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Characteristics of peripheral arterial disease in Japanese type 2 diabetic patients

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To the Editor:

It is well known that diabetes is an important factor in the progression of peripheral arterial disease [1, 2]. Indeed, peripheral arterial disease in diabetic patients often leads to extremity amputation and has a poorer prognosis and higher mortality [3, 4], suggesting that vessel lesions are even worse in diabetes. There have been few reports, however, that directly compare the characteristics of peripheral arterial disease in type 2 diabetic and non-diabetic subjects as observed by angiography. The aim of this study was to directly compare the characteristics of peripheral arterial disease in type 2 diabetic and non-diabetic subjects according to the TransAtlantic Inter-Society Consensus (TASC) [1, 5], which is thought to provide strong worldwide consensus. The TASC classifies vessel lesions into four categories based on severity of the lesions from a therapeutic point of view. The categories are as follows: A, an intravascular intervention is recommended; B, an intravascular intervention tends to be recommended; C, a surgical operation tends to be recommended; D, a surgical operation is recommended.

To examine the characteristics of peripheral arterial disease in type 2 diabetic subjects, we screened patients in Kansai Rosai Hospital from January 2000 to July 2004, and

recruited 211 patients who had significant stenosis in the lower limb arteries upon observation by aortography and who were thought to need revascularisation. We believe that revascularisation is necessary when patients meet the following criteria: (1) patients have symptoms such as rest pain, foot ulcer, foot gangrene (Fontaine classification III or IV) and significant stenosis upon observation by aortography; or (2) subjects have symptoms such as paresthesia, numbness, intermittent claudication (Fontaine classification I or II), significant stenosis, and are resistant to 6-month exercise and internal medication. Clinical characteristics and features of the vessel lesions such as severity, length, calcification, and distribution were compared between type 2 diabetic ($n=122$) and non-diabetic subjects ($n=89$). Coronary artery disease was diagnosed when there was clinical evidence of angina or myocardial infarction, abnormalities on electrocardiography, or significant stenosis or obstruction of the coronary artery on angiography. Diabetes was diagnosed when the fasting glucose level was 7 mmol/l or higher, HbA_{1c} was 6.5% or greater, or the patient was currently on anti-diabetic treatment. In this study, hypertension was provisionally diagnosed when systolic blood pressure was 140 mmHg or higher and/or diastolic blood pressure was 90 mmHg or higher, or when the patient was taking anti-hypertensive medication. Hyperlipidaemia was provisionally diagnosed when total cholesterol was 5.7 mmol/l or more, or when the patient was taking anti-hyperlipidaemic medication. The criteria for diagnosis of nephropathy were continuous macro-albuminuria or a serum creatinine level of 140 μ mol/l or higher. We evaluated the results of aortography according to TASC.

A total of 122 subjects (58%) had diabetes with a duration of $15. \pm 12.5$ years (mean $\pm$ SD). Type 2 diabetic and non-diabetic subjects showed similar age (68.2 ± 8.5 and 69.7 ± 9.9 years) and sex distribution (male: 74.6 and 84.3%). There was no difference in the proportion of patients with a smoking habit (41.7 and 46.4%), hyperten-

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Fig. 1 **a** Diameter of the major axis of vessel lesions. Type 2 diabetic subjects (T2DM) (black bars) had a greater proportion of long vessel lesions (more than 10 cm) and a smaller proportion of short vessel lesions (less than 2 cm) than non-diabetic subjects (NDM) (white bars). * $p < 0.05$. **b** Distribution of vessel lesions. T2DM (black bars) had a greater proportion of infringuinal (femoral+below knee) lesions and a smaller proportion of iliac lesions than NDM subjects (white bars). * $p < 0.05$. **c** Correlation of HbA_{1c} levels and the ratio of infringuinal lesions. The ratio of infringuinal lesions in T2DM (black bars) was not correlated with HbA_{1c} levels but was much higher than that in NDM (white bars)

