

# Association Between Chronic Periodontitis and Vasculogenic Erectile Dysfunction

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**Background:** Erectile dysfunction (ED) and chronic periodontitis (CP) share common risk factors. There is only one report on the association between ED and CP. Thus, the aim of this study is to find the association between vasculogenic ED and CP.

**Methods:** A total of 70 patients (mean age:  $35.3 \pm 3.64$  years) clinically diagnosed with ED were included in the study. They were given the Sexual Health Inventory for Men Questionnaire and subjected to colored penile Doppler ultrasound. Periodontal parameters of probing depth and periodontal attachment level were recorded. Five patients with ED and CP were selected randomly for cardiac color Doppler to assess the integrity.

**Results:** Among the selected vasculogenic patients with ED, mild-to-moderate vasculogenic ED showed the highest prevalence, whereas prevalence for CP among all vasculogenic patients with ED was highest among severe ED (81.8%). Association of CP and vasculogenic ED was found to be correlated positively, but it showed no statistical significance. Two of five patients were found to have vascular insufficiency.

**Conclusions:** It can be hypothesized that an association exists between vasculogenic ED and CP in young males. However, a large-scale study with confounder analysis and a longitudinal follow-up is warranted. *J Periodontol* 2011;82:1665-1669.

## KEY WORDS

Chronic periodontitis; coronary disease; erectile dysfunction.

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Erectile dysfunction (ED) is defined by the National Institutes of Health as the inability to attain or maintain an erection sufficient for satisfactory sexual performance.<sup>1</sup> ED is usually experienced at the age  $\geq 40$  years.<sup>2</sup> In a random sample of 40- to 70-year-old men in Massachusetts, the prevalence of ED was 52%, with the prevalence of complete impotence tripling from 5% to 15% in this age range.<sup>3</sup> ED may result from organic causes (e.g., vascular, neurogenic, hormonal, anatomic, or drug-induced), psychologic causes, or a combination of both.<sup>4</sup> ED resulting from organic causes comprises  $\leq 80\%$  of cases, whereas vascular disease is the most common pathophysiology of ED.<sup>5</sup>

Chronic periodontitis (CP) is defined as the loss of both the attachment of the periodontal ligament and bony support of the tooth and most often occurs with inflammation of the gingival tissues.<sup>6</sup>

The mutual risk factors<sup>4,7</sup> (smoking, diabetes mellitus, and cardiac diseases) shared by ED and CP each contribute to endothelial dysfunction (EDys). Vasculogenic ED may result from impairment of endothelial-dependent or -independent smooth muscle relaxation (i.e., functional vasculogenic ED, early stages), occlusion of the penile arteries by atherosclerosis (i.e., structural vasculogenic ED, late stages), or a combination of these processes.<sup>8</sup> An early case-control study indicated that patients with periodontitis had higher levels of EDys, measured

as flow-mediated dilatation of the brachial artery, compared to matched controls.<sup>9</sup> It has also been demonstrated that periodontitis impaired endothelium-dependent vasodilation but not endothelium-independent vasodilation in healthy young men.<sup>10</sup> Zadik et al.<sup>11</sup> explored the link between ED and CP using the Sexual Health Inventory for Men (SHIM) Questionnaire and proposed that ED might be associated with CP in young men. However, the patients selected in the study had not been separated for those caused by vasculogenic from other causes.

The aim of this study is to find the association between vasculogenic ED and CP using the SHIM questionnaire and penile color Doppler in a population of young men.

## MATERIALS AND METHODS

Initially, 103 male patients (aged 25 to 40 years) clinically diagnosed with ED on the basis of case history and clinical examination were selected from the outpatient section of Ankur Healthcare (andrology clinics), Rajaji Nagar, Bangalore, India, for this study. Twenty-one patients were excluded because they did not fulfill the inclusion criteria, did not agree to provide SHIM questionnaires, or had systemic diseases other than ED. A total of 82 patients remained as participants in the study and were given the SHIM questionnaire and subsequently subjected to colored penile Doppler ultrasound. Only 70 patients (mean age:  $35.3 \pm 3.64$  years) with vasculogenic cause were included in the study after colored penile Doppler ultrasound. Periodontal status for each patient was assessed for probing depth (PD) and periodontal attachment level (PAL). The study was conducted from January 2010 to March 2010. The research protocol was initially submitted to the Institutional Ethical Committee and Review Board of the Government Dental College and Research Institute, Bangalore. After ethical approval, all patients were verbally informed, and written informed consent was taken for participation in the study.

All systemically healthy patients, aged 25 to 40 years, who completed the SHIM questionnaire, had  $\geq 20$  natural permanent teeth, and had not received periodontal therapy within the preceding 6 months were included in the study. Patients who used alcohol or tobacco in any form, had suffered from any acute or chronic medical conditions except ED, and were on medication that can alter the course of ED and CP were excluded from the study.

