Relationship of Periodontal Bacterium Genotypic Variations With Periodontitis in Type 2 Diabetic Patients

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Periodontitis is characterized by gingival inflammation, as well as loss of connective tissue and bone from around the roots of the teeth, which leads to eventual tooth exfoliation. Severe periodontitis often coexists with diabetes and is considered to be the sixth complication of the disease, as both type 1 and type 2 diabetic patients show a three- to fourfold increased risk of periodontitis (1–4). However, the involved factors and mechanisms are still unclear.

Periodontitis is caused by a small subset of periodontal Gram-negative bacteria that attach to the gingival margin, such as *Porphyromonas gingivalis*, *Actinobacillus actinomycetemcomitans*, *Tannerella forsythia*, *Treponema denticola*, and *Prevotella intermedia* (5). Among them, *P. gingivalis* is considered to be a bona fide periodontal pathogen (5–7). *P. gingivalis* fimbriae are hair-like appendages on the bacterial surface that mediate bacterial interactions with and invasion of host tissues (8). These fimbriae have been classified into six types (I through V and Ib), based on the diversity of the *fimA* genes encoding FimA (a subunit protein of fimbriae) (9,10). Studies have shown that clones with type II *fimA* have a significantly greater virulence in vitro and in vivo (10–12). Therefore, specific *P. gingivalis fimA* types may be related to periodontitis associated with type 2 diabetes.

RESEARCH DESIGN AND METHODS

— We selected 97 Japanese adults (53 men and 44 women) with type 2 diabetes with or without adult periodontitis according to a protocol approved by the Ethics Committee of Osaka Rosai Hospital. All of the subjects completed questionnaires and were excluded if antibiotics, corticosteroids, and/or nonsteroidal drugs had been used during the previous 3 weeks. Subjects had >10 functional teeth and had not received professional periodontal treatment during the 6-month period before the study.

Periodontal condition was determined by measuring the level of attachment loss as described previously (13). The development of periodontitis was assessed by attachment loss level, i.e., individuals who had more than a tooth with an attachment loss of >5 mm were classified into the periodontitis group and the others comprised the nonperiodontitis group. The ratio (a percentage) of teeth with an attachment loss of >5 mm among all teeth in each subject was used as an index of periodontal deterioration.

Bacterial samples were collected from subgingival pockets and analyzed using a PCR method as described previously (13–15). The target microorganisms were *P. gingivalis*, *A. actinomycetemcomitans, T. forsythia*, *T. denticola*, and *P. intermedia*. *P. gingivalis fimA* types were also analyzed. Statistical analyses were performed using a *t* test and χ^2 test.

RESULTS

— General condition and bacterial occurrence were analyzed in relation to periodontitis development. No significant differences were found in sex, BMI (mean 23.6 ± 4.9 kg/m^2), HbA_{1c} level (9.6 ± 2.0%), and disease duration (8.5 ± 7.6 years) between the periodontitis and nonperiodontitis groups, but age was significant (Table 1). Of the five periodontal bacteria, only the occurrence of *P. gingivalis* was significantly different between the two groups, and its type II *fimA* clone was more predominant in the periodontitis group (42.0%) than in the nonperiodontitis group (35.7%) but not significantly. The ratio of teeth with an attachment loss of >5 mm, used as an index of periodontitis deterioration, varied from 3.3 to 100.0% (means ± SD 30.5 ± 27.6%) in the periodontitis group. *P. gingivalis* was found to be the only pathogen with a significant relationship to periodontitis deterioration (Table 1). Among the six genotypes of *P. gingivalis*, the occurrence of type II *fimA* clone was significantly associated with disease deterioration. On the other hand, type I and IV *fimA* clones showed a tendency to be negatively associated with the deterioration. Furthermore, a regression model was constructed to independently confirm the relationship of *P. gingivalis* type II *fimA* with deterioration of periodontitis, which included age and sex as adjusting variables. This model indicated that the occurrence of type II *fimA* clone was independently related to periodontitis deterioration (standard regression coefficient 0.274, $P = 0.025$), but age and sex were not.

CONCLUSIONS

— *P. gingivalis* is reported to be the most frequently detected pathogen in periodontitis diseased sites of

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Received for publication 28 October 2004 and accepted in revised form 29 October 2004.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Factors related to the development and deterioration of periodontitis in type 2 diabetic patients*

	Subjects	
	Nonperiodontitis	Periodontitis
Factors related to the development		
Age (years)*	53.7 ± 14.1	59.5 ± 1.3
P. gingivalis (all *fimA* types)†	50.0	79.7
	Ratio of diseased teeth (%)	
	Occurrence$^-$	Occurrence$^+$
P. gingivalis clones related to the deterioration		
P. gingivalis (all *fimA* types)*	26.4 ± 28.8	31.5 ± 27.4
I	32.7 ± 28.1	13.2 ± 14.8
II*	24.0 ± 24.3	39.4 ± 29.7
III	30.4 ± 27.5	31.2 ± 29.4
IV	32.4 ± 28.6	19.2 ± 17.2
Ib	28.2 ± 27.4	45.5 ± 25.2

Data are means ± SD and %. Type V *fimA* was excluded for the deterioration due to the insufficiently small number of subjects possessing that type. *$P < 0.05$ by *t* test, †$P < 0.05$ by χ^2 test.

type 2 diabetic and nondiabetic populations (16,17). In the present study, *P. gingivalis* type II *fimA* was found to have a significant association with deterioration of periodontitis, whereas types I and IV clones were not related to disease progression. We previously reported that the occurrence of type II *fimA* clones is significantly correlated with both the development and deterioration of periodontitis in systemic healthy subjects, as compared with other *fimA* types, while the most prevalent *fimA* type in periodontal healthy sites was type I (9,14). Other studies performed in different countries with systemic healthy populations have confirmed our findings (18–20). Similar findings have been reported in Down's syndrome patients, who are congenitally susceptible to periodontitis, and in young adults with mental disability, a major factor in determining oral hygiene (13).

Diabetic patients are at greater risk of developing periodontitis due to their high susceptibility to infection (7). The present findings also suggest that *P. gingivalis* clones, even with lower pathogenicity, can lead to periodontitis in diabetic patients. They hardly respond to periodontal therapy (7); thus, patients infected with the type II clone require careful attention to bacteria elimination and periodontal management by professional periodontists.

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