Prevalence of Carotid Artery Atheromas in Postmenopausal Women: A Digital Panoramic Radiographic Study

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ABSTRACT

Objective: The aim of this study was to determine the prevalence of calcified atherosclerotic lesions in the region of carotid bifurcation in a group of postmenopausal women using panoramic radiographs and to assess other atherogenic risk factors such as hypertension, obesity, diabetes mellitus and hyperlipidemia associated with carotid atheroma.

Materials and methods: Digital panoramic radiographs of 44 postmenopausal women (age range: 48-76 years) with a history of amenorrhea of at least 12 months duration were examined on panoramic radiographs for any unusual radiopacities adjacent to or just below the intervertebral space between C3 and C4 and also assessed for risk factors associated with atherosclerosis.

Results: Panoramic radiographs of 19 (43.2%) subjects revealed CCAA (calcified carotid artery atheroma), 10 subjects (22.7%), revealed calcification on the left side. The medical histories of these subjects were heavily laden with atherogenic risk factors. Mainly hypertension (84.2%), hyperlipidemia (81.8%) to be highly significant atherogenic risk factors and obesity (31.6%), diabetes mellitus (36.8%) were not very significant atherogenic risk factors in postmenopausal women.

Conclusion: Panoramic radiography is a simple, noninvasive tool in detecting calcified carotid artery calcification in the cervical portion of the common carotid artery and for identifying stroke-prone postmenopausal women during the course of routine dental examination. Patients with such calcifications may be at risk of experiencing stroke and should be referred to a physician for confirmation of the disease.

Keywords: Atheroma, Digital, Postmenopausal women, Panoramic radiography, Stroke.


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INTRODUCTION

Stroke, or cerebrovascular accident (CVA), is the third leading cause of death. It remains the third largest killer after heart disease and cancer in the developed world and the commonest cause of adult disability. Atherosclerotic disease is the most common cause of cerebrovascular accident accounting for 85%. Factors predisposing to carotid atherosclerosis include advancing age, male sex, systolic hypertension, hypercholesterolemia, cigarette smoking, diabetes mellitus, obesity, hemostatic factors, sleep apnea, head and neck radiation therapy, and coronary artery disease. The prevalence of atherosclerosis associated with mortality is very high. Arterial calcification has long been recognized as a highly specific indicator of atherosclerosis. In 1961, Blankenhorn summarized the evidence that coronary calcification occurred only at sites affected by atherosclerosis. Postmenopausal women are at high risk of developing carotid artery atherosclerosis because they frequently develop an atherogenic blood lipid profile at the time menses cease. Reduced levels of circulating estrogen are associated with an increase in hepatic lipase activity and a decrease in LDL (low density lipoprotein) catabolism, which result in increased levels of LDL cholesterol and reduced levels of HDL (high density lipoprotein) cholesterol. The vast majority of strokes in postmenopausal women, as in men, are the result of ischemic cerebral injury caused by atherosclerotic disease.

Hypertension, a disorder common in women at the age of menopause, was a significant risk factor for the development of atherosclerosis in the area of carotid bifurcation. HRT, hormone replacement therapy (that is estrogen alone or estrogen combined with progestin) did not appear to influence the development of these lesions.

Calcium salts taken up by the lesion during the maturation process correspond to radiopacities seen on radiographs. These calcified carotid atheroma, found as incidentally on panoramic radiographs are powerful markers for future cerebrovascular and cardiovascular events and death. Detecting patient at risk of experiencing cerebrovascular accident early is critical to both the success of preventive strategies and the design of long term patient management protocols.

Hence, dentist should scrupulously review the panoramic radiographs of all individuals with medical histories of hypertension, diabetes mellitus, hypercholesterolemia and coronary artery disease or whose behavior includes smoking, ethanol abuse or dietary indiscretion coupled with overweight, and sedentary life style. Hence the dentist must be able to recognize these lesions and refer patients to appropriate medical practitioners, as general health promotion becomes an increasingly important component of dental practice.
women using panoramic radiographs and to assess other atherogenic risk factors such as hypertension, obesity, diabetes mellitus, and hyperlipidemia associated with carotid atheroma.

