Particularities of peripheral arterial disease managed in vascular surgery in the French West Indies

Particularités de l’artériopathie oblitérante des membres inférieurs vue en chirurgie vasculaire aux Antilles

M. Deneuville*, J.M. Pierrot, R. N’Guyen

Service de chirurgie vasculaire et thoracique, CHU de Pointe-à-Pitre-Abymes, France.

Summary

Background. — Epidemiology of peripheral arterial disease is currently unknown in French West Indies (Antilles).

Aims and methods. — The aim of this study is to present peripheral arterial disease (PAD) occurring in the French West Indian subjects through the analysis of our database of vascular surgery. The study population included 754 patients (mean age 73 ± 10 years), mostly from African descents. The main clinical presentation was critical limb ischemia (66%, including tissue loss in 48% of cases), followed by claudication (20%). The lesions affected the infragenicular arteries in 86% of cases, including 24% isolated to this level as well as 51% combined to femoro-popliteal lesions and only 7% of cases affecting the aorto-iliac level.

Results. — Ankle-brachial index was at 0.57 ± 0.13 and 0.34 ± 0.22 (p<0.001) in patients with claudication and critical limb ischemia (CLI), respectively. The severity scores were significantly higher in claudicants with aorto-iliac disease and CLI patients with infragenicular lesions.

Except for hypertension (85%) and obesity (19%), the other risk factors were differently distributed between the 2 groups. While in the CLI group, patients were older, with higher rates of female sex, diabetes (62% vs. 48%, p<0.001) and severe renal failure, claudicants were significantly younger, with higher rates of smokers among men (75% vs. 51%, p<0.001) and moderate dyslipidemia (52% vs. 36%, p<0.001). The association with carotid stenosis (12%) and ischemic heart disease (18%) were quite uncommon. Renal disease (glomerular filtration rate <60 ml/min/1.73 m²) was present in 61% of cases.

Conclusion. — This study highlights clear differences regarding the presentation, localization and associations of PAD in the West Indies subjects managed in vascular surgery, especially with a severe infragenicular disease, even in claudicants. This study suggests the effect of a different distribution of risk factors as well as other ethnic and socio-economic factors.

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* M. Deneuville, Service de chirurgie vasculaire et thoracique, CHU de Pointe-à-Pitre-Abymes, Route de Chauvel, 97139 Abymes cedex, France.
E-mail: m.deneuville@chu-guadeloupe.fr
Introduction

Data regarding peripheral arterial disease (PAD) in non-White subjects are sparse but concordant to other reports regarding cerebrovascular disease (1) and coronary artery disease (2,3), supporting differences according to ethnicity (4). Studies performed in patients of African descents show a trend for more distal (5,6,8,9) and severe (5,6,8) disease (4). Studies performed in patients of African descents show disease (2,3), supporting differences according to ethnicity (4). We excluded patients of European and North-African origin.

Methods

Since January 1998, a database of PAD patients referred at the Department of Vascular Surger, University Hospital of Guadeloupe was set up. Sixty-five pre-determined clinical, angiographic, biological, surgical and follow-up parameters were recorded. For this first overall analysis, aneurysmal and non-atheromatous diseases were excluded. Similarly, we excluded patients of European and North-African origin.

Surgical and follow-up data has not been studied for the purpose of this study.

Clinical and biological assessments

Data regarding cardiovascular history, risk factors, treatments and smoking habits (current or past smokers, pack-years quantification) were retrieved by patients interrogation. Blood pressure at rest was measured twice, and hypertension (HTN) was defined in case of treated hypertension and/or systolic blood pressure >140 mmHg and/or diastolic blood pressure >90 mmHg. Body mass index was calculated after weight (patients lightly clothed) and height measurements. Blood samples were obtained for total cholesterol, triglycerides, apo-A1 and apo-B lipoproteins (estimated by immunonephelometry) and creatinine prior to angiography. Planell method was used to estimate LDL-cholesterol levels, excluding patients with triglycerides levels > 4 mmol/L. Dyslipidemia was defined according to the 2000 guidelines of the French Agency of Sanitary Security of Health-related Products (AFSSAPS). Glomerular filtration rate (GFR) was calculated according to Cockroft and Gault.

Assessment of atherosclerosis lesions

Clinical stage was defined as usual, completed by a grading of tissue loss (toe necrosis or ischemic ulcer, infected neuro-ischemic foot, or mixed presentation).

