Effects of smoking on health and anaesthesia

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Abstract

Legislation prohibiting smoking in workplaces and enclosed public places was introduced in England in July 2007. This, in addition to the 2012 prohibition of tobacco promotion, and the increased use of e-cigarettes, are all changing our smoking behaviour as a nation. Nevertheless tobacco remains a major factor in disease development and smokers continue to present a number of anaesthetic challenges. Perioperative smoking cessation is beneficial and NHS support is available to facilitate this. The use of e-cigarettes to aid smoking cessation is increasing in popularity but their role within the perioperative period to facilitate reduction and cessation is ill-defined.

Keywords Anaesthesia; electronic cigarettes; smoking

Royal College of Anaesthetists CPD Matrix: 1A01, 1A02, 2A03

Learning objectives

After reading this article, you should be able to:

- explain the effects of smoking on health
- describe the perioperative effects of smoking and the beneficial effects of smoking cessation prior to surgery
- discuss the changes in smoking behaviour in relation to electronic cigarettes (e-cigarettes)
- discuss the role of the anaesthetist in facilitating smoking cessation

Cigarette smoking

Epidemiology

Smoking is the leading preventable cause of morbidity and mortality in the UK with a prevalence estimated at 10 million. Despite the significant fall in the rate of adult smokers from 1974 (46%) to 2017 (15.1%),[1] approximately 4% of all hospital admissions in the over-35s are still attributable to smoking.

General, pathophysiological and perioperative effects of smoking

Smoking is the largest cause of preventable deaths in England. Tobacco smoke contains over 4000 chemicals, many of which are harmful and carcinogenic, for example carbon monoxide, ammonia and hydrogen cyanide.

The multisystem effects of tobacco smoking are listed in Table 1 along with the perioperative effects.

E-cigarettes

The use of e-cigarettes has rapidly increased over recent years but in Great Britain, the prevalence of e-cigarette use in adults has plateaued at approximately 6% of the adult population.[3] They are most commonly used by current and former smokers but there is an emerging population of previous non-smokers who use e-cigarettes.

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In 1979 Professor Mike Russell from the Maudsley Smokers' Clinic wrote 'Smokers smoke for nicotine but die from tar'. The fundamental principle behind the creation of e-cigarettes is the separation of nicotine from smoke. Nicotine is the principal addictive component of tobacco smoke but nicotine itself is not carcinogenic.

Producing nicotine vapour from a solution rather than by burning tobacco means that the vapour is free from the toxic chemicals of conventional smoke. It is the nicotine delivery that is essential for e-cigarettes to have a role in smoking cessation. The most common reported reasons for use of e-cigarettes are to help stop smoking entirely, help reduce the amount of tobacco smoked and help keep off tobacco in the long term.

E-cigarettes are an electronic inhaler that vaporizes a liquid solution into an aerosol mist. They provide inhaled doses of vaporized nicotine by heating a solution of nicotine with propylene glycol or glycerine. In addition to propylene glycol, e-cigarettes contain toxic substances like formaldehyde and acetaldehyde. In some cases, the vapour also contains traces of nitrosamines, cadmium, nickel and lead[4] which carry a harmful effect although the amounts within the e-cigarette are very small.

The main components of an e-cigarette are:

- a battery
- a microprocessor, controlling a heater and light
- a heater to vaporize nicotine
- a cartridge, containing nicotine dissolved in propylene glycol
- LED lights, which shine as the smoker inhales.

E-cigarettes are currently classed as nicotine-containing products and regulated as general consumer products. Evidence on the content and emission or the arterial nicotine levels achieved with e-cigarettes is limited and characteristics of the devices vary extensively across manufacturers; in fact there are over 600 different e-cigarette devices available on the consumer market. The doses of nicotine delivered by e-cigarettes are, however, extremely unlikely to cause significant adverse effects according to the 2018 Public Health England report.[3] Nevertheless, there are major concerns about e-cigarette regulation considering the toxic substances they can contain. Formaldehyde, for example, is carcinogenic and the long-term respiratory effects of propylene glycol are unknown.[3]

Since their emergence onto the market in 2007, many smokers are turning to e-cigarettes as their first choice in an attempt to quit traditional tobacco smoking. For e-cigarettes to

Effects of tobacco smoking[2]

System	Pathophysiological effects	Perioperative effects
Respiratory	Recurrent cough	Laryngospasm and bronchospasm
	Mucus hypersecretion	Sputum retention
	Mucociliary dysfunction	Hypoxaemia
	Loss of integrity of airway epithelium	Baro/volutrauma
	Increased upper and lower airway reactivity	Need for re-intubation
	Recurrent chest infections	Postoperative atelectasis
	Loss of elasticity of airways	Postoperative chest infection
	Increased closing volume	
	Chronic obstructive pulmonary disease	
Cardiovascular	Tachycardia	Tachycardia
	Hypertension	Hypertension
	Raised carbon monoxide levels	Perioperative risk of myocardial ischaemia
	Reduced oxygen carrying capacity	Venous thrombo-embolism risk
	Left shift of oxygen haemoglobin dissociation curve	
	Reduced oxygen delivery	
	Increased blood viscosity	
	Atheroma and clot formation	
	Risk of myocardial, cerebral and peripheral	
	vascular ischaemia/infarction	
	Venous thrombo-embolism risk	
Haematology	Hypercoagulability	Risk of perioperative sepsis
	Increased blood viscosity	Risk of perioperative arterial/venous clot formation
	High white blood cell count	
	Impaired humoral activity and cell-mediated immunity	
	Increased risk of infection	
	Vulnerable to autoimmune diseases	
	Reduced ability to attack malignant cells	
Wound healing	Prolonged wound healing due to long term	Wound breakdown
	immunosuppression and poor tissue perfusion	Perioperative wound infection
Bones	Reduced bone density and osteoporosis	
	Increased fracture risk	
Cancer associations	Lung	
	Gastrointestinal (oesophageal, stomach, liver, pancreas, bowel)	
	Head and neck	
	Genitourinary (bladder, ovarian, cervical)	
	Leukaemia	

