Electronic Cigarette: a Review on Physical/Chemical Profile and Human Health Implications

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Abstract

During these last years a large phenomenon is exploded worldwide: the use of electronic cigarettes (e-cig). It is a new idea of smoking where tobacco combustion is not (apparently) involved whereas nicotine and the other components are aerosolised prior to inhalation. This absence of combustion in e-cigs, essentially due to the no presence of paper, drastically reduces toxicant exposure if compared to traditional cigarettes. The "relative" novel adoption of this lifestyle has not allowed to get a lot of data about chemical substances present in the exhaled and consequently in literature there is scarce information about the health effects even if some evaluation could be drawn. This review would like to show published data on the health effects associated with exposure to e-cigarettes.

Introduction

Electronic cigarettes (e-cigarettes) are products that deliver a nicotine-containing aerosol (commonly called vapor) to users by heating a solution typically made up of propylene glycol or glycerol (glycerin), nicotine, and flavoring agents (Fig. 1). Electronic cigarettes, or e-cigarettes, include e-pens, e-pipes, e-hookah, and e-cigars are known collectively as ENDS – electronic nicotine delivery systems. According to the FDA, e-cigarettes are devices that allow users to inhale an aerosol (vapor) containing nicotine or other substances.

Engineers developed e-cigarettes several years ago to provide tobacco users a smoke-free source of nicotine. The devices heat up a liquid that a user inhales, or "vapes." Basically, because e-cigarettes burn nothing, they release no smoke. The main point regards that a puff on an e-cigarette is less toxic than a puff on a regular cigarette. But few studies have looked at the toxicity of their vapors. As a result, scientists have been circumspect about describing e-cigarettes as safe.

In a review published in 2014 [1], Glantz and his team pored over emerging data on what vapers are inhaling and found greater risk than scientists had thought. E-cigarettes deliver high levels of nanoparticles, the researchers found, which can trigger inflammation and have been linked to asthma, stroke, heart disease, and diabetes. They stated that the levels "really raise concerns about heart disease and other chronic conditions where inflammation is involved". The long-term effects of e-cigarette use are unknown: the risk is probably low from the inhalation of propylene glycol and glycerin whereas no information is available on the long-term effects of the inhalation of flavors.

This review would like to explore and show the state-of-art of the electronic cigarette from different points of view, chemical and physical and relative human health implications, for giving an overview of this relevant and emerging issue.

Materials & Methods

The review has been conducted using PubMed and Scopus database and using key words such as electronic cigarette, chemical composition, size, human health and respiratory system: this search yielded almost 60 studies. Basically, most of the paper deal chemical data or size granulometric data: on the other hand, the papers putting in relationship these properties with the human health are relatively scarce due to the difficult to the issue. The physical data are collected using aerosol size

monitors, the chemical composition is performed both on the liquids used by vapers and the exhaled as well using common analytical techniques.

An important issue related to the e-cigarette task regards the social aspect of using these devices: a lot of papers, expecially in specialized journals, are devoted to this problem that nowadays represents one of the most important goal.

Results

The main component of e-cigarettes is the e-liquid contained in cartridges. To create an e-liquid, nicotine is extracted from tobacco and mixed with a base (usually propylene glycol), and may also include flavorings, colorings and other chemicals.

Nicotine is an addictive substance, and almost all e-cigarettes contain nicotine. Even some products that claim not to have any nicotine in them may still contain it. For instance, initial FDA lab tests conducted in 2009 found that cartridges labeled as nicotine-free had traceable levels of nicotine. About chemicals the situation is not so clear: we don't presently know what is in e-cigarettes. However, in initial lab tests conducted in 2009 the FDA found detectable levels of toxic cancer-causing chemicals, including an ingredient used in anti-freeze, in two leading brands of e-cigarettes and 18 various cartridges. A review of studies found that levels of toxins in e-cigarette aerosol varied considerably within and between brands. A 2014 study found that aerosol from e-cigarettes with a higher voltage level contains more formaldehyde, another carcinogen with the potential to cause cancer. As public spaces increasingly become smoke free, anecdotal reports show some people are attempting to use e-cigarettes indoors and in public spaces that are smoke free, like bars, restaurants and even public transit.
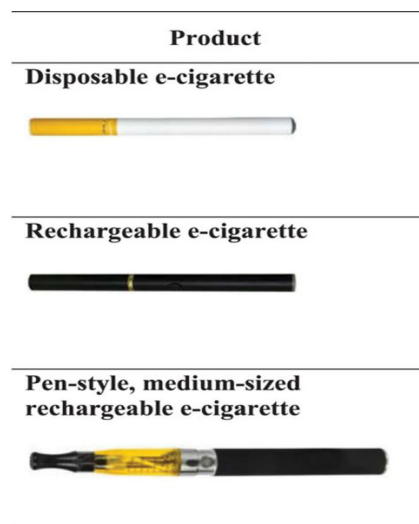

Fig. 1; Different electronic cigarette (e-cig) products.

On the other hand, the physical approach is little bit different, the situation is more clear both for the aerosol size classification and the dose deposited in the respiratory system. This issue has been deeply investigated and the studies are well discussed [2,3]. Preliminarily, it can be stated that exposure to submicron particles generated by electronic devices occurs only during the smoking period and it becomes negligible when the device is turned off [4]. After a single 2-s puff, almost 10^{11} particles are deposited, which is more than double the dose compared to conventional cigarettes [3]. In the tracheobronchial and alveolar regions, a single puff delivers total regional doses that represent 40 % and 30 % of the daily dose of a no-smoking Italian individual.

Conclusions

Briefly, from this information, the main advantage regards the use of e-cigarette as a tool to help smokers quit. But, there is also the opposite point: youth are using e-cigarettes at increasing and alarming rates. This is the very standpoint, the debate that this paper would like to open.

References
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