RENOGRAMS COMPARED WITH UROGRAMS, ARTERIOGRAMS AND FUNCTION STUDIES

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In 1956 the use of isotopic renography for the recognition of renal disease was reported (*1,2*). Numerous reports concerning the usefulness of this procedure as a screening test for unilateral renal ischemia appeared subsequently (*3–6*), and this technique was claimed to be an accurate method for recognizing unilateral renal disease (*7*). Various mathematical manipulations for quantitatively correlating renograms and effective renal plasma flow appeared (*8–11*).

The purpose of this report is to present results of timed excretory urograms, renograms, unilateral renal function studies and renal arteriograms on a series of hypertensive patients.

METHODS

Forty-seven hypertensive patients were studied. Hypertension was defined as a resting diastolic blood pressure of 90 mmHg or more. Each patient had timed excretory urograms, radiohippuran renograms, unilateral renal function studies and renal arteriograms. Excretory urograms were done initially on all patients, and the other diagnostic procedures were done in random order.

Excretory urograms were done in the postabsorptive state after 12 hr of dehydration. Supine films were exposed 1, 3, 5, 10 and 15 min after intravenous injection of contrast media. The procedure was completed by exposing one film with the patient standing.

Renograms were done using the Picker Twin-Prober with 2 × 2-in. NaI(Tl) crystals with 20-deg collimators. The patients were studied in the postabsorptive hydrated state and in the supine position. Studies were done on a standard examining table with the area corresponding to the kidneys replaced by a canvas window. Probe positioning was accomplished by placing the probes beneath the table in the position indicated by the excretory urogram. Final positioning was done using an audible signal after the injection of 1 μCi of *ortho*-iodohippuran. When renogram asymmetry was present, the renogram was repeated for verification. Three individuals interpreted each tracing independently of each other.

Unilateral renal function studies were done using the technique of external ureteral compression as described previously (*12,13*). Clearances of urea, creatinine, inulin and *para*-aminohippurate were measured by the methods of Smith and coworkers (*14*). Urea was determined by spectrophotometry (*15*), creatinine by a modification of the method of Bonsnes and Taussky (*16,17*), inulin by the photometric method (*18*) and PAH by the method of Brun (*19*). Values were corrected to 1.73 M^2 SA. Renal arteriograms were performed using the technique of retrograde femoral catheterization.

RESULTS

Table 1 gives the results of the three separate interpretations of the renograms. The table shows that there was close agreement for the interpretations on these 47 patients.

Table 2 gives the results of a comparison between the renograms and the excretory urograms. It shows that of the 22 patients with normal renograms four patients had unilateral abnormalities on the excretory urogram and three patients had bilateral abnormalities on the excretory urogram. In addition, it shows that of the 13 patients with unilaterally abnormal renograms, six patients had normal excretory urograms and four patients had bilateral abnormalities on the excretory urograms. Finally it shows that of the 12 patients with bilaterally abnormal renograms, five patients had normal excretory urograms and one patient had a unilateral abnormality on the excretory urogram.

In this series of 47 hypertensive patients there were no discrepancies between the results obtained

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TABLE 1. RENOGRAM INTERPRETATIONS

Interpreting individual	Normal function	Unilateral disease	Bilateral disease	Total
1	23	12	12	47
2	23	13	11	47
3	22	13	12	47

TABLE 2. COMPARISON BETWEEN RENOGRAMS AND UROGRAMS

		Radiohippuran Renograms			Total excretory urograms
		Normal function	Unilateral disease	Bilateral disease	
EXCRETORY UROGRAMS	Normal function	15	6	5	26
	Unilateral disease	4	3	1	8
	Bilateral disease	3	4	6	13
	Total renograms	22	13	12	47

TABLE 3. SUMMARY AND COMPARISON OF RESULTS

		Arteriograms and Unilateral Renal Function Studies			
		Normal function	Unilateral disease	Bilateral disease	Total renograms
RENOGRAMS	Normal function	20	2	0	22
	Unilateral disease	7	2	4	13
	Bilateral disease	6	3	3	12
	Total arteriograms and renal function studies	33	7	7	47

with the function studies and with renal arteriograms. Consequently the results of these two testing procedures are discussed simultaneously.

