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Who and How to Make the Diagnosis of Peripheral Arterial Disease

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Who and How to Make the Diagnosis of Peripheral Arterial Disease

R. Mathies

Abstract: Atherosclerosis is the most frequent cause of death worldwide. While death is caused mostly by cardiovascular or cerebrovascular events, the manifestation of arteriosclerosis of the limb vessels only seldomly leads to death. More frequent is a reduction of quality of life by limited walking distance or by amputation. Recently, the role of peripheral arterial disease (PAD) as an independent risk factor for cardiovascular morbidity and mortality has become more evident. Therefore it is most important to detect PAD-patients in time to recognize patients at high risk for cardiovascular complications. To achieve this, the non-invasive diagnostic methods are the most important tools. Depending on the diagnostic methods used,

prevalence of PAD in the population > 50 years is almost 10 %, whereas the number of patients with presence of intermittent claudication or diagnosed PAD is about 7 times lower.

Kurzfassung: Diagnose der peripheren arteriellen Verschlusskrankheit. Die Atherosklerose ist heute weltweit die häufigste Todesursache. Während der Tod meist durch kardiovaskuläre oder zerebrovaskuläre Ereignisse herbeigeführt wird, ist die Manifestation der Atherosklerose an den unteren Extremitäten nur selten direkt tödlich. Sehr viel häufiger ist eine Verminderung der

Lebensqualität durch eingeschränkte Gehstrecke oder Amputation die Folge der peripheren arteriellen Verschlusskrankheit (PAVK). Seit kurzem weiß man um die Rolle der PAVK als unabhängigen Risikofaktor für kardiovaskuläre Morbidität und Mortalität. Daher ist es extrem wichtig, die PAVK-Patienten als solche zu erkennen, und damit deren hohes Risiko für kardiovaskuläre Komplikationen. Die nichtinvasiven diagnostischen Verfahren sind dabei am hilfreichsten. Je nach benutzter diagnostischer Methode beträgt die PAVK-Prävalenz in der Bevölkerung über 50 Jahre fast 10 %, während die Zahl der Patienten mit manifester Claudicatio intermittens ca. 7fach geringer ist. *J Kardiologie* 2003; 10: 142–5.

■ Introduction

Peripheral arterial disease (PAD) is the manifestation of atherosclerosis of the arteries of the limbs. There is a high coincidence of arteriosclerotic disease of the cardiovascular, cerebrovascular and the periphery vascular bed [1]. Male PAD-patients have a 29.4 % chance of symptomatic coronary heart disease (CHD) (previous myocardial infarction or coronary bypass surgery) and/or cerebrovascular disease (CVD) (previous ischaemic stroke or stroke related surgery). Female PAD-patients have a 21.2 % chance of CHD and/or CVD. In a population without PAD the prevalence of CHD and CVD is 11.5 % in males and 9.3 % in females. This means that cardiovascular and cerebrovascular events occur 2–3 times more often in PAD-patients.

It is rather difficult to determine the prevalence of PAD in the population because normally only patients with symptomatic disease ask for medical advice. Existing data show enormous variations depending on the diagnostic methods employed and the populations being studied. While former studies show a lower prevalence of intermittent claudication (IC), more recent data seem to demonstrate an evident increase of IC in both genders. Studies from the late 70's [2, 3] show a prevalence of intermittent claudication of 0.8 % in males 40–49 yrs of age and of 2.3 % in 50–59 yrs old males. In studies from the 90's the prevalence is 4.7 % for 40–49 yrs old men and women and 9.2 % in 50–59 yrs old men and women in a Sicilian population [4], while it is 1.1 % in 40–59 yrs old Scottish men and women [5].

Due to other studies [6] for every patient with diagnosed PAD there is another one with symptoms of PAD who did not seek medical advice and another patient with asymptomatic PAD. Epidemiological studies based on Doppler-method revealed that PAD has a prevalence of 9.5 % in male population > 50 yrs [1].

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■ Natural History of PAD

The natural history of PAD has to be evaluated separately for local and systemic events.

Local events

In a 5-year follow up [6] 25 % of patients presenting with symptomatic PAD demonstrate a deterioration of their pain-free walking distance, 10 % will undergo endovascular or surgical revascularization and 2 % major amputation. The rare number of severe complications has led to the erroneous opinion that PAD is a relatively “benign disease”.

