Prevalence of lower extremity arterial disease among elderly people in the community

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SUMMARY. To estimate the prevalence of lower extremity arterial disease, all patients aged over 65 years registered with a rural general practice near Cambridge were invited to attend for examination of the circulation to the lower extremities; 265 subjects (80%) accepted. Three methods were used to investigate the presence of lower extremity arterial disease — enquiring about symptoms of intermittent claudication; clinical examination (and particularly the detection of arterial bruits); and pressure index calculations from measurements of the ankle and brachial systolic blood pressure using a Doppler ultrasound probe. When examining the legs, the presence of a bruit was taken as stronger evidence of disease than inability to palpate the pulses which may be difficult or impossible to detect for a number of reasons. Forty seven of the 264 patients examined (18%) showed evidence of lower extremity arterial disease. Seven patients showed unequivocal evidence of lower extremity arterial disease as demonstrated by all three criteria, 12 by two criteria and 28 patients on one criterion alone. While the pressure index followed a normal distribution curve, there was a tendency for it to decline with age. Other risk factors which showed a correlation with evidence of disease included current, but not previous, cigarette smoking, and a history of stroke. The significance of the findings is discussed in the context of some degree of arterial pathology in many British subjects in this age group.

Keywords: arteriosclerosis; peripheral vascular disease; legs; elderly; physical examinations.

Introduction

IT has been claimed that there is little information concerning the epidemiology of asymptomatic arterial disease of the legs[1-3] although one survey has found 12% of a North American population of average age 66 years had evidence of large vessel disease on non-invasive testing,[4] and another survey of Danish people aged 60 years found a prevalence of 14%.[5]

Lower extremity arterial disease becomes increasingly prevalent with advancing age.[2,6] Intermittent claudication is a significant risk factor for coronary artery disease[3] and for disabling sequelae, including gangrene. At least one third of patients with arterial stenosis or arterial occlusion are symptom-free[7] and, especially in elderly people with restricted mobility, critical ischaemia, where the patient experiences pain at rest, skin necrosis or ulceration, is often the presenting manifestation.[8]

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The identification of asymptomatic or undiagnosed but clinically significant lower extremity arterial disease is of intuitive, if unproven, desirability. It allows the doctor to elucidate its epidemiology, to exercise caution when prescribing beta adrenergic blocking drugs, and to offer advice and preventive health education to the patient. The latter includes offering counselling concerning foot hygiene (and the need to inform chiropodists) and advice on the benefit of exercise, and the avoidance of tobacco and compression hosiery.

A survey was therefore undertaken to assess the prevalence of large vessel lower extremity arterial disease among elderly people aged over 65 years in a community, and evaluate ways of screening for lower extremity arterial disease in this age group. Approval for the study was gained from the Cambridge Health Authority ethical committee.

Method

All 330 patients aged over 65 years registered with a rural general practice caring for virtually all the inhabitants of two Cambridgeshire villages were sent a letter with an explanation of the procedure and a request to attend the practice. Those unable to come to the surgery were offered transport or a home visit.

Each patient was examined by either N C or M T and all the details were recorded on a specially designed form. The examination, which took 20 to 25 minutes, started with questions about mobility and leg pain to establish the presence of intermittent claudication using Rose's criteria[9] or pain at rest. Further questions were directed towards other manifestations of arterial disease and risk factors including stroke, myocardial infarction, treated hypertension, diabetes and cigarette smoking. Cigarette smoking was classified as current, past (for over 10 years at some time in the past) or negligible (less than 10 years ever).

Physical examination included auscultation for carotid bruits, assessment of heart rhythm and examination for arcus senilis. The decision was taken to omit any search for abdominal aneurysm because of the unreliability of palpation, the more intrusive nature of abdominal examination, and the ethical issues that might arise. The examination also included palpation of the femoral, popliteal and foot pulses and auscultation over the femoral, superficial femoral and popliteal arteries. A note was made of any disparity between the skin temperatures of the two extremities and of the presence or absence of skin changes, oedema, trophic changes in the toenails and the presence or absence of hair over the upper part of the tibia, the lower half, the dorsum of the foot and the toes.

