Five Vaccine Myths Debunked

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Common Vaccine Misconceptions and Fears

Considerable discussion about the effectiveness and safety of vaccines has led to debate about the usefulness of vaccination in general, and especially in defined populations. In this article, we comment on data that refute five common misconceptions and fears related to vaccines.

Myth 1: Vaccination Is No Longer Necessary

The belief that vaccination is no longer necessary stems from the misunderstanding that most of the illnesses for which we are vaccinated have disappeared. It is true that diseases that used to be common in the past—some of which, such as diphtheria and poliomyelitis, have been associated with considerable morbidity—have become rare in developed countries, to the point that people and perhaps even some healthcare professionals believe that these diseases have now disappeared. This, however, is not true. In fact, the only infectious disease that has officially been eradicated globally is smallpox, with the last naturally occurring case in 1977 in Somalia.[1] Of course, vaccines have achieved substantial reductions in the incidence of several infectious diseases, including tetanus, diphtheria, pertussis (whooping cough), congenital rubella, measles, mumps, and poliomyelitis.[2-4]

The case of measles demonstrates the importance of mass vaccination for the prevention of severe diseases. Measles is a highly contagious viral illness with potentially severe complications. It was very common in the United States before vaccination was introduced in 1963, with an estimated 4 million cases and 450 deaths related to measles annually. In 2000, endemic measles was declared eradicated from the United States, but cases have still been imported from other countries.[5] In 2015, a total of 159 cases of measles were reported in the United States. The vast majority of these patients had not received the vaccine (45%) or had an unknown vaccination status (38%).[6]

The increasing number of people who choose not to get vaccinated may lead to problems related to attenuated "herd immunity." It is frequently unappreciated by the public and scientists that herd immunity protects vulnerable population groups that cannot receive complete vaccination (such as immunocompromised patients) from potentially severe, life-threatening illnesses, by reducing the probability of transmission of infectious diseases from other members of the community.[7]

Myth 2: Vaccines Cause Autism

This myth is a very common argument against vaccination and stems mainly from the 1998 *Lancet* publication by Andrew Wakefield and associates.[8] In this article, Wakefield suggested an association between measles, mumps, and rubella (MMR) vaccination and autism, based on eight cases, prompting significant concern about the safety of vaccines. However, after extensive investigation, several important issues related to this research were identified, including severe methodological inconsistencies and conflicts of interest. This controversy resulted in a partial retraction of the article by the *Lancet* in 2004,[9] followed by a full retraction in 2010.[10] The main author of the study also had his license to practice medicine in England revoked by the General Medical Council owing to serious professional misconduct.[11]

Nevertheless, these allegations were originally taken seriously by the medical community and subsequently, several well-designed, epidemiological studies were performed to evaluate a possible association between the administration of vaccines and autism.[12] A 2011 meta-analysis[13] evaluated the data collected from five cohort studies (involving 1,256,407 children) and five case/control studies (involving 9920 children) on the association between vaccines and the development of autism or autism spectrum disorders. No association was found between the MMR vaccine and autism (odds ratio [OR], 0.84; 95% confidence interval [CI], 0.70-1.01).

In addition, two vaccine components (thimerosal and mercury) that have also been accused of causing autism have been further studied.[14] No association was found between thimerosal (OR,1.00; 95% CI, 0.77-1.31) or mercury (OR,1.00; 95% CI, 0.93-1.07) and autism.

Although the association between MMR vaccination and autism has been disproven, it should be emphasized that the considerable burden of morbidity and mortality of potentially preventable infectious diseases is certain, including deaths due to diphtheria in developed countries; for example, the death of a 6-year-old boy in Spain in 2015[15] and a 3-year-old girl in Belgium in 2016,[16] both of whom had not been vaccinated.

Myth 3: Vaccines Cause Autoimmune Disease

The role of vaccination in the pathogenesis of autoimmune diseases (presumably by triggering autoimmunity) has long been a matter of debate. Although the cause of these diseases is still unclear, several factors, including genetic predisposition, environmental factors, and infectious diseases, may play a role.[17]

The relationship between vaccines and autoimmunity is still under study; however, no definitive evidence supporting a causative association exists to date. Most of the data linking vaccines with autoimmunity comes from case studies,[18] which are considered to offer a low level of evidence. So far, no large epidemiologic studies have been conducted to provide us with relevant compelling clinical evidence.[19] Given the nature and heterogeneity of autoimmune disorders, such studies are very difficult to be performed.

Autoimmune/autoinflammatory syndrome induced by adjuvants (ASIA) was recently introduced as a classification for a range of emerging autoimmune diseases potentially related to vaccine adjuvants (substances that enhance a vaccine's immunogenicity).[20] ASIA attracted a lot of medical attention, with a large number of papers discussing the subject. However, it remains a theoretical concept with very general inclusion criteria and without sufficient clear clinical data, at least at this time.[21]

Studies have examined the incidence of autoimmune diseases in vaccinated vs unvaccinated groups. None have shown that vaccines cause an increase in any autoimmune disease.[22,23] Our opinion is that this theoretical risk should not prevent us from supporting vaccinations, in view of their undeniable benefits.