Systemic events

Within 5 years 10–20 % of patients with known IC will suffer a non-fatal myocardial infarction or an ischaemic stroke, 30 % die, $\frac{2}{3}$ of them of cardio- or cerebrovascular death. Another study [7] looked at the 10-year mortality of a population with an average age of 66 years at entrance. Whereas the 10-year mortality of subjects without PAD was 16.9 % in males and 11.6 % in females, mortality of PAD-patients was 61.8 % for males and 33.3 % for females (about 50 %, 60 % and 75 % in asymptomatic, symptomatic [stage II] and severe symptomatic [stages III and IV] PAD-patients, respectively).

Therefore PAD-patients have a prognosis which is similar to that of patients with malignant diseases such as lymphoma or carcinoma [8]. Further on in symptomatic PAD-patients the disease could be proven as an independent risk factor for mortality even after adjustment for coronary risk factors [9].

■ How can PAD be Diagnosed?

As in any other disease, it is a valid principle that diagnostic procedures must not be more invasive than possible therapeutic means. The actual guidelines [10] for PAD-therapy concern endovascular or surgical therapy for PAD only in the stages III (pain at rest) and IV (trophic lesion) of Fontaine's classifica-

Table 1: Stage-adjusted therapy in PAD [10]

Stage (Fontaine)	Platelet-antagonists	Treatment of risk factors	Walking exercise/treadmill	Adjuvant pharm. therapy	Prosta-noids	Revasculari-sation/PTA
Stage I (asymptomatic)	+	+	?	–	–	–
Stage II (intermittent claudication)	+	+	+	?	?	–/(+)
Stage III and IV (pain at rest, trophical lesion, critical limbischaemia)	+	+	–	?	+	+

tion, while in stage II (IC)-patients invasive therapies should be used only in exceptional cases (Tab. 1). This means that the diagnosis of PAD has to be performed by non-invasive techniques in the majority of cases. Nowadays these non-invasive methods used by specialists are secure tools with high sensitivity and specificity.

Medical history

The patient's description of the symptoms gives the most important direction: localisation and quality of pain, beginning of pain, constancy of pain after a determined walking distance, increase of pain walking up- or downhill, pain forcing the patient to rest, position required for the patient to gain pain relief (Fig. 1), other present cardiovascular risk factors or other manifestations of atherosclerosis.

Clinical examination

Inspection of the extremities: trophism of the skin, hair and nails, colour of the skin, presence of trophic disorders or lesions, mycotic infections. Evaluation of pulses: femoral arteries, popliteal arteries, posterior tibial arteries, dorsal foot arteries, brachial, radial, ulnar and carotid arteries. Differences of temperature of the feet. Auscultation of bruits: aorta, pelvic, femoral, popliteal, subclavian, brachial and carotid arteries. Ratschow's manoeuvre. Measurement of pain-free and maximal walking distance (treadmill to be preferred).

Ankle-brachial-index (ABI)

Measuring the systolic blood pressure of the ankle and the brachial arteries and forming the quotient ankle-blood pressure/

brachial-blood pressure, reveals reliable information about the vessel bed of the lower extremities. With an index < 0.8 the diagnosis of PAD is certain [11, 12] (Fig. 2). There is a (rather rare) possibility of false-negative results in case of reduced compressibility of the ankle arteries. This happens in sclerosis of the median layer (Mönckeberg), ankle oedema or trophic disturbances in chronic venous insufficiency. By use of a bi-directional cw-Doppler device and analysing the cw-Doppler waveform, such false-negative results can be detected. Distal to the haemodynamically relevant obstructions the normal triphasic Doppler wave turns into a monophasic one (Fig. 3). In addition, the ABI and the absolute value of the ankle-blood pressure give important information about the individual cardiovascular risk [13, 14] and the possibility of ulcer healing in PAD stage IV. In the CAPRIE study the PAD-patients' ABI-values at entry showed a significant 10 %-increase in relative

