Risk Factors Leading To Arterial Occlusion Following Diagnostic Arteriography

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Objectives: Arteriography may precipitate occlusive complications in stenotic vessels by a toxic effect on the vascular endothelium, leading to intra-arterial thrombosis. The aim of this retrospective study was to determine the incidence of arterial occlusion following arteriography.

Methods: We studied 101 consecutive patients (71 male, 30 female; median age 72 years) undergoing percutaneous transluminal angioplasty (PTA) of stenotic lesions, which had been identified on diagnostic arteriograms performed a median of 109 days (range 6-519) previously. One hundred and thirty-one arterial stenoses suitable for PTA were identified in the patient cohort.

Results: Seventeen patients (17%) progressed to occlusion in the period between diagnostic arteriography and PTA. Stenoses in the femoro-popliteal segment (21%) progressed to occlusion more frequently than lesions of the iliac arteries (3%). Independent risk factors were analysed to determine the risk factors predisposing to arterial occlusion following diagnostic arteriography. Both groups were well matched for age and sex. The mode of presentation, the presence of ischaemic heart disease, hypertension, diabetes or current smoking habits did not predict progression of disease to arterial occlusion. However, the rate of occlusion appeared to be influenced by the proportion of patients taking anti-platelet medication (51% in non-occluders as compared to 11% in patients who occluded, 95% CI 0.1 to 10), and to the length of time between arteriography and PTA (median of 92 days in non-occluders as compared to 125 days in patients who occluded, 95% CI 21 to 57).

Conclusions: These data demonstrate that occlusion of pre-existing arterial stenoses following diagnostic arteriography is significantly more frequent in patients not taking anti-platelet medication and when the time interval between arteriography and PTA exceeds 92 days. To minimise thrombotic arterial occlusion both diagnostic and therapeutic procedures should be performed simultaneously, but if a delay is unavoidable, patients should be treated with anti-platelet medication, which reduces the incidence of arterial occlusion.

Key Words: Arteriography; Percutaneous transluminal angioplasty; Stenosis; Occlusion.

Introduction

Since the introduction of the Seldinger technique for trans-femoral catheterisation, percutaneous transluminal angioplasty (PTA) has become an established treatment in lower limb arterial occlusive disease.

Unfortunately, due to the increasing specialisation within both interventional radiology and vascular surgery, and the finite time constraints of angiographic interventions, there may often be a temporal delay between diagnostic arteriography and PTA. This interval is often utilised to discuss the arteriographic findings and to plan endovascular or reconstructive treatment. However, this delay may not be without adverse consequences, as during the interim period between diagnostic arteriography and balloon dilatation, arterial stenoses may progress to total arterial occlusion. Disease progression of this nature has significant consequences, as angioplasty of arterial occlusions is associated with higher failure and complication rates than dilatation of stenotic lesions.

Previous studies have suggested that angiographic contrast media may be toxic to vascular endothelium and may thus be partially responsible for accelerated disease progression by encouraging platelet deposition. This study aims to identify specific
risk factors that predict progression of stenotic to occlusive lesions during the delay between diagnostic arteriography and percutaneous balloon dilatation.

Methods

All patients undergoing lower limb arteriography for arterial occlusive disease between Jan 1988 and Dec 1993 were identified from the arteriography register of Leicester Royal Infirmary, and their case records inspected. From these records, patients were identified who had a delay between diagnostic arteriography and subsequent PTA. These were patients who had a significant arterial stenosis demonstrated on an initial arteriogram, who then had a separate and planned PTA at a later time point. For the purposes of this study, a significant stenosis was defined as a stenotic arterial lesion thought to be responsible for symptoms of lower limb ischaemia and which was considered to require treatment by either angioplasty or bypass surgery. Seven patients had an arteriogram and simultaneous failure of angioplasty due to an inability to cross the lesion. These patients were included in the study as they all had a successful angioplasty at a later date, and any complications could not be attributed to guide wire manipulation alone.

