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RESEARCH ARTICLE

ELECTRONIC CIGARETTE: A NEW MODALITY FOR TOBACCO USAGE & CESSATION

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ABSTRACT

Electronic cigarettes are an alternative to nicotine deliveryhave been recently introduced &is considered a very popular mode of tobacco deaddiction. The purpose of this paper is to review the literature about the design, components & contents, effects, safety considerations along with the potential for smoking initiation and cessation. Patients should be counselled& educated regarding the usage. Though it's increasing in popularity and readily available in many nations there are controversies regarding their safety& effective role in smoking deaddiction.

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INTRODUCTION

Electronic cigarettes, also known as e - cigarettes or electronic nicotine delivery system, vaping .Personal vaporizers, advanced personal vaporizers. These are often packaged to appear and feel like traditional cigarettes so also known as cigar like e cigarettes. It was invented by Lik Hon in Hong Kong in 2003 (Hon Lik, 2015). This is a new product & very less is knownabout it in the Indian scenario.

Aims

- To provide the details about the design, concept& detailed functioning along with the contents used in electronic cigarettes
- Give an insight about the safety considerations and effect of cigarettes on smokers

A backward search was performed from the references of relevant studies.

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A MEDLINE search (PUBMED) of articles published was conducted which included clinical trials and reviews published within a period of 5 years. Key words used are electronic cigarettes, e cigarettes,and electronic nicotine delivery systems. The articles which were reviewed had to be in English and to be publically available and had to deal completely or partly on one of the following - product features, design, components, effects, safety considerations or any potential for addiction.

What are e- cigarettes?

E- Cigarettes or electronic cigarettes are non combustible cigarettes which deliver nicotine without combustion and are thought to be less toxic and reduce craving and relapse symptom, aid in smoking cessation and in relapse. It aids individuals to quit combustible cigarette smoking and prevent relapse and aresaid to be less expensive than traditional cigarettes (Allison, 2015; Etter, 2011). Another important aspect is that it can be smoked everywhere without disturbing people with passive smoking. They also address the psychological social and behavioral aspects of smoking (Sarah, 2014). These cigarettes are packaged to look like traditional

cigarettes and mimic hand to mouth and oral sensory experiences of traditional cigarettes. New generation e cigarettes are said to deliver more nicotine to the users but the amount of nicotine they deliver is comparatively less than combustible cigarettes (Sarah, 2014 and Li, 2013). Though they were introduced for deaddiction it may attract individuals to smoking. They are sold as single use disposable devices or as reusable devices. The major concern here is that both combustible and non combustible forms of tobacco pose an adverse health effect (Christopher, 2014).

Design

They are battery operated electronic devices which release aerosolized nicotine for inhalation. The design consists of

- A cartridge / e liquid container present in a plastic mouth piece, containing liquid to be vaporized.
- Atomizer or aerosol generator
- Heating element / vaporization chamber that vaporizes the liquid and produces the aerosol for inhalation
- A battery / power source which powers heating element
- A microprocessor
- A LED light that produces a glow when triggered by an inhalation (Christopher, 2014; Hon Lik, 2015; Sarah, 2014; Zhu, 2013; Vansickel, 2010).

Table 1. Generation of Electronic Cigarettes

Generations	Features
First generation electronic cigarettes/ Cig-a-Likes	Look like a combustible cigarettes Cartomiser that combines the vapouring system and electronic cigarette liquid in a single unit .when puffed a heating coil gets activated and subsequently vaporizes the liquid producing a vapour that can be inhaled. 9 They have a led on end which glows.
Second generation devices/ Mid-size Electronic Cigarettes	Look less of regular cigarettes and they contain tank that the user fills with their choice of electronic liquid where in flavor and strength can be decided by the users 9 Here nicotine concentration ranges from 0 t0 24 g/ml.they mostly use large batteries adjustable power settings and replaceable coils and wicks. 11 A tank or a "clearomizer".the clearomizer tanks are meant to be refilled with e-juice.10,11,12
Third generation devices/ Advanced Personal Vaporizers (APVs)	Include mechanical mods and variable voltage devices. They can hold bigger batteries or multiple batteries and is often replaceable. Variable devices often have ausb connector for recharging and some can be used while charging which is referred to as a "pass through" feature. 13,14,15,16 Digital e-cigarette
A fourth generation / Innovative Regulated Mods	Contains battery together with chamber of nicotine that is recyclable. Most prominent factor of this generation is the provision of utmost level of user accessibility as well as feasibility.10,16,17,18 Nicotine content from 0 – 36 mg/ml (max 20 mg/ml in eu from 2016)18,19

Detailed Operation

The Adjustments pertaining the heating element temperature air flow rate and other functions are made prior to puffing (Christopher, 2014; Brandon, 2015 and Eissenberg, 2010).