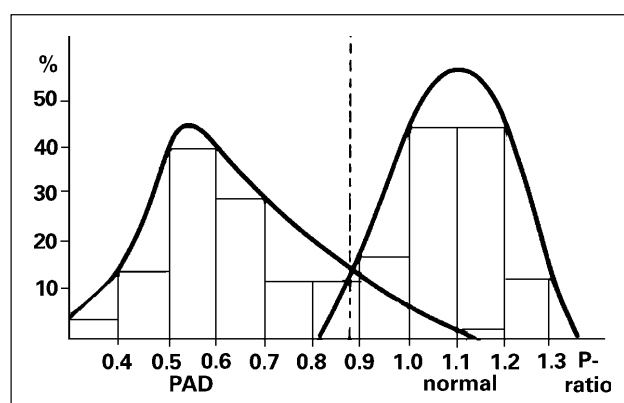


Figure 2: Ankle-brachial-index ABI. With friendly permission from Springer Verlag from [11]

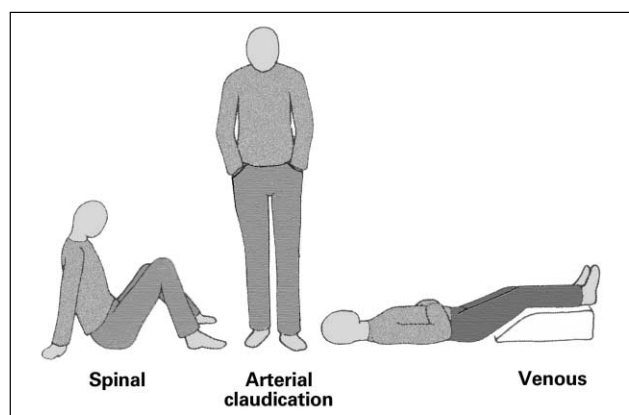


Figure 1: Patient's positions for pain relief. With friendly permission from Springer Verlag from [17]

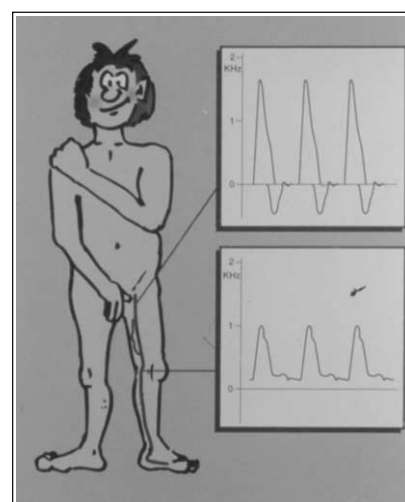


Figure 3: Changes of Doppler wave form distally to arterial occlusion

risk for myocardial infarction, ischaemic stroke and vascular death for every 0.1 decrease in ABI [13]. The absolute value of ankle-blood pressure is well correlated with healing of ulcers and gangrene of the lower extremities in diabetic patients: while ankle-blood pressures < 40 mmHg practically exclude spontaneous healing, blood pressures > 120 mmHg provide healing in 80 % of patients [15]. Therefore ankle-blood pressure is an additional criterion for the decision for conservative therapy or revascularisation.

Colour coded Doppler (CCD)

The combination of real time ultrasound and CCD offers an exact imaging of vascular morphology and haemodynamics. Early arteriosclerotic changes such as thickening of the intima-media double layer and atheromatous plaques are revealed. The exact localisation of lesions, differentiation between stenosis and complete occlusion, length of occlusion, formation of collateral vessels, haemodynamic relevance of obstruction and peripheral run-off can be detected. By this means planning of therapy – also of invasive therapeutic procedures – is possible by a non-invasive method. In addition, important differential diagnoses of degenerative arteriosclerotic processes (Tab. 2) can be recognised by CCD, even better than with angiography (Fig. 4) in most cases.

Oscillography

Oscillography presents a good method to detect the complete blood-flow of the main and the collateral vessels of the extremities. It is a quick method to know localisation and severity of haemodynamic alterations.

