Archives of Radiology

ISSN: 2638-521X

Volume 3, Issue 1, 2020, PP: 1-6

Analysis of Risk Factors for the Development of Carotid Artery Atheroma and the Role of Panoramic Radiography for Diagnosis: A Literature Review

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Abstract

This literature review aims to address numerous researches that have associated the prevalence of carotid artery atheromas detected in panoramic radiographs in relation to the patients presenting the risk factors for its development.

The articles were searched in the PubMed and SciELO databases, using the following descriptors: atherosclerosis, carotid, infarction, panoramic, radiography. Articles cover the period between 2012 and 2018. Of the 25 articles found, 10 were discarded because they were not compatible with the proposed research.

Considered the main result of atherosclerosis, the atheromas are plaques accumulated in the internal wall of the carotid artery; being a cardiovascular pathology, whose process consists of the thickening of the arterial walls, linked to the narrowing and stiffening of the vessels.

The existence of atheromas in the carotid artery in asymptomatic individuals is constantly associated with the future development of stroke, angina, myocardial infarction and death.[2]

In conclusion, new findings provide compelling evidence that atherosclerotic plaques of the carotid artery are a common finding in panoramic images of patients with the systemic diseases addressed in this article.

Keywords: *atherosclerosis, carotid, infarct, panoramic, radiography.*

Introduction

According to Gonçalves et al.[1], "Atherosclerosis is a chronic inflammatory disease characterized by thickening, narrowing or loss of elasticity of artery walls". The multifactorial origin of atherosclerosis involves a biochemical phenomenon that creates pathological arterial calcifications. These calcifications, now called atheromas, originate from local proliferation of fibroblasts and calcium deposition.

The existence of atheromas in the carotid artery in asymptomatic individuals is constantly associated with future development of stroke, angina, myocardial infarction and death.[2]

Calcium deposits were identified in the carotid arteries in a considerable number of patients with inflammatory and/or systemic diseases, such as rheumatoid arthritis, gout, hypertension and diabetes mellitus, by the use of panoramic radiographs.[3, 4]

Finally, dentists play an important role in the early diagnosis of atheromas of calcified carotid artery through the detection of images in panoramic x-rays.

This literature review has as its main objectives to address numerous researches that associate the prevalence of carotid atheromas detected in panoramic radiographs in relation to patients who presented the risk factors for its development; in addition to reviewing the accuracy and sensitivity of complementary imaging tests as an auxiliary

instrument for the dental surgeon when detecting this pathology.

Literature Review

Considered the main result of atherosclerosis, the atheromas are plaques accumulated in the internal wall of the carotid artery; being a cardiovascular pathology, whose process consists of the thickening of arterial walls, linked to the narrowing and stiffening of vessels.

Faced with this alteration, the atheromas bring with them a systemic impairment that must be diagnosed before performing any medical and/or dental procedures.

Through clinical examination, dentists play an important role in the prevention of vascular accidents by the early diagnosis of images suggestive of carotid artery atheromas (CAA), generally seen in panoramic radiographs (RP).

The study by Gustafsson et al.[5] was based on the prevalence of carotid atheromas visualized from panoramic radiographs in patients who suffered a first myocardial infarction (MI), compared to the control group. The prevalence of CAA detected by RP was 33.8% (235/696) in the cases and 27.6% (192/696) in the controls. Among males, 32.7% (184/562) of the cases and 26.5% (149/562) of the controls presented CAA.

Souza et al.[6] proposed to confirm the connection between the concomitance of individuals who presented the diagonal crease of the earlobe and had the CAA detected in RPs, both already described as indicators of validated risk of future MI. Among the study group, of the 41 individuals, composed of 28 men and 13 women, approximately 88% (N = 36) had the diagonal crease of the ear lobe concomitant to the CAA. Among the members of the control group (N = 41), composed of 25 men and 16 women, 17 patients presented the two indicators concomitantly. The results showed that between the full cohort of mixed genders (N = 82), the association between CAA and the diagonal crease of the earlobe were statistically significant (P = 0.0001).

Lee et al.[7] studied the predominance of men with chronic pancreatitis and alcohol-related comorbid diabetes, who presented CAA in RPs. Of the 32 men who participated in the research, 25% demonstrated an atheroma in their panoramic radiographic image; proving that the dental surgeon (DS) should become familiar with clinical correlates associated with the complexity of the disease and its risk factors.