An arterial severity score has been performed secondarily, with a double lecture of angiographic images. According to Rutherford et al. guidelines (11), a score of 0 to 3 has been attributed to each anatomic segment made opaque at angiography, from the infra-renal aorta to pedal and
plantar arteries. Non-opaque infragenicular arteries were considered as occluded only if collateral vessels and/or a distal segment were visible. A mean score was calculated for the aorto-iliac, femoro-popliteal, leg, and foot arteries separately. Proximal cerebrovascular disease was noted in case of a report of neck arteries Duplex performed either prior or after hospital admission, by any operator. Ischemic heart disease was defined as documented history of coronary artery disease, typical angina, post-operative myocardial ischemia on ECG or acute coronary syndrome. Detection of asymptomatic coronary artery disease was not systematically performed in this study.

**Statiscic methods**

Data were collected using Excel® software, with anonymous coding. The comparisons between patients with CLI and claudication were performed using a Chi-2 test for categorical variables and analysis of variance (angiographic score) or Student’s t-test (biology data).

**Results**

The study population included 754 patients (385 women and 369 men), mean age 73 ± 10 years (Table 1). Among them, 196 (26%) were older than 80 years but only 18 (2%) were under 50 years in age. Ethnic origin was African-Caribbean (without Indian decent) for 670 patients, from Indian descent in 79 cases (10.5%) and from other origin in 5 cases. Clinical stage and presentation are detailed in Table 1. A majority (n=427, 57%) presented tissue loss including 363 cases with CLI, 40 cases of neuro-ischemic diabetic foot and 24 cases of mixed origin. Chronic limb ischemia limited to rest pain and claudication were less routinely observed, in respectively 138 (18%) and 153 (20%) patients. Acute ischemia and athero-embolism represented only 5% of total admissions.

Mean ankle-brachial index (ABI) was at 0.41 ± 0.20 but significantly lower in CLI (0.34 ± 0.22) comparatively to ischemia and athero-embolism represented only 5% of total cases in 138 (18%) and 153 (20%) patients. Acute ischemia and athero-embolism represented only 5% of total admissions.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Clinical stage at admission in 754 patients with PAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=754</td>
<td></td>
</tr>
<tr>
<td>Ankle-Brachial Index*</td>
<td>0.41 ± 0.20</td>
</tr>
<tr>
<td>Acute ischemia n, (%)</td>
<td>11 (1,4)</td>
</tr>
<tr>
<td>Ischemic claudication n, (%)</td>
<td>153 (20)</td>
</tr>
<tr>
<td>Critical limb ischemia n, (%)</td>
<td>501 (66)</td>
</tr>
<tr>
<td>With rest pain</td>
<td>138 (18)</td>
</tr>
<tr>
<td>With tissue loss</td>
<td>363 (48)</td>
</tr>
<tr>
<td>Neuro-ischemic foot n, (%)</td>
<td>40 (5,3)</td>
</tr>
<tr>
<td>Mixed trophic lesions § n, (%)</td>
<td>24 (3,2)</td>
</tr>
<tr>
<td>Other ** n, (%)</td>
<td>25 (3,3)</td>
</tr>
</tbody>
</table>

* 584 patients ; 17% incompressible arteries and 42 with missing data
** blue toe, athero-embolism
§ delayed or failed healing of various tissue loss (venous or pressure ulcers, necrotizing angiodenmitis or miscellaneous) with ABI <07 and severe lesions of PAD documented by angiography

As follows: 596 (86%) with infragenicular involvement either isolated (160, 24%) or associated to femoral and/or popliteal lesions (351, 51%) and 46 (7%) with aorto-iliac disease. In overall, severity scores (mean ± SD, Figure 1) were significantly higher at the infragenicular (1.99 ± 0.03) and foot levels (1.66 ± 0.03), compared to the femoro-popliteal (1.12 ± 0.02) and aorto-iliac (0.22 ± 0.03) levels. For the latter, the scores were significantly higher in claudicants than in case of CLI (0.42 ± 0.03 vs. 0.18 ± 0.01, p<0.001). The scores obtained in other localizations were similar between claudication and CLI groups, except for the leg arteries (Figure 1B) where the severity score was slightly but significantly higher in the CLI group (2.04 ± 0.03 vs. 1.89 ± 0.02 in the claudicant group, p<0.05).

