

Arterial Hypertension in Traumatic Subcapsular Perirenal Hematoma (Page Kidney)*

Evidence for Renal Ischemia

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A case of traumatic, subcapsular perirenal hematoma giving rise to arterial hypertension is reported. The ischemic functional pattern demonstrated during the phase of hypertension and its return to normal after subsidence of hypertension is testimony to the validity of Page's original concept of ischemia as the basic mechanism of hypertension in cases of extrinsic compression of one kidney.

THE classic studies of Page in 1939 [1] demonstrated that experimental compression of one or both kidneys in dogs by cellophane-induced fibrous perinephritis results in arterial hypertension, and that the mechanism is probably ischemic and therefore akin to Goldblatt's clamp [2] with the difference that ischemia in the Page kidney is caused by external compression of the small intraparenchymal arteries. Since that time a large number of cases have been reported in which hypertension was caused by various unilateral renal problems and cured by nephrectomy. Only thirteen of these cases are acceptable examples of the Page kidney [3-15]. Another four cases are of doubtful validity because they either have been alluded to briefly in reviews dealing with renal hypertension [16-18] or were impure and possibly possessed features of both Page and Goldblatt kidneys [19].

Our case of subcapsular perirenal hematoma in which individual renal function tests were performed both during the period of hypertension and after spontaneous return of blood pressure to normal will serve to support the existence of renal ischemia and its pathogenic role in the production of hypertension.

CASE REPORT

This sixteen year old boy was admitted to the Urological Service of the D. C. General Hospital

because of gross hematuria. Three days earlier he had fallen while running and struck the lower part of his right hemithorax and right flank against the edge of the curb. The only visible sequel, an abrasion of the skin which followed the course of the last two ribs on the right, was ignored until he noted blood in the urine the day after the fall. The boy had no complaints referable to hypertension. His blood pressure, recorded eleven times during the first day and four times during the second day, ranged between 170/100 and 156/90 mm. Hg. Blood pressures during the ensuing three weeks were within these ranges with only one reading of 120/90 mm. Hg. on the seventeenth hospital day. Pressure readings were equal in both arms and slightly higher in the thighs. Although the level of his blood pressure prior to the fall was not known, he had never been told that he had hypertension by pediatricians who had examined him previously. Examination of the members of his immediate family did not disclose high blood pressure. There were no abnormalities in the eyegrounds. The heart was not enlarged and the electrocardiogram was normal. Examination of the right flank demonstrated some tenderness, making palpation of the kidney difficult. No abnormal bruits could be heard over the kidneys. The urine was grossly bloody for one week and gradually became clear during the second week. Urinalysis was otherwise unremarkable as were the blood count, blood urea nitrogen, liver function studies and blood clotting studies. Cystoscopic examination showed no abnormalities except for bleeding from the right ureter. An intra-

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TABLE I
INDIVIDUAL RENAL EXCRETORY FUNCTION TESTS*

Test	Left Kidney			Right Kidney			Differences in %		
	1	2	3	1	2	3	1	2	3
Volume (ml.)									
(H)	26	49	70	15	18	21	-42	-63	-70
(N)	19	19	19	15	13	15	-22	-33	-22
Osmolality (mOsm./kg.)									
(H)	285	282	280	319	292	284	+12	+3	+1
(N)	434	420	407	511	432	419	+17	+3	+3
Sodium (mEq./L.)									
(H)	70	66	65	30	28	28	-55	-59	-59
(N)	96	99	100	96	102	103	0	+3	+3
Creatinine (mg./100 ml.)									
(H)	11	8.8	8.8	17	14.6	12	+55	+72	+37
(N)	3.2	2.9	3.2	3.2	3.4	3.1	0	+17	-3

* Performed once during the early post-traumatic period of hypertension (H) and six months after the blood pressure had returned to normal (N). The last column under "Differences" depicts per cent changes between the two kidneys. For computation of the differences, the first, second and third collections (1, 2 and 3) from each kidney were compared with the respective collections from the opposite kidney, the values belonging to the normal left kidney serving as 100 per cent. Note that the decreases in volume and sodium concentration exceeded 50 per cent as did the increase in creatinine concentration. Changes in osmolality, however, were not diagnostic.

venous pyelogram demonstrated modestly impaired excretion of the contrast medium from the right kidney. The size of the kidney, however, could not be evaluated with certainty.

The persistence of hypertension and tenderness in the right costovertebral angle suggested perirenal hematoma. Individual renal function tests performed before arteriography showed significant reductions in volume and sodium concentration and increased creatinine concentration from the right kidney as compared with the left (Table I).

A selective renal arteriogram and an aortogram performed three weeks after the accident (Fig. 1) showed patent renal arteries including their intraparenchymal segments. The two kidneys were of roughly equal size. The right kidney was surrounded by a density through which an enlarged and somewhat tortuous twelfth intercostal artery was visible. The outer contour of this kidney, as seen in the capillary-phase films, was irregularly lobulated and depressed in three areas (Fig. 2). The interpretation was a perirenal hematoma compressing the cortex in several areas. The presence of hematuria suggested a tear or contusion of the kidney and therefore favored a subcapsular localization of the hematoma. The high blood pressure was attributed to compression ischemia of the renal parenchyma, similar to that in the Page kidney.

