

# Perirenal Lucency ("Kidney Sweat"): A New Sign of Renal Failure

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**OBJECTIVE.** This study describes a new sonographic finding in renal failure: perirenal lucency, which we call the "kidney sweat" sign.

**MATERIALS AND METHODS.** During 1 year at our institution, 502 renal sonograms were obtained. Sonography evaluated 330 patients with renal failure. All of the examinations were retrospectively analyzed.

**RESULTS.** An extracapsular hypoechoic rim was present in 47 (14%) of the 330 patients with renal failure. The finding, when present, was always bilateral. The hypoechoic rim was not present in the remaining 283 patients with renal failure. Forty (85%) of the 47 patients had kidneys that were hyperechoic compared with the liver. Twenty-eight (60%) of the 47 patients had kidneys that were hyperechoic compared with the spleen. In 15 (32%) of the 47 patients, the kidneys were small. Ascites was present in 11 (23%) of the 47 patients. Of the 283 patients with renal failure whose sonograms did not show the hypoechoic rim, 76 patients had normal sonographic findings. The remaining 207 patients with renal failure who did not show the kidney sweat sign had hydronephrosis, stones, cysts, echogenic kidneys, small kidneys, or ascites.

**CONCLUSION.** An extracapsular hypoechoic rim is found in patients with renal failure. We call this finding "kidney sweat." We believe, but cannot currently prove, that the kidney sweat sign represents edema. It is an additional sonographic finding in patients with renal failure.

**S**onography is often the initial imaging technique to examine patients with renal disease. Sonographic diagnosis of renal parenchymal disease is based on, among other findings, renal size, corticomedullary differentiation, and echo texture relative to adjacent organs [1–3]. We describe a new finding for renal parenchymal disease, an extracapsular hypoechoic rim that we call the "kidney sweat" sign.

Images from these 330 patients were evaluated for renal size, parenchymal echogenicity, ascites, if present, and the presence of a renal extracapsular hypoechoic rim, the kidney sweat sign. Renal parenchymal echogenicity was analyzed on longitudinal scans with the patient supine by comparing the echo texture of the kidney with that of the liver and the spleen [4]. Kidney sweat was considered present if a hypoechoic rim surrounding the renal parenchyma was seen just outside the renal capsule.

## Results

A renal extracapsular hypoechoic rim that measured 2–10 mm was seen in 47 (14%) of the 330 sonographic examinations of patients with renal failure. The finding, when present, was always bilateral. The causes of renal failure in these 47 patients were hypertension ( $n = 14$ ), heart failure ( $n = 13$ ), glomerulonephritis ( $n = 11$ ), acute tubular necrosis ( $n = 7$ ), and sepsis ( $n = 2$ ). These associated findings were also present in patients with renal failure whose images did not reveal the hypoechoic rim, but were absent in non-renal

## Materials and Methods

From July 1997 through July 1998, 502 renal sonograms were obtained at our institution. The studies were retrospectively reviewed. Of these studies, 330 were performed to examine patients with renal failure. All examinations were performed on XP or Sequoia (Acuson, Mountain View, CA) or LOGIQ 700 (General Electric Medical Systems, Milwaukee, WI) sonographic systems using 3- to 7-MHz transducers. Two experienced sonographers reviewed all the renal sonograms without knowledge of the clinical findings. Disagreements were resolved by consensus.

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failure patients. Renal failure was present if patients had a serum creatinine level of 2 mg/dl or greater. No correlation was found between the degree of renal failure and the presence of the hypoechoic rim.

In five (11%) of the 47 patients, the hypoechoic rim was seen only at the lower poles (Figs. 1 and 2). In the remaining patients, it was present circumferentially (Figs. 3 and 4).