Finally, with the subject supine, systolic blood pressure measurements were taken at each brachial artery and each ankle (at both dorsalis pedis and posterior tibial vessels) using a Doppler shift ultrasound probe and a mercury gravity sphygmomanometer with a 12 cm cuff. The pressure index for each leg was taken as the higher of the two ankle pressures for that limb divided by the mean of the two brachial systolic pressures. Many of the patients would have been unable to complete the conventional treadmill exercise test, so a modified stress test was used which consisted of one minute's flexion and extension of each ankle with the subject supine.[10] The vessel with the higher pressure was then remeasured. In a subset of 37 subjects the pressure measurements were made in-

dependently by both examiners, in order to quantify inter-observer variation.

Using a combination of symptoms, physical signs and pressure measurements, each subject was assessed as having or not having evidence of lower extremity arterial disease. Those showing evidence were divided into three groups: patients with intermittent claudication, and/or a bruit over the femoral, superficial femoral or popliteal arteries, and/or a pressure index of 0.75 or less.

The results were analysed using the generalized linear interactive modelling (GLIM) system. The methods used were linear modelling, analysis of variance and covariance, F tests for significance of linear effects, and calculation of confidence intervals using the normal and t distributions. The critical level of statistical significance was taken as $P<0.05$.

Results

A total of 265 people were examined both before and after the modified stress test, representing 80.3% of those approached. There were 112 men (mean age 74.0 years, range 66–89 years) and 153 women (mean age 76.1 years, range 66–96 years). A satisfactory examination was possible in 264 subjects, and 47 showed evidence of lower extremity arterial disease, giving an overall prevalence of 17.8%.

Table 1 shows the number of subjects fulfilling the three different criteria indicating lower extremity arterial disease. Seven people satisfied all three criteria, 12 people fulfilled two criteria and 28 fulfilled one criterion. Of the nine patients with a low pressure index but neither bruits nor symptoms, four had impalpable pulses below the femorals, which was only the case in five of the 217 normal subjects, where all had obvious non-vascular reasons for this, such as obesity, oedema or deformity. The modified stress test was helpful for the three patients with intermittent claudication only (all of whom had palpable foot pulses), where post-exercise measurements showed falls in the pressure index of 22%, 25% and 55%.

Table 2 shows the age distribution of patients fulfilling the three criteria of lower extremity arterial disease.

Table 1. Number of patients fulfilling the three different criteria indicating lower extremity arterial disease ($n=264$).

	Number of patients			
	Intermittent claudication present		Intermittent claudication absent	
Pressure index	Bruits present	Bruits absent	Bruits present	Bruits absent
⩽0.75	7	2	6	9
>0.75	4	3	16	217

n = total number of patients.

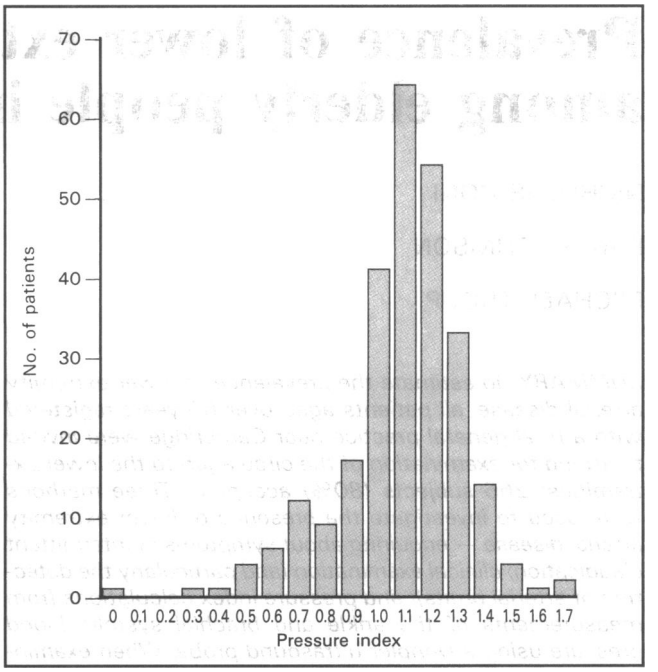

Figure 1. *Distribution of pressure indices for the 264 patients.*

No significant pattern was found concerning lower extremity arterial disease and trophic skin or nail changes, oedema nor hair distribution.