No specific treatment was advised and the blood pressure returned to normal three weeks after the fall and has remained so since. The present values

are 120/70 to 130/90 mm. Hg. Aortography and selective renal arteriography were repeated six months later (Fig. 3). The renal arteries were again found to be normal throughout. The enlarged twelfth intercostal artery and the notches in the cortex produced by external compression were no longer present. The right kidney was smaller than the left in its greatest diameter by 1.0 cm. Otherwise, the study was considered normal. Individual renal function tests were also repeated and showed a return of volume, sodium and creatinine concentration toward normal (Table I).

COMMENTS

In his original report on the production of arterial hypertension by cellophane perinephritis Page suggested that the clinical counterpart of the cellophane kidney may be found in perirenal organizing hematomas. Two years later two cases of hypertension secondary to perirenal hematoma were recorded [3,4]. It is of interest that nine years earlier McKenzie [20] had described hypertension (155/115 mm. Hg) in a thirty-nine year old polycythemic man suffering from a subcapsular hematoma of the left kidney in whom blood pressure levels returned to normal (120/60 mm. Hg) after nephrectomy. Unaware of the role of renal ischemia in the genesis of hyper-

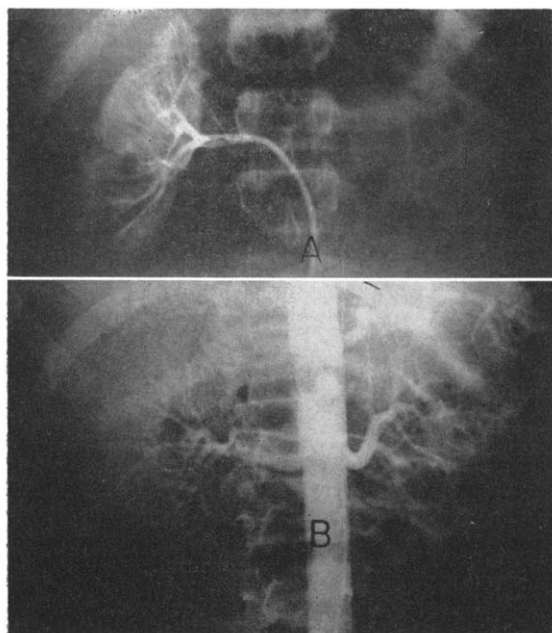


FIG. 1. Selective right renal arteriogram (A) and retrograde aortogram (B) performed three weeks after the fall. There is patency of all of the main renal artery and its branches but the capillary phase shows three distinct notches in the cortex corresponding to areas of compression. The area surrounding the right kidney is dense and hypervascular.

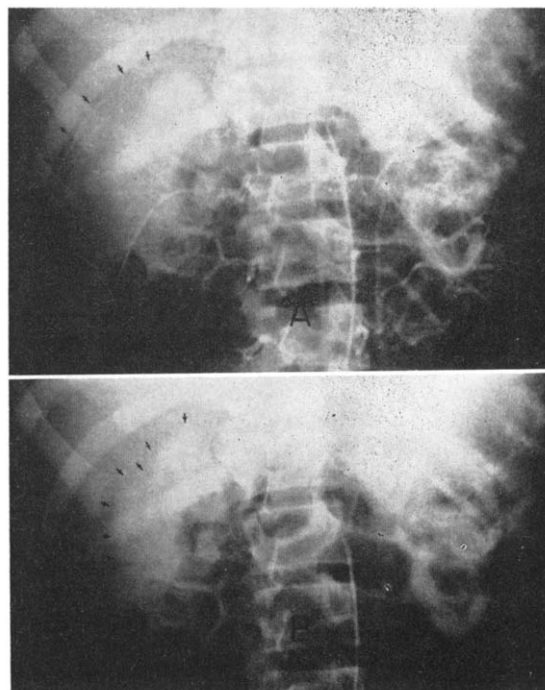


FIG. 2. Later films in the same series as in Figure 1 showing the enlarged, tortuous twelfth intercostal artery on the right (A) and persistence of the notches in nephrographic phase (B).

tension, McKenzie did not incriminate the renal compression and seems to have been more impressed with the finding of polycythemia. More recent reports [5-15] have, explicitly or implicitly, advanced Page's concept to explain the hypertension. That the perirenal condition was the cause of hypertension may be appreciated from a study of Table II, which shows return of blood pressure to normal in thirteen cases following nephrectomy. Sobel's case [4] and ours were managed conservatively and in both normal blood pressure was achieved. It must be emphasized, however, that in most of the other cases the perirenal hematoma had been present much longer and therefore could not be expected to respond to conservative therapy. In fact, thick-walled perirenal cysts resulting from liquefaction of the hematoma were present in several cases, a few of which had calcification in the wall of the cyst.

