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JOEL BEACHEY: Hello, and welcome back to the Mayo Clinic Medscape video series. I'm Joel Beachey, cardiology fellow at Mayo Clinic. Today, we will be discussing e-cigarettes and their effectiveness for smoking cessation. I'm joined today by Dr. Jon O, Ebbert, internist and addiction researcher here at Mayo Clinic. Welcome.

JON O. EBBERT: Happy to be here.

JOEL BEACHEY: So vaping, specifically through the use of e-cigarettes, has been a hot topic recently. Recently, the surgeon general, Dr. Jerome Adams, actually released a statement that was advising about the concerns and health risks for use of e-cigarettes, specifically amongst young people and adults. But can you tell us, to start off, what is an e-cigarette?

JON O. EBBERT: So an electronic cigarette is it a device that heats an e-liquid. E-liquid has, essentially, four components. It has propylene glycol-- which is a food additive or is in cosmetics-- vegetable glycerin, nicotine, and flavoring agents. Those comprise an e-liquid.

The e-liquid is heated by a device. There's about five different types of metal coils that heat the e-liquid. And that e-liquid device then heats that e-liquid at about 350 degrees or less, creating an aerosol. That aerosol can then be inhaled by the user and can deliver nicotine to the system of the user.

JOEL D. BEACHEY: OK. So what's the difference between a product like an e-cigarette and another type of product like a Nicotrol or a nicotine inhaler.

JON O. EBBERT: So an e-cigarette will aerosolized a liquid and create anywhere from large amounts of vapor to very small amounts of vapor. And there's different products on the market, creating different amounts of aerosol. a Nicotrol inhaler is a product that delivers nicotine, but the nicotine is delivered predominantly to the oral mucosa where it's absorbed. There is no heating involved in a Nicotrol inhaler.

Another important distinction is, what's the difference between an electronic cigarette and burned conventional tobacco? So when you burn conventional tobacco, you're heating that tobacco at about 1,000 degrees Celsius. And that creates tar, which then is deposited in the lungs.

That tar also delivers the nicotine that comes from the burned tobacco. There are about 6,000 chemicals in burned tobacco. E-cigarettes only heat up to no more than 350 degrees, and that creates the aerosol, as I mentioned before. But there aren't as many chemicals in electronic cigarettes as there are in burned conventional tobacco.

JOEL D. BEACHEY: Why do you think that e-cigarettes have become so prevalent, especially amongst young people and young adults?

JON O. EBBERT: That's a great question. I think it's a confluence of a couple of events. Number one is I think that what makes e-cigarettes attractive to youth is that it's a device. Kids are attracted to technology. And essentially, what an e-cigarette is is, essentially, some sort of advanced drug delivery device app. It is a product that delivers nicotine, which is a reinforcing drug or a chemical.

And there have been e-cigarettes that are designed specifically to conceal. You can hide them in your hand. They create very low vapor profiles, that is they're easy to vape and actually not create a lot of aerosol that can be detected. And so it allows patients and individuals to sort of secretly deliver nicotine.

So I think those confluence of events is the technology, advances in the attractiveness of the e-cigarette devices, they're very tailored to the user-- comfort-level, ease, cost-- and then also the fact that kids', adolescents' brains under the age of 25 like to experiment with chemicals many times. Not all kids, but some do.

And those kids that are experimenting with chemicals have an easy access to nicotine, which is a legal substance. And so it's something that I think that those confluence of events have really sort of predicted or would have predicted the current crisis or epidemic we have with youth using electronic cigarettes.

JOEL D. BEACHEY: Sure. So e-cigarettes are frequently marketed as a more safe alternative to traditional cigarettes. But what are some of the risks of using an e-cigarette?

JON O. EBBERT: So that's a great question. So as I mentioned, conventional cigarettes have about 6,000 chemicals or so. Electronic cigarettes are relatively less complex from the chemicals produced in the aerosol. And when we look at those chemicals, if you took electronic cigarette fluid or e-liquid and you looked at the chemical species in there and then compared that to the chemicals in the aerosol, at least 16 new chemical species are created through the heating process even though it's only up to 350 degrees.

And those chemical species that are created include things like free oxygen radicals, polycyclic aromatic hydrocarbons and reactive oxygen species and carbonyl species like formaldehyde. Those are created through the heating process. And although it's low temperature heating relative to a conventional cigarette, it still creates a lot of potentially dangerous substances that repeatedly get inhaled into the lungs. And so the risk really is associated with the exposure to these new chemical species that are created.

And I think that the other thing you need to think about is we don't really know what the long-term risks of repeated inhalation of vegetable glycerin and propylene glycol, which are two chemicals in electronic cigarettes-- we know those are safe as food additives. But once you inhale something, it's a very different prospect and a very different risk prospect than something that you take orally. Right? So I think we need to think about those risks. And so the risks would be to the lungs, and then also, potentially, to the heart. I think those are things that we need to consider.

JOEL D. BEACHEY: Are e-cigarettes any less addictive than traditional cigarettes?

