

Electronic Cigarette Cessation in Youth and Young Adults: A Case Series

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ABSTRACT

INTRODUCTION: Electronic cigarette (e-cigarette) usage use has increased exponentially, especially in youth and young adults. For many, the usage of these products results in a severe addiction, one that is difficult to discontinue. Further, e-cigarette cessation is challenging as there are no specific guidelines directing such medical management for patients and their respective clinicians. Here, we report a case series of patients who we are attempting to wean from e-cigarettes with medical guidance.

METHODS: Six patients who self-reported daily e-cigarette usage and were enrolled in our Tobacco Treatment Clinic (TTC) were followed for 12-months. An inventory of the e-cigarette product and usage was captured, along with responses to identify when the patients experienced majority of their cravings. Co-morbidities, if present, were documented. Documentation of interventions, counseling with or without pharmacological therapies, were captured. Primary outcome was cessation at 6-months.

RESULTS: The 6 patients enrolled in clinic ranged in age from 17 to 31 years, with 4 of the patients identifying as males and 2 as females. Patients were using e-cigarettes for 1 to 6 years prior to enrolling into the TTC. As for interventions, all patients received counseling and pharmacological interventions in the form of nicotine replacement therapies (NRTs). Three of the 6 patients were weaned off e-cigarettes by 6-months, with a fourth patient weaned off at the 8-month mark. Variables identified as barriers to cessation included non-compliance with medical regimen and peer influence.

DISCUSSION: Here we present a case series of attempting to wean persons from electronic cigarettes use. Given the lack of international guidelines in e-cigarette addiction management, we believe this case series will be of value for clinicians and their patients. Further studies are warranted to help patients with e-cigarette addiction in their attempt at cessation.

KEYWORDS: Electronic cigarettes, nicotine addiction, electronic cigarette cessation

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Introduction

Introduced early in the 21st century, an addition to nicotine delivery systems has been electronic cigarette (e-cigarettes) or vapes.¹ The e-cigarette was invented with intentions to aid in cessation from combustible cigarettes, achieved with the utilization of various chemicals with or without nicotine.² However, e-cigarettes have found their way into the hands of never smokers, with a resulting rise in youth usage in the United States.³ The incidence of e-cigarette use has increased, particularly in adolescent and young adults. E-cigarette use in middle and high school students increased 900% from 2011 through 2015.⁴ Thereafter, e-cigarette use further increased in youth, with 3.6 million high and middle school users in 2018 up from 2.1 million a year earlier.³ With such a rise in youth usage, and many e-cigarette users reporting addictive behaviors,⁵ clinicians must be prepared to aid youth and young adults in e-cigarette cessation strategies.

Over the years e-cigarettes have evolved in design making them easy to conceal, longer lasting battery, and higher voltage, and are customizable for different flavors and nicotine

content.^{6,7} With the possibility of higher nicotine content, e-cigarettes have the ability to amplify the pharmacodynamics of nicotine, which may result in significant addictions in adolescents and young adults. At the same time, the aerosol generated and inhaled contains varied amounts of heavy metals, volatile organic compounds, and particulate matter, with resulting various health concerns, from mental health to cardiopulmonary.^{6,7} Finally, many of the e-cigarettes also utilize various flavors, appealing to adolescents and young adults, and some of the chemicals used to make these flavors have known serious health sequelae.⁷ Therefore, adolescents and young adults with e-cigarette addictions warrant management to assist in cessation and prevention of disease.

Current international guidelines exist for strategies on cessation from combustible cigarettes.⁸ One of the focuses of these guidelines is to identify the most optimal medication for tobacco dependence management that is approved by the Food and Drug Administration (FDA) in the United States (nicotine replacement therapies, varenicline, bupropion). However, all



FDA approved medications for tobacco dependence are effective when compared to placebos for helping patients achieve smoking cessation.⁹⁻¹¹ With such emphasis on the management of nicotine addiction and resulting tobacco dependence from combustible cigarettes, it is unclear if a similar approach can be extrapolated to nicotine addiction from e-cigarettes. Thereby, investigating if FDA approved medications for tobacco dependence management from combustible cigarettes is effective in nicotine addiction from e-cigarettes is warranted.

We present a case series of patients with an e-cigarette addiction, sharing insight into strategies to aid in e-cigarette cessation. We emphasize the successes of pharmacological therapies and barriers perceived by the patients toward successful e-cigarette usage cessation.