Patients were diagnosed for ED by an expert andrologist (Dr. S.S. Vasan, Ankur Healthcare, Rajaji Nagar, Bangalore, India). One examiner (AR) collected the SHIM questionnaire, and a second examiner (AS) recorded periodontal parameters. A sonologist (Dr. Mohammed Sajid, Ankur Healthcare,

Rajaji Nagar, Bangalore, India) performed penile Doppler ultrasound. All examiners were masked to SHIM scores.

### SHIM Questionnaire

The questionnaire consisted of five questions rated on a six-point scale from 0 to 5, except for one question on a five-point scale from 1 to 5.<sup>12</sup> The total score is calculated by adding all question scores together. Scores  $>21$  represent normal erectile function and scores  $\leq 21$  represent ED. ED severity can be classified into four types based on the SHIM scores as given in Table 1.

### Color Doppler Ultrasound for Penis

Each patient who filled out the SHIM questionnaire was screened through color Doppler ultrasound<sup>†</sup> with an 8-L probe<sup>§</sup> for the penis. The purpose was to assess vascularity of the penis and for confirmation of diagnosis of vasculogenic ED. All patients were given an intracavernous injection of 20  $\mu\text{g}$  prostaglandin E<sub>1</sub> and were then evaluated by penile dynamic duplex study using color ultrasound. Arterial insufficiency was diagnosed when peak systolic velocity was  $<25$  cm/s.

### Periodontal Examination

Patients with PD  $\geq 5$  mm and attachment loss (i.e., PAL  $\geq 3$  mm at  $>30\%$  sites with radiographic evidence of bone loss [distance of cemento-enamel junction to alveolar bone crest of  $\geq 6$  mm])<sup>13,14</sup> were classified under the CP group. A previously calibrated examiner (AS) performed all the clinical assessments using a University of North Carolina No.15 periodontal probe. Calibration trials were performed before the study to ensure adequate intraexaminer reproducibility. No statistically significant difference was found between obtained duplicate measurements ( $r = 0.92$  for PD and  $r = 0.89$  for attachment loss).

### Color Doppler Ultrasound for Coronary Vessels

Five patients with ED and CP were selected randomly for cardiac color Doppler to assess any changes in vascularity of the heart in patients with ED and CP.

### Statistical Analyses

Based on the outcome of a previous study, sample size of the study was calculated at 80% power with an  $\alpha$  of 0.05. Categorical data were assessed using the chi-square test. A comparison was termed statistically significant if the  $P$  value was  $<0.05$ . Data were statistically analyzed using a software program.<sup>||</sup>

## RESULTS

The data of patients with varying severity of vasculogenic ED associated with CP are summarized in Table 2. All the patients except 12, who reported to the

† GE Logiq Book Enhanced, Sound-Eklin, Carlsbad, CA.

§ GE Logiq Book Enhanced, Sound-Eklin.

|| SPSS package version 11.0, IBM, Chicago, IL.

clinic with complaints of ED, showed positive findings for both the SHIM questionnaire and color Doppler. Among all the selected patients, prevalence for vasculogenic ED was highest in the mild-to-moderate vasculogenic ED group. Prevalence for CP among all vasculogenic patients with ED was highest among severe vasculogenic ED (81.8%). Prevalence for CP increased continuously from the mild vasculogenic ED group to the severe vasculogenic ED group. Association of CP and vasculogenic ED was found to be correlated positively, but it showed no statistical significance. Mean values for PD and PAL in each ED group are shown in Table 2. Although all the patients in each ED group were not affected with CP, mean PD and mean PAL values continuously increased with severity of ED. Among all ED groups, patients with mild vasculogenic ED with CP showed a statistically significant difference compared to patients with severe ED ( $P < 0.05$ ). Two of five patients screened for cardiac Doppler showed initial cardiac vascular insufficiency.

## DISCUSSION

In this study, the association between vasculogenic ED and CP in 25- to 40-year-old men was explored by using the SHIM questionnaire and penile color Doppler.

Loss of the functional integrity of the endothelium and subsequent EDys play a pivotal role in the occur-

rence of ED. There is a close relationship among ED, aging, and EDys.<sup>15</sup> Because old age is a common risk factor for both ED and CP, only young males (25 to 40 years) were selected for the current study.

The diagnosis of CP was made with PD  $\geq 5$  mm and attachment loss (i.e., PAL  $\geq 3$  mm at  $>30\%$  sites with radiographic evidence of bone loss [distance of cemento-enamel junction to alveolar bone crest of  $\geq 6$  mm]).<sup>13,14</sup> The patients diagnosed with aggressive periodontitis on the basis of clinical and radiographic assessment using the classification workshop criteria<sup>16</sup> and the specific characteristic radiographic appearance of aggressive periodontitis were not included in the study.<sup>17</sup>

The SHIM index was used to assess ED. This is a valid and reliable questionnaire,<sup>12</sup> and its simplicity makes it an easy method for large-scale ED studies.<sup>18</sup> Color Doppler ultrasound was used because it has a role in the evaluation of patients with vasculogenic ED and has an increasing role in the detection of silent coronary artery diseases in men presenting with vasculogenic ED.<sup>19</sup> Additional use of color Doppler ultrasound was to identify and differentiate patients with ED suffering from vasculogenic cause.

