

Primary Author: Treated Title

Impact of smoking cessation techniques (electronic cigarettes and nicotine patches) on the circulatory metrics of lung cancer patients

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Abstract

Introduction

Lung cancer has been the number one cause of all cancers for years up until the year 2010 when its prevalence dropped. Smoking has been known for years as the number one cause of lung cancer. However, smoking cessation is still an ongoing challenge to completely eradicate the number one cause of this deadly disease, especially for smokers. Nicotine replacement therapy consisting of a nicotine patch or other means has been the mainstay of pharmacological treatment for years. With the advancement of technology, however, China was able to develop the electronic cigarette which can provide nicotine to the body, the addictive substance that prevents smokers from quitting smoking. Nicotine therapy has been known to help smokers quit. The safety and efficacy of these devices, though, have yet to be proven in smoking cessation even in healthy smokers. Considering how unrevealed the capabilities of these devices are known, it is, therefore of utmost importance to examine whether these devices would be helpful for lung cancer patients who have a hard time quitting smoking and if so, what the potential impact on the circulatory metrics of this category of patients. It is expected, however, that these devices would cause more harm than good to the metrics of patients considering how according to past research, nicotine delivery affects even healthy smokers.

Literature Review

Historical Background

Lung cancer is a form of cancer that begins in the lungs. Lung cancer is the second most common cause of cancer diagnosis among both men and women behind prostate cancer for men and breast cancer for women (de Groot, Wu, Carter & Munden, 2018). According to Hanspeter Witschi (2001), lung cancer is a widespread disease that constitutes a significant public health

issue. However, this was not always the case in the history of the disease because some ^{//}150 years ago, it was a rare disease (p. 4). World War I popularized the smoking of cigarettes, a habit that soldiers learned in Europe and brought back to the United States. They used it as a means to relieve stress, Witschi reports ~~(2001, p. 5)~~. The link between cigarette smoking and lung cancer began to be suspected in the 1930s when a sudden rise in the cases of lung cancer started appearing which coincided with the sudden increase in tobacco use at the time. It was also realized that most people ^{//}affected with this strange disease ^{//}were men (Witschi, 2001, ~~p. 4~~). Cigarette smoking was identified, therefore, as the most common risk factor associated with lung cancer.

Cigarette smoking can be either through active smoking of cigarettes where the patient is the actual smoker or through passive smoking where the patient inhales cigarette smoke from a close relative. Cigarette content has been known to change over time. The first cigarettes were hand rolled and were very expensive. The creation of a machine that automated their manufacture led to the boom of the tobacco industry. After the Surgeon General reported in 1964 that tobacco was a hazard, the trend in lung cancer incidence slowly decreased ~~(Witschi, 2001)~~.

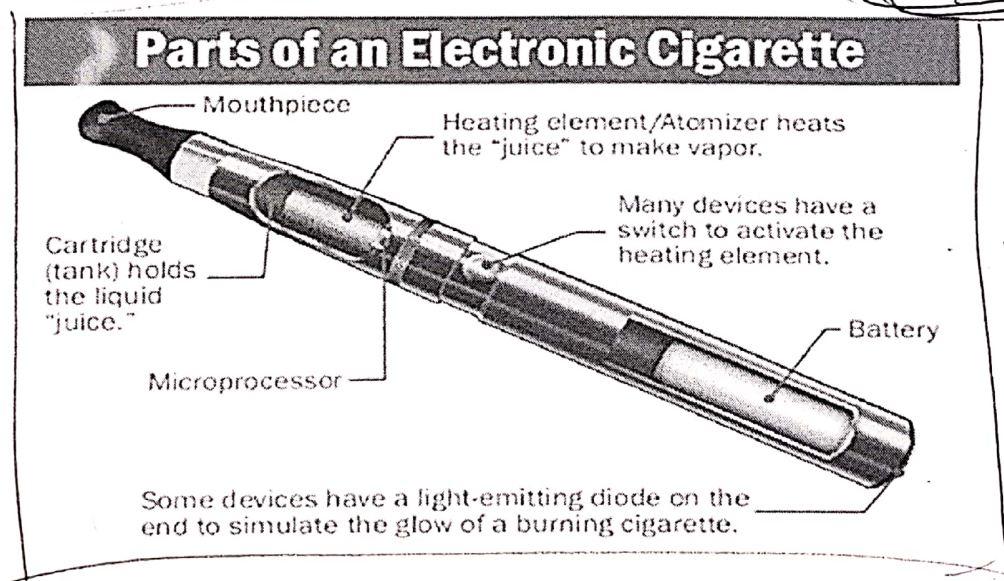


Figure 1: Typical design of an electronic cigarette (Blaha & Ratchford, 2019).