Lee et al.[3], in another of his published works, sought to establish a cause and effect relationship between male patients diagnosed with rheumatoid arthritis (RA) and the prevalence of CAA obtained from the analysis of PRs, since men with AR present an extremely high risk of presenting eventual emergencies due to myocardial ischemia, given the role of systemic inflammation in the atherogenic process. A total of 100 male patients (69.89 ± 8.92 years) were enrolled in the study. Of these, 29 (average age 72.10 ± 7.68 years) evidenced atheroma in their panoramic radiographic images.

Friedlander et al.[4] demonstrated from a retrospective descriptive study the degree of correlation in individuals with Gout whose RPs manifest the presence of CAA. Of the 531 men evaluated, 31% were diagnosed with CAA. The average age was 72.7 ± 9.3 years. All showed hypertension (100.0%), most of them also presented dyslipidemia (91.7%) and 37.5%, diabetes mellitus. Body mass index (BMI) ranged from 15.9 to 53.2.

Markman et al.[8] sought to verify whether head and neck radiotherapy (RT) would be capable of inducing calcification of the carotid artery. The study population consisted of 180 patients, most of them males (83.89%), with an average age of 59.4 years (ranging from 20 to 85 years). Regarding habits, most of the patients were smokers and/or alcoholics. Oropharynx (33.89%), oral cavity (26.67%) and larynx (25%) were the most frequent tumor sites and 162 patients (90%) were clinically diagnosed in stages III and IV. A review of their medical histories showed that 63 patients (35%) had arterial hypertension, 22 (12.22%) were diabetic, 11 (6.11%) were on lipid-lowering medication, 5 (2.78%) suffered an stroke and 5 (2.78%) had a history of acute myocardial infarction. Of the 180 patients enrolled, 57 (31.67%) were identified with CAA on both radiographs (before and after TR), 4 (2.22%) presented only on radiographs after RT and 2 (1.11%) only on radiographs before RT. None of the patients with CAA on both radiographs showed an increase in size or morphology after RT.

In the study by Ngamson et al.[9], 265 patients (56 men,

209 women) with dental implants were evaluated at the Dental Unit of Neurology of Prasat. Cal Institute, Bangkok, Thailand. The evaluation consisted of establishing a correlation between CAA identified and detected in digital panoramic radiographs and underlying systemic diseases. The average age of the patients was 71 ± 7.1 years. The prevalence of CAA was 38.49%. The main underlying systemic diseases were hypertension, hyperlipidemia, diabetes mellitus and cardiovascular diseases (CVD), respectively. No relationship was found between these four systemic diseases in CAA detection on panoramic radiographs.

Discussion

It is evident, therefore, that the risk factors for the development of carotid artery atheroma are constantly associated with age, arterial hypertension, hyperlipidemia, diabetes mellitus, alcoholism and smoking.[8,9]

In addition, other systemic alterations such as rheumatoid arthritis, gout and chronic pancreatitis promote the occurrence of CAA and are frequently correlated in new studies.[3,4,7]

It is clear that there is a need for a greater knowledge of this issue by the DS, identifying the risk factors and performing the complementary tests for the differential diagnosis of this pathology, which is validated as a future MI indicator.[5]

In the mentioned studies, the authors detected the atheromas by means of panoramic radiographs, as shown in figures 1 and 2.

Although the use of ultrasonography shows high sensitivity in detecting carotid artery calcification and stenoses, as proposed by Jashari et al. [10], whose carotid ultrasound was highly accurate in detecting the presence of calcification; with a sensitivity of 88.2%.

Figure 1. *Panoramic radiograph with atheroma (arrows)*

Source: Tuñas et al.[2]

Figure 2. *Panoramic radiograph with atheroma (arrows)*

Source: Tuñas et al.[2]

Garoff et al. [11] also suggested that the amount of calcification was not associated with the degree of stenosis when analyzing plaques of excised carotid arteries (N = 103) on the volume of calcium through concomitant computed tomography (CBCT) of carotid artery. However, the amount of calcification does not influence the possibility of detecting carotid calcifications in panoramic radiographs, which, therefore, motivates referral for ultrasonographic examination.

Zeb et al.[12] described several algorithms that have been used to delineate the risk factors of these diseases. Among the best known ones are the levels of ultra-sensitive C-reactive protein (hs-CRP), also called high-sensitivity (hs-CRP).

