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Percutaneous renal biopsy utilizing real time, ultrasonic guidance and a semiautomated biopsy device

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Percutaneous renal biopsy is a fundamental diagnostic technique in clinical nephrology. Since its introduction in 1951 [1], there have been several descriptions of the technique with refinements of the procedure, more recently employing ultrasonic guidance [2–10]. The technique described in this paper is a biopsy method employing real-time ultrasonic guidance and a semiautomated, spring-loaded biopsy needle.

Methods

The described technique has been successfully employed on 22 native and 2 pelvic allograft kidneys. The biopsy device employed was the Roth biopsy needle (Cook Canada Inc., Markham, Ontario, Canada). It employs a needle similar to traditional biopsy needles. A cannula is advanced over the stylet, trapping and cutting a core of tissue within the slotted portion of the stylet (Fig. 1). The Roth needle requires that the stylet first be manually advanced into the tissue of interest. Following this, a spring-loaded device activated by a trigger automatically advances the cannula over the stylet. Both 14 gauge or 18 gauge needles are available; however, we used exclusively 18 gauge. The cannula and stylet are disposable, while the handle of the Roth biopsy device can be sterilized and reused. When biopsy was performed with this instrument, it was assembled and loaded prior to insertion of the biopsy needle into the patient.

Prior to the procedure, informed consent was obtained from all patients. Coagulation status was screened with platelet count, PT and PTT. Blood pressure was controlled with antihypertensive medications, when indicated.

The biopsy was performed by a radiologist and nephrologist. Initially, both kidneys were scanned in a longitudinal manner utilizing a Diasonics Wideview scanner (Diasonics Corporate Headquarters, Milpitas, California, USA) or Acuson 128 Computed Sonography System (1220 Charleston Road, Mountainview, California) with 3.5 MHz mechanical sector transducers. Empirically, preference was given to biopsy of the left native kidney, but this technique could be similarly applied to the right if required. To approach the left kidney, the patient was placed in the prone position. In some patients, a pillow was placed under the abdomen, slightly reducing the lumbar lordosis. Pelvic kidneys were studied with the patient supine. The lower pole of the left native kidney or the superior pole of the pelvic allograft was located in the biopsy needle pathway displayed on the monitor.

The patient's skin surface was cleansed and draped. The 3.5 MHz transducer was placed in a sterile polyethylene transducer cover (Swemed Lab, Frolunde, Sweden) and a sterile 18 gauge needle guide needle attachment (Diasonics) was attached to the probe. Aquasonic 100 sterile ultrasound transmission gel (Parker Laboratories Inc., Orange, New York) enabled scanning within the biopsy field. The lower pole of the native kidney was again located to allow marking of the skin surface at the expected needle entry point. The skin, subcutaneous, and perirenal tissues were infiltrated with local anesthetic using ultrasonic guidance, ensuring adequate local anaesthesia along the intended biopsy pathway. A small incision was made through the weal to facilitate passage of the biopsy needle.

Using the transducer guide, the biopsy needle was directed through the skin incision, and then under real time ultrasonic guidance toward the lower pole of the kidney (Figs. 2 and 3A). Advancement of the needle was halted when the tip of the needle was seen to penetrate the renal capsule (Fig. 3B). The central stylet was advanced by a brisk tap on its proximal end, allowing it to advance into the kidney 2.5 cm (Fig. 3C). The spring-loaded mechanism was then activated, instantaneously advancing the cannula over the stylet and obtaining a core of renal parenchyma of predetermined length (Fig. 3D). Repeat passes were performed to obtain two or three, adequately sized biopsy specimens. After the procedure, the kidney was scanned to assess for the presence of hematoma or active bleeding. The patients were returned to the hospital ward for overnight observation.

Results

The biopsy methods described were assessed for utility in patients undergoing consecutive renal biopsies. In general, the procedure was completed within 20 minutes and was very well tolerated by all patients with only mild sedation. Diagnostically satisfactory material containing an average of 12 glomeruli per specimen was obtained from 24 patients. Renal tissue was not obtained in one situation due to extreme mobility of the kidney,

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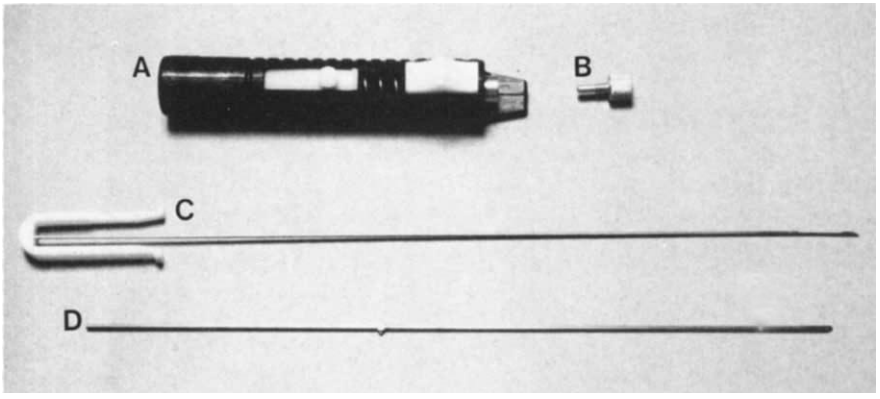

Fig. 1. *Unassembled Roth biopsy needle; components include (A) spring-loaded handle, (B) locking screw, (C) stylet and (D) cannula.*