However, in 2003, electronic cigarettes were developed in China. Electronic cigarettes are electronic nicotine delivery systems that were initially promoted as tools to help people quit smoking. However, these devices deliver nicotine along with other constituents raising concerns about their toxicity and their role in smoking cessation (Couraud et al., 2018; Walton et al., 2014). An electronic cigarette has multiple parts including a rechargeable battery, a heating device that vaporizes the solution, and the cartridge that holds the liquid. They have been available throughout Europe and the United States since 2006 (Blaha & Ratchford, 2019, X). According to Walker et al., there is some evidence that points to the fact that electronic cigarettes can help people quit smoking; therefore, reducing the incidence of lung cancer cases. However, no trials ever evaluated how effective it would be to combine e-cigarettes with nicotine patches for smoking cessation neither did they ever assess the safety of such a combination (2019, p. 1). Blaha and Ratchford (2019) however, argue that knowing the effect of e-cigarettes as smoking cessation tools is a difficult question to answer because these devices were not marketed as therapeutic products to treat something. As such, they did not go through FDA approval. Extensive research and clinical trials are required to ensure that these devices are safe before proceeding to initiate them into smoking cessation programs (p. 4).

Benefits of smoking cessation

Smoking cessation has been the primary goal of WHO for preventing lung cancer cases worldwide. De Groot et al. argue that tobacco consumption is the single most significant risk factor in the development of lung cancer, with up to 90% of them attributed to smoking (2018, M). Because of nicotine addiction, most smokers, however, fail to stop smoking even in the very advanced stages of the disease. The benefits of smoking cessation can be grouped into two: the immediate and the long-term benefits.

According to Cataldo, Dubey & Prochaska (2010),^{Pg} the immediate benefits of smoking cessation include:

- Improved oxygenation
- Lowered blood pressure
- Improved immune response

Long-term benefits of smoking cessation include: 1)

- Decreased risk of disease
- Increased survival time
- Decreased postoperative complications
- Improved response to chemotherapy and radiation
- Improved quality of life (p. 290- 292).

Table

or

IP

Nicotine replacement therapy remains, after counseling, the mainstay of treatment for smoking cessation. It comes with the idea that nicotine is the addictive substance in cigarettes that make the smoker not want to stop. After advising lung cancer patients to stop smoking, they can be provided nicotine through a nicotine patch or other means. Electronic cigarettes may count as nicotine replacement therapies; however, some studies report this would be detrimental for lung cancer patients. William Stephens (2018) reports that the vapors that are expelled from electronic cigarettes release potential carcinogens that may interfere with the disease of lung cancer patients (p. 16). Nicotine is not carcinogenic, by itself, but studies in vivo show that it favors the proliferation of lung cancer cell lines and resistance of the destruction of these cell lines by chemotherapy (Cataldo et al., 2010, p. 290).

The estimated new cases of lung cancer in the United States for 2018 are 121,680 for men and 112,350 for women, for a total of 234,030, the equivalent of 641 lung cancer cases diagnosed per day (de Groot et al., 2019, 2). Lung cancer accounts for 14 % of new cancers in men and 13 % of new cancers in women in the US. Around the world, lung cancer rates vary depending on tobacco use and air quality, but rates are higher in developed countries than in less-developed ones, predominantly from smoking habits (de Groot et al., 2019). Estimates of mortality from lung cancer are 83,550 deaths for men and 70,500 for women, around 25% of annual fatalities. Usually, diagnosis of the disease is made in the advanced stage, and at this stage, the prognosis is very poor with a 5-year survival rate of only 5% (de Groot et al., 2019, p. 2).

The use of e-cigarettes has increased drastically in recent years. Couraud et al. report that their use by both adolescents and adults doubled worldwide between 2008 and 2012. According to the Centers for Disease Control and Prevention, “in 2015, 29.8% of adult e-cigarette users were former regular cigarette smokers, 58.8% were current regular cigarette smokers, and 11.4% had never smoked. In 2017, 2.8% of US adults were current e-cigarette users” (CDC.gov, 2019). This data points out that e-cigarette smoking has been an uprising trend and it needs to be addressed. According to Couraud et al., electronic cigarettes are a means for tobacco smokers to quit smoking and reduce their lung cancer mortality chances usually by combining e-cigarettes and tobacco cigarettes. (2018, p.336). However, Walton et al. postulate that dual use does not offer better chances at reducing the risk associated. The long-term impact of dual-use is unknown and may alter nicotine dependence (2015, p. 265).

Previous Studies

A study performed by Walker et al. (2019) reports the effects e-cigarettes (with and without nicotine) may have on smoking cessation therapy. However, their randomized controlled trial fails to account for lung cancer patients who are the target of our research. Najem et al. (2006) report the effects of nicotine replacement therapy on the cardiovascular system, specifically the sympathetic effects of nicotine in healthy smokers. This study fails to address the effects on lung cancer patients and does not quite report the effects of electronic cigarettes. This study focuses on metrics like systolic and diastolic blood pressure, heart rate, muscle sympathetic nerve activity and ventilation. This research plans to observe the effects of nicotine from e-cigarettes and nicotine patches on similar metrics as these previous studies. These gaps in previous research studies prompt the following research proposal.