MATERIALS AND METHODS

Forty four physiologically induced postmenopausal women, within the age range of 48 to 76 years and with a history of amenorrhea of at least 12 months duration, those referred to Department of Oral Medicine and Radiology are participated in this study. Subjects with a history of transient ischemic attack (TIA) and also cerebrovascular accident (CVA), surgically induced postmenopause, hormone replacement therapy, were excluded from the study and the study has been approved by the Ethical Committee of Ambedkar Dental College and Hospital, Bengaluru, Karnataka, India.

The OPG was taken using the KODAK-8000C Digital panoramic and cephalometric system after positioning the subject as per the guidelines provided by the manufacturer of the X-ray unit. The subjects were exposed for a period of 13.9 sec at 73 kV a and 12 mA, to get the panoramic image. The acquired image was captured by CCD+ optical fiber digital sensor and directly stored in a computer. The evaluation was done using specially designed Windows Trophy Dicom software.

The radiographs were examined in subdued ambient light through use of transmitted light from a standard viewing box for the presence of a calcified carotid artery atheroma. Calcifications consistent with the diagnosis appear as single or multiple discrete radiopaque nodular masses within the soft tissues of the neck, 1.5 cm inferior and 2.5 cm posterior to the cortical rim of the midpoint of the mandibular angle, i.e. in the region of C3-C4 vertebrae (at the level of carotid bifurcation). The lesions are separate and distinct from the hyoid bone and variably appear above or below this structure. Their location and appearance should be differentiated from other anatomical and pathological entities. Three dentists interpreted all radiographs and concurred on a diagnosis of carotid artery atheroma.

All subjects were assessed for age at naturally induced menopause, hypertension, excess weight/obesity, diabetes mellitus, and hyperlipidemia.

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in number (%). Significance is assessed at 5% level of significance. Student t-test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups. The statistical software namely SPSS 15.0, State 8.0, Medical 9.0.1 and System 11.0 were used for the analysis of the data and Microsoft Word and Excel have been used to generate graphs, tables, etc.

RESULTS

Age

Our study comprised of 44 known postmenopausal women within the age range of 47 to 76 years and a mean age of 60.6 years. The panoramic radiographs of 19 subjects (43.2%), within the age range of 50 to 70 years and a mean age of 62.31 years, exhibited calcified carotid artery disease (Table 1).

Years since Onset of Menopause

All subjects had been postmenopausal for mean of 8.50 years. At the time we detected the atheroma via panoramic radiography of the 19 subjects, they had been postmenopausal for a mean of 7.05 years, within the range of 1 to 17 years.

Imaging Findings

panoramic radiographs of 19 (43.2%) subjects revealed calcification in the carotid artery in which 10 (52.6%) subjects revealed calcifications on the left side (Figs 1A and B) and 3 (15.8%) subjects revealed on the right side. (Figs 2A to C) 6 subjects (31.6%) revealed bilateral calcification (Graphs 1A and B).

Hypertension

In this study out of 44 postmenopausal subjects, 30 subjects (68.2%) had hypertension. Hypertension was highly significant in postmenopausal subjects. Out of 19 subjects who had CCAA, 16 (84.2%) subjects had hypertension, which was significantly associated with CCAA. This finding was statistically significant (p = 0.047) (Table 2).

Body Mass Index

In the present study, out of 44 postmenopausal subjects 26 (56.8%) were normal, 11 (25.0%) were overweight

| Table 1: Age distribution of calcified carotid artery atheroma’s (CCAA) subjects |
|-----------------|------------------|------------------|
| **Age in years** | **Atheroma’s** | **Absent (%)** |
|                  | **Present (%)**  |                  |
| ≤50              | 1 (5.3)          | 4 (16.0)         |
| 51-60            | 7 (36.8)         | 10 (40.0)        |
| 61-70            | 11 (57.9)        | 9 (36.0)         |
| >70              | 0                | 2 (8.0)          |
| **Total**        | 19 (100.0)       | 25 (100.0)       |
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8 (18.2%) were obese. Out of 19 subjects who had CCAA, 3 subjects (15.8%) were obese and 3 subjects (15.8%) were overweight. Association of obesity with calcified carotid artery atheroma was not statistically significant with a p-value = 0.383 (Table 3).

**Diabetes Mellitus**

Our study showed that out of 44 postmenopausal subjects, 13 (29.5%) subjects had diabetes and out of 19 subjects who had CCAA, 7 (36.8%) had diabetes. Association of diabetes mellitus with calcified carotid artery atheroma was not statistically significant (p = 0.355) (Table 4).

