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TECHNICAL NOTE

Use of computerized tomography to diagnose complications of percutaneous renal biopsy

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Complications following percutaneous renal biopsy have been infrequent with a 0.7% reported incidence [1–3]. Recently, an analysis of 1,000 consecutive renal biopsies yielded an overall complication rate of 9.4% [4]. Complications considered included gross hematuria, perirenal hematoma, oliguric obstruction, or hypertension. Specifically, the incidence of perirenal hematomas in this report was only 1.4%.

We have noted a small but consistent decrease in hematocrit following percutaneous renal biopsy, an observation also recently reported by Bolten [5]. Review of 342 biopsies revealed that the decrease in hematocrit was 4% or less in 80% of these cases, with only one complication in this group. Consideration of the cause for the hematocrit drop in these uncomplicated cases led to the hypothesis that the incidence of subclinical perirenal hematomas might be quite high. To assess this possibility, computed tomography (CT) was employed as a sensitive, noninvasive technique for demonstrating the presence of subclinical perirenal hematomas.

Retrospectively, 342 percutaneous renal biopsy cases were analyzed for hematocrit changes and recorded complications. Prospectively, 20 consecutive patients undergoing percutaneous renal biopsy, from May through October, 1977, with fluoroscopic techniques [6] underwent a CT scan of the abdomen one day following percutaneous renal biopsy. Fourteen of these patients had a repeat scan one to three months after biopsy. All prospective biopsies were performed utilizing the Franklin modification of the Vim-Silverman needle under fluoroscopic control, with radiographic contrast agent to visualize the collecting system and nephrogram. Two specimens of tissue were obtained from each patient. Intraoperatively, each patient was required to hold a full inspiration whenever the biopsy needle was positioned or manipulated, usually for about 15 to 20 sec, to avoid movement of the kidney. Postoperatively, each patient remained horizontal, usually for at least 24 hr following biopsy. If gross hematuria or if a hematocrit decrease greater than 4% occurred, complete bed rest was maintained for 48 to 72 hr or until gross hematuria disappeared or hematocrit stabilized for 48 hr. No local application of pressure was utilized. Regular diet and fluids were begun after the biopsy. Twenty-four hours prior to biopsy, all patients were evaluated and were found to have a normal coagulation system. The examinations performed included platelet count, prothrombin time, partial thromboplastin time, clotting time, bleeding time, and clot retraction. Hematocrits were obtained on the morning of biopsy and at 8, 24, 48, and 72 hr following biopsy. A negative urine culture was documented on each patient prior to biopsy. Twenty consecutive

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patients underwent percutaneous renal biopsy for diagnosis of newly found nephrotic syndrome, or to determine renal involvement in systemic lupus erythematosus. The 20 patients ranged in age from 24 to 72 yr, with a mean age of 42 yr. Fifteen of the patients were normotensive. Five patients required antihypertensive therapy prior to and after biopsy. Blood pressure was maintained at or below 140/80 mm Hg in the supine position. Creatinine clearance ranged from 120 to 25 cc/min. Patients were not allowed to have salicylates for 72 hr preceding biopsy, nor were they given pain medication after biopsy. Other drugs known to affect clotting parameters were not taken by any patient prior to biopsy. Kidney size was determined by prior i.v. pyelography and was deemed normal for body size and age in all patients.

The distribution of decreases in hematocrit in the retrospective biopsy group (342 patients) is shown in Table 1. Only one clinically significant complication (a subcapsular hematoma) was seen in the group of patients with a decrease in hematocrit of 4% or less (Table 2). In the 20% of patients with a decrease in hematocrit greater than 4%, there were 16 clinically significant complications. It is noteworthy that hematocrit decreases of 4 to 13% were observed in the absence of gross hematuria, changes in blood pressure, fever, or local pain.