Methods

Patient selection and variable collection

Between 2018 and 2020, patients were selected if they enrolled into the Tobacco Treatment Clinic at Johns Hopkins Medicine, which allows enrollment of patients to as young as 16 years of age. For the purpose of this case series, selected patients must identify as to daily use of electronic cigarettes that has occurred for a minimum of 1 year and usage of a minimum of 1 nicotine-containing pod per month for their electronic cigarette nicotine addiction. In addition, these patients selected for this case series must have no active or no prior use of combustible cigarette usage. Patients were excluded if they had concurrent pulmonary complications from e-cigarette usage, were pregnant, or were already on FDA-approved first line tobacco dependence pharmacological agents (bupropion, varenicline, or nicotine replacement therapies). Pre-existing conditions were self-reported during the clinic visit (eg, if the patients had any mental health or physical health issues) and collected. The study was approved by Institutional Review Board at Johns Hopkins School of Medicine (IRB00282725) and all actions undertaken by the authors were in accordance with the Declaration of Helsinki.

Variable we collected included sociodemographic information, insight into any co-morbidities (self-reported), as well as reason for stopping e-cigarettes. Further data on e-cigarette usage included when did they start e-cigarette usage, e-cigarette pods per month used, and an understanding of when they are most motivated to use their e-cigarettes (eg, when are their cravings for e-cigarettes the greatest). Motivation and cravings for e-cigarette usage is recorded as “conditional responses,” with these responses being open-ended.

Study oversight and safety monitoring

Patients were followed for a minimum of 12-months, with clinical visitations every 3 months, in addition to counseling provided by the Tobacco Treatment Clinic’s staff outside of scheduled clinical visits. Counseling sessions included an understanding of why the patient is currently using e-cigarettes (eg, for enjoyment,

for stress, peer pressure), what they identify as a barrier to quitting e-cigarettes, and then motivational interviewing centered on implementation strategies to wean off of e-cigarettes. Counseling sessions occurred every 2-weeks for patients and were conducted by telephone and lasted for up to 30-minutes.

Pharmacological interventions were selected based on FDA-approved first line agents. These medications were used as either controllers or relievers. Controllers are defined as a medication with the intention to have a steady state presence of greater than 12-hours; these medications include varenicline, bupropion, and transdermal nicotine replacement therapy (TDNRT). Relievers are medications intended to provide therapy that has a steady-state of less than 6-hours; these medications include gum nicotine replacement therapy (GNRT), lozenges nicotine replacement therapy (LNRT), and nasal spray nicotine replacement therapy (NSNRT). For TDNRT, we dosed all patients at 21-mg for 24-hours for the first month, then transitioning to 14-mg TDNRT for the second month, with the final transition to 7-mg TDNRT until the patient is off of e-cigarettes. For GNRT and LNRT, we started at 4mg with no tapering. Finally, for the GNRT, LNRT, and NSNRT, if selected, patients would be instructed to use these NRT relievers as needed, and at a frequency as described by the medication’s instructions.

For all patients, if pharmacological interventions were initiated, at each counseling session and clinic visit, side-effects of the tobacco dependence medications were monitored and evaluated. Note that type(s) of pharmacological interventions were selected by patients, with the ability to change the pharmacological strategy depending on abstinence status and tolerance of the medications. All patients had initial blood work evaluating hepatic status and renal function, given that these medications’ metabolism is hepatic- or renal-dependent. If the side-effects of the medications outweighed the benefit the patient is achieving, or are identified as life-threatening, these medications would then be discontinued.

Outcome measurements

The primary outcome for this case series was e-cigarette cessation at 6-months mark, with cessation defined as 7-days without e-cigarette usage. A 7-day abstinence was used as it is a predictor for ongoing cessation in combustible cigarettes.⁹ Secondary outcomes include tobacco dependence-specific medication adherence, e-cigarette cessation at 12-months, and identification of barriers which confounded e-cigarette cessation. If a patient would relapse after e-cigarette cessation, it would be documented, noting time from e-cigarette cessation to time to relapse to e-cigarette usage.

Results

Between 2018 and 2020, 6 patients were identified for review in this case series, all of whom were followed for 12-months. None

Table 1. Sociodemographic summary and intervention for patients being managed for e-cigarette addiction.

