorandum from the Renal Physicians Association found that 35% of percutaneous renal biopsies were now being performed by radiologists. So disturbing was this finding that in his presidential address to the American Society of Nephrology in 1998, Dr. Wadi Suki voiced his concern that the shift from nephrologists to radiologists in performing the PRB could undermine the nephrologist's status as a subspecialist (36). In a recent report from 2011, it was found that only 55% of nephrologists are performing renal biopsies in Australia (37). Unfortunately, the reasons that fewer nephrologists are performing renal biopsies have been attributed to a number of issues including reimbursement, liability, inconvenience, and increasing workload (27,29).

The declining trend in the performance of PRB by practicing nephrologists should be alarming to all of us and especially to those of us who are involved with training fellows. As nephrologists, we have a vested interest in the biopsies we perform that is not shared by radiologists, because the information provided by this procedure directly affects the care we provide our patients. As a result, in training our fellows, we must emphasize the importance of performing renal biopsies as part of the practice of nephrology. We need to provide our fellows with an experience that makes them competent and comfortable performing this procedure so they will continue to incorporate it into their clinical practice. Given the increased demands on those nephrologists in private practice, the time may have come that these practices consider allocating biopsies to either a single nephrologist within their groups or to incorporate an interventional nephrologist into their practice. Alternatively, nephrologists should consider referring patients for biopsy to university programs that provide renal biopsy services, as well as outstanding nephropathologic support. Otherwise, as shown by the Norwegian experience, the PRB, a procedure so important in the development of our subspecialty, is in jeopardy of being lost along the way.

Disclosures

None.

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