The inflammatory process, in addition to promoting the risk of hypertension and type 2 diabetes, also promotes elevated levels of cytokines, which is directly related to the recruitment and infiltration of defense cells due to inflammation in the arterial wall, thus forming the plate, according to Alie et al.[13]

Hyperglycemia and the development of Diabetes are closely linked with the development of atherosclerosis and the formation of atheroma by different mechanisms. Perhaps the most well-studied mechanism is related to AGEs (advanced glycation products), which may lead to the synthesis of Interleukin-6, macrophage activation and oxidative stress, culminating to the production of CRP, contributing to the inflammation.[14]

These products act as mediators of endothelial injury, inflammation and lipid alterations, such as, for example, the oxidation of LDL-c, which in this situation are highly atherogenic, since the macrophages involved in plate formation have scavenger receptors for LDL uptake-c oxidized.

For Barbalho et al.[15], it is imperative that the DS controls risk factors and stratifies them in relation to the association between the prevalence of concomitant occurrence of numerous systemic diseases. It is important to delineate prognostic factors, adopting them as a tool of daily use in the prevention of CVD.

Final Considerations

In conclusion, new findings provide compelling evidence that atherosclerotic plaques of the carotid artery are a common finding in panoramic images of patients with the systemic diseases addressed in this article.

Considering that the causes of carotid artery atheromas are of multifactorial nature, it is of vital importance to carry out more research that evidences the cause-effect relation of the risk factors and formation of the CAA, exposing the main cellular mechanisms.

Regarding the professional performance of DSs and physicians, new means are needed to detect carotid calcification – in addition to RPs, CBCT and ultrasonography; aiming at a better prognosis for the patient, when designing the treatment plan and thus doing so, bypassing a future myocardial infarction and / or stroke.

Oral and maxillofacial surgeons who identify such patients should refer them to their physicians for further evaluation because the symptoms of ischemic vascular disease are often silent or atypical, further increasing their cardiovascular morbidity, mortality, and morbidity.

References

[1] Gonçalves JRSN, Yamada JLY, Berrocal C, Westphalen FH, Franco A, Fernandes A. Prevalence of Pathologic Findings in Panoramic Radiographs: Calcified Carotid Artery Atheroma. [publicação online]. Acta Stomatol Croat. 2016;50(3):230-234. [acesso em 1 nov, 2018]. Disponível em: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5108282>

[2] Tunas ITC, Santos EJC, de Veiga LM, Deluiz LF, Weyne SC. Ateromas de carótida nas panorâmicas: como o clínico pode identificar?. [publicação online]. Rev. Bras. Odontol. 2012;69(2):203-206. [acesso em 1 nov, 2018]. Disponível em: <http://revodonto.bvsalud.org/scielo.php?script=sci_arttext&pid=S003472722012000200013&lng=es>

[3] Lee UK, Chang TI, Garrett N, Friedlander AH. Males With Rheumatoid Arthritis Often Evidence Carotid Atheromas on Panoramic Imaging: A Risk Indicator of Future Cardiovascular Events. [publicação online]. J Oral Maxillofac Surg. 2018;76(7):1447-1453. [acesso em 1 nov, 2018].

Disponível em: <https://www.ncbi.nlm.nih.gov/pubmed/29406256 >

[4] Friedlander AH, Graves LL, Grabich SG, Aghazadehsanai N, Chang TI. Prevalence of calcified carotid artery atheromas on panoramic images of older men with gout: a descriptive retrospective study. [publicação online]. Dentomaxillofacial Radiology, 2017;46(5):20160406. [acesso em 1 nov, 2018]. Disponível em: <https://www.ncbi.nlm.nih.gov/pubmed/28186844>

[5] Gustafsson N, Ahlqvist JB, Näslund U, Wester P, Buhlin K, Gustafsson A, Levring Jäghagen E. Calcified carotid artery atheromas in panoramic radiographs are associated with a first myocardial infarction: a case-control study. [publicação online]. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology, 2018;125(2):199-204.e1. [acesso em 31 out, 2018]. Disponível em: <https://www.ncbi.nlm.nih.gov/pubmed/29242130>