Table 3 compares the results from the renal arteriograms (and unilateral renal function studies) and those from the renograms. Of the 22 patients with normal renograms two were found to have unilateral renal artery stenosis. Of the 13 patients with unilateral renogram abnormalities seven patients had normal renal arteriograms (and unilateral renal function studies) and four had bilaterally abnormal renal arteriograms (and unilateral renal function studies). Of the 12 patients with bilateral renogram abnormalities six patients had normal renal arteriograms (and unilateral renal function studies) and three patients had unilateral abnormalities on their renal arteriograms (and unilateral renal function studies). The seven patients in this series who have been shown to have unilateral renal vascular disease have undergone surgery and remain normotensive at this time.

DISCUSSION

The ideal screening procedure for a given disease entity would be one that resulted in no false-positive or false-negative results. A large number of false-positive results do not necessarily affect the usefulness of a screening procedure because no significant disease is missed. The presence of false-negative results, therefore, is the significant determining factor concerning the usefulness of a screen procedure.

The comparison between excretory urograms and renograms reveals agreement in 24 (51%) cases. There was disagreement between the two techniques in 10 cases (21.3%) in which one test was interpreted as normal and the other showed unilateral abnormality and in 8 cases (17%) in which one test was interpreted as normal and the other revealed a bilateral abnormality. In the remaining five cases (10.6%) both tests were interpreted as abnormal. This comparison results in decreased numbers of patients in the normal group from 22 on renogram alone to 15 using the combined results. The importance of this is recognized when the results from arteriograms (and renal function studies) are compared with the renograms (Table 3). Two patients whose renograms were interpreted as normal were found to have unilateral renal artery stenosis by renal angiography. These renograms are given in Figs. 1 and 2 which show symmetrical tracings for the kidneys. The renal arteriogram from one of these patients is shown in Fig. 3. The right renal artery stenosis (arrows Fig. 3) is clearly shown. Excretory urograms in each of these two patients were suggestive of unilateral renal disease. That these two patients had significant stenoses has been shown by their reversion to normotension after surgical removal of the obstructive lesion and 2-year minimal followup periods.

Such findings suggest that the renogram will not serve as an adequate screening procedure for recognizing unilateral renal disease. They also suggest that the combination of the renogram and the timed urogram might serve as an adequate screening procedure.

Renogram results disagreed with the results from arteriograms in 22 patients (46.8%). This large