Certain features seem to be common to most or all patients with hypertension secondary to traumatic perirenal hematoma. It may be

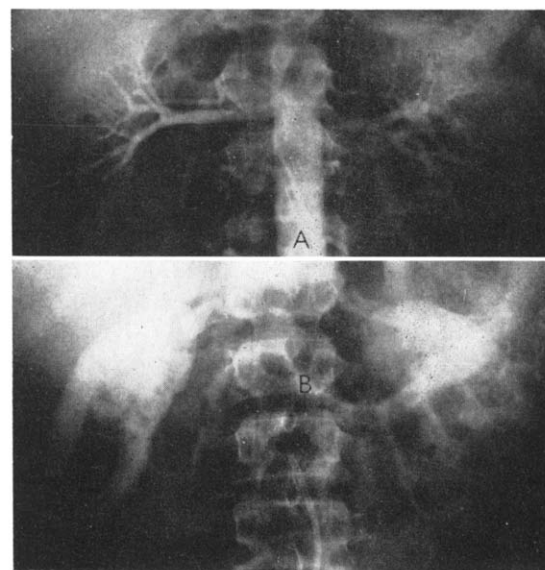


FIG. 3. Retrograde aortograms obtained six months after the accident showing uniform renal arterial flow and absence of the increased flow in the right perirenal area (A) and disappearance of the notches in the cortex (B).

TABLE II
DATA PERTAINING TO ALL CASES OF HYPERTENSION RESULTING FROM PERIRENAL PATHOLOGIC PROCESSES

Year	Reference	Age (yr.) and Sex	Trauma and Lesions	Blood Pressure (mm. Hg)		Specific Treatment
				Before Therapy	After Therapy	
1930	McKenzie [20]	35, M	Chopping wood, subcapsular hematoma (left)	155/115	120/60	Nephrectomy
1941	Killian et al. [3]	7, F	Fall over a chair, hematuria, tear of pelvis, subcapsular collection of urine under tension (left)	134/90	110/60	Nephrectomy
1941	Sobel [4]	4, M	Rolled down a bannister, hematuria (left)	170/120	Normal	None
1942	Farrell et al. [5]	18, M	Hit by a roller skate (right)	150/102	104/62	Nephrectomy
1944	Hayward [6]	51, F	Postnephropexy, perirenal fibrosis, also ischemia of lower pole (right)	210/110	120/58	Nephrectomy
1944	McKay et al. [7]	31, M	Removal of renal calculus, post-operative fibrous hull (right)	210/140	112/58	Nephrectomy
1949	Miller et al. [8]	34, M	? Football injury subcapsular calcified hematoma (right)	155/115	115/78	Nephrectomy
1951	Gilliam [9]	22, M	No known trauma, subcapsular cyst (left)	160/108	118/78	Nephrectomy
1955	Engel, Page [10]	19, M	? Football injury, calcified subcapsular cyst (right)	170/110	118/72	Nephrectomy
1956	Smith [11]	?, ?	?	High	Normal	Nephrectomy
1959	Uson et al. [12]	50, F	Trauma unknown, subcapsular hematoma (right)	High	Normal	Nephrectomy
1962	Downs et al. [13]	29, M	Trauma unknown, hematuria 10 yr. before, subcapsular cyst (right)	240/100	120/80	Nephrectomy
1966	Lange [14]	8, M	Ran into lamppost, fibrous hull compressed lower half (left)	170/130	Normal	Partial nephrectomy
1966	Schroeder et al. [15]	17, M	Blow to flank, hematuria, perirenal cyst (left)	190/120	130/75	Nephrectomy

noted in Table II that the patients' ages in cases of accidental injury range between four and thirty-five years, with six of the eight being under twenty. This may be explained by the greater vulnerability of the kidney in children to nonpenetrating trauma by virtue of its lower position, thinner fat pads, and perhaps the more resilient twelfth rib which is readily pushed into the substance of the kidney [21]. Another noteworthy feature is the relatively low level of blood pressure, around 160/100 mm. Hg, and never reaching alarmingly high values. This is in keeping with Page's original observations indicating a milder degree of hypertension following cellophane wrapping of only one kidney.

Demonstration of the ischemic functional pattern during the phase of hypertension and the return toward normal after subsidence of hypertension is the first documentation in

such a case since Page's original speculation thirty years ago. In only one other case, that of Schroeder and Correa [15], were divided renal function tests performed which showed an ischemic picture. However, the study was not repeated after the blood pressure returned to normal levels through nephrectomy.

In patients in whom significant perinephric hematomas develop following renal biopsy, the first signs of bleeding are pain, flank mass and a rise in blood pressure levels which return to normal when the bleeding ceases. This may be a transient demonstration of the Page kidney with rapid reversal of the hypertensive effect.

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