RENOVASCULAR HYPERTENSION: EASIER DIAGNOSIS AND TREATMENT WITH INTRAVENOUS RENAL ARTERIOGRAPHY AND PERCUTANEOUS TRANSLUMINAL DILATATION

J P Cecile, A Fournier*, J P Sorez, D Delambre, Cl Galy*, P Fievet*, A Remond*

Centre Hospitalier de Lens, and *CHU d’Amiens, France

Summary

For the diagnosis of renovascular disease, the authors propose the use of intravenous arteriography with photographic subtraction as the method of choice and advise the use of pyelogram wash-out to assess the functional significance of the stenosis.

Furthermore they report their experience with percutaneous transluminal dilatation in 41 patients (10 fibrotic – 31 atherosclerotic renal artery stenoses) and suggest that this method is a valid alternative to surgery specially in poor risk patients. A controlled trial of this method versus surgery needs however to be undertaken to define the respective roles of these treatments.

Introduction

The classical approach for the diagnosis and treatment of renovascular hypertension (RVH) consists in the following steps [1]:

A) Screening of hypertensive patients for renovascular disease on the basis of clinical (abdominal bruit) and urographic data,

B) Performing renal arteriography by the technique of Seldinger in selected patients and then,

C) In patients with renovascular disease, performing tests such as divided function studies, renal vein renin ratio, and angiotensin suppression test in order to select the patients most likely to be improved by surgery. All these procedures are money and time consuming and not without hazard. Therefore we propose an easier, cheaper and safer alternative approach: screening the patients by intravenous arteriography, assessing functional significance of the stenosis by frusemide pyelogram wash-out and performing percutaneous transluminal dilatation of the renal arterial stenosis.

Technique and results of intravenous renal arteriography with pyelogram wash-out

Intravenous renal arteriography (IRA) is performed by rapid automatic injection of an i.v. bolus (2–3ml/kg) of a 38 per cent contrast medium. The film changer

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is turned on when the bolus (followed on a video screen) reaches the 11th dorsal vertebra to present six films at two sec. interval. The film preceding abdominal aorta opacification is used for photographic subtraction. Films are then taken for pyelography at five and 15 minutes [2].

This technique was performed in 1695 hypertensive patients, the diagnostic accuracy was 95 per cent and 114 renal artery stenoses were discovered suggesting a prevalence of renovascular disease of 6.6 per cent. This technique is well tolerated although it induces a flush in two-thirds of the cases when usual contrast media are used. This side effect is much less common with non-ionic contrast media. This procedure can be safely performed in out-patients and does not have the serious complications of arterial catheterisation which still occur in 1.3 per cent of the cases [3]. Irradiation cost is about the same as that of rapid frequency urography. Cost effectiveness calculations showed us that this procedure is about 25 per cent cheaper than the classical approach for the diagnosis of each case of renovascular disease [2]. The definition with this technique is comparable to that of digital subtraction angiography (DSA) [4] which is not yet readily available because of its high investment cost but has the advantage of requiring a smaller dose of contrast medium and fewer films. IRA by our technique or DSA is, furthermore, a simple, non-invasive method of assessing the quality of renal artery repair by surgery or dilatation.

On the basis of previous work [1, 5] we strongly recommend testing the functional significance of the stenosis by the pyelogram wash-out test (WO). This, previously performed by i.v. injection of urea, is now performed by i.v. injection of 40mg of frusemide (which unlike urea does not induce headache) and by taking three small films at two min. interval after the pyelographic film of the 15th minute. In a series of 68 cases of RVH correctly operated by the same team, we found that the presence of a delayed wash-out on the side of the stenosis correctly predicted the surgical outcome on hypertension in 84 per cent of the cases (i.e. improvement when present and vice versa) whereas there were six per cent false positive and 10 per cent false negative results. Furthermore in a group of 35 of these patients who had had split renal function studies (SRF) we could show that our criteria of functional significance (U creat. stenotic side – U creat. contralateral/U creat. contralateral × 100 > 15%) closely corresponded to a delayed wash-out except in two cases improved by surgery with positive SRF study and no delayed wash-out.

**Percutaneous transluminal dilatation of renal artery stenosis (PTD)**

**Patients**

PTD was performed in 41 patients (27 men, 14 women) selected because all had severe hypertension resistant to medical treatment including diuretic + renin inhibiting drug (betablocker, clonidine, methyldopa) ± vasodilator and a renal artery stenosis detected by intravenous renal arteriography.

Thirty-one had atherosclerotic stenosis (A group: 20 men, 11 women) and 10 localised fibrodysplastic stenosis (F group: 7 males, 3 females). The A group (41–75 years) was significantly older than the F group (8–41 years). Further-
more it was associated with renal function impairment in eight (sCr 16–34mg/dl) with left ventricular hypertrophy in 24, coronary and/or cerebrovascular insufficiency in 11, hypertensive retinopathy (grade III) in 11 whereas no patient of the F group had these complications.