Myth 4: Influenza Is a Harmless Illness, so Vaccination Is Unnecessary

Although influenza is commonly considered to be a mild illness, this is certainly not always the case. Influenza is a large threat to public health, with three pandemics and millions of deaths from influenza in the 20th century. During the last pandemic period of the H1N1 virus (June 11, 2009 to August 1, 2010), 18,449 deaths were attributed to influenza, although the global death rate was certainly higher.[24]

Influenza can have serious complications, including severe pneumonia, and extrarespiratory complications, such as encephalopathy and myocarditis.[25] In addition, a considerable number of deaths related to cardiac and pulmonary complications typically follow influenza epidemics. Particularly among the elderly, people with underlying medical conditions, and pregnant women, the risk for influenza-associated complications is higher and flu vaccination is strongly recommended.[26]

Myth 5: Vaccines Should Not Be Administered to Pregnant Women

Most vaccines are not only safe during pregnancy, but they are recommended. Two vaccines are especially important for pregnant women: Tdap (tetanus, diphtheria, acellular pertussis) vaccine (preferably given between 27 and 36 weeks of pregnancy[27]) and influenza vaccine. Tetanus, pertussis, and influenza are diseases with potentially severe consequences for the child and/or the mother that can be prevented through vaccination. The vaccination of a pregnant woman against pertussis offers substantial protection of the newborn against this infection.[28]

An evaluation of the available data suggests that vaccines containing inactivated microorganisms are safe for administration during any week of pregnancy. Influenza, in particular, can be very severe during pregnancy, thus it is recommended that pregnant women receive flu vaccination during flu season.[29] The safety of influenza vaccination has been evaluated in various studies. In a meta-analysis,[30] no association was found between influenza vaccination and congenital malformations, in any trimester (OR, 0.96; 95% CI, 0.86-1.07). Hepatitis B, pneumococcal polysaccharide, and meningococcal polysaccharide vaccines have also been evaluated and were found to be safe for administration during pregnancy.[31]

Live-virus vaccines, such as the vaccine against varicella-zoster virus and MMR, are not recommended 1 month before or during pregnancy, owing to the potential risk for transmission of the virus to the fetus. Although retrospective studies of

women who received live-virus vaccinations while pregnant did not demonstrate higher risk for congenital infection, the administration of live-virus vaccines continues to be contraindicated in pregnancy.[32-34]

Take-Home Messages for Clinicians

Several myths and speculations currently exist around vaccinations. Even though there is insufficient scientific evidence supporting those fears, they have become real threats to the success of public health vaccination programs. Unfortunately, a considerable number of people refuse vaccinations for themselves or their children as a result of misinformation and fear.[35]

While we support further research on achieving higher effectiveness of future vaccines (eg, for influenza) and studies on the immunogenicity of vaccines, it is essential for the healthcare community to support vaccinations and help boost compliance with vaccination programs.

References

1. Moss B. Smallpox vaccines: targets of protective immunity. Immunol Rev. 2011;239:8-26.
2. Aylward RB, Acharya A, England S, Agocs M, Linkins J. Global health goals: lessons from the worldwide effort to eradicate poliomyelitis. Lancet. 2003;362:909-914.
3. Barrett S. Eradication versus control: the economics of global infectious disease policies. Bull World Health Organ. 2004;82:683-688.
4. Wagner KS, White JM, Lucenko I, et al; Diphtheria Surveillance Network. Diphtheria in the postepidemic period, Europe, 2000-2009. Emerg Infect Dis. 2012;18:217-225.
5. Goodson JL, Seward JF. Measles 50 years after use of measles vaccine. Infect Dis Clin North Am. 2015;29:725-743.
6. Clemmons NS, Gastanaduy PA, Fiebelkorn AP, Redd SB, Wallace GS; Centers for Disease Control and Prevention (CDC). Measles—United States, January 4-April 2, 2015. MMWR Morb Mortal Wkly Rep. 2015;64:373-376.
7. Metcalf CJ, Ferrari M, Graham AL, Grenfell BT. Understanding herd immunity. Trends Immunol. 2015;36:753-755.
8. Wakefield AJ, Murch SH, Anthony A, et al. Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. Lancet. 1998;351:637-641.
9. Murch SH, Anthony A, Casson DH, et al. Retraction of an interpretation. Lancet. 2004;363:750.
10. Retraction—ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. Lancet. 2010;375:445.
11. Flaherty DK. The vaccine-autism connection: a public health crisis caused by unethical medical practices and fraudulent science. Ann Pharmacother. 2011;45:1302-1304.
12. Gerber JS, Offit PA. Vaccines and autism: a tale of shifting hypotheses. Clin Infect Dis. 2009;48:456-461.
13. Parker SK, Schwartz B, Todd J, Pickering LK. Thimerosal-containing vaccines and autistic spectrum disorder: a critical review of published original data. Pediatrics. 2004;114:793-804.
14. Taylor LE, Swerdfeger AL, Eslick GD. Vaccines are not associated with autism: an evidence-based meta-analysis of case-control and cohort studies. Vaccine. 2014;32:3623-3629.
15. European Center for Disease Prevention and Control. Rapid risk assessment. A case of diphtheria in Spain. June 15, 2015. http://ecdc.europa.eu/en/publications/Publications/diphtheria-spain-rapid-risk-assessment-june-2015.pdf Accessed December 15, 2016.
16. European Center for Disease Prevention and Control. Rapid risk assessment. A fatal case of diphtheria in Belgium. March 24, 2016. http://ecdc.europa.eu/en/publications/Publications/RRA-Diphtheria-Belgium.pdf Accessed December

15, 2016.

