Short Communication

Incompressible lower limb arteries in Malaysian patients with diabetic foot complications

Cheng Hoon Khor[1], Kevin Moissinac[1], Cheng Boon Koay[1], Harwant Singh[1] and Boon Chong Se To[2] *[1]Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia; [2]Penang General Hospital, Penang. (Correspondence: Dr Kevin Moissinac)*

Abstract

Clinicians frequently feel uneasy when faced with the task of interpreting ankle systolic pressures and ankle brachial indices in diabetic patients. Although it is well known that ankle systolic pressures and ankle brachial indices may be spuriously elevated in diabetics due to medial calcific stenosis, and the resulting incompressibility of peripheral arteries, the prevalence of this phenomenon has not been widely addressed. This phenomenon was observed in 4 of 43 (9.3%) Malaysian patients admitted to Hospital Kuala Lumpur for diabetic foot complications and in whom ankle systolic pressures were measured. Incompressibility was not observed in all the three lower limb arteries. This relative low prevalence suggests that the ankle brachial index measurement can still be a useful screening procedure for the presence of peripheral arterial macrovascular disease especially if measured in all 3 lower limb arteries and interpreted in conjunction with other clinical parameters of arterial evaluation.

Key Words: ankle brachial index; ankle systolic pressures; diabetic foot

Diabetic foot complications are the most feared complications of diabetes because of the prospect of major amputation and its subsequent incapacitation. Fifty per cent of foot complications have been ascribed to be of neuropathic and 50% to be of neuroischaemic in origin (Edmonds & Foster, 1996). At primary care level, screening for vascular insufficiency with view to referral for reconstructive revascularisation depends on the examination of peripheral pulses, arterial Doppler signals and the ankle brachial index (ABI)(ratio of ankle systolic pressure to brachial systolic pressure).

Clinicians frequently feel uneasy when faced with the task of interpreting ankle systolic pressures and ABIs in diabetic patients. It is well known that ankle systolic pressures and thence ABIs can be spuriously elevated. This most commonly occurs because of medial calcific stenosis (MCS), also called Monckerberg's arteriosclerosis which is found most frequently in diabetics (Baker, 1998). Medial calcific stenosis consists of progressive degeneration and calcification of the tunica media of muscular arteries which ultimately results in affected vessels becoming long rigid tubes of calcium (Mueller *et al.*, 1994). Unlike the more common intimal artherosclerosis, medial calcific stenosis does not typically result in an anatomic stenosis but causes a functional stenosis due to decreased vascular compliance which prevents the full systolic expansion of arteries (Mueller *et al.*, 1994).

When the artery is rigid due to heavy calcification, the pressure (exerted by the sphygmomanometer cuff) required to obliterate flow in the artery, is that needed to collapse the vessel wall and that required to overcome the intraluminal arterial pressure. Thus this will be higher than the arterial systolic pressure.

There has been so far, no accepted value of elevated ABI at which spurious elevation of ankle systolic pressures due to medial calcific stenosis should be suspected. ABI values of greater than 1.1 (Emanuele, 1981), 1.2 (Chantelau *et al.*, 1990) and 1.3 (Baker, 1998) have been advocated to be reflective of medial calcific stenosis. The presence of medial calcific stenosis and spuriously elevated ankle systolic pressures in diabetics and/or patients with diabetic foot complications has not been widely addressed in the medical literature. It has been quoted to occur in about 5 – 10% of Western diabetic populations (Lo Gerfo, 1995; Edmonds & Foster, 1996).

As part of a study on 53 patients with diabetic foot complications admitted to Hospital Kuala Lumpur, 43 patients had ankle systolic pressures measured and ABI determined. Of these 43, 4 (9.3%) patients were found to have at least one incompressible (by the sphygmomanometer cuff) peripheral artery. Nine patients withdrew consent for ankle systolic pressure measurement because of discomfort during inflation of the sphygmomanometer cuff and one patient declined consent.