Forty (85%) of the 47 patients had kidneys that were hyperechoic compared with the liver, and 28 (60%) of the 47 patients had kidneys that were hyperechoic compared with the spleen. Small kidneys ( $\leq 8$  cm longitudinally) were present in 15 (32%) of the 47 patients. Ascites was present in 11 (23%) of 47 patients (Fig. 5). Small echogenic kidneys and ascites were present in five patients (11%).

Of the remaining 283 sonograms obtained for renal insufficiency, none showed the kidney sweat sign. Seventy-six patients had nor-

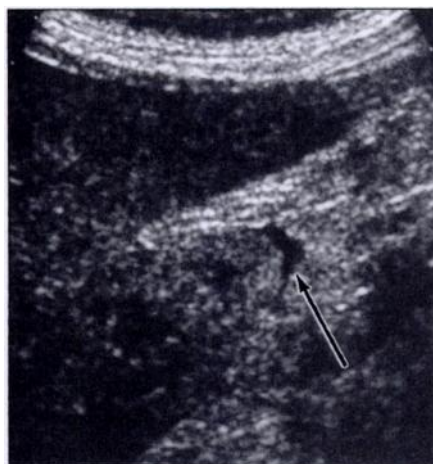
mal sonographic findings. Hydronephrosis was present in 147 (52%) of these 283 patients, cysts in 133 (47%), and stones in 85 (30%) patients. The kidneys were small in 79 patients (28%) and echogenic in 74 patients (26%). Ascites was present in 71 patients (25%). Small echogenic kidneys accompanied by ascites were noted in 37 patients (13%). The kidney sweat sign was not present in any of our 172 renal sonograms obtained in patients who did not have clinical or laboratory evidence of renal failure (Table 1). No significant difference in patient age, sex, or acuity of symptoms was present between renal failure patients whose images showed the hypoechoic rim and those whose images did not, or between renal failure and non-renal failure patients. No correlation was found between the degree of renal failure and the presence of the hypoechoic rim. Statistical analysis was performed, and the proportion of

patients with renal failure who showed the kidney sweat sign was 14% in the patients and 0% in the patients without renal failure; this difference was statistically significant ( $\chi^2 = 27.03$ ,  $p = 0.001$ ; Fisher's exact test,  $p < .0001$ ).

## Discussion

Sonography of the kidneys plays an important role in the examination of patients with renal failure. Sonography is used to examine patients for obstruction as a cause of or contributing factor to renal failure. In patients with renal parenchymal disease, the kidneys may be small and show increased echogenicity throughout the renal parenchyma, with loss of corticomedullary differentiation. Increased echogenicity is nonspecific and does not correspond to a specific acute or chronic renal disease [5].

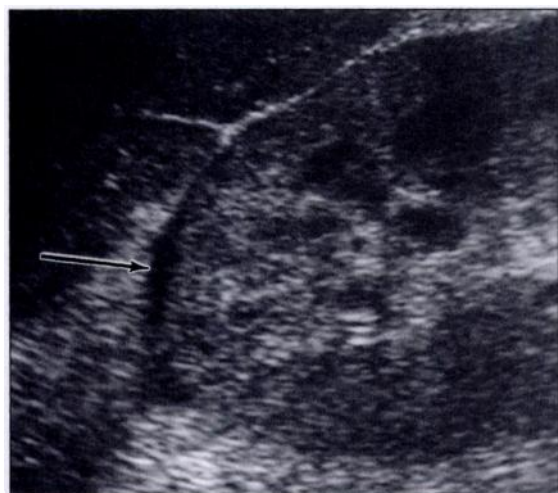
We describe a new finding in evaluating renal parenchymal disease. The sonograms of



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**Fig. 1.**—51-year-old man with hypertensive nephropathy. Sonogram shows echogenic right kidney with inferior pole hypoechoic rim (arrow).

**Fig. 2.**—38-year-old woman with history of IV drug abuse and heroin-induced nephropathy. Sonogram shows slightly echogenic right kidney with inferior pole hypoechoic rim (arrow).

