Acute effects of using an electronic nicotine-delivery device (e-cigarette) on myocardial function: comparison with the effects of regular cigarettes

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Purpose: The addictive properties and devastating consequences of cigarette smoke on human health, including cardiac function, are well known. In recent years the electronic cigarette (e-cigarette), a battery-powered nicotine delivery device, has been marketed as a safer habit. Despite the global debate about its' use, no studies have examined the device's consequences on cardiac function. The purpose of our study was to evaluate the acute effects of using the e-cigarette on left ventricular myocardial function and to compare them with the effects of regular cigarettes.

Methods: Participants were 42 healthy volunteers (age 25-45 years): ex-smokers who were using the e-cigarette (group eCIG, n=22), and regular cigarette smokers (group SM, n=20). A complete echocardiographic exam was performed in both groups after 3-hours abstinence from alcohol, coffee and e-cigarette use or smoking (eCIG-1 and SM-1 respectively). A repeat echocardiogram was performed in eCIG subjects after using an e-cigarette with nicotine concentration of 11mg/ml for 7 minutes (eCIG-2). In smokers, the repeat echocardiogram was done after smoking one cigarette (SM-2). Transmitral Doppler flow parameters (MV-E and MV-A wave, E/A ratio and deceleration time-DT) and averaged (lateral, septal, anterior and inferior) tissue Doppler mitral annulus velocities (systolic: Sm, early diastolic: Em, late diastolic: Am) were measured. The isovolumic relaxation time (IVRT) and myocardial performance index (MPI) of the left ventricle were also measured.

Results: The two groups had similar characteristics, baseline echocardiographic and haemodynamic parameters. Subjects in the eCIG group had quit smoking for 93±65 days and were using an e-cigarette for 95±64 days; however, they had significantly higher total smoking exposure, with a Brinkman index (number of daily cigarettes x smoking years) of 533±270 compared to 369±150 in SM ($p = 0.019$). Using the e-cigarette for 7 minutes lead to no significant alterations in any echocardiographic parameters, except for a slight rise in MV-A wave ($p = 0.047$). On the contrary, a significant decrease in Em velocity ($p = 0.005$) and Em/Am ratio ($p = 0.001$), and an increase in IVRT ($p = 0.032$) and MPI ($p=0.01$) were found in SM-2 compared to baseline.

Conclusions: Although regular smoking leads to an acute impairment of left ventricular function, the use of e-cigarette for inhaling nicotine-containing liquid exerts no acute adverse effects on cardiac function. Further research is urgently needed since the use of e-cigarettes is continuously rising and it could be a potentially useful method for smoking cessation.

Electronic cigarettes do not damage the heart

First-hand smoke, second-hand smoke or electronic cigarettes

Topics: Cardiovascular Disease Prevention - Risk Assessment and Management
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Electronic cigarettes have no acute adverse effects on cardiac function, according to research presented today at an ESC Congress 2012 press conference by Dr Konstantinos Farsalinos from Greece.

Smoking is the most preventable risk factor for cardiac and lung disease and is expected to cause 1 billion deaths during the 21st century. Electronic cigarettes have been marketed in recent years as a safer habit for smokers, with several millions of people already using them worldwide.

Abstract

Electronic cigarettes simulate the effect of smoking by producing an inhaled vapor. The device consists of a battery, a cartridge containing liquid and a heating element which gets warm and evaporates the liquid. Laboratory analyses of the liquids show that they are less toxic than regular cigarettes. Most studies have found no nitrosamines, but even in studies where nitrosamines were found, the levels detected were 500-1400 times less than the amount present in one tobacco cigarette. This means that electronic cigarettes must be used daily for 4-12 months to get the amount of nitrosamines present in a single tobacco cigarette.

Since heart disease is the main cause of morbidity and mortality in smokers, with 40% of deaths in smokers due to coronary artery disease alone, the research team decided to perform the first clinical study of the acute effects of electronic cigarettes on cardiac function.
They decided to compare their results with the acute effects of regular cigarettes on cardiac function since electronic cigarettes are marketed to smokers only, as an alternative habit.

Previous studies from the research group and several others have shown that acute smoking inhalation produces significant defects in myocardial function. This indicates that subclinical dysfunction is already present in apparently healthy asymptomatic young people who smoke tobacco cigarettes. The goal was to evaluate whether these signs of preclinical disease appear in a similar population after using electronic cigarettes.

The researchers measured myocardial function in 20 healthy young daily smokers aged 25-45 years before and after smoking one tobacco cigarette and 22 daily electronic cigarette users of similar age before and after using the device for 7 minutes.

Experienced users of electronic cigarettes were studied because they use the device more intensively than first-time users. Although both groups were of equal age, users of electronic cigarettes had a 44% higher lifetime tobacco smoking exposure compared to current smokers.

For the electronic cigarettes, a commercially available liquid with a nicotine concentration of 11mg/ml was used (NOBACCO USA Mix). This was tested by an independent toxicology laboratory and found to contain no nitrosamines or polycyclic aromatic hydrocarbons.

Myocardial function was examined using cardiac ultrasound (echocardiography) and hemodynamic measurements (blood pressure and heart rate).