**Lipid Parameters**

In our study we found that out of 44 postmenopausal women, 36 (81.8%) had hyperlipidemia. Hyperlipidemia was highly significant in postmenopausal subjects. Out of 19 calcified carotid artery atheroma subjects, 17 (89.47%) had hyperlipidemia. Hyperlipidemia was significantly associated with CCAA in postmenopausal subjects (Table 5).

Postmenopausal subjects had increased mean cholesterol, LDL, VLDL, triglycerides and decreased mean HDL values than normal values.

Out of 19 CCAA subjects, 12 (63.2%) had increased total cholesterol levels, 11 (57.9%) had increased LDL levels, 9 (47.4%) had increased VLDL levels, 16 (84.2%) had increased triglyceride levels and 19 (76%) had decreased HDL levels.

Out of 25 nonatheroma subjects, 12 (48%) had increased total cholesterol levels, 10 (40%) had increased LDL levels, 15 (60%) had increased VLDL levels, 19 (76%) had increased triglyceride levels and 19 (76%) had decreased HDL levels (Table 6).

**DISCUSSION**

Stroke, or cerebrovascular accident (CVA), is the third leading cause of death in most countries in the world,
following cardiovascular diseases and cancer. Calcification is a morphologic complication in the evolution of athermanous plaque. Generally, CCAAs are found at the branch point of artery vessels where turbulent flow is increased.

The physiological changes associated with menopause (for example, reduced levels of estrogen) and other processes associated with ageing result in women being at a disproportionately high risk of developing stroke. The vast majority of strokes in postmenopausal women, as in men, are the result of ischemic cerebral injury caused by atherosclerotic disease (thrombus and embolus formation).

The risk of stroke resulting from atherosclerosis of the carotid artery triples in postmenopausal women. Epidemiologic studies have noted that 16% of women die of a stroke, whereas only 8% of men die of a stroke.

In postmenopausal women, circulating estrogens are derived largely from extraglandular aromatization of plasma androstenedione to estrone in the adipose tissue. Thus, estrogen production in postmenopausal women is directly correlated with body weight. Obesity also is associated with decreased sex hormone binding globulin production and increased proportions of free and albumin-bound estrogens, resulting in more biologically active estrogen in circulation.

Calcified carotid artery atheromas appeared as radiopacities and were located within the soft tissues of the neck in the region of the C3-C4 vertebrae (in the area of carotid bifurcation) by their location and appearance. Care was taken to differentiate them from other anatomical and

| Table 5: Correlation of hiperlipidemia and prevalence of calcified carotid artery atheroma’s |
|---------------------------------|-----------------|-----------------|-----------------|
| Hiperlipidemia                  | Present (%)     | Absent (%)      |
| Yes                             | 17 (89.47)      | 19 (76)         |
| No                              | 2 (10.53)       | 6 (24)          |
| Total                           | 19 (100)        | 25 (100)        |

Fig. 2B: Portion of panoramic radiograph reveals calcified carotid artery atheroma at C3-C4 level on the right side

Fig. 2C: Ultrasonograph reveals calcified carotid artery atheroma in right common carotid artery

Graph 1A: Panoramic radiographic findings: prevalence of calcified carotid artery atheroma’s

Graph 1B: Panoramic radiographic findings: side distribution of calcified carotid artery atheromas
pathological entities, such as, Hyoid bone, stylohyoid ligament, stylomandibular ligament, thyroid cartilage, triticeous cartilage, epiglottis, calcified lymph nodes, phleboliths, submandibular salivary gland sialoliths, and tonsilloliths.3,12,14

Arthur H Friedlander was the first to use panoramic radiographs to identify calcified carotid atheroma and has subsequently conducted studies on various high risk groups. Similarly, we also sought to ascertain if calcified carotid atheroma could be detected on panoramic radiograph of high risk group of postmenopausal women, thereby leading to an early diagnosis and possible prevention of future development of fatal or disabling stroke.

Suspected subjects were referred for confirmation by ultrasonography and all were positive for carotid artery calcification. Ultrasound has the advantage of being able to detect early lesions that are devoid of calcium or that have minimal amounts of calcium.

We found that calcified carotid atheroma were very easy to identify on panoramic radiographs and did not require any special training. Hence all dental specialists and even general dentists could look for the same while viewing routine panoramic radiographs especially in high risk groups.