Of the 20 patients studied prospectively, clinically significant complications developed in only one. This patient had a 10% decrease in hematocrit and local flank pain at the biopsy site, without gross hematuria, or hypotension. CT scan demonstrated a perirenal hematoma. The extent of the hematoma is shown in Figure 1, where a large posterior perirenal hematoma may be seen; this hematoma was not detectable on repeat CT scan three months later. Angiography one day postbiopsy revealed the right kidney to be markedly displaced in an anterior and superior direction with the upper pole directed medially. No therapy other than bed rest was necessary for this patient. Another patient with gross hematuria had contrast medium from the previous day's infusion in the hematoma, suggesting a leak from the urinary collecting system into the perirenal hematoma (Fig. 2a). Infusion of a second bolus of contrast medium demonstrated a communication between the hematoma and the renal collecting system (Fig. 2b). This patient maintained a stable blood pressure, pulse, and hematocrit with cessation of gross hematuria two days following renal biopsy. No specific therapy other than bed rest was required. Seventeen patients had less than a 4% decrease in their hematocrit (Table 3), yet 14 had a demonstrable perirenal hematoma visualized by CT scan (Fig. 3). Fourteen of 20 patients had repeat CT scan examinations one to three months following biopsy. All previously noted perirenal hematomas had resolved.

Computed tomography of the body, introduced in early 1975, demonstrates normal and pathologic anatomy in a unique, cross-sectional format, unmatched in clarity by other methods [7, 8]. It is a very sensitive technique for detecting intraabdominal hemorrhage and, specifically, perirenal hematomas [9, 10]. Although not fully understood, acute hematomas in the abdomen have a higher attenuation value than flowing blood, a phenomenon well-recog-

Table 1. Distribution of decreases in hematocrit following percutaneous renal biopsy in 342 cases

	Hematocrit decrease, %			
	0%	1–4%	5–9%	10–13%
No. of patients	111	165	59	7
Percent of total	(32%)	(48.2%)	(17.2%)	(2.7%)
Incidence of clinically recognized complications	0	1	11	5

Table 2. Complications following percutaneous renal biopsy in 342 patients studied retrospectively

Patient no.	Hct decrease, %	Complication
1	4	Subcapsular hematoma
2	5	Gross hematuria-hypotension, 4 U BR[a]
3	5	Gross hematuria, 3 U BR
4	5	Delayed bleeding with clots in bladder
5	6	Hypotension-flank pain, anuria, death[b]
6	6	Hypotension-gross hematuria, 2 U BR
7	6	Perirenal hematoma, 3 U BR
8	6	Perirenal hematoma, hypertension nephrectomy
9	7	Hypotension, 3 U BR
10	7	Recurrent gross hematuria, hypotension, heminephrectomy, death, multiple BR[c]
11	9	Hypotension, 2 U BR
12	9	Local bleeding, clots in bladder
13	10	Gross hematuria, bladder clots, 6 U BR
14	10	Gross hematuria, 2 U BR
15	12	Hypotension
16	12	Abdominal pain
17	13	Hypotension, 3 U BR

[a] BR, blood replacement in units of either packed cells or whole blood.
[b] Biopsied in 1961 for acute renal failure, 7 U of BR.
[c] Prebiopsy active urinary tract infection, death from infected perirenal hematoma and sepsis.