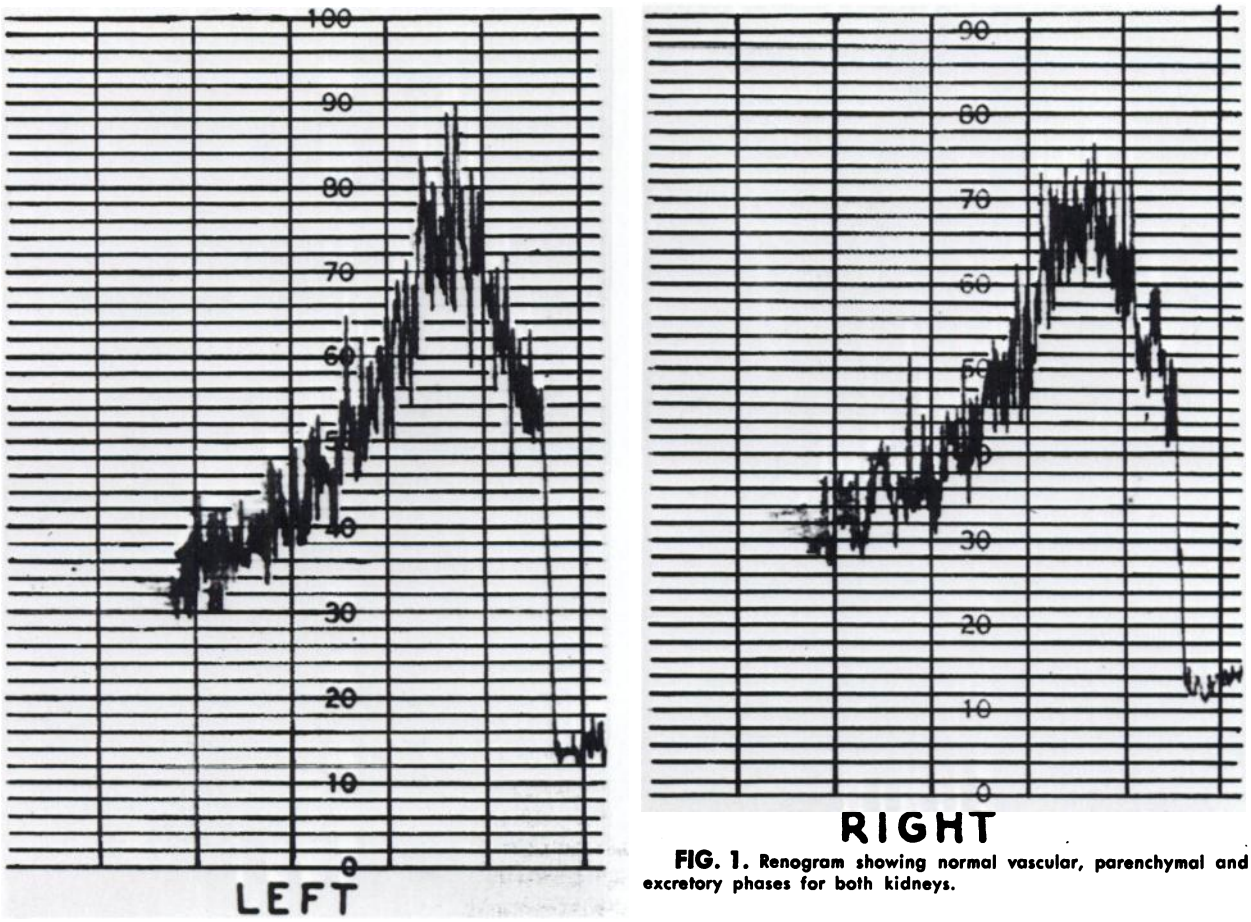

FIG. 1. Renogram showing normal vascular, parenchymal and excretory phases for both kidneys.