PATIENT	AGE	GENDER	RACE	PODS PER MONTH	DURATION OF DAILY E-CIGARETTE USE	MOTIVATION FOR CESSATION	PHARMACOLOGICAL INTERVENTION	6-MONTH E-CIGARETTE STATUS
1	19	Female	White	5	3 years	At request of family.	NRT transdermal	Ongoing use
2	21	Female	White	4	4 years	Concern for health.	NRT nasal spray	Ongoing use
3	31	Male	White	2	6 years	Expense of addiction.	NRT transdermal	Achieved cessation
4	17	Male	White	1	1 year	At request of family.	NRT nasal spray	Achieved cessation
5	26	Male	Black	2	5 years	Expense of addiction.	NRT transdermal NRT gum NRT nasal spray	Achieved cessation
6	24	Male	White	4	6 years	Concern for health.	NRT transdermal NRT nasal spray	Ongoing use*

Abbreviation: NRT, nicotine replacement therapy.

*Patient 6 achieved cessation at 8-month mark.

of the patients reported pre-existing conditions. Table 1 provides a summary of demographic data of the 6 patients, along with identified motivation for why they desired to stop e-cigarettes. All patients used e-cigarettes for a minimum of 1-year, with the range being 1- to 6-years. With regards to pods per month for the 6 patients, this ranged from 1 pod per month (Patient 4) to 5 pods per month (Patient 1). None of the patients had used combustible cigarettes prior to enrolling in the Clinic and none of the patients had attempted e-cigarette cessation.

Conditional responses

Patients were asked as to when they felt majority of their cravings. All patients identified “time of the day” (specifically, first thing in the morning), “after breakfast,” “anxiety,” and “stress” as variables where they felt their cravings for an e-cigarette the strongest. Other than Patient 6, the remaining patients identified “peer usage” as a significant variable influencing their usage. Patient 1 identified nocturnal awakenings for e-cigarette cravings. Other factors associated with e-cigarette usage included with coffee (Patient 1, Patient 5, Patient 6), alcohol (Patient 3), while driving (all patients except Patient 4), and at work (Patient 2, Patient 3). No one identified living with a person who actively used e-cigarettes.

Pharmacological intervention selection and usage

Nicotine replacement therapy (NRT) was selected by all patients. Patient 4 used NRT nasal spray with approval as well by the patient’s legal guardian. Four patients used controllers in the form of NRT transdermal. Of the 4 patients, 2 of them were also given NRT relievers simultaneously. Patient 5

experienced an intolerance with the NRT nasal spray, resulting in a switch to NRT gum. A summary of the pharmacological interventions is found in Table 1.

All patients received counseling in the form of electronic messaging via cellular devices (delivered twice a month) and telephone calls (monthly). All patients had their respective formal clinical sessions every 3 months. All 6 participants engaged with the electronic messaging, telephone counseling, and clinical visitations. Of note, the clinical visitations beginning in March of 2020 shifted from in-person to telemedicine, affecting only 2 of the 6 patients in the case series.

Outcomes

At the 6-month marking, 3 patients had discontinued e-cigarette usage for a minimum of 7-days. Patient 4 was able to achieve cessation at the 6-week mark, with ultimately weaning off NRT nasal spray by the patient’s second formal clinical visit. Patient 3 achieved e-cigarette cessation at the third month and continued to be e-cigarette independent at the 6-month mark. Patient 5 was able to achieve e-cigarette cessation at the 2-month mark, but relapsed at month 4 (identifies stress). The patient was able to resume pharmacological interventions again, ultimately achieving e-cigarette abstinence at the 6-month mark. Patient 6 had periods of e-cigarette cessation prior to the 6-month mark, with self-reported 2- to 3-day intervals; however, Patient 6 did not achieve a 7-day e-cigarette abstinence until the 8-month mark.

Patients 1 and 2 continued to remain compliant with pharmacological interventions, and engagement with counseling. However, neither was able to achieve cessation at the 6-month

mark, nor at the 12-month mark. Both patients identify ability to wean considerably, with Patient 1 reducing monthly pod-intake to 1 a month and Patient 2 to 2 pods per month. Patient 2 also notes the ability to be e-cigarette independent for 2-day stretches during the week.

All 6 patients reported usage of the pharmacological agents majority of each week. For the 4 patients using NRT transdermals, all 4 reported missing no more than 1 day of usage. As for usage of short-acting NRT products as the sole therapy, Patients 2 and 4 reported consistent non-adherence with their respective products for at times up to 48 hours; these non-adherence moments occurred on weekends. Patient 4 identified lack of stress that resulted in controllable cravings without pharmacological interventions. Patient 2 reported significant peer usage that resulted in e-cigarette usage on weekends.

Barriers to e-cigarette cessation were stress (identified by all 6 patients) and peer usage. While all patients identified both extrinsic (eg, with food, driving) and intrinsic (eg, anxiety) reasons they craved e-cigarettes, with counseling and pharmacological therapy, the patients were able to mitigate and control their respective cravings around all conditional variables. However, the stress and peer usage were barriers that the patients felt strongly they struggled to control their cravings. More so, they felt an immediate calming affect with e-cigarette usage when the craving was around stress, as well as peer acceptance when using e-cigarette usage occurred amongst peers.