Major risk factors (Tables 2 et 3) were HTN (n=638, 85%) and diabetes (n=455, 60%) followed by dyslipidemia (n=274, 36%) and smoking (n=243, 32%). The latter was almost absent among women (n=24, 6%) but clearly present among men (n=219, 59%). Among patients with dyslipidemia, only a moderate elevation of LDL-cholesterol (3.6 ± 1.1 mmol/L) was noted, slightly above the therapeutic threshold as proposed by the AFSSAPS 2000 guidelines, despite a poor number of patients (21%) under lipid-lowering therapy at admission. Obesity and overweight (19% and 16%, respectively) were present in 165 women (42%) including 100 (26%) cases of obesity, while the prevalence of obesity among men was only at 11% (p<0.001).

A majority of patients (n=587, 78%) presented at least two risk factors. In case of isolated risk factor (n=140, 19%), hypertension was largely predominant, especially among subjects older than 80 years. Hypertension was unknown or non-treated in 17% of hypertensive cases. Diabetes was predominantly treated by insulin (56%) far in front of oral anti-diabetic agents (37%). In 7%, the patient was unaware of this condition. The mean levels of glycosylated hemoglobin (8.1 ± 2%) were above the therapeutic targets proposed for an adequate treatment. Comorbidities are presented in Table 4. Renal failure (GFR <60 ml/mn/1.73 m 2) was present in 460 cases (61%), classified as severe (GFR <20 ml/mn/1.73 m 2) in 74 patients (10%) including 48 cases of end-stage renal disease with dialysis. Cardiovascular comorbidities were stroke (11%), ischaemic heart disease (18%) and other cardiac diseases (21%). A significant stenosis (>60%) of carotid bifurcations were detected in 12% out of 407 patients explored.

The group of patients with CLI was significantly older than those with claudication (Table 2), and was characterized by higher proportions of female patients, diabetics patients (62% vs. 48% in claudicants, p<0.001) as well as glomerular filtration rates (patients treated by dialysis excluded) significantly lower (53 ± 23 vs. 67 ± 25, p<0.001). Conversely, smoking in men (75% vs. 51%, p<0.001) and dyslipidemia (52 % vs. 36%, p <0.001) were significantly more frequent among claudicans. The levels of triglycerides were also significantly higher in this group (Table 3).

**Discussion**

This is the first study conducted on PAD in Guadeloupe. It highlights several discrepancies compared to usual surgical
series (12-15) as well as epidemiological studies on PAD managed in vascular surgery departments (5,7,16). The most striking discrepancy is the elevated (66%) proportion of CLI, substantially higher not only compared to surgical series (14,15) but also to regional and national studies (17,18). Bailey et al. report 15% of cases of admissions in vascular surgery, for an equivalent population to the one in Guadeloupe (14). In the National Finnish Registry, the proportion of surgery for CLI is estimated at 10% (17). The predominance of CLI in Guadeloupe explains directly the age over 70 years and the important proportion of female and diabetic patients, in accordance with the inter-gender differences attenuation in the elderly (18) and in case of diabetes (14,17). This surprisingly high rate of CLI in Guadeloupe.

Figures 1 A et B. Overall severity scores (mean ± SD) of 639 exploitable angiographies (gray columns) and comparison of those with critical limb ischemia (shaded columns) and claudication (white columns), (A) at the aorto-iliac and femoro-popliteal levels, (B) at the leg and foot arteries (analysis of variance test, $p=ns$, $* p<0.05$, $**p<0.01$).

### Tableau 2 Clinical characteristics in all 754 patients and comparisons between claudicants and those with critical limb ischemia (CLI)

<table>
<thead>
<tr>
<th></th>
<th>Overall N=754</th>
<th>Claudicants N=153</th>
<th>CLI N=501</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years ± standard deviation)</td>
<td>73 ± 10</td>
<td>68 ± 10</td>
<td>75 ± 9,4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sex ratio (males/females)</td>
<td>0.96 (369/385)</td>
<td>1.55 (93/60)</td>
<td>0.84 (229/272)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HTN n, (%)</td>
<td>638 (85)</td>
<td>130 (85)</td>
<td>412 (82)</td>
<td>ns</td>
</tr>
<tr>
<td>Diabetes n, (%)</td>
<td>455 (60)</td>
<td>73 (48)</td>
<td>312 (62)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male smokers n, (%)</td>
<td>219 (59)</td>
<td>69 (74)</td>
<td>117 (51)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female smokers n, (%)</td>
<td>24 (6)</td>
<td>3 (5)</td>
<td>14 (5,1)</td>
<td>ns</td>
</tr>
<tr>
<td>Dyslipidemia* n, (%)</td>
<td>274 (36)</td>
<td>94 (61)</td>
<td>181 (36)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Obesity (BMI &gt; 30kg/m2) n, (%)</td>
<td>140 (19)</td>
<td>29 (19)</td>
<td>95 (19)</td>
<td>ns</td>
</tr>
</tbody>
</table>