Research Question

Which smoking cessation technique (electronic cigarettes or nicotine patch) does less harm to lung cancer patients as measured by blood nicotine levels, heart rate, blood pressure, and arterial gas levels? This question would enable us to explore the impact of each smoking cessation technique on the life of lung cancer patients and determine whether the benefit exceeds the harm caused by each considering those patients who have a hard time to quit smoking.

Hypothesis

Based on the research question, blood nicotine levels are expected to rise regardless of whether electronic cigarettes or nicotine patches are used. However, blood nicotine levels may be higher in the case of electronic cigarettes. The heart rate of patients is also expected to increase regardless of the nicotine administration route. Nicotine activates nicotinic receptors in the sympathetic nervous system, which is expected to increase the heart rate as well as blood pressure. The level of activation of the receptors depends on the amount of nicotine in the system. It is demonstrated in the study of Najem et al. that nicotine increases the activity of the

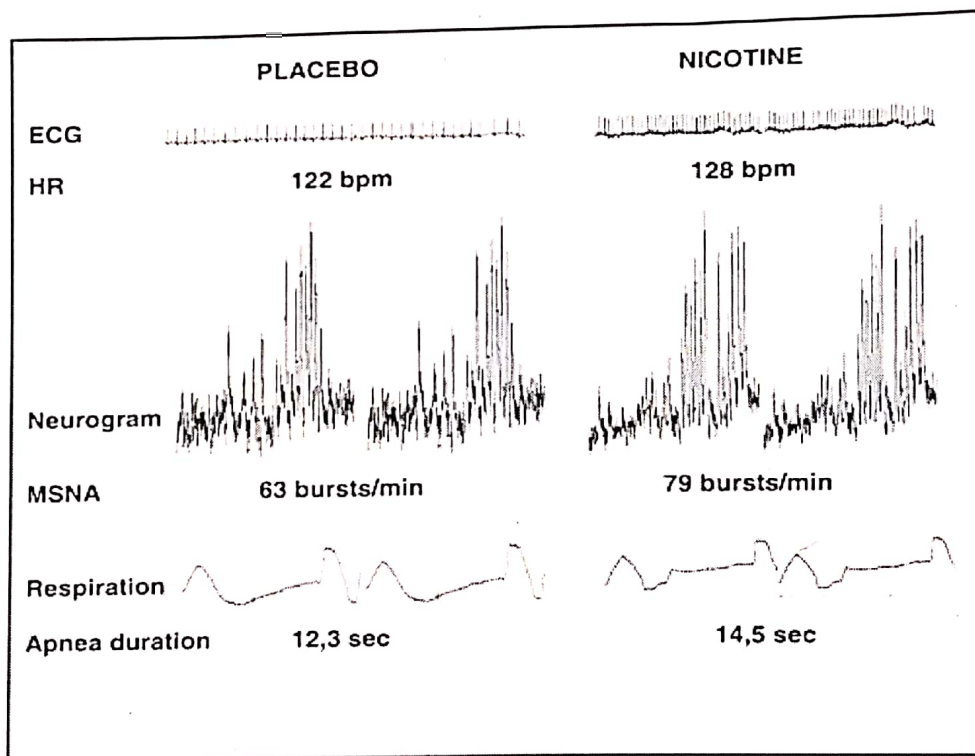


Figure 2: Recordings of ECG, neurogram, and respiration during apnea in hypoxia in a subject after taking a placebo tablet and after a nicotine tablet. The oxygen saturation shown in the figure is the lowest saturation achieved at the end of the apnea. Heart Rate (HR) and Muscle Sympathetic Nerve Activity (MSNA) were higher after nicotine than after placebo (Najem et al., 2006, p. 1164).

sympathetic nervous system, and therefore causes an increase in blood pressure and heart rate.

However, effects on the oxygen saturation were inconclusive and did not suggest any effect on

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arterial gas levels. It should, however, be noted that this study was performed in healthy cigarette smokers and not lung cancer patients (2006, p. 1165). An effect on arterial gas levels is expected because patients with lung cancer have trouble breathing and have anemia from lung cancer.

Variables

Dependent variable: Blood pressure (systolic and diastolic blood pressure), heart rate, arterial gas levels (O_2 and CO_2) of lung cancer patients.

Independent variable: The administration of the nicotine patch, the administration of electronic cigarettes, the dosage and the timing of administration, the type of electronic cigarette used, the type and brand of nicotine patch used, the number of pack-years of cigarette smoked by the lung cancer patients.

Control variable: The patients should only have lung cancer. No other chronic diseases.

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