[6] Couto Souza PH, Berti-Couto SA, Majewski CNM, da Silva IC, Donaduzzi LC, Silva IMV et al. Association of calcified carotid artery plaque in panoramic images and diagonal earlobe crease. [publicação online]. Dentomaxillofacial Radiology, 2018;30:20170256. [acesso em 1 nov, 2018]. Disponível em: <https://www.ncbi.nlm.nih.gov/pubmed/30059235>

[7] Lee UK, Chang TI, Polanco JC, Pisegna JR, Friedlander AH. Prevalence of Panoramically Imaged Carotid Atheromas in Alcoholic Patients With Chronic Pancreatitis and Comorbid Diabetes. [publicação online]. Journal of Oral and Maxillofacial Surgery, 2018 Sep;76(9):1929.e1-1929.e7. [acesso em 1 nov, 2018]. Disponível em:<https://www.ncbi.nlm.nih.gov/pubmed/29859950>

[8] Markman RL, Moutinho KG, Vasconcelos C, Brandão TB, Ribeiro ACP, Silva ARS, Lopes MA. Calcified carotid artery atheromas on panoramic radiographs of head and neck cancer patients before and after radiotherapy. [publicação online]. Med Oral Patol Oral Cir Bucal, 2017; 22(2): e153–e158. [acesso em 31 out, 2018]. Disponível em: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5359713>

[9] Ngamsom S, Arayasantiparb R, Pornprasertsuk-Damrongsri S, Sureephong B. Relationship between calcified carotid atheromas in digital panoramic radiographs and underlying systemic diseases in implant patients. [publicação online]. Journal of Investigative and Clinical Dentistry, 2015;6(4):301-306. [acesso em 31 out, 2018]. Disponível em: <https://www.ncbi.nlm.nih.gov/pubmed/25047894>

[10] Jashari F, Ibrahimi P, Johansson E, Ahlqvist J, Arnerlöv C, Garoff M et al. Atherosclerotic Calcification Detection: A Comparative Study of Carotid Ultrasound and Cone Beam CT. [publicação online]. International Journal of Molecular Sciences, 2015;16(8):19978-88. [acesso em 1 nov, 2018]. Disponível em: <https://www.ncbi.nlm.nih.gov/pubmed/26307978>

[11] Garoff M, Johansson E, Ahlqvist J, Arnerlöv C, Levring Jäghagen E, Wester P. Calcium quantity in carotid plaques: detection in panoramic radiographs and association with degree of stenosis. [publicação online]. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology, 2015;120(2):269-274. [acesso em 31 out, 2018]. Disponível em: <https://www.ncbi.nlm.nih.gov/pubmed/26166031>

[12] Zeb I, Budoff M. Coronary Artery Calcium Screening: Does it Perform Better than Other Cardiovascular Risk Stratification Tools?. [publicação online]. International Journal of Molecular Sciences, 2015; 16(3): 6606–6620. [acesso em 3 nov, 2018]. Disponível em: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4394551/>

[13] Alie N, Eldib M, Fayad ZA, Mani V. Inflammation, Atherosclerosis, and Coronary Artery Disease: PET/CT for the Evaluation of Atherosclerosis and Inflammation. [publicação online]. Clinical Medicine Insights: Cardiology, 2015;8(3):13-21. [acesso em 3 nov, 2018].

Disponível em:<https://www.ncbi.nlm.nih.gov/pubmed/25674025>

[14] Nowotny K, Jung T, Höhn A, Weber D, Grune T. Advanced Glycation End Products and Oxidative Stress in Type 2 Diabetes Mellitus. [publicação online].Biomolecules,2015Mar16;5(1):194-222. [acesso em 3 nov, 2018]. Disponível em: <https://www.ncbi.nlm.nih.gov/pubmed/25786107>

[15] Barbalho SM, Bechara MD, Quesada K, Gabaldi MR, Goulart RA, Tofano RJ. Síndrome metabólica, aterosclerose e inflamação: tríade indissociável?. [publicação online]. J. vasc. bras. 2015;14(4):319-327. [acesso em 3 nov, 2018]. Disponível em: <http://www.scielo.br/scielo.php?pid=S167754492015000400319&script=sci_abstract&tlng=pt>

Citation: **Leonardo Alvarenga, Raquel Tolentino**. *Analysis of Risk Factors for the Development of Carotid Artery Atheroma and the Role of Panoramic Radiography for Diagnosis: A Literature Review. Archives of Radiology. 2020; 3(1): 1-6.*