RENAL ANGIOGRAPHY IN HYPERTENSIVE DISEASE*

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In the last decade aortography has become an increasingly popular method of investigation in cases of hypertension. It has, however, never achieved the degree of recognition and use which in the light of recent knowledge we know it to deserve. Two reasons for this are apparent, viz. (1) that many hypertensives were not restored to normal health after nephrectomy performed in the first flush of enthusiasm arising from Goldblatt's epoch-making experimental work,[1] and (2) that radiologists and other interested workers tried to read more into the radiographs than they really have to offer.

We refer specifically to the radiographic appearances in the pyelonephritic contracted kidney. We have learnt from experience, and Hodgson[2] has recently pointed out, that

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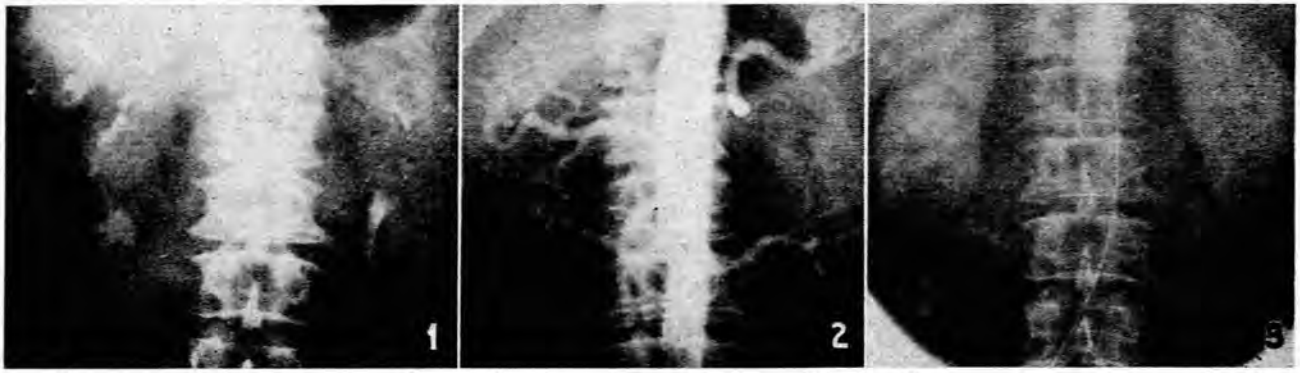

Fig. 1. Middle-aged man. Hypertension of sudden onset; 3 month's duration. Double kidney right side and slight foreshortening of inferior calyx of inferior pole.
Fig. 2. Same patient as in Fig 1. Arterial phase. Incomplete ramification of vessels to lower pole of right kidney.
Fig. 3. Negative defect of lower pole of right kidney in nephrographic phase. (Segmental resection with return of blood pressure to normal.)

Fig. 4. Hypertensive aorta with inadequate filling of left renal artery.
Fig. 5. Selective catheterization of the left renal artery showing patent vessel.
Fig. 6. Aortogram with Somerville pump showing excellent opacification and developing stenosis in a mildly hypertensive female with obliterative peripheral vascular disease.

any attempt to detect abnormality in the interlobular and arcuate vessels is fruitless. With the means of radiography at present at our disposal it is clear that our efforts must be confined to the larger renal vessels. An exception is the negative defect in the nephrographic phase associated with a localized renal infarction (Figs. 1 - 3). Gellman[1] has clarified the position, and with his work and that of Poutasse[4] aortography has assumed its rightful place as a significant and important investigation.

We now accept that this examination is of positive value only when it demonstrates an inteference with the normal renal blood supply due to one of the many causes found in Gellman's published group of cases†.[3]

Hodgson[2] has indicated that a normal pyelogram may be obtained in the Goldblatt type of kidney where occlusion is not complete, and we have had similar experiences confirming this observation. It is clear, then, that within the confines of Gellman's criteria for aortography,[3] a normal pyelogram is no contra-indication to aortography, which should be proceeded with immediately.

As to the technique of aortography, the translumbar technique with its attendant dangers is definitely outmoded and redundant. Samuel and Denny[5] have already indicated this view and now, after 5 year's uninterrupted experience with the Seldinger technique,[6] we can reaffirm this opinion. The contrast medium — 76% urografin — which we have also used since 1955 without demonstrable ill effect on the kidneys, has recently been shown in an experimental study by Berg[7] to have no chemotoxic effect on the kidney in rabbits.

Our present technique is as follows:

We first catheterize the patient's femoral artery by the Seldinger method[6] and pass a 205 polythene catheter up to the level of the 2nd lumbar vertebra, using the Phillips 5-inch image intensifier to control the level. The catheter is rendered radiopaque by being filled with contrast medium, after which the proximal stopcock is turned off. A trial dose of 10 c.c. or less of contrast medium is then injected and a film is exposed, or the area is viewed through the intensifier, to ascertain whether there is evidence of filling of the commencement of the renal vessels. If so, a further 20 c.c. is injected by means of the Stirling pressure device,[8] producing a pressure of approximately 500 mm. of mercury. Three films are then rapidly exposed, the first immediately before the completion of the injection.