Figure 1 shows the distribution of the pressure indices for the 264 patients. The smaller of the right and left pressure index was taken as the dependent variable in a series of generalized linear models. These showed a statistically significant dependence of the pressure index on age ($P<0.001$) and sex ($P<0.05$). The model for age indicated a mean decrease of 0.01 in the pressure index (95% confidence interval (CI) 0.006 to 0.014) for each year over the age of 65 years. This is shown in Figure 2, together with a line of best fit. Although men had a higher pressure index than women, this effect was no longer statistically significant when age was taken into account (equivalent to analysis of covariance).

Nine patients were known to have diabetes mellitus. Arcus senilis, diabetes, treated hypertension and history of myocardial infarction each failed to show a statistically significant effect on the pressure index. History of stroke (16 cases, 6.1%) was statistically significant ($P<0.05$), reducing the pressure index by a mean of 0.13 (95% CI 0.01 to 0.25) when age was taken into account.

Cigarette smoking had a statistically significant effect ($P<0.05$) on the pressure index when age and sex were taken into account. Current smoking (38 subjects, 14.4%) reduced the pressure index

Table 2. Number of patients fulfilling the three criteria indicating lower extremity arterial disease (LEAD) according to age, with percentage prevalence of LEAD cases within age groups in parentheses.

	No. (%) of patients aged:					
Criteria	66–69 years ($n=73$)	70–74 years ($n=54$)	75–79 years ($n=71$)	80–84 years ($n=36$)	85+ years ($n=30$)	Total ($n=264$)
Pressure index ⩽0.75	3	3	7	5	6	24
Bruits	7	4	11	4	7	33
Intermittent claudication	4	2	8	1	1	16
LEAD cases[a]	8 *(11.0)*	5 *(9.3)*	15 *(21.1)*	7 *(19.4)*	12 *(40.0)*	47 *(17.8)*

n = number of patients. [a] Some patients fulfilled more than one criterion.

