The Effect of Nicotine Vaccines on Smoking Cessation for Adults: An Updated Systematic Review

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Opportunity

• The proposed mechanism of nicotine vaccines is to produce antibodies that bind to nicotine in the bloodstream to downregulate nicotine stimulus effects. Increased amounts of antibodies may result in a decreased amount of nicotine crossing the blood brain barrier and, consequently, decreased stimulation of the reward pathway in the brain when smoking a cigarette.
• Currently, it is hypothesized that nicotine vaccines will result in a dissociation of tobacco use and stimulation of the reward pathway and aid in the process of smoking cessation by decreasing symptoms of withdrawal, craving, and relapse.
• Niccine and NicVAX are examples of novel nicotine vaccines that are being evaluated for clinical efficacy and safety.

This is an update to the Cochrane review published in 2012, including 10 additional articles from 2013 to 2016.

• Aim 1 is to evaluate the role of nicotine vaccines in the process of smoking cessation and preventing the occurrence of relapse.
• Aim 2 is to determine the efficacy of nicotine vaccines by measuring antibody development, which is the proposed mechanism of nicotine vaccines.

Approach

• Searches were initiated on Google Scholar, Pubmed, MEDLINE, EMBASE, PsycINFO, and clinicaltrials.gov.
• Randomized controlled trials, observational studies, and preclinical studies from 2013 to 2016 were utilized in this updated review.

Results

• In a Niccine trial (n=355), non-relapse rate was 43.3% in the experimental group versus 51.1% in placebo (95% CI -20.6% to 4.9%).
• In a Niccine plus varenicline trial (n=558), there was no significant difference in cessation at 12 months (33.8% versus 33.2% placebo, 95% CI 0.73 to 1.46). Experimental participants with high NicAb levels had a 42.2% cessation rate at 12 months versus 33.2% placebo (95% CI 0.89 to 2.42).
• One trial found that despite higher NicAb levels, there was no difference in brain activity in response to smoking cues between NicVAX and placebo.
• One cohort study (n=71) concluded that NicVAX reduced nicotine binding by 12.5% to nicotinic acetylcholine receptors (p=0.05).
• One primate study found that a nanoparticle-based vaccine significantly reduced stimulation by nicotine.
• Three preclinical studies found that hapten antigens, adjuvant use, and intradermal formulation induced higher NicAb levels.
• All studies were assessed at low or moderate risk of bias in at least one domain. Due to broad lack of significant findings and risk of bias in the body of evidence for nicotine vaccines, the evidence judge that the body of evidence for nicotine vaccines is weak.

Impact

• The unique feature about my innovation/research is: the updating of a Cochrane systematic review about developmental vaccines.
• This addresses the problem of: evaluating recent studies on nicotine vaccines' role in smoking cessation.
• The evidence is lacking to support nicotine vaccine use in smoking cessation.
• There is a non-significant association of NicAb level and cessation rate.
• Higher dosing and frequent administration may be associated with higher cessation rates.
• Preclinical studies support that nanoparticle-based vaccines may reduce nicotine discrimination.
• Preclinical studies support that incorporation of hapten antigens and intradermal delivery may increase NicAb levels.
• Future research with Phase III clinical trials, randomized control trials, and larger studies are needed to elucidate the role of nicotine vaccines with respect to antibody level, immunogenicity, dosage form, adjuvant use, and dosing regimen.
• Longer follow-up of greater than 12 months is needed with patients in clinical studies to elucidate the longitudinal effects of nicotine vaccination with respect to antibody level.

References