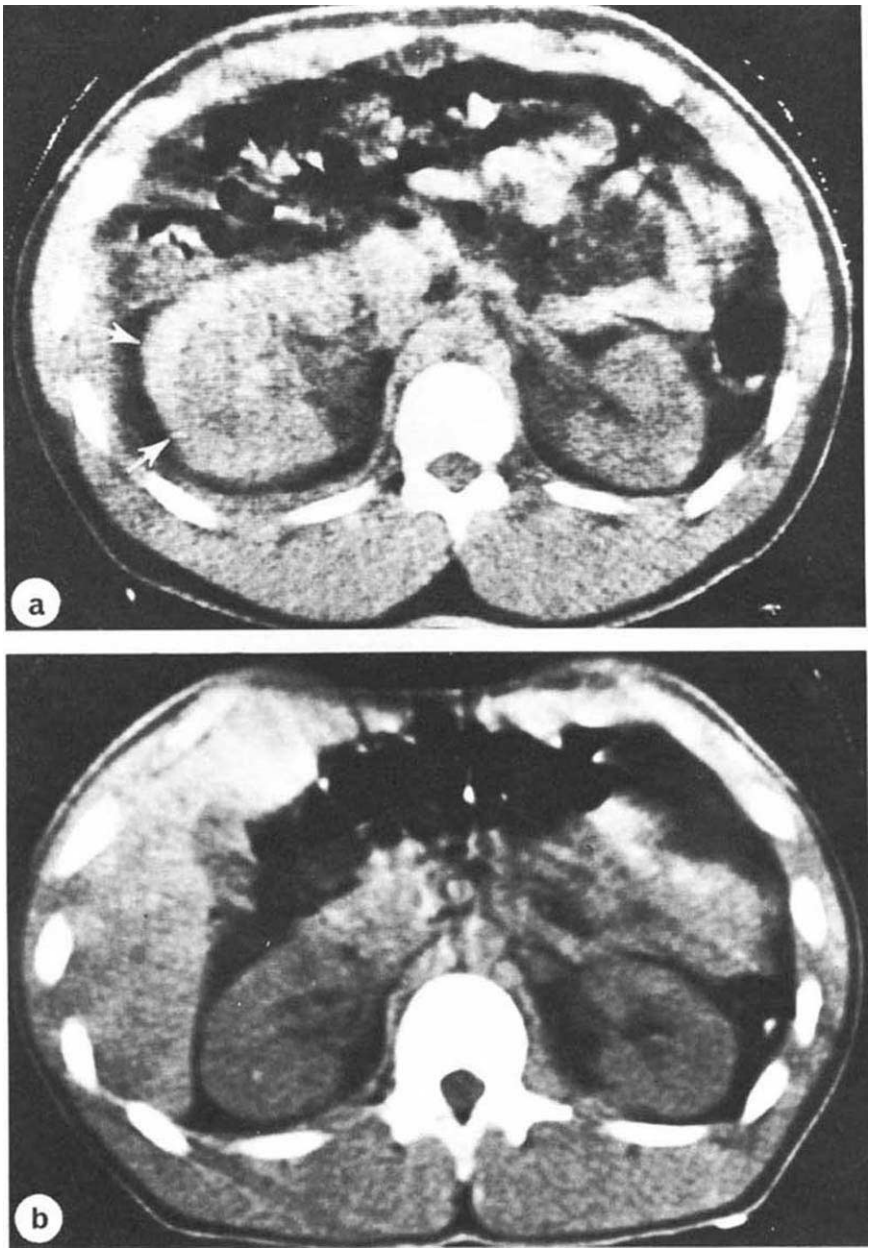

Fig 1. a) *CT scan at the level of the midzone of the right kidney demonstrating a large perinephric hematoma (white arrows) surrounding all but the medial surface of the right kidney.* Note that the density of the hematoma is slightly greater than the adjacent renal parenchyma. Compare also to the density of the left kidney. **b)** *Follow up CT scan, 3 months after renal biopsy, demonstrating complete resolution of the right-sided perinephric hematoma.*

nized in CT brain-scanning [11, 12]. A perinephric hematoma will commonly appear denser than the adjacent renal parenchyma.

The incidence of perirenal hematomas has previously been reported to be 14 cases in 1,000 biopsies [4]. It might be expected, however, that puncture of an organ receiving approximately one-fifth of the cardiac output per minute at rest at systemic blood pressure would lead to the development of significant hemorrhage. Our data reveal an 85% incidence of perirenal hematoma formation in 20 consecutive patients following percutaneous renal biopsy as determined by CT scanning. Fourteen of these documented perirenal hematomas occurred with little or no change in hematocrit, blood pressure, or pulse rate. Only one patient had a clinically evident com-