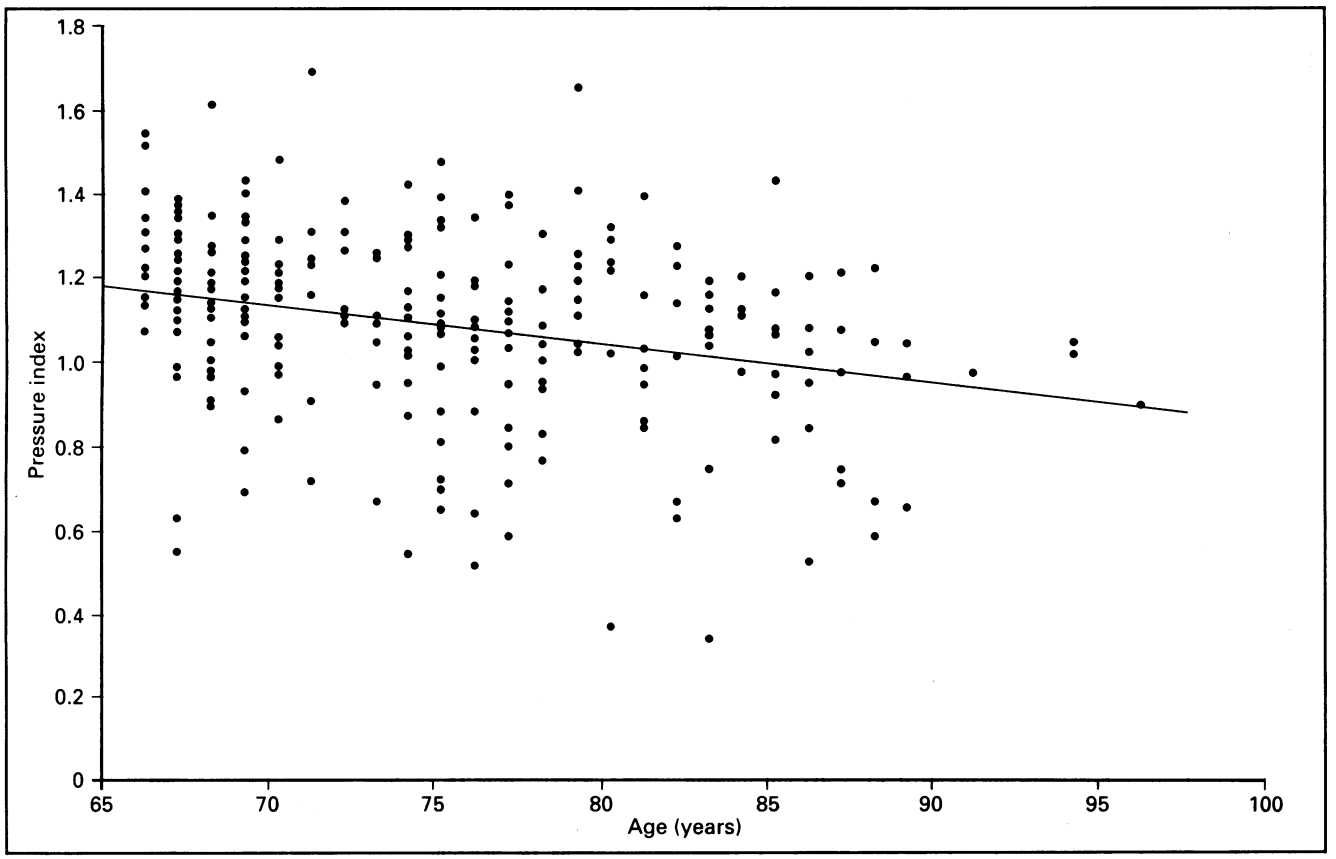

Figure 2. *Relationship between age and pressure indices for the 264 patients. The line is a best fit straight line.*

by an average of 0.14 (95% CI 0.05 to 0.22), but past smoking had a much smaller effect which was not statistically significant.

The 37 subjects examined by both observers gave rise to 255 paired readings of Doppler pressures. The mean difference in pressure readings was 0.9 mmHg, standard deviation 22 mmHg. There was no discernable pattern regarding body site of measurement. In order to assess the effect of this variation between observers on the results, the mean analyses were repeated on the two subsets of subjects who had been examined by each single observer (split halves analysis). The results were consistent with similar estimated effects, but the effects of a history of stroke and of current smoking were no longer statistically significant for the subjects of one of the observers.

Discussion

Some degree of arterial disease is relatively common in elderly people. In a series of unselected autopsies, ulcerated atherosclerotic plaques were found in the iliac arteries of 33% of those aged 75 years and over.[11] The presence of symptomatic or asymptomatic lower extremity arterial disease must be regarded as a risk factor for the development of gangrene, and its detection is therefore of importance. Various methods have been employed to detect lower extremity arterial disease. Absence of distal pulses does not provide evidence since the pulses may be obscured by oedema, abnormally situated, congenitally missing, subject to observer error, or apparently non-pulsatile owing to arterial stiffness.[10,12,13] The three criteria used in this study — presence of arterial bruit, intermittent claudication and pressure index of 0.75 or less — are complementary in the overall assessment of the circulation to the lower leg. They are all more reliable than signs such as skin appearance, colour and temperature,[8] and are reasonably quickly elicited. There is general agreement that a bruit, especially over the adductor canal or in the popliteal fossa, is indicative of disease[14,15] although sensitivity is lower than specificity, so auscultation cannot be relied upon.

