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Virtue of Coenzyme Q10 as an Antioxidant Drug in Periodontal Disease : A Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Periodontal disease is a disease of inflammatory origin. In the oxidative phosphorylation process for ATP generation, coenzyme Q10 (CoQ10) plays a vital role. Coenzyme Q10 is a vital antioxidant. In cellular bioenergetics, the coenzyme Q10 plays a major role. Because of its large molecular weight and its medicinal properties, the absorption of dietary coenzyme Q10 has numerous therapeutic application in human diseases. Evidence of beneficial effect in cardiovascular and neuro degenerative disease were noted and it was found that Q10 has superior safety record. This article gives the relation of CoQ10 to the periodontal disease.

Keywords: Coenzyme Q10; antioxidant and periodontitis.

1. INTRODUCTION

Periodontal disease is an inflammatory origin arising from the presence of dental plaque and thereby leading to the loss of tooth supporting structures [1]. Periodontal pathogens play a very important role in the etiology of periodontal disease. The destruction of the periodontal tissues is especially mediated by the host derived inflammatory mediators [2]. Arrays of molecules are considered to mediate the inflammatory response at one time or another,

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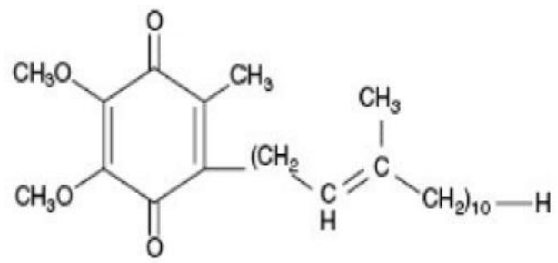
among which the free radicals and reactive oxygen species (ROS) plays a prominent role [3]. Periodontal pathogens can induce ROS overproduction, thereby causing collagen and periodontal cell breakdown. When antioxidants scavenges ROS, there is a decreased collagen degradation. Periodontal therapy aims at not only to limit the destruction of periodontal tissues, but also to rebuild the lost periodontal tissues [4]. The limitation of mechanical debridement introduced the administration of systemic and local administration of drugs to treat periodontal disease [5]. Currently interest has been shifted towards treating the host components that leads to the periodontal disease [6]. Ubiquinol which is a reduced form of coenzyme Q 10 acts as an endogenous antioxidant by increasing the concentration of CoQ10 in the diseased gingiva thereby playing a role in effectively suppressing the advanced form of periodontal diseases [7].

2. STRUCTURE OF COENZYME Q10

Two groups were isolated and characterised in coenzyme Q10, of which one group uses the term “COENZYME Q10” and the other group uses the term “UBIQUINONE” also known as “ubiquitous quinone” [8]. Coenzyme Q10 has a “head and tail” structure and the long isoprenoid side chain keeps it in the mitochondrial or cytoplasmic membrane.

Chemical synthesis, semi-chemical synthesis, and microbial conversion are the methods for producing coenzyme Q10 [9]. Coenzyme Q is found in all cell membrane. The enzymes involved in coenzyme Q oxidation reduction have well-defined protein binding sites in mitochondria. A decrease in coenzyme Q in serum or tissue can be caused by genetic mutation, ageing, cancer, or statin type drugs [10]. Coenzyme Q is synthesised in all cells and under normal conditions; local tissue production is adequate to meet cellular demands. A decrease in the amount of coQ impairs respiratory function and the functioning of antioxidants [11].



3. DEFICIENCY OF COENZYMEQ10

Because coQ10 is synthesised from scratch in all tissues, it is assumed that they are not dependent on an exogenous supply of coQ10. Despite the fact coQ10 can be synthesised “in vivo” there may be time when the bodies synthetic capacity becomes insufficient to meet the requirements coQ10. In metabolically active cells (such as those in the heart, immune system, gingiva and gastric mucosa) there is a greater susceptibility to coQ10 deficiency and this becomes greater as the cells require increased amount of coQ10 [12]. Deficiency may result from inadequate synthesis as a result of nutritional deficiency, synthesis flaw, either genetic or acquired, increased tissue requirement as a result of illness, COQ10 level decrease due to age increases.