Case notes were obtained from all patients fulfilling these criteria, and demographic details recorded. Potential risk factors predisposing to arterial occlusion were noted (Table 1), as was the reason for the delay between angiography and PTA. All arteriograms were studied to determine whether the initial stenotic lesion had progressed to an occlusion between diagnostic and therapeutic procedures.

All arteriograms were performed using non-ionic contrast media.

Table 1. Factors analysed to predict disease progression following arteriography

<table>
<thead>
<tr>
<th>Factor</th>
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<tr>
<td>Age</td>
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<td>Sex</td>
<td></td>
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<tr>
<td>Presentation (claudication, critical ischaemia)</td>
<td></td>
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<tr>
<td>Smoking</td>
<td></td>
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<tr>
<td>Hypertension</td>
<td></td>
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<tr>
<td>Ischaemic heart disease</td>
<td></td>
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<tr>
<td>Cerebrovascular disease</td>
<td></td>
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<tr>
<td>Diabetes</td>
<td></td>
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<tr>
<td>Anti-platelet medication</td>
<td></td>
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<td>Interim time delay</td>
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<tr>
<td>Level of lesion</td>
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</table>

Results

During the 5-year period studied, 131 lower limb arterial stenoses in 101 patients (71 male, 30 female, median age 72 years) were identified that were managed by diagnostic arteriography followed by interim angioplasty. The reasons for not performing simultaneous angioplasty at the time of original angiography were failure to cross the stenotic lesion in seven patients; the need for discussion as to the most appropriate form of treatment in 28, and in the remaining 66 patients arteriography was performed by non-specialist radiologists who did not routinely attempt balloon dilatation.

Level of occlusion

Eighty-six stenoses (66%) occurred in the femoropopliteal segment, 34 in the iliac arteries (26%) and 11 infragenicularly (8%). Overall 17 patients (17%) developed an arterial occlusion in the interim delay between diagnostic arteriography and therapeutic angioplasty (Fig. 1). New occlusions occurred in one iliac (3%), 18 femoropopliteal (21%), and one below-knee stenosis (9%). Although there were too few patients in the infragenicular region for meaningful analysis, there was a higher rate of disease progression in the femoropopliteal segment than in wider diameter iliac arteries (95% CI 7.7% to 28.3%).

Risk factors

Analysis of risk factors predicting the progression of arterial stenoses to occlusion are illustrated in Table 2. Patients were stratified into two groups: those who progressed to arterial occlusion and those who did not. The two groups were well matched for age (occluders median age 73 years (67-70 years), non-occluders 71 years (68-75 years) — 95% CI 3.0 to 7.0, W = 912, p = 0.69) and sex (occluders male: female ratio 1.8, non-occluders male:female ratio 2.5—95% CI -18.0% to 31.4%).

Statistical analysis

Results are presented as medians with 95% confidence intervals (CI). Continuous variables are analysed by the non-parametric Mann-Whitney test, and discrete variables by differences in proportions.¹⁵
The mode of presentation, the presence of diabetes, hypertension, cerebrovascular disease, ischaemic heart disease or smoking did not predict the progression of arterial stenoses to occlusion after diagnostic arteriography. However, the rate of occlusion appeared to be significantly influenced by the proportion of patients taking anti-platelet medication, and to the length of time between arteriography and PTA.

**Discussion**

In most vascular centres retrograde femoral arteriography remains the 'gold standard' in the investigation of occlusive peripheral vascular disease, although ultrasound-based techniques seem likely to play an expanded role in diagnostic arterial imaging. The increasing demand for radiological interventional procedures has, in our unit, led to delays between diagnostic arteriography and percutaneous balloon dilatation. This may be attributed to finite time resources and by some diagnostic procedures being performed by non-specialist radiologists who do not routinely perform complex angioplasties.