* according to the 2000 guidelines of the French Agency of Sanitary Security of Health-related Products (Afssaps).
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Tableau 3  Biological characteristics in all 754 patients and comparisons between claudicants and those with critical limb ischemia (CLI)

<table>
<thead>
<tr>
<th></th>
<th>Overall N=754</th>
<th>Claudicants N=153</th>
<th>CLI N=501</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index (kg/m²)</td>
<td>25.3 ± 5.1</td>
<td>26 ± 4.8</td>
<td>25 ± 5.3</td>
<td>ns</td>
</tr>
<tr>
<td>Glomerular filtration rate* (ml/mn)</td>
<td>58 ± 24</td>
<td>67 ± 25</td>
<td>53 ± 23</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Glycosylated hemoglobin (%)**</td>
<td>8.01 ± 2</td>
<td>7.95 ± 1.59</td>
<td>8.05 ± 2.05</td>
<td>ns</td>
</tr>
<tr>
<td>LDL-cholesterol (mM/L)</td>
<td>3.1 ± 1.0</td>
<td>3.4 ± 0.9</td>
<td>3.0 ± 0.9</td>
<td>ns</td>
</tr>
<tr>
<td>Triglycerides (mM/L)</td>
<td>1.4 ± 0.9</td>
<td>1.8 ± 1.1</td>
<td>1.4 ± 0.8</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* excluding patients under dialysis, calculated according to the Cockcroft et Gault formula
** diabetic patients only
*** median [25th-75th percentile]

Tableau 4  Comorbidities associated to PAD, with the comparison of claudicants vs. those with chronic limb ischemia (CLI)

<table>
<thead>
<tr>
<th></th>
<th>Overall N=754</th>
<th>Claudicants N=153</th>
<th>CLI N=501</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous stroke n, (%)</td>
<td>83 (11)</td>
<td>15 (10)</td>
<td>69 (14)</td>
<td>ns</td>
</tr>
<tr>
<td>Carotid stenosis* &gt;60% n, (%)</td>
<td>48 (12)*</td>
<td>22 (14)</td>
<td>29 (11)</td>
<td>ns</td>
</tr>
<tr>
<td>Ischemic heart disease n, (%)</td>
<td>136 (18)</td>
<td>37 (24)</td>
<td>93 (18)</td>
<td>ns</td>
</tr>
<tr>
<td>Other cardiac diseases n, (%)</td>
<td>159 (21)</td>
<td>25 (16)</td>
<td>120 (24)</td>
<td>ns</td>
</tr>
<tr>
<td>Severe renal failure** n, (%)</td>
<td>74 (10)</td>
<td>2 (1,1)</td>
<td>58 (12)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>with dialysis n, (%)</td>
<td>48 (6)</td>
<td></td>
<td>43 (8.6)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*among 407 Duplex imaging cases
** estimated glomerular filtration rate (<20 ml/mn)

The predominance of CLI more probably results both from a selection bias related to the hospital recruitment as well as in the processes leading to CLI.

These may involve socioeconomic status, patient’s habits in seeking health care and inappropriate recognition and treatment of early CLI. Our team had previously reported significant delay (9) and inadequate initial management (23) which may indeed contribute to an admission’s rate (72%) at the stage of tissue loss among the highest seen in the literature (12-17). Eventually, other factors such as micro-trauma related to bare feet walking, infections in tropical oceanic climate and difficulties to diagnose gangrene on black skin contribute almost certainly to the rate and severity of lesions noticed.

Besides, available epidemiological studies in Europe (16,17,24) and the USA (6,7) indicate an incidence of revascularization for any indication ranging between 24 (17) and 71 (6) interventions per 100,000 inhabitants per year. In a recent prospective survey (25), this incidence has been estimated in the FWI at 17/100,000, indicating a lower reference of PAD to the vascular surgeon.

Interestingly, trends and limitations on management of PAD in Guadeloupe despite a better access to care are very similar to those reported for the African American community (5,10) suggesting that common cultural and behavioral factors at both individual and medical levels may be operating.

The second striking finding of this study is the anatomic pattern, with uncommon aorto-iliac lesions (7%) compared to almost constant and severe lesions at the infragenicular and foot level. In the Unites States, aorto-iliac revascularizations account to 16% of all procedures according to Feinglass et al. (7) and in Europe, this rate varies from 48% (15) to 61% (16).