Intermittent claudication, provided that cord ischaemia (which can give rise to almost identical symptoms) can be ruled out, provides strong evidence for lower extremity arterial disease. Prevalences of intermittent claudication are assessed by means of interviews and questionnaires but those of lower extremity arterial disease require examination and investigation. Many elderly people do not walk far enough to experience the symptoms of intermittent claudication, and trophic changes in skin and nails may be misleading. Gangrene can, therefore, be precipitated by a haemodynamic crisis similar to a hypotensive stroke[16] which may be mistaken for an embolus.[8] Cardiac failure can be a potent precipitating factor if acute, but can itself greatly reduce walking distance if chronic. The infrequency of intermittent claudication in the subjects aged over 80 years in this study despite a high prevalence of lower extremity arterial disease is probably due to these factors. A recent study of intermittent claudication found a prevalence of over 14% in ambulatory elderly subjects.[17] In men over 60 years of age symptomatic claudication has been claimed to be two or three times as common as diabetes mellitus, with an obviously higher prevalence of asymptomatic lower extremity arterial disease,[1] and our population contained 16 patients with intermittent claudication and nine known diabetics.

The pressure index is widely regarded as the most valuable non-invasive tool for establishing the presence of lower extremity arterial disease,[18-20] and a standard text states that reduction in arterial pressure reflects a 75% reduction in the cross-sectional area of a vessel.[21] However, the method can only give an indication of the presence of asymptomatic lower extremity arterial disease, and the definitive investigation, angiography, occasionally

reveals a superficial femoral block in subjects who have a normal pressure index, owing to a well developed collateral circulation. The pressure index uses a non-invasive method of investigating lower limb perfusion and most studies have relied heavily on Doppler ultrasound pressure measurements together with a stress test, hailed as the gold standard among readily available bedside techniques. It is unsurprising to find that, in common with many other biological measurements, the pressure index in this population seemed to exhibit a normal distribution curve and failed to fall into two clearly demarcated groups representing normality and disease. A pressure index of 0.5 has been shown to predict the progression of lower extremity arterial disease,[22] but there is a lack of unanimity among authors concerning the precise figure which should be regarded as abnormal, ranging from 0.97 to 0.75.[23,24] In this study, the mean reductions in pressure index owing to age and to current smoking (0.01 per year and 0.14 respectively) suggest that current smoking is equivalent in its effect on the pressure index to approximately 14 years of extra ageing. Advising these patients to give up smoking is therefore an important precautionary measure.

The prevalence of lower extremity arterial disease as assessed here (18%) seems reasonably consistent with other surveys, although there have been few that are comparable with regard to method and population studied. In people over 60 years of age with isolated systolic hypertension, the prevalence of lower extremity arterial disease was found to be 42%,[2] and a survey of diabetic patients aged 40 years and over revealed a prevalence of 39.9% with the majority (25.7%) having no symptoms or clinical signs.[25] An examination of patients admitted for hernia repair with an approximate age range of 50 to 70 years yielded an overall prevalence of symptomatic and asymptomatic lower extremity arterial disease of 14.3%.[26] Screening 109 healthy men and women in their sixth decade for asymptomatic lower extremity arterial disease demonstrated a prevalence of 14.7%,[24] while a major survey of patients with leg ulcers found that 21% had detectable lower extremity arterial disease.[27] Investigation of women in a nursing home (average age 85 years) showed a pressure index below 0.7 in 38% of patients;[28] and objective evidence of lower extremity arterial disease was found in 8.5% of men aged 65 to 74 years being screened for abdominal aortic aneurysm.[29]

It should be emphasized that this was a whole population study of a small population, located in a comparatively healthy part of the United Kingdom. Other studies have also tended to survey small populations, but it must be recognized that the results cannot necessarily be extrapolated to an urban population or one of a different ethnic composition. But a prevalence of 18% in those aged over 65 years would mean that a general practitioner with a list of 2000 patients could expect to have about 57 patients in this age group with symptomatic or asymptomatic lower extremity arterial disease. In the absence of severe symptoms, one is looking for a prediction of the liability to progress to gangrene, and we hope that the prognostic significance of our findings will emerge from a follow-up study in two to three years time. Specifically, the relative predictive values of intermittent claudication, an arterial bruit, and a low pressure index will be sought, there currently being little evidence that predictive values of any of these parameters are strong.[10]

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