In some cases inadequate filling (Fig. 4) or no filling of one or other renal artery is noted; the cause of this may be either technical or pathological. Where the patient has a high blood pressure at the time of the investigation, the tremendous velocity of blood flow tends to sweep the dye away extremely rapidly and also enhances the 'streamlining' effect of flow, seen on occasions in normal individuals. This, together with a particular inclination of the catheter tip, may well produce an erroneous impression that the vessel is occluded. In cases like this we consider it pointless, and probably unwise, to persist with further attempts to opacify the vessel by the same technique, and we then turn to the green Kifa opaque catheter with its preformed curve. This catheter can be introduced immediately after the attempt with the Seldinger method, or it may be postponed for a day or two.

Should it be necessary to proceed with selective catheterization, there are 2 manœuvres for the introduction of the green Kifa catheter that can be used.

In the first of these, the 205 polythene catheter, already in the aorta, is withdrawn, with or without screen control, into the femoral artery, and the long 160 Seldinger guide wire[6] is passed through it into the aorta, leaving an extra-arterial length of wire greater than that of the polythene catheter. The catheter is then withdrawn and firm compression over the artery is exercised. The Kifa catheter is introduced into the aorta over the 160 wire, care being taken that the preformed curve is inclined at the site of the renal artery which one desires to fill. Edeling *et al*,[8] have recently indicated that with renal arterial catheterization there is a danger from a possible ischaemic effect produced on the kidney by the degree of obstruction which the catheter produces in the renal artery. Dr. E. Lipworth has also informed us that the Swedes consider that the dislodgement of an atheromatous plaque, with consequent renal arterial embolization, is a possibility.

We have found that in the cases in which it is necessary to perform a selective arterial catheterization, in any part of the aorta, it is not essential to place the catheter within the artery, but merely to approximate the tip of the catheter to the orifice of origin of the artery, preferably in an inferior position. Futhermore, we have never experienced arterial embolization, even in the most atherosclerotic arteries, when using the Seldinger 205 catheter. Our experience with the Kifa catheter is limited, but we see no reason why it should not be equally safe when carefully manipulated, for its resilience is almost equal to that of the 205 catheter.

With the catheter in position, a small test injection of 5 c.c. is made and the filling of the artery is confirmed on the angled intensification viewer. A further injection of 8 c.c. of 60% urografin is then made and a single 1-second exposure is executed immediately after the commencement of the injection (Fig. 5).

The second manœuvre that may be used is to insert the green Kifa catheter by repuncture of the opposite femoral artery, using the 205 cannular needle for this purpose.

One of us demonstrated the preparation of the opaque catheter at the Congress by means of a cinema film, and said, however:

It is as well to emphasize the necessity of a small second aperture 1 cm. proximal to the tip of the catheter. This aperture is angled towards the aortic wall and is on the superior and convex aspect of the catheter. The purpose is to ensure filling of the aorta at the point of origin of the renal artery. This is of particular importance if by any chance, probably during the injection, the tip of the catheter enters the renal artery. In such circumstances it is conceivable that a narrowed origin of the renal artery would otherwise be missed, in the absence of associated opacification of the adjacent aortic blood flow (Fig. 6). We have in recent months found that in using the Somerville pump with a pressure of 60 lb. per square inch through the reduction valve, an extremely rapid injection of contrast media (20 c.c.) can be made. The images of the aorta and the renal arteries are brilliant

† The indications are discussed in the article by Drs. Denny and Tinker on page 848 of this issue.

and, since the introduction of this method, we have not been obliged to resort to selective catheterization.

Another procedure of value in ensuring better filling of the renal artery is to reduce the blood pressure to near normal levels by medical means. To achieve this result Poutasse[4] uses intravenous arfonad before the injection. To further enhance the brilliance of the image and the adequacy of renal arterial filling, we now use general anaesthesia and find that fluothane in many instances reduces the blood pressure to, or almost to, half the pre-anaesthetic level.

Where the blood pressure is very high, an intravenous drip containing arfonad has quickly and satisfactorily reduced the pressure to half the pre-anaesthetic level. As soon as the desired level is obtained, the drip is stopped and the injection given. The blood pressure returns to its normal level within 15 minutes.

In conclusion we wish to emphasize how much the use of the image intensifier has facilitated the performance of this investigation. A 9-inch image intensifier and 35 mm. camera is now in use, and with some refinement of technique with respect to film speed, type, and development, it would appear that the whole nephrographic procedure will possibly be satisfactorily achieved on ciné film.

We wish to thank Dr. R. G. Sauer for permission to publish Figs. 1 - 3.

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