Correlation between the Detection of Carotid Artery Calcifications on Panoramic Radiographs and the Presence of the Potential Risk Factors

Subashini Suyambukesan, Gopuchandran Lenin Perumal

ABSTRACT

Aims and Objectives: To correlate between the detection of carotid artery calcifications (CACs) on panoramic radiographs (PRs) and the presence of risk factors for atherosclerosis among different races in Malaysia. Materials and Methods: A random sample of 587 digital PRs taken during the years 2008 to 2010 for patients who had been treated in Penang International Dental College were analyzed for the presence of CACs. Demographic data, medical history and records were charted out and the risk factors were evaluated for the association with CACs, by means of logistic regression. Results: 29 CACs (8.1%) were identified on 358 PRs of 17 males (58.6%) and 12 females (41.4%). It was unilateral in 16 and bilateral in 13 cases. Among the 29 cases with CACs, 22 were smokers, 19 had hyperlipidemia, 18 were obese and significantly 23 had periodontitis. The patients with CACs had multiple risk factors compared with the patients who had no detectable CACs on PRs. Conclusions: There was a positive correlation between the detection of CACs on PRs with the presence of the risk factors for atherosclerosis, in different races in Malaysia which can lead to myocardial infarction or stroke, which is one of the leading causes of death globally. The dentists therefore should acquire appropriate medical history and should be competent in identifying CACs on routine PRs which can provide life-saving information.

Key words: Carotid Artery Calcifications; Panoramic Radiography; Atherosclerosis; Risk Factors

Introduction

Stroke or cerebrovascular disease is a global concern which can cause death or life long severe disability. Atherosclerosis (Greek: gruel or hardening), is the most frequent and clinically important pattern of arteriosclerosis. Atherosclerosis is present in the intimal layer of the arteries and protrudes into vascular lumina. They obstruct blood flow, weaken the underlying media, can rupture thus causing thrombosis and embolus formation. Atherosclerosis can lead to stroke, peripheral artery disease or coronary artery disease. Ischemic heart Disease is the top cause of death in Malaysia.5 Most of the patients who survive stroke are disabled. Embolic occlusion at the carotid bifurcation, due to the presence of Carotid Artery Calcifications (CACs) is one of the prime aetiology for ischemic stroke.6 Friedlander and Lande6 demonstrated in 1981 that Panoramic Radiographs (PRs) can be used to detect CACs and stressed the importance of early diagnosis of CACs.

A number of studies5-7 have revealed the detection of Carotid Artery Calcifications (CACs) on Panoramic Radiographs (PRs), but to say this is the first study done with specific identification of risk factors and stressing the role of appropriate medical history questionnaire. Hardening of arteries can occur as a process of aging, but this can also occur at a younger age if the blood cholesterol levels are high.6 Atherosclerosis is characterized by various risk factors, which include unhealthy life styles, smoking, inappropriate diet, obesity, alcohol abuse, diabetes mellitus, arterial hypertension, renal disease, menopause, periodontitis and hyperlipidemia. The three existing races in Malaysia namely Malays, Chinese and Indians were separately identified for these risk factors based upon their age and gender. The associative value of the presence of carotid artery calcifications to the risk factors was analyzed using unadjusted simple and multiple logistic regressions. Statistical significance was observed at a p value of less than 0.05. CACs prevalence between different races was analyzed using chi square test.

Materials and Methods

About 587 digital PRs taken during the period of September 2008 to September 2011 at Penang International Dental College, department of Oral Medicine Diagnosis and Radiology were considered for this study. All the radiographs were taken using Planmeca Proline XC model S:N XC 429572 (80 Kv Max; 180-240 V- 1500 VA, 50 Hz; Total filtration-2.5 mm Al). Amongst these PRs 358 were considered excluding the cases where the patient`s age was less than 40 and if the cervical vertebrae regions were not visualized.

Carotid artery Calcifications were diagnosed as the presence of radiopaque mass(es) near or below the intervertebral space between C3 and C4, postero-inferior to the angle of the mandible (Figure 1). The side of presentation, size and position of the mass was noted. The other cervical calcifications like calcified triticeous cartilage, calcified thyroid cartilage and sialoliths of the Wharton`s duct were excluded. To rule out variations in detection of these calcifications the PRs were re-evaluated twice after a month independently by the authors.

The medical data were evaluated for all the 358 patients whose radiographs were analyzed. The risk factors which were considered included habits like smoking and alcohol, obesity, diabetes mellitus, arterial hypertension, renal disease, menopause, periodontitis and hyperlipidemia. The three existing races in Malaysia namely Malays, Chinese and Indians were separately identified for these risk factors based upon their age and gender. The associative value of the presence of carotid artery calcifications to the risk factors was analyzed using unadjusted simple and multiple logistic regressions. Statistical significance was observed at a p value of less than 0.05. CACs prevalence between different races was analyzed using chi square test.
Results
This study comprised of 358 subjects which includes 191 males and 167 females. Amongst which 29 had CACs which included about 11, 8 & 10 Malays, Chinese & Indians respectively (Table 1). The PRs were those of 130 Malays, 93 Chinese, 112 Indians and 23 were other nationals. The risk factors as mentioned previously were categorized and analyzed. In the other group of 329 cases where CACs were not detected, 261 people (48.9 %) had the identifiable risk factors, which includes 37.9% Malays, 26.1% Chinese, 31.7% Indians and 4.3% other nationals.

