

E-cigarettes and oral health



Introduction

E-cigarettes are battery-operated devices that heat up chemical solutions, which are referred to as liquids. Aerosols in different flavors are produced, many of which can contain nicotine [6]. A survey in Germany indicated a population of 1,4 % that use e-cigarettes regularly, which corresponds to approximately one million people in Germany. The main users of e-cigarettes are between the ages of 20 and 60 years [5]. The American PATH-study of 2018 indicated, that 1,7 % of participants solely smoked e-cigarettes and 1,4 % smoked cigarettes as well as e-cigarettes in their daily lives. [1]. E-cigarettes are a common and established phenomenon in the population [11]. Due to frequent use and recent development, the question is raised of what effect this has on oral health.

Statement

The process of „vaping“ produces aerosol, which contains fine particles, rather than tobacco smoke [1]. The basic ingredients include propylene glycol, glycol, nicotine and various flavors [3]. It is important to differentiate ingredients because liquids can differ greatly. Studies suggest that propylene glycol in general is harmless for children and adults, however, it can induce rhinitis, asthma, eczema and allergic reactions. Furthermore, nicotine extracts from tobacco contain impurities such as cotinine, anabasine, anatabine, myosmine and heavy metals [7].

Ganapathy et al. (2017) investigated the effect of e-cigarette extract in bronchial epithelial cells (NuLi-1) and in cells of the squamous cell carcinoma of the oral cavity (UM-

SCC-1). The extracts testes induced significant increases of dose-dependent DNA-damage in cells. It was determined that extracts from e-cigarettes caused less DNA damages than extracts from regular cigarettes. E-cigarette extracts cause a significant increase of reactive oxygen species (ROS) and lower the cellular antioxidative capacity. This resulted in a significant increase in 8-hydroxydesoxyguanosin level, which causes one of the most common mutagenic DNA lesion [6]. Munakata et al. (2018) measured a rise in concentration of IL-8 and makrophage colony-stimulating factor (GM-CSF) in bronchial epithelial cells (BEAS-2B) [9]. In healthy study participants a one-time e-cigarette use caused an increased number of endothelial progenitor cells in the blood, which is a sign for a potential vascular change, according to Antoniewicz et al. (2016). After 24 h the progenitor cell count returned to the level of the control group [4].

Furthermore, first conclusions on the impact of e-cigarettes on the oral cavity and enamel were drawn. The working group of Sancilio et al. (2016) investigated the effect of e-liquids on humane gingiva fibroblasts (HGF). A dose-dependent reduction of 20 % of the HGF activity was determined for liquids with and without nicotine. The apoptotic percentage of HGF-cells increased just like the prevalence of the pro-apoptotic Bax protein [10]. Kim et al. (2018) examined how the use of e-cigarettes impacts healthy enamel and the oral flora. Enamel samples of extracted, cavity-free wisdom teeth were exposed to the aerosol of e-cigarettes (10 drags and 150 drags) and

subsequently cultivated with *S. mutans* in corrugated sheets. The aerosols formed a viscous surface that significantly increased the adhesion of *S. mutans* on enamel surfaces. Besides facilitated bacteria adhesion, Kim et al. noted that the used flavors (such as sucralose, ethyl butyrate, triacetin, hexylacetate) and their metabolites have a significant impact on surface hardness of the enamel sample. It was found that the hardness decreased by up to 21,5 % [8]. The working group of Willershhausen et al. (2014) investigated the effect of menthol as an additive: The menthol additive in the liquid causes a significant reduction of the proliferation rate of periodontal ligament cells (PDL). Due to these results the working group recommends to not use menthol as an additive in the liquid of e-cigarettes [13].

Besides the effect on the enamel, Al Qahtani et al. (2018) also determined insights on the impact on the periodontium. The percentage of probing depths ≥ 4 mm was increased significantly in hookah smokers (7,0 % \pm 1,1 %) and cigarette smokers- (7,8 % \pm 1,2 %) or rather e-cigarette smokers (5,3 % \pm 1,5 %), when compared to non-smokers (4,4 % \pm 0,6 %). The plaque index also showed significantly higher values for all smoking habits. E-cigarette smokers exhibit a plaque index of 51,9 % \pm 10,2 %, while it was 34,1 % \pm 14,7 % in non-smokers. The concentration of cytokines in the patients' periimplanted sulcus fluid was also examined. All smoking habits caused a significant rise of proinflammatory cytokines TNF- α , IL-1 β and IL-6. The total volume of sulcus fluid also increased significantly [2].

Summary

The present findings from in-vitro and in-vivo investigations allow an initial assessment of potential consequences of the use of e-cigarettes.

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Currently, electronic smoking devices cannot be seen as a safe means to quit smoking due to potentially harmful effects [12]. Longterm studies are necessary for substantiated state-

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