The reasons explaining this poor rate of proximal localization of PAD are unclear. The effect of CLI is suggested by a severity score significantly higher at the aorto-iliac level for claudicants. However, in the National Finnish Registry,
25% of revascularization procedures for CLI were performed at the proximal level (17). For similar reasons, a relation to diabetes is unlikely, even though the infragenicular lesions are more commonly reported in diabetics, since angiographic studies comparing diabetic and non-diabetic patients (26,27) do not report significant differences in terms of aorto-iliac disease. Additionally, Calle-Pascual (16) reports a rate of 36% of proximal interventions in diabetic patients, although lower than in non-diabetic patients. Our findings could be explained by very low rates of tobacco smoking in Guadeloupe, compared to global data (19), as well as those reported in series of CLI, ranging 70-90% (12,13). It should be noticed that our group of claudicants which comprised more smokers had a mildly higher although significant severity score at the aorto-iliac level.

The relative paucity of occlusive aorto-iliac lesions in Guadeloupe can be compared to the very few number of carotid stenoses and aneurysms of aorta, almost at 1:20 of the expected rate in a corresponding population in Europe (14). Additionally, symptomatic ischemic heart disease (9) and carotid artery disease rates seem abnormally lower than in other surgical series (13,14) and epidemiological studies (18). This poor association between PAD and other common localization of atherosclerosis in this study is even more surprising in the perspective of high rates of diabetes and ABI <0.7 (18). Conversely, our data in Guadeloupe are completely concordant with a lower prevalence of carotid stenoses (1,28), aortic aneurysms (29) and ischemic heart disease in communities of African descent in Caribbean Islands (25) or in the Unites States in the 1980’s (2,3). The reasons explaining the variation of co-localization of atherosclerotic disease in African Americans are largely debated (2,3) and may involve different genetic and environmental factors.

The prevalence of subclinical PAD is significantly higher in African Americans than in White Americans (4). In addition, data issued from North American studies suggest a more severe and diffuse pattern of PAD in African Americans, notably with lower rates of infra inguinal revascularizations by angioplasty (5) vs. bypass (6,7), reduced primary success after infra inguinal bypass grafts (8) and significantly higher risks for amputation (1.8 to 7.6), especially among female patients even without diabetes (5). Despite lower rates of smoking and a more egalitarian access to healthcare than in the USA, the striking similarity between these observations and those obtained in Guadeloupe may suggest a specific pattern of atherosclerosis in subjects of African descent. However, providing evidence for this hypothesis was beyond the objectives of this study, which more strongly indicate a different distribution of risk factors.

Actually, our study clearly shows the burden of associated hypertension-diabetes, present in more than half of the cases, as well as renal failure. The sub-optimal management of these risk factors (30), very common in Guadeloupe (20) like in all migrants of African descent (2,4,21,22), might also have an impact on PAD. Similar to other reports, the current adherence to guidelines regarding the management of dyslipidemia in secondary prevention is poor (13,29). The development of emerging factors such as smoking in young women and severe dyslipidemia with the expansion of accidental diet may predict an increase of cardiovascular diseases in the FWI.

The main limitation of this study is related to its mode of enrollment in a surgery department, leading undoubtedly to a selection bias, with only the most severe cases included. In addition, the lack of a systematic non-invasive screening of carotid and coronary diseases weakens the conclusion regarding the global variation of atherosclerosis in subjects of the West Indies.

Hence, our conclusion cannot be extrapolated to the PAD in the overall population of the FWI. However, the severity of PAD and its mode of presentation as well as hypotheses raised in this study mandate for an urgent screening and characterization of PAD in the West Indies, given the public health implications.

Conclusion

This study shows that PAD currently affects the older population of both sexes in the West Indies, mostly seen at the stage of critical limb ischemia with tissue loss. Severe lesions involve predominantly the infragenicular and foot levels, even in case of intermittent claudication, contrasting with few lesions of the aorta, carotid and coronary arteries. This study suggests that the particularity of anatomical pattern might be related to a different distribution of risk factors, with a high predominance of hypertension-diabetes, and conversely a weak prevalence of smoking and a low-atherogenic lipid profile. However, several similarities with the PAD reported in African Americans suggest the impact of other (ethnic, social and economic) factors, requiring further ongoing studies.

Références

[10] Daumit GL, Hermann JA, Coresh J, Powe NR. Use of cardiovascular procedures among black persons and white persons: a 7-
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