4. PHARMACOKINETICS

CoQ10 is now recommended as a supplement to traditional cardiovascular disease treatment [13]. Despite being a lipophilic compound, coQ10 solubility is extremely limited, and preparation exhibits a low bioavailability [14]. Physiochemical properties has influenced its absorption, so preparation of coenzymeQ10 has varying bioavailability in powder form, in suspension, oil form, or solubilized from.

Solubilized coenzyme Q10 is clearly preferred due to its better absorption, higher plasma concentration being 2-2.5 times higher during long- term oral therapy with solubilized forms [15] and bioavailability being 3-6 times higher in comparison to powder [16]. The pharmacokinetic advantages of the solubilized form account for its high efficiency as a cardio-protector. Long term management increased (2.5 times) the levels of coenzymeQ10 in plasma and increased concentration in rat myocardium, due to which the survival of cardiomyocyte under ischemia increased and there is a gradual decrease in the size of the necrotic zone of postinfarction [17].

5. ROLE OF COENZYME Q10 IN PERIODONTAL HEALTH

Chronic periodontics is caused by subgingival plaque accumulation. The microflora of this plaque is extremely complex, making it difficult to determine which organisms are responsible for the disease tissue destruction. Despite these issues, researchers agree on one point that is

the subgingival flora [18]. Inflammation is the reaction of organisms to a noxious stimulus, whether mechanical, chemical or infectious. It is a localised protective response elicited by tissue injury or destruction that serves to destroy, dilute or wall off the injurious agent as well as the injured tissue.

Inflammation whether acute or chronic, is dependent on regulated humoral and cellular responses. Coenzyme Q10 deficiency at its enzyme sites in gingival tissue may exist independently of and as a result of periodontal disease. Nutritional deficiencies and not periodontal disease, could exacerbate the deficiency of gingival coenzyme Q10.

Oral dental treatment and oral hygiene could correct the plaque and calculus, but not the part of the coQ10 deficiency caused by a systemic cause. CoQ10 therapy can be combined with oral hygiene for an improved treatment of this type of periodontal disease. The specific activity of succinic dehydrogenase-coenzyme Q10 reductase in gingival tissues from patient with periodontal disease was compared to normal periodontal tissues using biopsies which revealed that in patients with periodontal disease there is a decreased level CoQ10.

In a deficient patient, exogenous coQ10 administration increased the specific activity of this mitochondrial enzyme [19]. The periodontal score was also reduced implying that coQ10 should be considered as an adjunct for periodontal treatment for current dental practice [20]. The coenzymeQ10 may reduce gingival inflammation without affecting Gingival Crevicular Fluid) GCF antioxidant levels [21]. Another study found a significant reduction in Thio Barbituric Acid Reactive Substance (TBRAS) in GCF of patients who received scaling and root planning with CoQ10 [22]. The effect of coQ10 application to the periodontal pocket with or without subgingival mechanical debridement have been studied and it was found that, during the first three weeks at the experimental sites there was a reduction in gingival crevicular fluid flow, probing depth, and attachment loss significantly, with a significant improvement in modified gingival index, bleeding on probing, and peptidase activity derived from periodontopathic bacteria were observed [23]. It suggested that the research literature on coenzymeQ10 periodontal effect does not extend to international English language dental literature.

Coenzyme Q10 deficiency has been discovered in the gingiva of the patient with periodontal disease [24]. In contrast to patient with normal periodontal tissues gingival biopsies from patient with inflamed periodontal tissues revealed a deficiency of coQ10. There have been numerous clinical trials involving the oral administration of coQ10 in patients with periodontal disease. Oral administration of coenzymes Q10 have been shown to increase its concentration in patients with diseased gingiva and suppresses advanced periodontal inflammation and the level of periodontal microorganisms [25] Studies have shown that administration of CoQ10 have reduced the inflammation persisiting within the gingival tissues even without affecting the level of antioxidants in GCF [26].

6. CONCLUSION

Various studies have reported the beneficial effects of Coenzyme Q10 in relation to periodontal disease. Although coenzyme Q10 was once thought to be an alternative medication, it is now used routinely by many dentists and periodontists, both topically and systemically. However there is a scarcity of new data on the use of coenzyme Q10 in the treatment of periodontal diseases. Therefore further studies are needed to evaluate the efficacy of the local administration of coenzymeQ10 in patients with periodontal disease.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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