Flavour of the moment?

Graham Cope enlightens us on the controversial pull of e-cigarettes and their role in smoking cessation

Cigarette smoking has profound effects on oral health and the public are increasingly aware of the harmful effects of tobacco on their general health. Consequently, they are looking to alternative 'healthier' forms of nicotine to maintain or in some cases to stop their addiction. Smoking is a well-established risk factor for periodontitis, and it enhances the pathogenic nature of oral bacteria and escalates the production of plaque. Tobacco smoke is also carcinogenic, increasing the tumours in the mouth and head and neck region.[1] The general public are gradually reducing their cigarette consumption and turning to the alternative forms of nicotine delivery devices, such as the electronic cigarette (e-cigs). Since their introduction in 2004, there has been rapid growth in sales, with an estimated 2.6 million regular users in the UK.[2] During this time, e-cigs have been largely unregulated, being widely available and have been heavily advertised on television and the internet. This significantly increased when the large tobacco companies, such as BAT, began buying up the small, independent manufacturers or producing their own brand, such as the e-Voke.[3]

Electronic cigarettes

Electronic cigarettes typically comprise an atomiser charged by a re-chargeable lithium battery that produces a vapour by heating a solution of nicotine, usually in propylene glycol or glycerine, sometimes up to 350°C.[4] The reported concentrations of nicotine vary from zero to 36 mg/mL, but there are many uncertainties about the nicotine delivery and the advertised amounts. There are also wide variations in the solvents used and the flavourings in the e-cig liquids or 'juice', many of which are chosen to be attractive to younger users.[5] The ingestion of nicotine from e-cigs is generally less efficient then from combustible cigarettes, with lower circulating nicotine levels.[6] Consequently, many users alter their smoking method or topography to compensate, inhaling deeper, more frequently and for longer than they would if they were using a conventional cigarette.[7]

Electronic cigarettes are generally considered by smokers to be a safer way of inhaling nicotine and more attractive than nicotine replacement therapy (NRT)[8], with a consequential fall in NRT sales and coinciding with a reduction in the numbers attending Stop Smoking Services.[9]

Government position

The government, through Public Health England, has taken a positive attitude to e-cigs, producing a report that concluding that smokers who have failed to quit with other methods, such as NRT, could be encouraged to try e-cigarettes and that Stop Smoking Services could support smokers using e-cigs to quit by offering them behavioural support. The report also suggested that smokers who cannot or do not want to quit to switch to e-cigs, as they are around 95% safer than conventional cigarettes as a harm reduction strategy.[10]

The report also commented on the allegations that e-cigs may be attractive to adolescents and may act as a gateway to them smoking in the conventional way. They stated: 'There is no evidence that e-cigs are undermining the long-term decline in cigarette smoking among adults and youth and may, in fact, be contributing to it. Despite some experimentation with e-cig among never smokers, e-cigs are attracting very few people who have never smoked into regular EC use.'[11]

Toxicology reports

Electronic cigarettes have been proposed by their manufacturers and supporters as an effective aid to quit, and while there is some evidence to support this.[12] A more recent review concluded that the opposite was true, with users of e-cigs being 28% less likely to quit smoking than non-users.[13]

Benefits of e-cigs over combustible cigarettes

- Vastly reduced particulate matter in the vapour
- No 'tar' and fewer carcinogens
- No carbon monoxide
- Significantly less secondhand emissions

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Solvent and flavours

Manufacturers and supporters of e-cigs often advocate that their products are healthier than conventional cigarettes and contain only water, nicotine, glycerin, propylene glycol and flavouring.[14] These claims, however, may be misleading as analysis has found varying levels of heavy metals in the vapour, including chromium, cadmium and mercury.[15]

Potential carcinogens have also been identified in the vapour, with tobacco-specific nitrosamines being emitted from some devices[16], and DNA-damaging free radicals have also been detected. [17] Toxic levels of formaldehyde and acetaldehyde have also been found, especially when the heating element is operated at high voltage.[18] Some e-cigs solutions also contain harmful flavourings including diacetyl and acetyl propionyl, which are used to add a buttery taste to the e-cig vapour and are known to cause bronchiolitis obliterans, a debilitating lung disease characterized by airway obstruction and chronic inflammation.[19] However, it is generally acknowledged that the levels of these and other toxins are much lower and less dangerous than in conventional cigarettes, however they may still pose a risk when inhaled over long periods.