**Technique and immediate results on the stenosis**

The technique is that described by Grünzig [6]. We used his coaxial balloon catheter introduced by puncture of the femoral artery in all cases except two where the axillary artery was punctured. 5000 IU of heparin are injected through the catheter and anticoagulants are prescribed for three to six months.

In the F group, PTD corrected stenosis in seven cases, improved it in two cases and failed in one case. Surgery was finally necessary in this latter case. A second dilatation was successful in one case and a third dilatation was required in the remaining case.

**TABLE I. Long term results of PTD on hypertension (> 1 year)**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Total</th>
<th>Mean (range) duration of follow-up months</th>
<th>Cure</th>
<th>Improved</th>
<th>Non improved</th>
<th>Significant recurrence of stenoses/new angiogram</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Atherosclerotic stenosis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grim et al 1981 [10]</td>
<td>16*</td>
<td>14 (4–24)</td>
<td>3</td>
<td>12*</td>
<td>1</td>
<td>12/12†</td>
</tr>
<tr>
<td>Present study</td>
<td>17</td>
<td>18 (12–36)</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>4/6‡</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>63</td>
<td>16 (25%)</td>
<td>35 (55%)</td>
<td>12 (19%)</td>
<td>21/32 (66%)</td>
<td></td>
</tr>
<tr>
<td><strong>Fibrodisplastic stenosis</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Grim et al 1981 [10]</td>
<td>10</td>
<td>12 (1–22)</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>1/6</td>
</tr>
<tr>
<td>Kuhlmann et al 1981 [6]</td>
<td>6</td>
<td>12 (6–24)</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0/5</td>
</tr>
<tr>
<td>Present study</td>
<td>5</td>
<td>18 (12–24)</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>2/7</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>29</td>
<td>22 (75%)</td>
<td>5 (17%)</td>
<td>2 (8%)</td>
<td>3/18 (16%)</td>
<td></td>
</tr>
</tbody>
</table>

* Seven solitary kidneys
† The data on hypertension of these series are contemporary with the restenosis
‡ The two cases with unimproved hypertension had a second successful PTD
In the A group PTD corrected stenosis in 19 cases, improved it in five but failed in seven cases because the catheter could not be passed through in five and because the atheroma was too rigid in two cases.

Complications

Two old patients (72–75 years) died in the week following PTD: one because of diabetic coma, the other because of hemiplegia. In this latter, blood pressure had decreased dramatically from 300/160 to 130/80mmHg.

Five local complications were observed: two haematomas necessitating surgery in one case, two mild dissections without permanent impairment of renal function, and one macrohaematuria.

Serum creatinine was measured before and three days after PTD. It increased significantly but transiently in three whereas it decreased significantly in four with initially high values. No significant change was observed in the 17 other patients.

Long term follow-up

Our results are summarised in Table I with other series giving separate data for fibrolydplastic and atherosclerotic stenosis with a mean follow-up > one year.

We classified the patients similar to Kuhlmann et al [6] as 1) cured when their diastolic pressure fell below 95mmHg without treatment; 2) improved when the diastolic fell between 95 and 110mmHg without treatment or when it fell below 95mmHg with antihypertensive drugs; 3) unimproved otherwise.

Predictive value of the pyelogram wash-out test and of the renal vein renin ratio

For this evaluation we have selected the 18 patients with unilateral stenosis who had both tests, and a technically successful dilatation. Plasma renin activity was measured by radioimmunoassay of angiotensin I. The patients had their antihypertensive drugs discontinued three days before dilatation with the exception of 40mg of frusemide in half of them. The only patient whose hypertension did not improve had a renin ratio < 1.5 and a negative wash-out test. Whereas out of the 17 patients whose hypertension improved, only 10 had a renin ratio ≥ 1.5 and 13 had a positive wash-out.

Renal vein renin was measured again a few days after the first PTD in six patients. The ratio was above 1.5 in four cases and decreased in all but in two cases. It remained above 1.5 in two patients confirming the functional significance of residual stenosis which necessitated a second dilatation.

Discussion

The promising short term results of Schwarten et al [7] and of Tegtmeyer et al [8] appear to be partially confirmed by the long term results of our present study and those of Martin et al [11], Grim et al [10] and Kuhlmann et al [6]. The results appear however much better in the fibrotic group than in the athero-
sclerotic group. In the series of Grim et al [10] and Kuhlmann et al [6] this is due in part to a high recurrence rate of atherosclerotic stenosis. Our two failures were, however, not due to restenosis but probably to severe nephroangiosclerotic lesions of the small arteries as suggested by their arteriographic pattern. This difference of results between fibrotic and atherosclerotic lesions has been recognised for a long time with surgery: in the series of 510 patients operated by Lacombe et al [1] cure of hypertension was observed in 52 per cent of the fibrotic lesions and in 24 per cent of the atherosclerotic lesions. With 75 per cent cure rate with fibrotic lesions and 25 per cent cure rate for the atherosclerotic lesions, the results of PTD are not inferior to those of surgery.