Contents

The chemical composition of the e liquid and aerosol is complicated as there are numerous brands and manufactures who use different e- liquids, batteries, heating elements nicotine concentrations and flavorings (Peter Hajek, 2014 and Nutt, 2014). Propylene Glycol i.e. propanediol - is an alcohol & is approved by FDA as a solubilizing agent which is used in food substances as a humidifier and emulsifier. A solvent in pharmaceuticals due to its affinity for water and used in aerosolized drug delivery systems in inhalers and nebulizers which is used here to prevent tobacco drying out. The mist produced dries the mucous membranes and eyes& chronic exposure is said to induce rhinitis asthma eczema and allergic symptoms (Http://Www.Ecigarette-Research.Org/, Dawkins, 2013 and Farsalinos, 2013). Glycerol – is the purified vegetable glycerine. It isnon toxic but if overheated produces acrolein which acts as an irritant and oxidizing agent which is thought to affect the cardiovascular and respiratory system adversely. The concentration produced in e cigarettes is very less (Kim, 2015). Impurities & toxicants – As nicotine is produced from tobacco, the impurities include cotinie, anabasine, anaatabine, myosmine, beta nictyrine& formaldehyde. But the nitrosamines or polycyclic hydrocarbons are absent or very minimal when compared to combustible cigarettes

Metals- Aerosols contain metal particles like

- Tin- found in the inner and outer fibers, and burning of the inner fiber. The presence of tin was more cytotoxic than in fluids that lacked particles (Behar, 2012).
- Lead - present in the solder joints, Nickel, iron was the part of mouthpiece and/or metallic base, silver (Lee, 2009).
- Silicate beads with particle like silicon, calcium, aluminum & magnesium originate in the fiberglass wick (Liu, 2004)

These metallic nano particles tend to penetrate into alveolar sacs increasing the oxidative stress and inflammation in lungand cardiac tissues. They travel into other organs like liver, kidney, heart, and brain. They emit reactive oxygen species from alveolar macrophages in vitro (Chen, 2005).Inducing malignant transformation of cultured bronchial epithelial cells (Bian, 2011). Thus Inhalation of tin dust has also been reported to cause stannosis in humans (Schuler, 1985). Fragrances & Aromas – menthol,linalool (floral), ethyl acetate (fruity),Tabanon (cigarette like),coffee, caramel etc(Bertholon, 2013).

Nicotine – Acute exposure to nicotine causesdizziness, nausea, or vomiting when inhaled. Dermal nicotine exposure occurs after spills of nicotine-containing liquids or occupational contact with tobacco leaves leading to toxic body reactions (Bertholon, 2013). A concentration ranges from 6 – 36 mg/ml which can be taken in varied concentrations and are labeled as low, medium and high (Vaper, 2014). 100mg/ml refill solution vials are available online. But the permissible level of nicotine

was to be maintained at20mg/ml by the European Commission (European, 2013). The maximum blood nicotine conc. in electronic cigarettes is 1.3ng/ml where as in cigarettes its 13.4ng/dl (Chatham-Stephens, 2014).

narcotics, steroids, marijuana etc could be of major concern (Conley, 2013). Old andcontaminated aerosol produces nano particles like tin, iron nickel and chromium which are grouped under potential harmful products by the Food and Drug