In our study, although all the patients in each ED group were not affected with CP, mean PD and PAL values continuously increased with increasing SHIM scores and severity of ED. All the groups showed difference, but it was not statistically significant. Prevalence of CP was highest among patients with severe ED. Similar results have been reported by Zadik et al.<sup>11</sup> A previous study has considered the SHIM questionnaire to assess the ED.<sup>12</sup> The SHIM questionnaire is a valid index, but it does not isolate vasculogenic ED from other causes. The current study has undertaken penile color Doppler to assess and consider patients with vasculogenic ED.

Periodontitis may contribute to the systemic inflammatory burden and process leading to atherosclerosis in otherwise healthy individuals.<sup>20</sup> It has been found that relatively high levels of endothelial

**Table 1.**

### SHIM Questionnaire

SHIM Scores	ED Severity
$\geq 22$	No
17 to 21	Mild
12 to 16	Mild to moderate
8 to 11	Moderate
1 to 7	Severe

**Table 2.**

### Chi-Square Test for the Association of CP With ED

ED Severity	Patients With ED	Patients With CP	Chi-Square Test	P Value	Mean PD (mm)	Mean Attachment Loss (mm)	ED Patients With CP (%)
Mild	18	7			5.5	3.6	38.8
Mild to moderate	24	11	5.67	0.128	6.2	4.7	45.8
Moderate	17	13			6.6	4.9	76.4
Severe	11	9			7.2	5.5	81.8

progenitor cells (EPC) may reflect an altered endothelial function that might, to some extent, be affected by an increased level of systemic inflammation arising from uncontrolled periodontal infections,<sup>21</sup> so it can be inferred that periodontitis can cause EDys. The novel endothelial biomarkers, including asymmetric dimethylarginine, circulating progenitor cells, endothelial microparticles, and EPCs, play an active role in both endothelial function and systemic inflammation.<sup>22</sup> Treatment of periodontitis significantly decreases EPCs, including circulating CD341 cell count.<sup>23</sup> Additionally, impaired endothelial-dependent vascular dilation, an established risk factor for cardiovascular disease, is also associated with periodontal disease.<sup>24</sup> Another possible explanation for the association between CP and coronary artery disease could be the coexistence of periodontal bacterial DNA (*Tannerella forsythia* [previously *T. forsythensis*], *Fusobacterium nucleatum*, *Prevotella intermedia*, and *Porphyromonas gingivalis*) in coronary atherosclerotic plaque and subgingival plaque in patients scheduled for coronary artery bypass graft.<sup>25</sup> ED is considered an early manifestation of EDys in the presence or absence of cardiovascular risk factors,<sup>26</sup> so it can be proposed that CP influences EDys, which can further lead to ED. Furthermore, because of the overlap between the risk factors for ED and cardiovascular disease, it is not surprising that ED is associated with impaired penile blood flow caused by atherosclerosis<sup>27</sup> and that conversely ED can be regarded as a harbinger of subsequent cardiovascular clinical events.<sup>28,29</sup> We selected five patients with ED and CP randomly to undergo cardiac Doppler ultrasound; two patients were recognized with cardiac vascular insufficiency. The main underlying pathologic pathway for coronary heart disease is atherosclerosis. Increasing evidence suggests that atherosclerosis is a dynamic and progressive disease that arises from a combination of EDys and inflammation.<sup>30</sup> A possible link among all three diseases (CP, vasculogenic ED, and cardiac disease) can be proposed.

Another factor, impaired fasting glucose associated with periodontal disease, could also contribute to the development of ED in young male patients in the current study. As proposed by Zadik et al.,<sup>31</sup> even “healthy” young people may have an underlying condition, such as impaired glucose level, which at this level is not considered to be “diabetes mellitus,” although it may be involved in both CP and ED.

The small diameter of the cavernosal arteries and the relatively high content of endothelium and smooth muscle on a per unit volume tissue basis compared to other organs suggest that the penile vascular bed may be a sensitive indicator of systemic vascular disease.<sup>32,33</sup> EDys caused by systemic inflammation induced by periodontitis might affect first the small vessels, such

as the penile vasculature, and later the larger arteries, such as the coronary arteries. It strengthens the idea that CP might be associated first with ED in young males, and later with coronary artery disease in middle-aged males,<sup>11</sup> but this is only speculative and requires exploration for its validity.

Only five patients were selected for cardiac Doppler ultrasound, which is a limitation of this study. A longitudinal study with a large sample size considering penile and cardiac Doppler along with various Doppler parameters and periodontal parameters with measurement of endothelial function should be explored for future research.

## CONCLUSION

The interrelation of vasculogenic ED, CP, and coronary heart disease may be complex, and studies with more appropriate measurements of the burden of periodontal inflammation and EDys are highly warranted to clarify the current findings.

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