Discussion

We report a case series of 6 patients with e-cigarette addiction, without prior mental health or physical co-morbidities, who underwent interventions to assist in e-cigarette cessation. All patients received counseling and pharmacological interventions, specifically nicotine replacement therapies, in an effort to assist in cessation. The data suggest that such interventions can be successful in both reducing e-cigarette usage, as measured by pods per month, and ultimate e-cigarette cessation. Further, these outcomes were achieved with minimal adverse events for patients, reaffirming the ability to allow patients with e-cigarette addictions to achieve reduction and cessation in a comfortable manner.

The patients in this case series received both pharmacological interventions and counseling to assist in discontinuing their e-cigarette usage. As for these interventions, significant evidence exists that emphasize how counseling and nicotine replacement therapies are able to assist adults in quitting combustible cigarettes.^{6,9,12} The patients in this case series were receptive and frequently participated in our individually delivered smoking cessation counseling outside of clinical visits. During these counseling sessions is when they would identify adherence to medication management as well as barriers toward weaning from e-cigarettes use. As for NRTs, these were selected for the patients for 3 reasons. First, all of the 6 patients felt comfortable using NRTs as oppose to an oral non-nicotine

containing medication. Second, the short-acting NRTs were well received due to the ability to use “as needed”; the patients in this case series would discuss that they would use such short-acting agents during moments where their e-cigarette cravings were exceptionally strong (eg, amongst peer users, while stressed). Finally, the patients felt they could titrate and eventually wean from the NRTs in a manner that allowed for more autonomy as oppose to the oral medications. The success of counseling and NRTs in this cohort warrants ongoing consideration for clinical usage and further investigations.

A concern to discuss that arose from our case series is the ability to discontinue e-cigarette usage while engaging with peers who are actively using. E-cigarette companies have expanded the e-cigarette market by targeting and marketing to adolescents, youth, and young adults, while developing e-cigarette flavors that appeal to this age group.^{13,14} Given such targeted marketing and chemical flavoring, youth and young adults are likely to engage in e-cigarette usage along with their peers.¹⁵⁻¹⁷ For instance, friends' cigarette smoking is recognized as a strong predictor of smoking in youth and young adults.¹⁵ Peer usage of e-cigarettes has an important relationship with adolescent and youth e-cigarette use and cessation,¹³ a finding that was reaffirmed in our case series with peer usage identified as a barrier to successful e-cigarette discontinuation. Moving forward, clinicians and public health officials must utilize e-cigarette denormalization strategies in an effort to instill proper e-cigarette perceptions in youth and young adults. Such efforts may both mitigate expansion of e-cigarette usage among adolescents and young adults, as well as aiding the efforts in young patients attempting to achieve e-cigarette cessation.

The study is limited by the small sample size and absence of controls. The benefits of the patients, with e-cigarette consumption resulting in reduction or cessation, is provocative, especially knowing the potential addiction of e-cigarettes. All patients received counseling in addition to pharmacological agents; however, all agents were nicotine replacement therapies. Therefore, future studies should evaluate efficacy of FDA-approved non-nicotine medications for tobacco dependence (varenicline and bupropion) in the ability to help with e-cigarette cessation. Further, it is unclear if other age groups would benefit from similar strategies for e-cigarette cessation, specifically older adults (50 years and older) or youth (age 13-16 years of age). While e-cigarette usage continues to be a public health crisis, especially in the youth, more studies are needed in order to provide guidelines that can be utilized by clinicians.

In conclusion, e-cigarette cessation in youth and young adults is possible utilizing both counseling and nicotine replacement therapies. All patients in this case series reduced e-cigarette consumption or were able to achieve cessation. Further studies should explore such interventions for youth aged 13 to 16 years old with regards to e-cigarette addiction, as well as to see if non-nicotine FDA-approved medications for tobacco dependence may play a significant clinical role for e-cigarette addictions in

the youth and young adults. While e-cigarette addiction continues in youth and young adults, these findings provide insight into potential interventions without major safety risk.

Author Contributions

Panagis Galiatsatos and Raiza Schreiber assisted with the management of the patients and collection of data; Gautam Sikka and MopeninuJesu Oluyinka and Panagis Galiatsatos assisted in the concept and drafting of the manuscript. All authors edited the manuscript and assisted with reviewing patient outcomes.

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