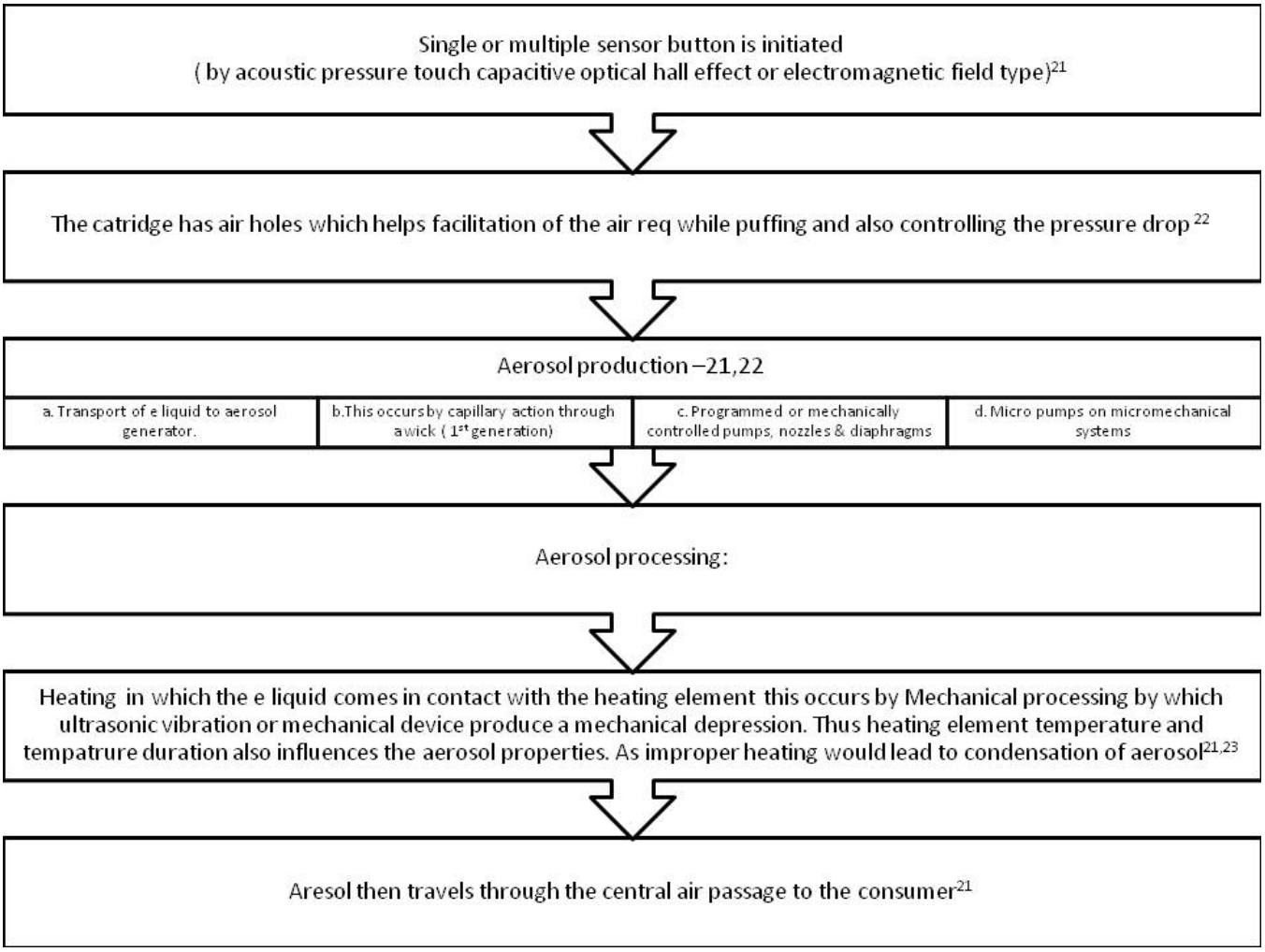

Figure 1. Operation of an electronic cigarette

Table 2. Regulations for use of electronic cigarettes

Regulation by FDA	Addresses marketing, youth access, labeling, quality control over manufacturing, free sampling, and standards for contaminants should be regulated by FDA42 There should be proper warning labeling and child proof packing on refill liquids& vials 56 FDA should approve companies who manufacture electronic cigarettes and claim its useful for tobacco cessation.42
Regulating taxing	Increasing tax on combustible products would prevent its use & may create interest in switching on to e cig.42, A tax too high on e cig would prevent switching of low income group users from combustible to e cig.57
Regulating marketing & Advertising	Marketing by using celebrities to promote about the flavorsetc tend to glamorize and might be misinterpreted amongst the youth for fun socially acceptable & desirable. 42,58 Regulations should be implemented on marketing which would prevent its accesses to minors.42 Researches should be carried out to recognize constructive communication techniques for health information, hazards/ benefits and regulatory issues.59
Surveillance	Surveys should be done in order to evaluate the health impact in the rural & urban health sector levels. 42,14 Evaluate long term physiological &behavioral effects on short term ,long-term & second hand users of e cigarettes .42,58 Help to accesses safety marketing & efficacy of the devices 42
Regulation of disposal	Inappropriate disposal of the vials, cartridges, batteries could lead to exposure of nicotine to children, adults along with animals causing contamination of the environment. 42 Policies should be advocated for correct methods of disposal. 42,60

Safety considerations

Nicotine in e liquid is toxic to infants and children when wrongly manipulated. Therefore child safety packaging with biometrics and sensors can be used (Christopher, 2014). Use of illegal substances have been reported with slight alteration of the container and refilling it with any other substances like administration association (Http://Www.Fda.Gov/Downloads/ Tobaccoproducts/Guidancecompliancegregulatoryinformation/ UCM297981.Pdf). Lithium batteries have a characteristic risk of fire and explosion. Therefore use of low quality materials, poor design along with any manufacturing defects could attribute to thermal run increasing the temperature causing either fire or even explosion (Sarah, 2014 and Ballard, 1983).