In the group of 29 cases (17 males & 12 females), where CACs were detected, the mean age was 55.62. CAC s was unilateral in 16 cases and bilateral in 13 cases. It was noted that all Malays, Chinese and Indian Males and Chinese females were smokers. All Chinese and Indian males consumed alcohol also. It should be noted that in this study, there was no significance to the observation of Carotid Artery Calcifications on Panoramic Radiographs with respect to race or sex. Among the 29 cases there were no patients with less than 2 risk factors. It was clearly appreciated that there was a strong correlation between the variables and the presence of CACs (Table 2 and Graph 1).

Discussion
Stoke or cerebrovascular damage can be attributed to modifiable and non-modifiable risk factors. An atherosclerotic change of the carotid vessels is one of the non-modifiable risk factor. The other non-modifiable risk factors include hypertension, diabetes mellitus, obesity and hyperlipidemia. In 1981, Friedlander demonstrated that standard PR can detect the presence of CACs at the level of C3-C4 intervertebral junction region and can thus be used to identify patients who are at risk for stroke. Dentists should be able to identify CACs and should be able to distinguish it from other lesions, artifacts or anatomical landmarks peculiar to these sites. Furthermore additional investigatory modalities like cervical spine radiographs, Doppler ultrasound, angiography and 3D CT has to be done to confirm the presence of CACs. The calcifications can present as linear or punctate, grouped together or separated and can be of varying sizes. There are some limitations in the use of PRs in detecting CACs. The extent of calcium debris attributable to cerebrovascular accidents cannot be assessed. Also correct identification of CACs cannot be done by all dental professionals. It should be observed that when CACs are detected it need not imply that there will be significant stenosis. Also not all plaques are calcified to be seen on plain radiographs. Cerebrovascular symptoms that occur in the process of stroke are more complex in nature. The plaque can disassociate from the vessel wall too to cause serious complications. The collateral blood supply through the circle of Willis has lots of significance in reducing the incidence of stroke.

Of the 29 cases with CACs, 23 had periodontitis, the diagnosis of which was made correlating the clinical and radiographic findings. The mean age of the periodontitis group (58.56) was greater than the case group of 29 subjects. Periodontitis was

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>CACs- P</th>
<th>CACs- A</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>N= 29</td>
<td>N= 329</td>
</tr>
<tr>
<td>Smoking</td>
<td>22</td>
<td>76</td>
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<tr>
<td>Alcohol</td>
<td>15</td>
<td>52</td>
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<tr>
<td>Obesity</td>
<td>18</td>
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<td>Diabetes</td>
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<td>Hypertension</td>
<td>8</td>
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</tr>
<tr>
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<td>10</td>
</tr>
<tr>
<td>Menopause</td>
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<td>38</td>
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<tr>
<td>Hyperlipidemia</td>
<td>19</td>
<td>66</td>
</tr>
<tr>
<td>Periodontitis</td>
<td>23</td>
<td>79</td>
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</tbody>
</table>

Table 2: Correlation between the risk factors for atherosclerosis and the presence of Carotid Artery Calcifications (CACs): P- Presence: A- Absence.
Endothelial vascular inflammation can provoke arterial hypertension and arteriosclerosis.\textsuperscript{16}

The biochemical pathogenesis of increased risk of atherosclerosis in diabetic patients has been proven in this study as 48.3\% of the case group has type 2 diabetes mellitus, compared with only 11.6 \% of the control group. Tauqir et al,\textsuperscript{17} in their study, stressed the need for aggressive prevention of atherosclerosis in all diabetic individuals. Prolactin plays a role in accelerated atherosclerosis in menopausal women by affecting central or peripheral blood pressure.\textsuperscript{18} In this study, there is only a slight increase in the prevalence of the presence of CACs in women who has attained menopause. This can be attributed to the selected age group of the patients. Among the 29 cases with CACs only (3 (10.3\%)) had renal problems, whereas among the 358 cases without CACs (excluding cases from other nationalities only 7 (2.0\%)) had renal disorders. This data is highly significant and is in conjunction with the study conducted by V.Campean et al,\textsuperscript{19} who stated that the extent of atherosclerosis is high in patients with Chronic Renal Failure as a result of early up regulation of markers of inflammation and increased oxidative stress.

Hyperlipidemia is a proven obvious cause for stenosis and atherosclerotic changes in the arterial vessel wall. In the present study, about 65.5\% of the case group revealed that they were under medication for hyperlipidemia, whereas only 11.6 \% of the control group had hyperlipidemia. This proves that there is a strong correlation between the hyperlipidemia and carotid artery calcifications. Peter W.F. Wilson\textsuperscript{20} suggested that smoking, hyperlipidemia and high blood pressure are associated with increased carotid artery calcifications in elderly people.

**Conclusion**

Good observation of PR should be stressed upon by general dental practitioners. Incidental detection of CACs on PRs can prevent the occurrence of stroke, cerebrovascular disease, peripheral arterial disease and also cardiovascular disease as the atherosclerotic plaques can also be present on the other blood vessels too. So, early detection of CACs can prevent life threatening disorders. The dentists also should possess sound knowledge about the other anatomic landmarks peculiar to this site. Appropriate evaluation of medical, social and personal history is necessary in perfect rendering of dental care. Proper elicitation of the risk factors is crucial for diagnosing any disorder. The important finding observed is that persons with CACs had multiple risk factors, whereas in cases with no detectable CACs only one or few risk factors were identified. It was observed that the probability of occurrence of CACs were different for different subjects. Also, all CACs cannot be detected on normal PRs. So, in this study, the needs for subsequent investigations are stressed for high risk patients. The role of dental health care providers in educating the patients about these risk factors is also emphasized.

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Correlation between the detection of carotid artery calcifications

References


How to cite this article

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Source of Support: Nil
Conflict of Interest: None Declared