In our study, standard panoramic dental radiographs detected the presence of calcified cervical carotid artery disease in approximately 43.2% of postmenopausal women with no history of transient ischemic attack or stroke. Our analysis of women with and without atheroma formation demonstrated that hypertension and hyperlipidemia were highly significant risk factors for the development of atheroma.

Our studies have noted that the age range of 61 to 70 years seemed to be the crucial period for women who develop significant atherosclerotic lesions (that is, stenosis of 40% or greater) at the carotid bifurcation. Stenotic lesions of this magnitude are capable of reducing cerebral blood flow and are associated with a yearly risk of cerebral infarction of approximately 5%.7,12,15,16 All subjects had been postmenopausal for mean of 8.50 years. At the time we detected the atheroma via panoramic radiography of the 19 subjects, they had been postmenopausal for a mean of 7.05 years, within the range of 1 to 17 years.

We noted that CCAAs were more commonly located on the left side rather than the right side. This finding is in concurrence with the AT Uthman et al.9 TAMURO17 Bayram B et al18 but this finding is not in agreement with the Arthur H Friedlander7,9,12,20 This may be explained by the fact that carotid bifurcation level varies in relation to the cervical vertebrae (C3, C4, C5) and differs with right and left sides. Besides bifurcation levels at C5 levels may not be visible on the panoramic view.

As noted by other studies7 we also found that hypertension was a common disorder in postmenopausal women. Out of 19 subjects who had CCAA, 16 (84.2%) subjects had hypertension which was statistically significant (p = 0.047). This shows that hypertension was a highly significant risk factor in postmenopausal women which can lead to CCAA formation. These findings are in concurrence with previous study conducted by Arthur H Friedlander7,9.

Association of obesity with calcified carotid artery atheroma was not statistically significant with a p-value = 0.383. This finding was in concurrence with Arthur H Friedlander.7 Since, we found increased BMI in 43.2% of postmenopausal subjects in general and in 31.6% of calcified carotid artery atheroma subjects, Obesity may be considered as a potential atherogenic risk factor in postmenopausal women.

Association of diabetes mellitus with calcified carotid artery atheroma was not statistically significant (p = 0.355). Since we found 29.5% of the postmenopausal women in general and 36.8% of those who had calcified carotid artery atheroma also associated with diabetes mellitus, it may be considered as a potential atherogenic risk factor in postmenopausal women.

In our study we found that out of 44 postmenopausal women, 36 (81.8%) had hyperlipidemia. Out of 19 calcified carotid artery atheroma subjects, 17 (89.47%) had hyperlipidemia. Thus, hyperlipidemia was significantly associated with postmenopausal women in general and also very significant in the development of CCAA. From our findings we can definitely consider hyperlipidemia as a highly significant atherogenic risk factor in postmenopausal women.

Since, the nonatheroma subjects also had atherogenic risk factors there could be a possibility that these
postmenopausal women might develop calcified carotid artery atheroma in the future. Or they might have had early atherosclerotic lesions which may not have been sufficiently calcified to be visualized on the panoramic radiographs.

We also noted in our study, that among the 44 postmenopausal women, there were 30 hypertensive subjects. Five were diagnosed by us and the known 25 hypertensive subjects were on medication. Out of the 13 diabetics, 3 were diagnosed by us and the 10 known diabetics were under medication. Out of the 36 hyperlipidemia subjects, 35 were diagnosed by us and the only known case was under treatment. This emphasizes the fact that as oral physicians, we have the opportunity as well as a responsibility to diagnose systemic diseases.

The results of this study leads to the conclusion that panoramic radiography is very useful in detecting calcified carotid artery atheroma in the cervical portion of the common carotid artery and identifying stroke-prone postmenopausal women during the course of a routine dental examination. We found mainly hypertension and hyperlipidemia to be highly significant atherogenic risk factors in postmenopausal women. Obesity and Diabetes Mellitus were not very significant atherogenic risk factors in postmenopausal women.

Incidental findings, such as these CCAA should be considered seriously and referred to appropriate specialists for confirmation of the disease, control of atherogenic risk factors, medical and surgical management. Early diagnosis and timely treatment can preclude strokes and this would be of great service to mankind. We suggest that further studies be carried out with larger sample size among various other high risk groups, which could help in lowering the incidence of strokes.

REFERENCES


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