17. Perricone C, Agmon-Levin N, Shoenfeld Y. Novel pebbles in the mosaic of autoimmunity. BMC Med. 2013;11:101.

18. Zafrir Y, Agmon-Levin N, Paz Z, Shilton T, Shoenfeld Y. Autoimmunity following hepatitis B vaccine as part of the spectrum of 'autoimmune (auto-inflammatory) syndrome induced by adjuvants' (ASIA): analysis of 93 cases. Lupus. 2012;21:146-152.

19. van der Laan JW, Gould S, Tanir JY; ILSI HESI Vaccines and Adjuvants Safety Project Committee. Safety of vaccine adjuvants: focus on autoimmunity. Vaccine. 2015;33:1507-1514.

20. Shoenfeld Y, Agmon-Levin N. 'ASIA'—autoimmune/inflammatory syndrome induced by adjuvants. J Autoimmun. 2011;36:4-8.

21. Hawkes D, Benhamu J, Sidwell T, Miles R, Dunlop RA. Revisiting adverse reactions to vaccines: a critical appraisal of autoimmune syndrome induced by adjuvants (ASIA). J Autoimmun. 2015;59:77-84.

22. Batista-Duharte A, Portuondo D, Perez O, Carlos IZ. Systemic immunotoxicity reactions induced by adjuvanted vaccines. Int Immunopharmacol. 2014;20:170-180.

23. Pellegrino P, Perrone V, Pozzi M, et al. The epidemiological profile of ASIA syndrome after HPV vaccination: an evaluation based on the Vaccine Adverse Event Reporting Systems. Immunol Res. 2015;61:90-96.

24. World Health Association. Pandemic (H1N1) 2009—update 112. August 6, 2010. http://www.who.int/csr/don/2010_08_06/en/ Accessed December 15, 2016.

25. Kuiken T, Taubenberger JK. Pathology of human influenza revisited. Vaccine. 2008;26 Suppl 4:D59-D66.

26. Mereckiene J, Cotter S, Nicoll A, et al; VENICE Project Gatekeepers Group. Seasonal influenza immunisation in Europe. Overview of recommendations and vaccination coverage for three seasons: pre-pandemic (2008/09), pandemic (2009/10) and post-pandemic (2010/11). Euro Surveill. 2014;19:20780.

27. Centers for Disease Control and Prevention (CDC). Updated recommendations for use of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis vaccine (Tdap) in pregnant women and persons who have or anticipate having close contact with an infant aged <12 months—Advisory Committee on Immunization Practices (ACIP), 2011. MMWR Morb Mortal Wkly Rep. 2011;60:1424-1426.

28. Suryadevara M, Domachowske JB. Prevention of pertussis through adult vaccination. Hum Vaccin Immunother. 2015;11:1744-1747.

29. Cleary BJ, Rice U, Eogan M, Metwally N, McAuliffe F. 2009 A/H1N1 influenza vaccination in pregnancy: uptake and pregnancy outcomes—a historical cohort study. Eur J Obstet Gynecol Reprod Biol. 2014;178:163-168.

30. Polyzos KA, Konstantelias AA, Pitsa CE, Falagas ME. Maternal influenza vaccination and risk for congenital malformations: a systematic review and meta-analysis. Obstet Gynecol. 2015;126:1075-1084.

31. Makris MC, Polyzos KA, Mavros MN, Athanasiou S, Rafailidis PI, Falagas ME. Safety of hepatitis B, pneumococcal polysaccharide and meningococcal polysaccharide vaccines in pregnancy: a systematic review. Drug Saf. 2012;35:1-14.

32. Badilla X, Morice A, Avila-Aguero ML, et al. Fetal risk associated with rubella vaccination during pregnancy. Pediatr Infect Dis J. 2007;26:830-835.

33. Castillo-Solorzano C, Reef SE, Morice A, et al. Rubella vaccination of unknowingly pregnant women during mass campaigns for rubella and congenital rubella syndrome elimination, the Americas 2001-2008. J Infect Dis. 2011;204 Suppl 2:S713-717.

34. Wilson E, Goss MA, Marin M, et al. Varicella vaccine exposure during pregnancy: data from 10 Years of the pregnancy registry. J Infect Dis. 2008;197 Suppl 2:S178-184.

35. Falagas ME, Zarkadoulia E. Factors associated with suboptimal compliance to vaccinations in children in developed countries: a systematic review. Curr Med Res Opin. 2008;24:1719-1741.

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