Percutaneous transluminal balloon angioplasty of
the aorta in patients with aortitis


ABSTRACT  Four patients with aortitis and stenotic lesions of the aorta were successfully treated by
percutaneous transluminal balloon angioplasty. The peak systolic gradient across the constrictions
decreased from 82.5 ± 35.7 to 37.5 ± 18.5 mm Hg immediately after dilatation. Repeat angiography
in the first three patients performed 2 months later showed a further decrease in the gradient to 13.8
± 9.5 mm Hg. There were no complications during or after the procedure, and all the patients have
shown remarkable symptomatic relief during the follow-up.


AORTITIS is a form of vasculitis with the character-
istic feature of "pulselessness." 1 The inflammatory
process commonly involves the aorta and its major
branches. Its clinical manifestations are variable
depending on the regional distribution of the disease,
the type of vascular lesions, and whether the inflam-
mation is persistent or has resolved. The etiology is still
uncertain. Specific treatment of the disease is not avail-
able without knowledge of the exact etiology. Surgical
treatment is used during the chronic phase to deal with
late complications of aortitis, but the scope of surgical
therapy is limited because of the multifocal and often
progressive nature of the disease.

After the introduction of percutaneous transluminal
balloon angioplasty in 1964 by Dotter and Judkins2 and
the development of the balloon dilatation catheter in
1974 by Grüntzig and Hopff,3 percutaneous transluminal
balloon angioplasty has become an accepted mode of treatment for stenotic lesions. Successful dilatation
of coarctation of the aorta,4 5 restenosis of coarctation,6
atherosclerotic stenosis of the lower abdominal aorta,7 8
and peripheral arteries has been reported.9–11 Experience with balloon dilatation angioplasty in aortitis is very limited. To our knowledge, only four cases of balloon angioplasty in this setting have been reported.12–14 Here we report for the first
time four cases in which successful dilatation of aortic
constrictions has been performed in patients with aortitis.

Methods

Four male patients with aortitis (ages 12 to 32 years, mean
22.2 ± 8.6) were subjected to percutaneous transluminal bal-
loon angioplasty. Their main presenting symptom was dyspnea
on exertion. One of them had associated features of nephrotic
syndrome, and all four had hypertension. In the first three
patients, femoral pulses were very feeble compared with the
upper extremity pulses, and the other lower limb pulsations were
not palpable. In the fourth patient, lower limb pulses, though
palpable, were feeble compared with the upper extremity pulses
(table 1).

Laboratory investigations showed normal leukocyte count,
and the erythrocyte sedimentation rate was elevated in two.
Studies for the lupus erythematous cell and antinuclear factor
were negative. One patient showed heavy proteinuria, hypoal-
buminemia, and hypercholesterolemia. Results of urinalysis were
normal in the others. The electrocardiogram showed left ven-
tricular hypertrophy in all four. Three had cardiomegaly on the
chest roentgenogram.

With the tentative diagnosis of aortitis, these patients were
subjected to cardiac catheterization and aortography. Under
local anesthesia, a No. 8F pigtail catheter was passed through the
right femoral artery percutaneously. Pressures were recorded at
different levels in the aorta, and gradients across the con-
strictions were obtained. The aortogram performed in antero-
posterior and lateral views showed features of aortitis.

After determination of the site, the diameter of the constricted
segment and of the "normal" aorta was calculated after cor-
recting for the magnification factor. A flexible-tip, 300 cm long,
0.038 inch guidewire was then passed through the pigtail cath-
eter, and its tip was advanced into the ascending aorta. Heparin
(2500 U) was given intravenously. With the exchange guidewire
kept in position, the pigtail catheter was taken out and a deflated
air-free No. 9F (Meditech, 12 to 20 mm diameter) balloon
catheter was passed over the guidewire and positioned across the
first constriction. The balloon size was selected as 60% to 100%
of the normal aortic segment, but this did not exceed three times
the constricted segment.4 The balloon was inflated with half-
TABLE I
Clinical findings in patients before angioplasty

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Pulsations</th>
<th>Blood pressure (mm Hg)</th>
<th>Other relevant findings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Upper limb</td>
<td>Lower limb</td>
<td>Upper limb</td>
</tr>
<tr>
<td>I</td>
<td>+ ++ +</td>
<td>Femoral + Others 0</td>
<td>200/120</td>
</tr>
<tr>
<td>II</td>
<td>+ ++ +</td>
<td>Femoral + Others 0</td>
<td>170/80</td>
</tr>
<tr>
<td>III</td>
<td>Left + + +</td>
<td>Femoral + Others 0</td>
<td>190/110</td>
</tr>
<tr>
<td></td>
<td>Right + +</td>
<td>+ +</td>
<td>180/120</td>
</tr>
</tbody>
</table>

0 = complete absence of pulsation; + = very feeble pulsation; ++ = reduced pulsation; +++ = normal pulsation; NR = not recordable.