sion (80.3 and 69.8%), or hyperlipidaemia (60.5 and 50.6%). Serum LDL cholesterol, HDL cholesterol, and triglyceride levels in type 2 diabetic and non-diabetic subjects were 2.97 ± 0.75 and 3.15 ± 0.93 mmol/l, 1.11 ± 0.28 and 1.14 ± 0.34 mmol/l, and 1.75 ± 1.23 and 1.35 ± 0.78 mmol/l, respectively. The type 2 diabetic and non-diabetic subject groups had the same proportion of patients with a history of coronary artery disease (52.7 and 50.0%), and renal failure (8.1 and 8.0%). In addition, there was no difference between type 2 diabetic and non-diabetic subjects in the severity of symptoms (Fontaine classification I: 1.0 and 4.3%, II: 74.3 and 78.3%, III: 8.9 and 5.8%, IV: 15.8 and 11.6%) or ankle brachial pressure index (0.59 ± 0.23 and 0.54 ± 0.25). There was also no definite difference in tendency for ankle brachial pressure index between type 2 diabetic and non-diabetic subjects at various stages of peripheral arterial disease (Fontaine classification I: 0.53 ± 0.00 and 0.86 ± 0.18 , II: 0.63 ± 0.19 and 0.56 ± 0.21 , III: 0.27 ± 0.21 and 0.48 ± 0.19 , IV: 0.41 ± 0.29 and 0.30 ± 0.38 , respectively), although the proportion of subjects with Fontaine classification I and III was very small for effective comparison.

We evaluated the severity of each vessel lesion according to TASC. There was no difference in the severity of vessel lesions between type 2 diabetic (193 lesions) and non-diabetic subjects (134 lesions). Classification by TASC in type 2 diabetic and non-diabetic subjects was as follows: A, 27 and 30%; B, 17 and 22%; C, 20 and 16%; D, 36 and 32%. However, as shown in Fig. 1a, type 2 diabetic subjects had a greater proportion of long vessel lesions (more than 10 cm), and had more multiple vessel lesions in the lower limbs than non-diabetic subjects (71.9 and 57.3%, $p = 0.028$), although there was no difference in calcification (44.8 and 43.1%, $p = 0.762$). Moreover, as shown in Fig. 1b, type 2 diabetic subjects had a greater proportion of infringuinal vessel lesions than non-diabetic subjects.

We performed multivariate regression analysis to evaluate the influence of various possible risk factors (age, sex, body mass index, hypertension, hyperlipidaemia, smoking, and diabetes) on the characteristics of vessel lesions. The presence of type 2 diabetes was closely correlated with the ratio of distal (infringuinal) lesion ($r = 0.283$, $p < 0.0001$), although there was no independent risk factor for the occurrence of long or multiple lesions. In addition, we examined the correlation between HbA_{1c} levels and peripheral lesions. Although the ratio of infringuinal lesions in type 2 diabetic subjects was much higher than in non-diabetic subjects, the ratio of infringuinal lesions in each group was not correlated with HbA_{1c} levels (Fig. 1c).

In conclusion, vessel lesions in type 2 diabetic subjects are longer in the major axis, more multiple, and more peripheral than those in non-diabetic subjects. In particular, the characteristics of peripheral lesion are strongly associated with the pathology of type 2 diabetes.

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References

1. Murabito JM, D'Agostino RB, Silbershatz H, Wilson WF (1997) Intermittent claudication: a risk profile from the Framingham Heart Study. *Circulation* 96:44–49
2. TransAtlantic Inter-Society Consensus (TASC) (2000) Management of peripheral arterial disease. *J Vasc Surg* 31(Suppl. Pt2): S1–S278
3. Dormandy J, Heeck L, Vig S (1999) Predicting which patients will develop chronic critical leg ischemia. *Semin Vasc Surg* 12:138–141
4. Jude EB, Oyibo SO, Chalmers N, Boulton AJ (2001) Peripheral arterial disease in diabetic and nondiabetic patients: a comparison of severity and outcome. *Diabetes Care* 24:1433–1437
5. Sacks D (2003) The TransAtlantic Inter-Society Consensus (TASC) on the management of peripheral arterial disease. *J Vasc Interv Radiol* 14:S351