**Fig. 3.**—66-year-old woman with diabetes and hypertension. Sonogram of echogenic right kidney shows circumferential hypoechoic rim, most prominent at superior pole (arrow).

**Fig. 4.**—37-year-old man with HIV and endocarditis. Sonogram of mildly echogenic left kidney shows circumferential hypoechoic rim (arrow).

## Sonographic Sign of Renal Failure



**Fig. 5.**—55-year-old man with history of hypertension. Sonogram shows profoundly echogenic right kidney with surrounding hypoechoic rim (arrows). Note ascites (arrowhead).

47 (14%) of 330 patients examined for renal failure showed an extracapsular hypoechoic rim. We have not yet determined if this finding is clinically significant. It is useful, however, to know about this finding so that confusion with more significant perirenal collections such as perinephric abscess or hematoma does not occur. Although not proven by this study, the kidney sweat sign might trigger the assessment for unsuspected renal failure.

We believe this hypoechoic rim most likely represents perirenal extracapsular edema, although this has not been proven pathologically. We have long called this finding "kidney sweat" because of that belief. This supposition is based strictly on morphologic grounds. Examination of the figures illustrates findings typical for fluid. A rounded or triangular configuration at the caudal aspect of the kidneys (Figs. 1 and 2) has the appearance of fluid elsewhere in the body. The hypoechoic rim, when seen around the kidney (Figs. 3–5), has an appearance similar to that of edema and fluid caused in the perirenal space by conditions such as pancreatitis. An extracapsular location is suggested because the adjacent cortex is not displaced, as would be expected with a subcapsular loca-

<b>TABLE I</b> Frequency of "Kidney Sweat" Sign in Patients With and Without Renal Failure					
Diagnosis	"Kidney Sweat" Sign	No. of Patients	Percentage of Patients Having		
			Hyperechoic Kidneys	Small Kidneys	Ascites
Renal failure	Present	47	85 compared with liver 60 compared with spleen	32	23
Renal failure	Absent	283	26	28	25
No renal failure	Absent	172	12	15	5

tion. None of our study patients had acute renal colic, as these patients were investigated with excretory urography and CT studies.

Kidney sweat was noted in some renal failure patients with or without ascites. It was not seen on any of our 172 renal sonograms obtained in patients who did not have clinical or laboratory evidence of renal failure. None of the patients whose sonograms showed the hyperechoic rim underwent other cross-sectional studies such as CT or MR imaging.

We have attempted to correlate our sonographic finding with pathology. However, this correlation was not possible because the renal capsule is routinely stripped in autopsies; therefore, a small amount of fluid adjacent to the capsule would be difficult to detect. The renal capsule is a fibrous envelope covering the kidney that firmly adheres to the renal substance. Pathologists at our institution see a layer of fibrosis in the superficial cortex (in a subcapsular location) in renal biopsies and autopsies of patients with renal insufficiency and failure. The sonographic appearance does not correlate pathologically with that of fibrosis, especially because kidney sweat appears in a perirenal location sonographically.

Cases of circumferential hypoechoic rims have been reported. Sefczek et al. [6] described a single case of acute cortical necrosis that showed loss of the normal corticomedullary junction with a hypoechoic outer rim. This hypoechoic rim was thought to correspond to a histologic zone of cortical necrosis. Those authors believed that this hypoechoic zone might be an important diagnostic sign for acute cortical necrosis. An-

other case, described by Alkrinawi et al. [7], showed a thin hypoechoic subcapsular cortical layer, which normally lacks glomeruli, in a patient with congenital nephrotic syndrome of Finnish type. It has also been reported that at histology, juxtamedullary glomeruli are larger and more likely to be sclerosed than glomeruli in the outer cortex, which may be spared, contributing to an outer hypoechoic cortical rim [8]. Ours was a retrospective study, and further prospective investigation with pathologic correlation will be necessary to confirm our findings.

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