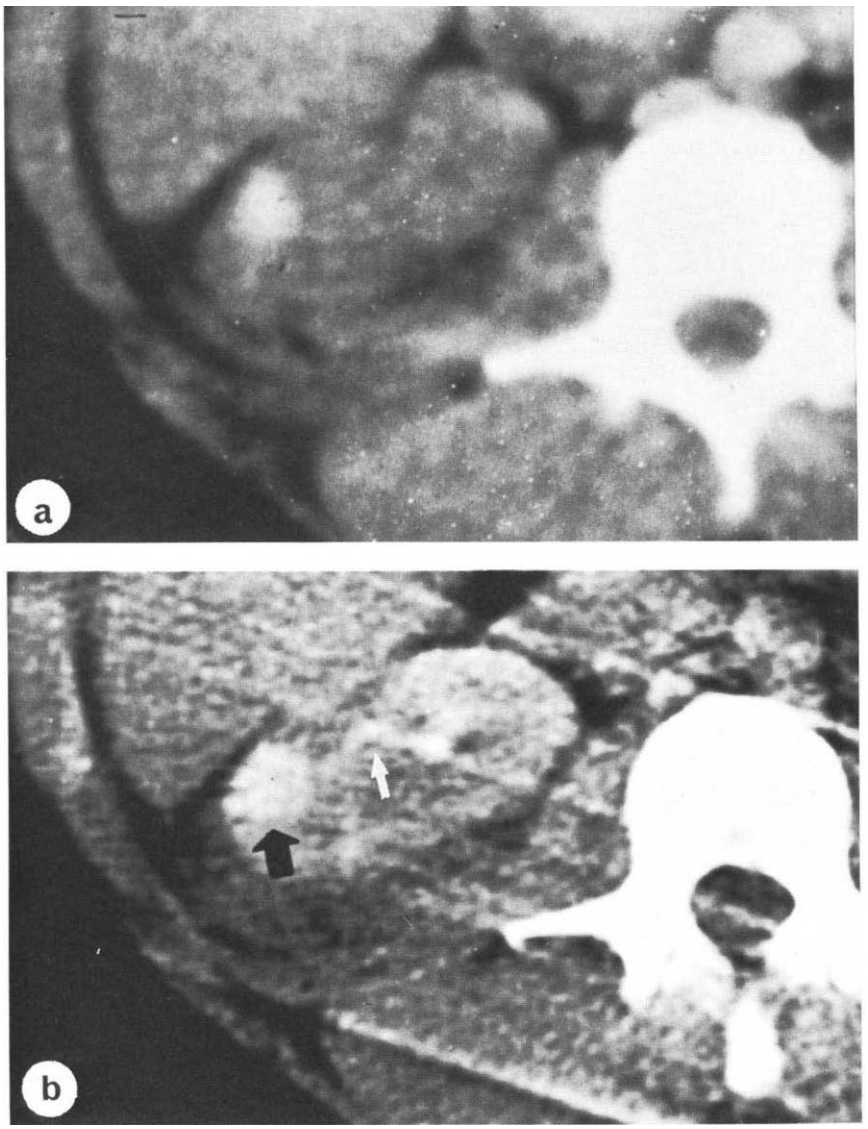

Fig. 2. a) *CT scan of the right kidney, showing a subcapsular collection of contrast medium from the previous days injection.* Also present is a small perinephric hematoma. **b)** *Detail view of the right kidney after injection of contrast medium the day after biopsy, showing intensification of the unusual concentration of contrast medium in the cortical parenchyma.* In addition, there may be a communication (*white arrows*) between the renal collecting system and the cortical collection of contrast material (*black arrows*).

Table 3. Correlation of perirenal hematoma as demonstrated by computerized tomography with decreases in hematocrit following percutaneous renal biopsy

	Hematocrit decrease			
	0%	1–4%	5–9%	>10
No. of patients	7	10	2	1
Perirenal hematoma proven by CT scan	4	10	2	1

plication, evidenced by flank pain and a 10% decrease in hematocrit.

All observed hematomas, as demonstrated by follow-up CT scan, resolved at one to three months without residual calcification. It is noteworthy that the renal capsule did not limit accumulation of a hematoma within the subcapsular space, thus explaining why compression of the renal parenchyma leading to hypertension occurs rarely [13].

We feel that perirenal hematomas following percutaneous renal biopsy occur more frequently than has been previously recognized, as judged by CT scan.