Of the 53 patients, there were 18 (34%) females and 35 (66%) males. The mean ages for females and males were 60 ± 10.71 (range 45-79) and 53.34 ± 9.72 (range

26-72) years respectively. Fifty percent (26 of 52), 34% (18 of 52), 5.8% (3 of 52) and 5.8% (3 of 52) had diabetes for 0-10, 11-20, 21-30 and more than 31 years respectively. Ten (18.9%) had Type I diabetes and 40 (75.5%) Type II diabetes. Diabetic type could not be determined in 3 (5.7%) patients.

Predominant diabetic foot complications necessitating hospital admission were ulceration in 18 (34.0%), gangrene in 24 (45.3%), cellulitis in 10 (18.9%) and septic foot in 1 (1.9%). Sites of the predominant foot complication were the distal foot in 27 (50.9%), midfoot in 8 (15.1%), proximal foot in 12 (22.6%) and diffusely throughout the foot in 6 (11.3%).

Of the 53 patients who underwent arterial Doppler evaluation of the foot complication bearing limb, 36 (67.9%) were found to have macrovascular disease (at least one artery). Of the 52 patients who underwent pulse examination, 37 (71.2%) were found to have macrovascular disease (at least one artery). Of the 43 patients who underwent measurement of ankle systolic pressure and determination of ABI, 15 (34.9%) were found to have macrovascular disease (at least one artery) on the basis of macrovascular disease deemed present when the ABI was less than 0.9. The characteristics of the patients who were found to have incompressible arteries are summarised in Table 1.

Although it is well known that ankle systolic pressures and ankle brachial indices can be spuriously elevated, the prevalence of this phenomenon has not been widely addressed. The prevalence of 9.3% (4 of 43) of absolutely incompressible peripheral arteries in this relatively small population of patients with diabetic foot complications is compatible to that of quoted, of Western diabetic populations by Edmonds and Foster (1996) and Lo Gerfo (1995).

This prevalence of 9.3% is relatively low and suggests that ankle systolic pressure and the ankle brachial index can be used in Malaysian patients to screen for the presence of peripheral arterial disease. All of the 4 patients found to have incompressible arteries did not have incompressibility of all the arteries in their lower limbs. Although the anterior tibial artery has been quoted to be the most commonly affected by calcification (Belcaro *et al*, 1998), of the 7 arteries found to be incompressible, only 2 (28.6%) were anterioir tibial arteries.

Screening for the presence of arterial insufficiency can perhaps be more accurate if ankle pressures and ankle brachial indices are determined in all of the 3 lower limb arteries (anterior tibial, posterior tibial and peroneal) instead of only in one. Also the values of ankle systolic pressures and ankle brachial indices should be interpreted in conjunction with peripheral pulse and doppler signal evaluation as a diminished pulse amplitude and an abnormal audible doppler signal in the presence of a normal or elevated ankle systolic pressure and ankle brachial index will alert the examiner of spurious elevation (Zierler and Summer, 1995).

Limitations of the study were, the small sample size, selection bias and observer bias. Perhaps studies with a larger populations and correlated with radiological examination for the presence of peripheral lower limb arterial calcification may shed further light on the issue.

Although ankle systolic pressures and ankle brachial indices, especially in diabetics may be spuriously elevated because of medial calcific stenosis and not reflect the presence of macrovascular disease the prevalence of this phenomenon is not widespread. When interpreted in

Table 1. Host Factors of patients with diabetic foot complications found to have incompressible peripheral arteries.

Age	54	55	55	46
Gender	Female	Male	Male	Female
Diabetic Type	II	I	II	II
Known Diabetic Duration (years)	4	6	15	9
Foot complications	Gangrene 1st Toe	Ulceration Diffuse	Gangrene Distal foot	Gangrene Distal foot
Artery Incompressible (Ankle systolic press of 250mmHg or more)	Lesion bearing limb Posterior tibial Peroneal	Contralateral limb Anterior tibial Posterior tibial	Lesion bearing limb Peroneal Contralateral limb Peroneal	Contralateral limb Anterior tibial
Brachial systolic pressure	160mm HG	160mm Hg	120 mmHg	138 mmHg
Ankle Brachial Index	> 1.56	> 1.56	> 2.08	> 1.81

conjunction with other clinical parameters of vascular evaluation, the ankle brachial index can still be a valuable screening procedure for the presence of lower limb arterial insufficiency.

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