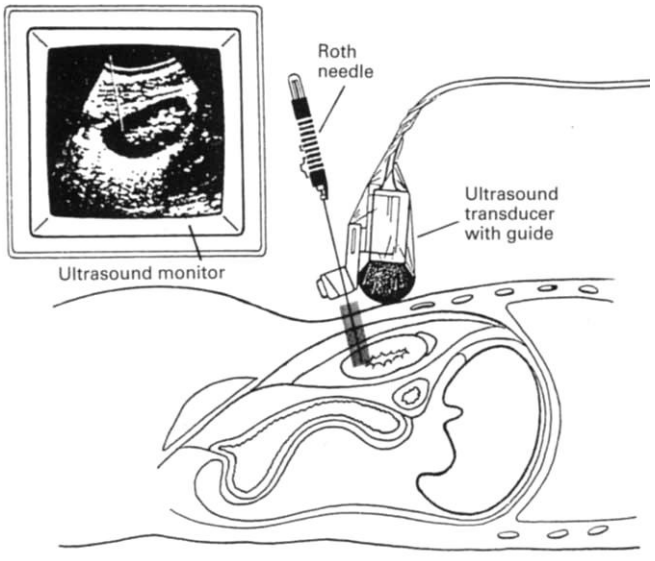

Fig. 2. *Schematic illustration of biopsy technique.*

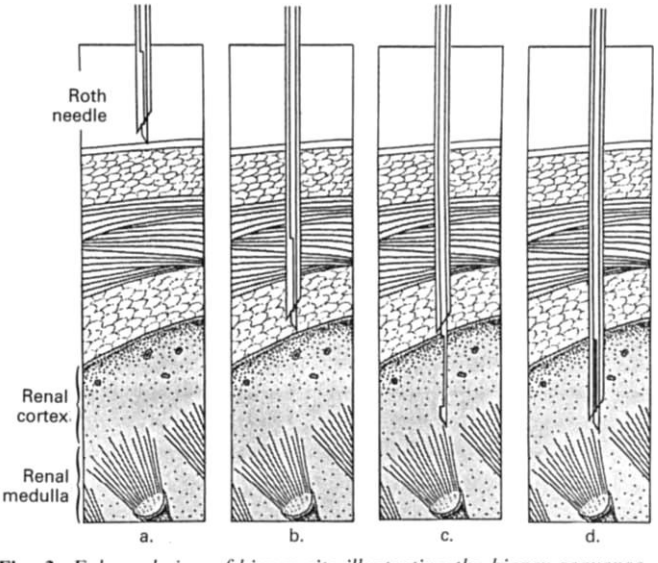

Fig. 3. *Enlarged view of biopsy site illustrating the biopsy sequence.*

and an oblique angle of incidence of the biopsy needle necessitated by the intervening position of the patient's lower ribs.

Complications of a significant nature were not encountered by any patient. No patient developed significant perinephric hematoma, nor was there any requirement for blood transfusion. No patient developed a significant fall in blood pressure, and no patient developed a fall in hemoglobin exceeding 10 g/liter (1.0 g/dl) as measured the morning following the procedure. One patient developed macroscopic hematuria which cleared within 12 hours of observation. No late consequences of the biopsy procedure were encountered following the overnight period of observation.

Discussion

The guidance method described has several advantages over the methods described by previous authors as well as sharing the advantages of recently reported techniques. Continuous ultrasound monitoring during the biopsy procedure facilitates visualization of the needle tip, and much like other reports permits improved tissue retrieval rates. This method does not require deep breath holding but allows for biopsy at any stage of the respiratory cycle. Breathing motion is stopped only during the instantaneous advancement of the stylet and activation of the cannula.

The mechanical needle guide controls the pathway which the needle will follow. Once the needle is advanced to the capsule of the kidney, the biopsy device controls for the depth of tissue specimen obtained. The "free-hand" methods of Yoshimoto, Fujisawa and Sudo [8] and Birnholz, Kasinath and Corwin [9] may convey more risk to the patient by virtue of the operator controlled depth of biopsy inherent in their methods. Like previous fluoroscopic and ultrasonic techniques, our requires two operators for ultrasonic guidance, advancement of the stylet, and activation of the cannula.

The advantage of the present technique over that described by V. Bonsdorff et al [10] is the use of the spring-loaded cannula device. This mechanism was first employed to obtain ultrasonically-guided biopsies of the prostate gland, but we have observed that it is ideally suited to renal biopsy described herein. Using this technique, we have found it much less likely to contain "deep" biopsies of renal medulla, and since the needle we recommend is 18 gauge, repeated passes into the lower pole of the kidney are well tolerated. While in the past, significant complications were routinely encountered with percutaneous

renal biopsy [11, 12], our short experience demonstrated only a single episode of macroscopic hematuria. It is our impression that patients experience less discomfort with this technique. Possible explanations include more precise local anaesthesia, smaller gauge biopsy needle, and the instantaneous cutting action of the needle. Ongoing assessment of our technique will follow.

In conclusion, we report a safe and reliable renal biopsy technique employing real-time ultrasonic guidance, a mechanical needle guide and a semiautomated, spring-loaded needle biopsy device, which, to our knowledge, has not previously been described for obtaining renal biopsy specimens. Although the number of patients we report is small, the combination of success rate (23 out of 24) and complication rate (1 out of 24) in obtaining diagnostic renal histologic specimens encourages us that this technique, employing readily available materials, is superior to other techniques commonly used in clinical practice.

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