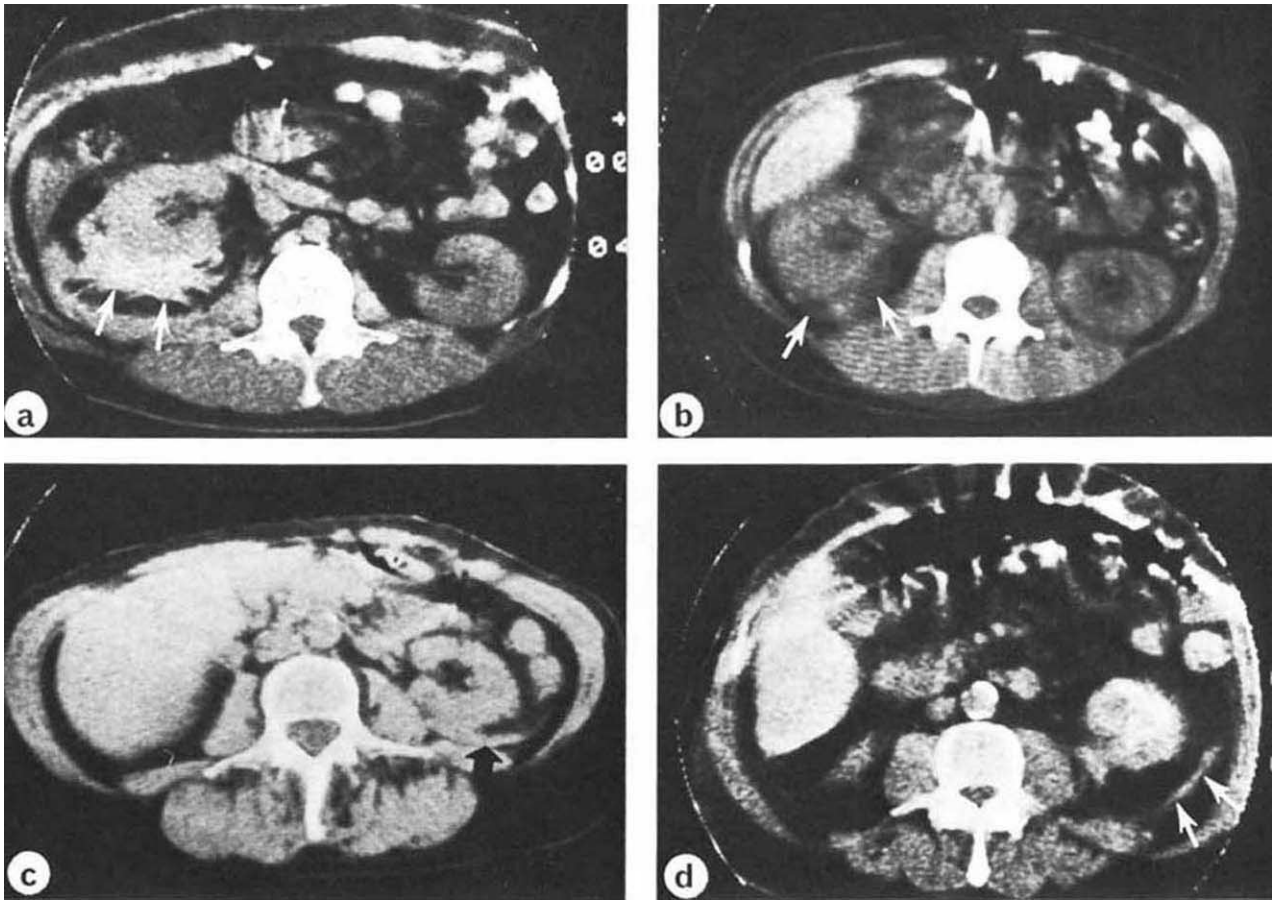

Fig. 3. *CT scans at the level of the kidneys in four separate patients demonstrating the varying size and appearance of the postrenal biopsy perinephric hematomas.* **a)** A large, dense perinephric hematoma (*white arrows*) displaces the right kidney anteriorly and appears to dissect out into adjacent fascial spaces. **b)** Similar anterior displacement of the right kidney is produced by a moderate-sized, postbiopsy perinephric hematoma (*white arrows*). In this case the hematoma does not have the same high density as the hematoma seen in Figure a. **c and d)** These scans illustrate small perinephric hematomas (*arrows*) which layer out along the posterior perirenal fascia and are generally confined to this space by the fascial plane.

Those perirenal hematomas associated with less than a 4% decrease in hematocrit are not likely to result in significant clinical problems, while hematomas associated with greater than a 4% decrease in hematocrit are likely to cause complications requiring major physician intervention. Because infection of a perirenal hematoma can be catastrophic [14], we feel that the presence of an active, untreated urinary tract infection represents a contraindication to the performance of percutaneous renal biopsy, especially in view of the potential communication of the collecting system and the perirenal hematoma as demonstrated in Figure 2b.

Acknowledgments

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