Table 1

play a significant part in smoking cessation, however, it is essential to harness their potential while minimizing risk. Combining the lack of robust evidence on the effectiveness of e-cigarettes in aiding smoking cessation, the shortage of safety data so far and the concerns over the intentions of tobacco companies who also own many of the e-cigarette makers, many remain sceptical about recommending the use of e-cigarettes in smoking cessation interventions. However, others believe the potential health benefit of using e-cigarettes over tobacco smoking (Table 2).

Beneficial effects of smoking cessation

Smoking cessation has a number of beneficial effects which are summarized in Table 3.

Management of the smoker in anaesthesia

Preoperative

A successful preoperative smoking intervention could potentially reduce perioperative complications. Further to this, if smoking cessation is sustained this could also lead to long-term health benefits for the patient. The anaesthetist therefore has a responsibility to capitalize on this opportunity to promote smoking cessation. Earlier assessment and intervention (4–8 weeks prior to surgery) is more likely to achieve the greatest benefit. Such perioperative planning will potentially allow a period of 'prehabilitation' including:

- the opportunity to seek respiratory physician review
- formal assessment of cardiorespiratory function and exercise tolerance

The case for and against e-cigarettes

FOR	AGAINST
Separates nicotine from tobacco	Not appropriately regulated
More popular than other nicotine replacement devices	Variation in nicotine doses
Surveys suggest that e-cigarettes are the key to quitting	Toxic substances such as formaldehyde and propylene glycol
Different nicotine grades allows a staged nicotine cessation	Previous non-smokers using nicotine products
Widely available, easily accessible and variety of flavours	Flavours and advertizing may influence children's behaviour

Table 2

Timeline of beneficial effects of smoking cessation

12–24 hours	Decreased carbon monoxide levels Decreased nicotine levels
48–72 hours	Carboxyhaemoglobin level normalizes Ciliary function improves
1–2 weeks	Decreased sputum production
4–6 weeks	Pulmonary function improves Cravings disappear
6–8 weeks	Immune function normalizes
8–12 weeks	Decreased overall postoperative morbidity and mortality

Table 3

- optimization of bronchodilator and disease-modifying therapies
- physiotherapy support
- smoking cessation team input and nicotine replacement therapy utilization.

Using a timeframe of 4–8 weeks will allow for most of the health benefits shown in Table 3 to occur should smoking cessation be successful. Often in anaesthetics, the preoperative window is less than ideal. Nevertheless, any preoperative opportunity to advise smokers to quit should be actioned as cessation can be beneficial right up to the evening before surgery (e.g. reduction in nicotine and carboxyhaemoglobin after 12 hours). General advice to smokers regarding the importance of coughing, clearing secretions and mobilizing postoperatively should be dispensed during preoperative assessment.

Perioperative

The use of bronchodilator therapy prior to theatre should be utilized if appropriate. Airway complications on induction, intubation and extubation should be anticipated due to the known airway hyperreactivity and mucus hypersecretion. Regional anaesthesia as the sole anaesthetic technique does hold advantages for smokers particularly those with respiratory disease as it avoids the need to manipulate the airway. Where a general anaesthetic is necessary, regional techniques for postoperative analgesia should be considered. If a general anaesthetic is to be undertaken, preoxygenation should be routine and adequate depth of anaesthesia with or without a muscle relaxant should be administered prior to manipulation of the airway to reduce provoking laryngospasm or bronchospasm. Care should be taken with airway pressures and lung volumes during positive pressure ventilation as reduced airway compliance and loss of airway elasticity increase susceptibility to baro/volutrauma.

Postoperative

Appropriate analgesia should be prescribed to ensure the patient is comfortable enough to breathe deeply and cough. Regional analgesic techniques may well have a role here. Early mobilization should be encouraged to improve lung function and clearance of sputum and postoperative physiotherapy should be considered. Saline nebulizers and mucolytic drugs will assist in sputum clearance as will the avoidance of dry oxygen therapy; humidified oxygen or the nasal route should be used wherever possible. The patient's routine bronchodilator therapy should be reinstated as soon as possible and additional rescue therapy prescribed as required. Continuing support and information with regard to smoking cessation should be offered. ◆

REFERENCES

1 Office for National Statistics. Adult smoking habits in the UK, 2017. Available from: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/bulletins/adultsmokinghabitsingreatbritain/2017 (accessed 9th Oct 2018).

2 Smokefree NHS: effects of smoking on the body. Available from https://www.nhs.uk/smokefree/why-quit/smoking-health-problems (accessed 9th Oct 2018).

3 McNeill A, Brose LS, Calder R, Bauld L, Robson D. Evidence review of e-cigarettes and heated tobacco products 2018. A report commissioned by Public Health England. London: Public Health England, 2018.

4 Goniewicz ML, Knysak J, Gawron M, et al. Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. *Tob Control* 2013; **0:** 1–7.