Table 2: Main differential diagnoses of arterial occlusions

Degenerative- arteriosclerotic thrombotic embolic
Inflammatory
Aneurysm
Compression-syndrome
Cystic adventitia-degeneration

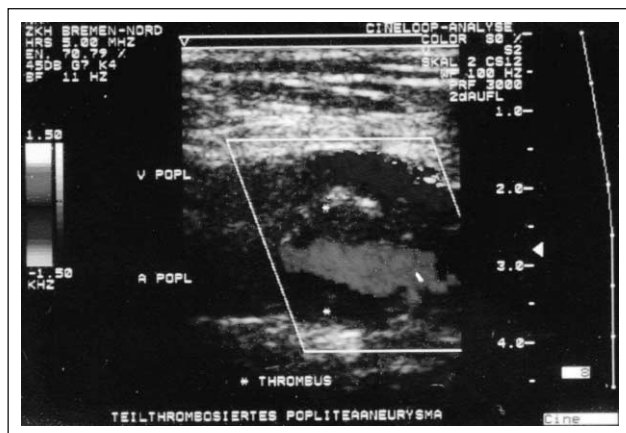


Figure 4: CCD of popliteal aneurysm (angiography normal lumen)

Intraarterial Digital Subtraction Angiography (i.a.-DSA)

Angiography is often regarded as the method of choice and the gold standard for the diagnosis of PAD. With correct examination techniques, occlusive processes are well imaged in their extension. DSA images the blood mixed with contrast agent, so the angiographic information is given by a negative print of the vessel lumen. No information is given about the arterial wall, therefore exact information about the pathogenesis of the arterial occlusion can be obtained only approximately. Intra-arterial DSA is an invasive procedure with the inherent risks of arterial puncture, X-ray exposure and administration of iodine contrast agents, which may cause intolerance, anaphylactic reactions and acute renal failure (in about 50 % of diabetic PAD-patients). After rational preliminary, non-invasive diagnostic procedures i.a.-DSA can be used directly for endovascular therapy such as percutaneous transluminal angioplasty and local fibrinolysis.

Magnetic Resonance Angiography (MRA)

MRA is the newest diagnostic tool in angiology and has some advantages over i.a.-DSA. The patient is not exposed to X-rays, the non-iodine contrast agents ordinarily are well tolerated and are not nephrotoxic. MRA gives an excellent imaging of blood-filled vessels. In a comparative study of PAD stage IV patients, more arteries suitable for surgery could be detected by MRA than by conventional angiography [16]. MRA tends to overestimate stenoses, however. Therefore this method is to be combined with another one, capable of a haemodynamic evaluation, previous to invasive therapy. Before a major amputation, a MRA of the limb vessels should be done to find any artery suitable for surgical treatment.

■ Diagnostic Decourse

The diagnostic examinations vary in asymptomatic and in symptomatic patients.

Asymptomatic patients

As mentioned before, it is very important to diagnose asymptomatic PAD-patients because of their high risk of cardio- and cerebrovascular morbidity and mortality. Therefore the general practitioners or specialists of internal medicine should refer their patients with cardiovascular risk factors or present CHD or CVD to an angiologic-clinical examination and a measurement of the ABI once a year. All physicians treating patients with cardiovascular risk factors, such as diabetes mellitus, hyperlipidaemia, arterial hypertension or smoking, should offer these diagnostic methods. Furthermore, CCD done by a specialist, ie the angiologist, can detect early vascular changes.

Symptomatic patients

Until today, patients with pain of the extremities and/or trophic lesions seek or are sent by their general practitioner to an orthopaedic surgeon, a neurologist or a dermatologist rather than

an angiologist. The physician first contacted by the patient should be able to recognize the possibility of PAD from a patient's history, clinical examination and, possibly, by measurement of the ABI. In case of suspected angiopathy, the patient should be referred to a specialist for vascular medicine (angiologist). The angiologist is capable of performing the essential diagnostic procedures such as oscillography and CCD in the clinical context and in a rational way. The angiologist knows the differential diagnoses of vascular diseases (Tab. 3) and their different therapeutic options. If endovascular procedures are indicated, the angiologist (or the radiologist) will perform the endoluminal intervention during i.a.-DSA. If surgical procedures are necessary, i.a.-DSA or MRA (if requested by the surgeon) can be arranged. In patients with a high risk of renal failure or prior to amputation MRA is to be preferred. Symptomatic PAD-patients should undergo once a year examinations regarding CHD and CVD with ECG, echocardiography, ergometry and CCD of the extra- (and intra-) cranial brain vessels.