The researchers found that smoking one tobacco cigarette led to significant acute myocardial dysfunction but electronic cigarettes had no acute adverse effects on cardiac function. Smoking a tobacco cigarette had important hemodynamic consequences, with significant increases in systolic and diastolic blood pressure and in heart rate. In contrast, electronic cigarettes produced only a slight elevation in diastolic blood pressure. Dr Farsalinos said: "This is an indication that although nicotine was present in the liquid used (11mg/ml), it is absorbed at a lower rate compared to regular cigarette smoking."

The echocardiography examination focused on the function of the left ventricle, the part of the heart that receives oxygenated blood from the lungs (filling or diastolic phase) and then delivers the blood to the whole body (pumping or systolic phase). The investigators found significant defects in the diastolic phase of left ventricular function after smoking one cigarette, with four echocardiographic parameters indicating worsening function. In contrast, none of the echocardiographic parameters showed any significant worsening in subjects after using the electronic cigarette. "Diastolic dysfunction is very important because it is usually the first defect that is detected before any clinically-evident cardiac disease develops," said Dr Farsalinos.

He added: "It is too early to say whether the electronic cigarette is a revolution in tobacco harm reduction but the potential is there. It is the only available product that deals with both the chemical (nicotine delivery) and psychological (inhaling and exhaling 'smoke', holding it, etc) addiction to smoking, laboratory analyses indicate that it is significantly less toxic and our study has shown no significant defects in cardiac function after acute use."

Dr Farsalinos continued: "More clinical studies need to be done before suggesting that this is a revolutionary product. However, considering the extreme hazards associated with cigarette smoking, currently available data suggest that electronic cigarettes are far less harmful and substituting tobacco with electronic cigarettes may be beneficial to health."

Dr Farsalinos will also present his results during an ESC Congress 2012 scientific session tomorrow.

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E-Cigarettes Don't Harm Heart, Study Shows

Electronic Cigarettes Useful as Smoking Cessation Aid, Researcher Says
By Charlene Laino
WebMD Health News
Reviewed by Louise Chang, MD

Aug. 28, 2012 (Munich, Germany) -- Electronic cigarettes do not appear to be bad for your heart, according to the first study to look at the effects of smoking e-cigarettes on heart function.

The devices -- battery-powered metal cartridges that simulate the effect of smoking by heating nicotine-containing liquid into vapor -- can be helpful to smokers trying to kick the habit, says researcher Konstantinos Farsalinos, MD, of the Onassis Cardiac Surgery Center in Athens, Greece.

"Considering the hazards associated with cigarette smoking, currently available data suggest that electronic cigarettes are far less harmful, and substituting tobacco with electronic cigarettes may be beneficial to health," he says.

Speaking here at the annual meeting of the European Society of Cardiology, Farsalinos acknowledges that the study was short and small -- only 22 people were studied immediately before and after using the devices.

Another small study shows that e-cigarettes may have short-term harmful effects on lung function, he says.

Many more people have to be studied for much longer before any firm conclusions can be made about the safety of electronic cigarettes, Farsalinos says.

Still, e-cigarettes are the only smoking cessation aids that satisfy both sides of addiction: the chemical craving for nicotine and "the psychological addiction that comes from having something in your hand, lighting it, and inhaling and exhaling it," he says. "Preliminary studies show this [two-pronged attack] helps people to quit."

Millions Use Electronic Cigarettes

Invented by a Chinese pharmacist in 2003, electronic cigarettes are now used by millions worldwide as an alternative to smoking. But the devices are not regulated, and the World Health Organization has called for studies on their effects on human health.

In the new study, the researchers compared the heart function of 20 daily smokers before and after smoking one tobacco cigarette to that of 22 e-cigarette users before and after using the device for seven minutes. The people studied were healthy and varied in age from 25 to 45.

Heart function got worse in the tobacco smokers, and their blood pressure and heart rate rose. People using e-cigarettes experienced only a slight elevation in blood pressure.

American Heart Association spokesman Russell Luepker, MD, of the University of Minnesota in Minneapolis, says that because they "light up," electronic cigarettes may be preferred over other smoking cessation aids by some people trying to quit.

It’s not surprising they are less harmful than the real thing, he says. "The e-cigarette has the advantage of not having the thousands of other chemicals, besides nicotine, that a real cigarette has," he says.

"I don't think it's conclusive but there's no doubt if you expose someone to fewer bioactive chemical compounds there is going to be less effect on the heart," Luepker says. But they should only be used as a temporary bridge while quitting smoking, he says.

The e-cigarettes used in the study contained 11 milligrams per milliliter of nicotine (Nobacco, USA Mix) in the liquid. That’s a "moderate" amount, according to Farsalinos, who says they can contain up to 23 milligrams per milliliter of nicotine.

Many laboratory analyses have shown electronic cigarettes do not contain carcinogens, he says. But even in studies where formaldehyde and other carcinogens were found, the levels detected were 500 to 1,400 times less than the amount present in one tobacco cigarette, Farsalinos says.

"You would have to use e-smokes for six to eight months to get the amount of chemical present in a single tobacco cigarette," he says.

An electronic cigarette kit typically costs from $30 to $200.

These findings were presented at a medical conference. They should be considered preliminary, as they have not yet undergone the "peer review" process, in which outside experts scrutinize the data prior to publication in a medical journal.