The hazards of PTD are small but not negligible. The two deaths we had were not directly related to the PTD procedure per se, but the occurrence of fatal hemiplegia with the dramatic drop of blood pressure in one case, strongly suggests that before performing PTD in elderly it would be advisable to detect and correct any carotid stenosis and/or that previous progressive medical treatment (especially by converting enzyme inhibitor) would be advisable to prevent a dramatic fall of blood pressure. We have observed only five local complications, none with serious consequences (i.e. in 12 per cent of the procedures). Higher rates of complications, however, have been reported (16–28%) in other series [6–12], a few leading to the loss of the kidney [12] or to the death of the patient [7]. Therefore this procedure has to be performed only in selected patients by a well trained radiologist working in close cooperation with the internist and the vascular surgeon who will have an operating room available in case of arterial thrombosis or perforation.

The hazards of PTD however compare favourably with those of surgery especially in elderly poor risk patients since in the American cooperative study on RVH, operative mortality for atherosclerotic patients was 9.3 per cent [1].

The selection of hypertensive patients for RVH screening and treatment is a matter of debate that we can only summarise here. In agreement with most authors [12], we propose that screening for RVH by the classical approach or by IRA should be decided on at least one of the following clinical findings: 1) systolodiastolic abdominal bruit; 2) abrupt onset or aggravation of hypertension; 3) onset of hypertension before 30 or after 55; 4) hypertensive retinopathy; 5) failure of medical treatment. The prognostic tests are performed once a renal artery stenosis is demonstrated. In our previous experience SRF had a better prognostic value than in the wash-out test or the renal vein renin ratio [1, 5] but we have abandoned it because it is painful and not without hazard. Therefore we recommend performing the wash-out test and the renal vein renin measurement although neither of these tests have sufficient value to contraindicate repair of a highly stenosed renal artery when negative. Our experience with renal vein renin is supported by the recent data of Luscher [13] and is at odds with that of others’ series in the literature which were possibly biased by the fact that only very few patients with non-lateralising renin hypersecretion were operated upon [1]. We recognised however that our renin measurements, although performed under diuretic therapy, were not always performed in optimal conditions of lateralisation since antirenin drugs were discontinued for only three days. Since it is sometimes hazardous to do so we now replace them by converting
enzyme inhibitor which stimulates renin secretion.

Another reason for repairing a tightly stenosed renal artery in severely hypertensive patients in spite of negative wash-out test or lateralisation of renin secretion is that, perhaps with the exception of medial fibroplasia with microaneurysms, the stenosis progresses and may lead to ischaemic necrosis of the kidney [12].

The choice between surgery and PTD depends first on the technical feasibility of PTD (usually impossible for tight stenosis of branch artery or multiple stenoses of medial fibroplasia with microaneurysms) and on the assessment of surgical risk. When this latter is negligible and when PTD is technically possible there is no strong reason to prefer one method to the other except that PTD is quicker and less expensive than surgery but has unknown follow-up above two years. A long term controlled trial comparing surgery and PTD for this group of patients is necessary to delineate the exact place of each procedure.

References


Address for correspondence: Pr A Fournier, Service de Néphrologie, Hôpital Nord, 80000 Amiens, France

Open Discussion

UNIDENTIFIED SPEAKER (Belgium) You mentioned in your atherosclerotic groups several patients were renal insufficient. What was the evolution of the renal insufficiency after dilatation in these patients?

FOURNIER Yes that is right. Dilatation induced an increase in creatinine in three but a decrease in four. One month later the patients who had increased creatinine had returned to their pre-dilatation values which was in the normal range for their age.
DAL CANTON (Naples) In responsive patients how long must you wait after angioplasty before the blood pressure reaches its stable and lowest value?

FOURNIER It is quite variable. With two elderly patients we had a dramatic fall within thirty minutes. Usually you have a good response by about a week, but you may have to wait longer to be sure that your procedure was really effective and useful to the patient.

LINDQUIST (Umea) A bolus injection may be potentially dangerous in some patients, such as in those with diabetes and uraemia, and you may induce contrast complications.

FOURNIER Certainly you are right. I would stress that in patients with diabetes mellitus and myeloma care should be taken particularly with respect to hydration and very careful follow-up.

KERR (Newcastle) Can I just follow that question by saying I find it surprising that you have a low incidence of allergic reactions after this bolus injection. Are you using the same contrast medium and the same dose as for conventional urography?

FOURNIER Yes, there is some pathophysiological explanation as regards the number of sites which liberate material which is less when the bolus is more rapidly injected. There are some reports in the literature explaining these discrepancies which have also been observed by other authors.