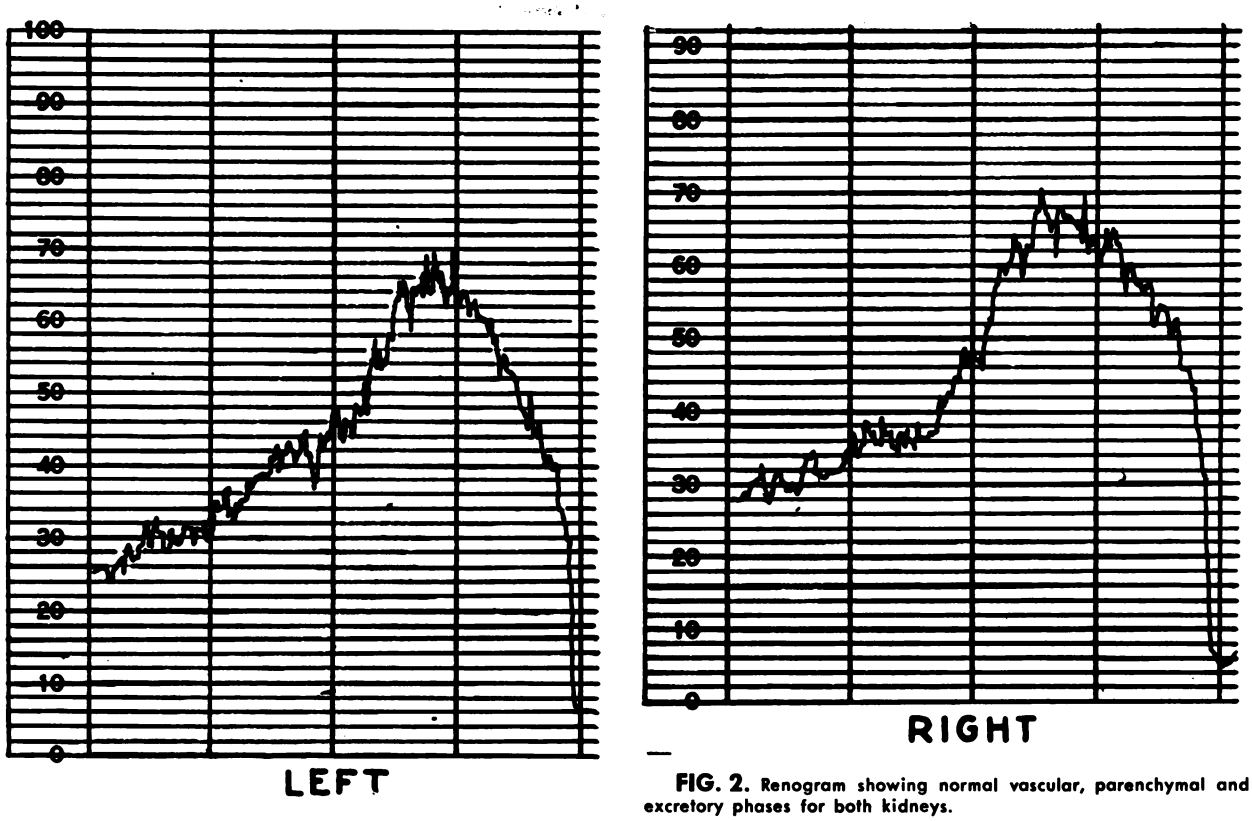

FIG. 2. Renogram showing normal vascular, parenchymal and excretory phases for both kidneys.

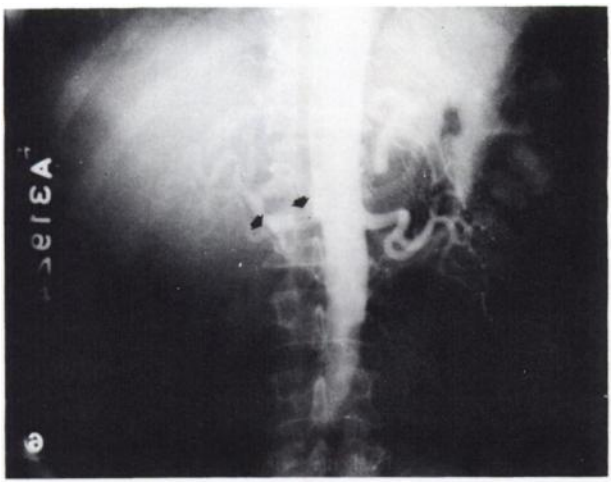

FIG. 3. Renal arteriogram from patient whose renogram is shown in Fig. 1. Proximal and distal stenotic areas of right renal artery are seen (arrows).

number of false-positive tests does not damage the usefulness of the renogram as a screening test for unilateral renal disease; however, it does affect any attempt to quantitate the tracings. These false positives are probably due to one or more factors which include inequality of the distance from the probe to the kidney, variability of renal blood flow, variability of kidney position, variability of blood volume and aberrations in the electronic equipment. Thus any attempt at quantitation of renograms must be subject to this initial, large number of faulty results plus the multiplication of these secondary to mathematical manipulation.

SUMMARY

Forty-seven hypertensive patients were studied with renograms, excretory urograms, unilateral renal function studies and renal arteriograms. Renograms failed to identify two patients with significant unilateral renal artery stenosis. All patients with significant unilateral renal vascular disease were identified by combining the results of the timed excretory urograms with the renogram. The study suggests that this combination of procedures is an adequate screening technique for the presence of unilateral renal vascular disease.

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