Conclusion

Patients presenting with cardiovascular risk factors, CHD, CVD or PAD should regularly undergo non-invasive diagnostic procedures such as specific angiologic history and clinical

examination, measurement of the ABI and CCD of the vessels of the extremities and the brain. The basic examinations can be executed by the general practitioner or the treating internist, the specialised examinations such as CCD a.o. should be done by the well trained specialist (angiologist) who knows the differential diagnoses of vascular diseases and their various therapeutic possibilities. In special cases, given the indication of invasive therapy, angiographic procedures may be necessary.

References

1. Criqui MH, Denenberg JO, Langer RD, Fronek A. The epidemiology of peripheral arterial disease: importance of identifying the population at risk. *Vasc Med* 1997; 2: 221-6.
2. Hughson WG, Mann JL, Garrod A. Intermittent claudication: prevalence and risk factors. *Br Med J* 1978; 31: 1379-81.
3. De Backer IG, Kornitzer M, Sobolski J, Denolin H. Intermittent claudication: epidemiology and natural history. *Acta Cardiol* 1979; 34: 115-24.
4. Novo S, Avellone G, Di Garbo V, Abrignani MG, Liquori M, Panno AV, Strano A. Prevalence of risk factors in patients with peripheral arterial disease: a clinical and epidemiological evaluation. *International Angiology* 1992; 11: 218-29.
5. Smith WCS, Woodward M, Tunstall-Pedoe H. Intermittent claudication in Scotland. In: Fowkes FGR (ed). *Epidemiology of Peripheral Vascular Disease*. Springer Verlag, London, 1991; 109-15.
6. Dormandy JA. Natural history of intermittent claudication. *Hosp Update* 1991; April: 314-8.
7. Criqui MH, Langer RD, Fronek A, Feigelson HS, Klauber MR, McCann TJ, Browner D. Mortality over a period of 10 years in patients with peripheral arterial disease. *N Engl J Med* 1992; 326: 381-6.
8. American Cancer Society. *Cancer Facts and Figures* - 1997.
9. Smith GD, Shipley MJ, Rose G. Intermittent claudication, heart disease risk factors, and mortality: the Whitehall study. *Circulation* 1990; 82: 1925-31.
10. Management of Peripheral Arterial Disease (PAD). Trans Atlantic Inter-Society Consensus (TASC). *Eur J Vasc Endovasc Surg* 2000; 19 (Suppl A): 66-103.
11. Thulesius O, Gjöres JE. Use of Doppler shift detection for determining peripheral arterial blood pressure. *Angiology* 1971; 22: 594-603.
12. Shinozaki T, Hasegawa T, Yano E. Ankle-Arm Index as an indicator of atherosclerosis: its application as a screening method. *J Clin Epidemiol* 1998; 15: 1263-9.
13. Dormandy JA, Creager MA. Ankle: arm blood pressure index as a predictor of atherothrombotic events: evidence from CAPRIE. *Cerebrovasc Dis* 1999; 9 (Suppl 1): 1-128 (Abstr 4).
14. Kornitzer M, Dramaix M, Sobolski J, Degre S, De Backer G. Ankle/arm pressure index in asymptomatic middle-aged males: an independent predictor of ten-year coronary heart disease mortality. *Angiology* 1995; 46: 211-9.
15. Apelqvist J, Castenfors J, Larssen J, Stenstrom A, Agardh CD. Prognostic value of systolic ankle and toe blood pressure levels in outcome of diabetic foot ulcer. *Diabetes Care* 1989; 12: 373-8.
16. Owen RS, Carpenter JP, Baum RA, Perloff LJ, Cope C. Magnetic resonance imaging of angiographically occult runoff vessels in peripheral arterial occlusive disease. *N Engl J Med* 1992; 326: 1577-81.
17. Bollinger A. In: Jäger KA, Landmann J (eds). *Praxis der angiologischen Diagnostik*. Springer Verlag, Berlin - Heidelberg - New York, 1994; 4.

Table 3: Diagnostic means in PAD

Non-invasive	Invasive
Medical history	i.a.-DSA (intra-arterial digital subtraction angiography)
Clinical examination	
Ankle-brachial index	
CW-Doppler	
Oscillography	
Colour-Doppler	
MRA (magnetic-resonance-angiography)	

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