The progression of an arterial stenosis to a complete occlusion following diagnostic arteriography is difficult to define accurately, as this sequence of

![Fig. 1. (a) Diagnostic arteriogram of a significant SFA stenosis thought suitable for treatment by percutaneous transluminal angioplasty. (b) The same lesion as in 1a, which has progressed to a complete arterial occlusion during an 85 day delay between diagnostic arteriography and PTA.](image-url)
events reflects both the natural progression of the atherosclerotic process and the toxic effect of contrast media on the vessel wall.\textsuperscript{13,14,19} However, irrespective of the aetiological events, progression to arterial occlusion has fundamental effects, as subsequent balloon dilatation is more difficult and more likely to be associated with adverse events.\textsuperscript{20}

In their original study, Coran and Warren\textsuperscript{21} followed up patients suffering from claudication using serial arteriograms over a 5 to 9-year period. During this time nearly 75\% of limbs deteriorated angiographically, although there was little correlation between arteriographic progression and the severity of ischaemic symptoms, hypertension, myocardial or cerebral ischaemia. Kuthan\textsuperscript{22} studied 1196 limbs and reported that progression of arterial occlusive disease in diabetics was significantly higher than in non-diabetics. It was also reported that proximal segments of the superficial femoral artery (SFA) were the most likely to progress to an occlusion, a finding confirmed in this study.

May and Nissl\textsuperscript{5} reported a 1.7\% occlusion rate within 8 days of diagnostic arteriography in 2000 patients, but did not analyse the predisposing factors for disease progression. More recent studies have demonstrated occlusion rates of 10\%,\textsuperscript{8,9} but comparisons are difficult due to patient selection and the use of non-ionic contrast media.

To date, a detailed analysis of risk factors predisposing to arterial occlusion following arteriography has not been reported. The results from this study suggest that, in the presence of a significant arterial stenosis, the longer the interim delay before angioplasty, the higher the risk of vessel occlusion. It was also notable that the proportion of patients receiving long-term anti-platelet medication after angiography, was significantly higher in those who did not demonstrate disease progression. Interestingly, in a study by Van Andel et al.,\textsuperscript{6} in which all patients received anti-platelet or anticoagulant therapy following angiography, the arterial occlusion rate was only 3\%. This finding is confirmed by data from Schoop and Levy,\textsuperscript{23} who demonstrated that long-term aspirin administration may slow disease progression.

The results from this study suggest that in order to minimise thrombotic arterial occlusion following arteriography, both diagnostic and therapeutic procedures should be performed simultaneously, especially in small-diameter vessels. However, if a delay is unavoidable, patients must be treated with anti-platelet medication, to reduce the incidence of arterial occlusion.

Table 2. Risk factor analysis for progression of arterial stenoses to occlusion. Discrete variables are presented as percentages, continuous variables are presented as medians with 95\% CI.

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Noocclusion</th>
<th>Occlusion</th>
<th>Difference (95% CI)</th>
</tr>
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<tbody>
<tr>
<td>Claudicants (%)</td>
<td>63</td>
<td>75</td>
<td>-40 to 15*</td>
</tr>
<tr>
<td>Ischaemic heart disease (%)</td>
<td>42</td>
<td>41</td>
<td>-23 to 27*</td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>28</td>
<td>29</td>
<td>-25 to 22*</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>48</td>
<td>58</td>
<td>-36 to 14*</td>
</tr>
<tr>
<td>Current smokers (%)</td>
<td>25</td>
<td>17</td>
<td>-12 to 28*</td>
</tr>
<tr>
<td>Time between arteriogram and PTA (days)</td>
<td>92 (50-125)</td>
<td>125 (99-234)</td>
<td>0.1 to 10†</td>
</tr>
<tr>
<td>Anti-platelet medication (%)</td>
<td>51</td>
<td>11</td>
<td>21 to 57*</td>
</tr>
</tbody>
</table>

* Difference in proportions.† Mann-Whitney test.

References


19 Morris TW. X ray contrast media: Where are we now, and where are we going. Radiology 1993; 11-16.


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