Results

In the first two patients, the aortogram showed two constrictions, one in the descending thoracic and other in the abdominal aorta; the third patient had a single constriction in the thoracic aorta. The fourth patient had narrowing in the abdominal aorta and in the right renal artery. Percutaneous transluminal balloon dilatation of the aorta was successfully accomplished in these patients. The peak systolic gradient across the constrictions decreased from 82.5 ± 35.7 to 37.5 ± 18.5 mm Hg immediately after dilatation without significant change in the cardiac index (3.6 ± 0.3 to 3.8 ± 0.4 liters/min/m²). In three patients, angiographic diameter of the constricted segments increased by almost two-fold to threefold (7.5 ± 2.4 to 15.2 ± 3.4 mm) (figures 1 and 2). Hemodynamic studies performed after 2 months showed a further fall in the gradient to 13.8 ± 9.5 mm Hg (table 2). Follow-up aortograms (figures 1, C and 2, C and D) demonstrated no evidence of restenosis or aneurysm formation.

These patients have now been followed from 5 to 14 months (mean 8.5 ± 4.1). The blood pressure in the upper and lower extremities was measured at rest and on exercise. The systolic pressure gradient between the upper and lower extremities was 17.5 ± 3.5 mm Hg at rest and increased to 25 ± 7 mm Hg on exercise. All the patients have shown remarkable symptomatic improvement, and the features of nephrotic syndrome in the second patient have disappeared.

Three of the four patients are normotensive without antihypertensive medication. Residual diastolic hypertension in the fourth patient is due to associated right renal artery stenosis, for which subsequent dilatation is planned.

Discussion

Percutaneous transluminal angioplasty has become an established technique in the treatment of atherosclerotic coronary artery disease. However, only sporadic reports refer to the efficacy of this method in patients with nonatherosclerotic lesions.4-11 Experience with percutaneous transluminal angioplasty in aortitis is extremely limited.12-14 Martin et al.12 reported successful dilatation of proximal left subclavian artery stenosis in one patient and of a renal artery occlusion in another case of aortitis. Successful dilatation of renal arteries in two patients with aortitis has been reported by Saddekni et al.13 and Srur et al.14 Our experience is the first attempt to dilate the constrictions in the aorta itself in patients with aortitis and has not been previously reported.

There was an immediate fall in the gradient by 54.5% (from 82.5 ± 35.7 to 37.5 ± 18.5 mm Hg), with a 90.6% increase in diameter of the constricted segments. Follow-up studies in the first three patients showed a further fall in the gradient by 70.4% from the immediate postdilatation values, indicating a sustained and progressive improvement. Incomplete relief of obstruction immediately after angioplasty followed by
FIGURE 1. Serial aortograms from the first patient, showing the second constriction before angioplasty (A), reconstitution of the aorta immediately after angioplasty (B), and digital subtraction angiogram on follow-up (C).

FIGURE 2. Serial aortograms from the second patient, showing both constrictions before angioplasty (A), reconstitution of the aorta immediately after angioplasty (B), on follow-up at the level of the first constriction (C), and at the level of the second constriction (D). Arrows show the site of angioplasty.
TABLE 2
Hemodynamic results of balloon angioplasty

<table>
<thead>
<tr>
<th>Patient no</th>
<th>Systolic aortic pressure (mm Hg)</th>
<th>PSG at constriction (mm Hg)</th>
<th>Lumen size (mm) of constriction</th>
<th>Balloon size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Above constriction</td>
<td>Below constriction</td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>1 B</td>
<td>200</td>
<td>95</td>
<td>60 + 45</td>
<td>3.9</td>
</tr>
<tr>
<td>A</td>
<td>200</td>
<td>165</td>
<td>35 + 0</td>
<td>11.6</td>
</tr>
<tr>
<td>F</td>
<td>150</td>
<td>130</td>
<td>20 + 0</td>
<td>14.8</td>
</tr>
<tr>
<td>2 B</td>
<td>205</td>
<td>100</td>
<td>50 + 55</td>
<td>10.8</td>
</tr>
<tr>
<td>A</td>
<td>185</td>
<td>125</td>
<td>0 + 60</td>
<td>19.6</td>
</tr>
<tr>
<td>F</td>
<td>138</td>
<td>138</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>3 B</td>
<td>200</td>
<td>110</td>
<td>90</td>
<td>7.6</td>
</tr>
<tr>
<td>A</td>
<td>180</td>
<td>140</td>
<td>40</td>
<td>12.1</td>
</tr>
<tr>
<td>F</td>
<td>160</td>
<td>140</td>
<td>20</td>
<td>13.2</td>
</tr>
<tr>
<td>4 B</td>
<td>180</td>
<td>150</td>
<td>30</td>
<td>6.4</td>
</tr>
<tr>
<td>A</td>
<td>155</td>
<td>140</td>
<td>15</td>
<td>7.4</td>
</tr>
</tbody>
</table>

B = before angioplasty; A = after angioplasty; F = follow-up restudy; PSG = peak systolic gradient.

Gradual regression in stenosis during follow-up was also observed by Srur et al. and has been explained by slow retraction of ruptured fibrous bands and possible release of superimposed spasm.

Pathologically, aortitis is a panarteritis with secondary reactive hyperplastic thickening of intima and sclerosis of the adventitia as the disease becomes chronic. This may appear to be incompressible. However, as this study shows, the constrictions can be dilated and near-normal diameter of the aorta restored.

Although the number of patients reported here is small and the duration of follow-up is too short to evaluate the long-term results of this nonsurgical technique, it is evident that the stenotic lesions in aortitis are amenable to balloon dilatation. This is a simple technique that can be carried out under local anesthesia and has dramatic immediate and early follow-up results. The procedure seems to offer a relatively safe and cost-effective alternative to surgery.

**References**

Percutaneous transluminal balloon angioplasty of the aorta in patients with aortitis.
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