Effect of electronic cigarettes on smokers

The US food and drug Administration or any other government organizations have approved the usage of electronic cigarettes.Australia and Canada have banned their retail sale of e cigarettes. Other countries like the United Kingdom are introducing laws for regulating laws for use of nicotine products with medicinal properties. WHO currently advices smokers should be initially encouraged to quit smoking and encourage nicotine de- addiction by using a combination of already-approved treatments protocols.

Effect on health

The effect on health is due to the inhaled vapor which contains nicotine and possible toxicants produced by the atomization process. The respiratory system acts as the primary target for effects of e vapor. 14 In order to measure the pulmonary effects the exhaled nitric oxide is measured which acts as a marker for eosinophilicinflammation

Acute effects reported were increase in both central airway resistance & carbon monoxide in the exhaled air (AruniBhatnagar, 2014). Short term use doesn't or have very little adverse affect on the CVS or the lung function tests (Vardavas, 2012). The passive smoke emitted from electronic cigarettes is which is exhaled after inhalation and doesn't generate any additive aerosols and seem to have no effect on the pulmonary function (Peter Hajek, 2014 and Http://Www.Fda.Gov/Downloads/ Tobaccoproducts/ Guidance complianceregulatoryinformation/UCM297981.Pdf). patients showed improvement in asthma, bronchitis,& chronic obstructive pulmonary diseases with less coughing or chocking, sore throats, improved fitness, and reduced bad breath & insomnia (My Hua, 2013 and Etter, 2009). The neurological and sensory systems also get affected which is basically due to an overdose or withdrawal of nicotine with symptoms like vomiting, nausea, changes in heart rhythm, confusion, dizziness, and fatigue which activates nicotinic cholinergic receptors in the brain (Review Pharmacology Of Nicotine, 2009 and Schep, 2009). Other Symptoms like anxiety and depression were also either caused by insufficient delivery of nicotine to some e-cigarette users or withdrawal symptoms.

Effect on nicotine levels

Nicotine levels in blood are generally lower from conventional cigarettes when an 18mg/ml nicotine containing vial was used (Peter Hajek, 2014; Nutt, 2014 and Review Pharmacology Of Nicotine, 2009).

- The aerosol is absorbed from the oral mucosa instead of the lungs
- Nicotine deposited in mucosa is said to be swallowed and is metabolised in the liver thus reducing the bioavailability (Peter Hajek, 2014 and Farsalinos, 2013).
- Propyelene glycol present in electronic cigarettes also negatively interacts with nicotine absorption from lungsbut the nicotine levels in electronic cigarette vials if higher improves the effectiveness & is expected to make it a better substitute when compared to other smoking substitutes (Http://Www.Ecigarette-Research. Org/, Farsalinos, 2013 and Caponnetto, 2013).

Acute nicotine toxicity occurs when e cig liquid is ingested, which could be accidentally or be a deliberate use as a suicidal overdose, or with dermal exposure. It commonly causes dizziness, nausea, vomiting, pallor, tachycardia, sweating, abdominal pain, salivation, lacrimation, and diarrhea. Confusion, agitation, lethargy, convulsions and possibly death occurs in severe cases due to cardiac arrest. These Symptoms are seen 15minutes of exposure and may resolve within 1 to 2 hours (Solarino, 2010).

Withdrawal symptoms

The possible withdrawal symptoms like feeling awake, calming down, lack of concentration, loss of pleasure & satisfying feeling along with reduction of hunger for food.51 Along with urge to smoke, irritability, restlessness and poor concentration was seen. These symptoms were definite & gender differences in withdrawal suppression was also identified (Dawkins, 2013).

Role on smoking cessation

Electronic cigarettes minimize the abuse by acting as a substitute to conventional cigarettes whichis less toxic& it helps in minimizing harm (Biener, 2015). The electronic cigarettes can reduce desire to smoke and all possible nicotine withdrawal symptoms 20 min after its use (Lynne Dawkins, 2012).

Potential for abuse / addiction

Addiction is directly related to the potential of the e cigarettes to cause dependency. It is due to the presence of Nicotine which is the principle component of tobacco. When compared to conventional cigarettes e cigarettes have a very low addiction potential & would depend on the persistent use, rate of absorption of these products. Studies have shown due to minimal increase in plasma nicotine from e cigarettes with a significant decrease in cravings (Eissenberg, 2010).

Conclusion

E cigarettes are less harmful in comparison to the combustible cigarettes. The government should enforce efforts to differentiate the potentially harmful or beneficial effects and evaluate its effects on smoker's non smokers& persons seriously interested to QUIT. Additional researches & surveys should be enforced for better understanding of the design, functioning as a number of different products have been introduced by different companies with specialized testing protocols. Clinicians should be made to obligate to promote smoking cessation using e cigarettes. But very less is known in India and negligible usage or researches have been advocated here. India being one of the leading nations for Oral Cancer deaths elimination or replacement of the combustible tobacco products could significantly reduce the number of deaths.

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