Another advantage to e-cigs is their lack of secondhand smoke as they emit largely water vapour. However, recent evidence suggests there is some particulate matter emitted along with nicotine, carbonyls and organic volatile compounds.[20]

Nicotine

Although nicotine from NRT and e-cigs is considered relatively safe[21], there is recent evidence that nicotine is deleterious to the developing brain and parts of the nervous system[22] but also it has harmful effects on many non-neurological cells, including those in the respiratory tract, gut, oral mucosa and in the different cell types of the immune system.[23] And while nicotine is not carcinogenic it has been shown to be tumour promoting[24] and has a significant role to play in oral squamous cell carcinoma, being a source of oxidative stress and it indirectly generates free radicals that are responsible for DNA strand breakage, protein cross-linking, and lipid peroxidation.[25]

Refill solutions for e-cigs often come in cartridges with high nicotine content, which can pose a risk when refilling e-cigs products and there are also increasing reports of harm following accidental ingestion of nicotine solutions by children[26] and of intentional intake during suicide attempts.[27] Other problems arise from substandard and unregulated manufacture leading the injuries due to explosions[28] and fires due to exploding battery chargers leading to loss of property.[29]

Potential dental effects

The research into the dental effects of e-cigs has been insufficient to assess any long-term effects. However, the effects of nicotine on the periodontium and related tissues are better understood through various mechanisms such as peripheral vasoconstriction.[30] Nicotine is one of the addictive components of tobacco smoke and the main ingredient in e-cigs. Its effect is through specific nicotinic receptors on neurones and mucosal and other cells types, including fibroblasts, lymphocytes and macrophages.[31]

Their activation by nicotine results in a greater number of inflammatory cells with a reduced or altered immune response, suppressing the wound healing process and down grading bone regeneration. This inhibits recovery from even minor surgery[32] increasing the risk of infections and wound dehiscence. This is particularly the case for dental implants, where nicotine inhibits production of collagen and bone-forming proteins and fibroblast growth factor and vascular endothelial growth factor are reduced.[33]

Tooth injury and dental caries induce new synthesis of dentine by the dental pulp[34] yet nicotine in vitro has been shown to induce inflammation and necrosis of the dental pulp, inhibiting dentine production and failure to repair caries.[35] Nicotine has also been shown to inhibit bone growth, to depress osteoblast activity and to impair bone repair.[36]

Advice to dental patients

Electronic cigarettes therefore pose a potential danger to dental patients. Therefore information needs to be gathered about their use. This can be problematic because as with normal cigarettes there may be a significant degree of denial or under-reporting.[37] For accurate determination, then point of care cotinine testing can be used.[38] This is the only simple approach as carbon monoxide (CO) is not generated by e-cigs.

If this is not possible it is important to integrate into routine

Advice about e-cigarettes for patients (Worsley et al, 2014)

- The long-term safety of e-cigarettes is not yet established
- E-cigarettes are likely to be less harmful than tobacco cigarettes
- The effectiveness of e-cigarettes as either a smoking cessation tool or a harm reduction tool is not yet established
- At present, no e-cigarettes are licensed as a medicine and patients are recommended to use licensed NRT products to quit or reduce tobacco consumption
- Advice to patients who are unable or unwilling to use licensed NRT products is that, although the safety of e-cigarettes cannot be assured, they are likely to be a lower risk option than continuing to smoke
- Advise patients that there is the potential for advice about e-cigarettes to change as findings from research about the safety and effectiveness of e-cigarettes is published
- Advise patients that referral to the Stop Smoking Services is an option to consider

consultation questions about the frequency of use of e-cigs along with enquiries about tobacco use.[39] Smoking cessation advice should rely on tried and tested methods with NRT being the first course of action, with the use of combination therapy of long (e.g., patches) and short duration (gum, lozenge or spray) formulae. This should be combined with the usual "5 A" counselling and follow up.[40] However, it should be considered that adherence to NRT is frequently inadequate[41] and this is when e-cigs may be a useful alternative. Table 1 lists the advice that dental health professionals, including dental nurses should impart to their patients. This includes details on the safety and potential harm of e-cigs. If the patient wants to use e-cigs then this should be only for a limited period as an alternative to NRT with a chosen quit date and regular discussions about the effects of e-cig use on their cravings and use of conventional cigarettes.

Conclusion

The role of e-cigs as a smoking cessation tool remains controversial, with some advocating their use as a safer alternative to conventional cigarettes[42], while others believe the devices should not be normalised and 'should be seen as a part of the armoury of devices intended to wean smokers away from cigarettes, and nothing more'.[43]

The reputation of e-cigs has been tainted by poor quality manufacture and variability in nicotine availability and other chemicals they contain. The proposed regulations which come into force in the UK on 20 May, when e-cigs will come under the revised EU Tobacco Products Directive, will regulate the amount of nicotine available and improve safety of the liquid containers.[44] Certainly, more research is required to determine the benefits of these devices as smoking cessation tools within the dental profession and also the potential toxic effects of long-term nicotine and the other chemicals produced. We await what changes will occur later in the year.

References available on request

Key points

- Electronic cigarette use is increasing
- Electronic cigarettes generate a water vapour containing nicotine
- There is no carbon monoxide and other toxins are reduced
- Nicotine may cause detrimental effects
- Safety of e-cigarettes yet to be established
- Role as a smoking cessation aid needs further investigation