JON O. EBBERT: Also a great question that requires a little bit of a more detailed answer. When we talk about addictiveness of a chemical, the addictiveness of any chemical is directly related to how quickly it gets into the central nervous system and in what concentration. So inhaled drugs such as nicotine or inhaled cocaine, for that matter-- inhaled substances that are potentially addictive are delivered to the brain faster, therefore potentially more reinforcing and potentially more addictive.

The issue with the electronic cigarette is that, at least in some of the products that are used on the market today, there's a lot of nicotine being delivered. But it's not necessarily being delivered in the same way that nicotine is delivered by a conventional tobacco cigarette.

So although there might be more total nicotine in e-liquid that's vaporized in an electronic cigarette, a lot of that nicotine is absorbed in the upper airway, in the mouth and in the throat. And it's not delivered at the same speed or in the same concentration as inhaled tobacco smoke with nicotine in it is. And that has a lot to do with the chemistry of tobacco and the chemistry of electronic cigarettes.

So lots of nicotine is delivered, but it's very difficult to really make a clear statement about relative addictive potential because the mechanisms of delivery are so very different.

JOEL D. Sure. Can e-cigarettes be an effective tool for smoking cessation?

BEACHEY:

JON O. EBBERT: There was a study that was published in *The New England Journal of Medicine* that compared the effectiveness of electronic cigarettes compared to nicotine replacement such as the nicotine patch or the gum or the nicotine lozenge in smokers who wanted to quit. So they randomized smokers who wanted to quit to take the e-cigarette or take the nicotine replacement therapy.

In that one year, electronic cigarettes nearly doubled the odds of quitting compared to the nicotine replacement therapy. The issue that was brought up with that particular study was that many of the people who used the electronic cigarette to quit actually were still on the e-cigarette by the end of the study, whereas most of the patients given the nicotine replacement therapy weren't on nicotine replacement therapy still.

So the question was, well, yeah, they quit, but they're still using the electronic cigarette. The most interesting finding is that very few of them were actually on an electronic cigarette delivering nicotine in any reasonably high concentration. So they were started on a particular e-cigarette with a concentration of nicotine that was in the normal or medium or moderate range.

But most of those patients, even though they were still on e-cigarettes, were using e-liquid that had zero nicotine in it. So it looks like they were still using the e-cigarette, but they were tapering off the nicotine. So the question is, what does that mean from a public health perspective? And I still think that's debated.

JOEL D. So should e-cigarettes be recommended to patients for smoking cessation from your perspective?

BEACHEY:

JON O. EBBERT: So we've heard many experts say that electronic cigarettes are 95% safer than conventional cigarettes, and that's just looking at the relative concentrations and the types of chemicals in electronic cigarettes compared to conventional cigarettes. So that's what the 95% safer means, but they're not completely safe. These products deliver these chemical species that we talked about.

There are a lot of things that manufacturers can do. And we recently completed a systematic review of the literature looking at all of the design elements that go into electronic cigarettes. And we looked at all those components that go into the manufacturing of those electronic cigarettes and identified some discrete things that manufacturers and regulatory officials can do to make them safer, and we ask that they make them safer.

Right now, with the Nicotine Dependence Center at the Mayo Clinic, we do not recommend electronic cigarettes for the treatment of tobacco dependence. Patients who are using them, we don't tell them to stop it, but we say that they need to use recommended tobacco treatment approaches that we traditionally use such as varenicline and bupropion and nicotine replacement therapy. And so we're not recommending it. And we think that these products need to be made safer, but they need to be made safer in a structured way through manufacturing or regulatory practice.

I will make one other comment that the huge caveat to that is I do not think that any adolescent under the age of 25 should be using any potentially addictive substance, period. So when we talk about electronic cigarettes and whether it's used for smoking cessation, it's a very different conversation than thinking about the current epidemic among adolescents.

My belief, as an addiction expert, is anytime you expose a brain younger than the age of 25 to a potentially addictive substance, you fundamentally change that neurochemistry forever, and that we really need to protect our kids and restrict access to these devices for our adolescents.

JOEL D. BEACHEY: Sure. So it sounds like, at this point, e-cigarettes are not something that we would typically recommend to patients for smoking cessation. However, if a patient were to come to you and say, without e-cigarettes, I'd be smoking traditional cigarettes, what do you say to that patient who says that e-cigarettes helped them quit and they feel like that was the thing that helped them?

JON O. EBBERT: So I support them in their quit. I talk to them about the risks that we just talked about, which are theoretical. There is some lung disease out there right now that we're talking about on the news that I think may be more related to other substances, non-nicotine substances in these e-cigarettes.

So apart from that, I tell them about the risks. We discuss options for coming off of the electronic cigarettes including nicotine weaning or reducing the nicotine concentration in electronic cigarettes or using nicotine replacement therapy-- bupropion, varenicline-- to get them to quit the electronic cigarette.

JOEL D. BEACHEY: Sure. Well, thanks, Dr. Ebbert, for joining us here today, and thanks for your important insights. It's a very important topic that I think we're going to continue to hear more about as we have more research into this area. So thanks again for joining us.

JON O. EBBERT: Great, pleasure being here.

JOEL D. BEACHEY: And thank you, audience, for joining us today on the theheart.org Medscape Cardiology.