INTERNATIONAL RESEARCH JOURNAL OF PHARMACY **ISSN 2230 – 8407**
Available online http://www.irjponline.com
Review Article

AN EMERGING APPROACH IN VACCINE DRUG DELIVERY SYSTEM – NANOPARTICLE OR NANOSIZED VACCINE

Rajiv Jaithlia*[1], Chetan Chouhan[1], Suresh K. Dev[1], Nishima Agarwal[2]
[1]Lachoo Memorial College of Sciences and Technology, Pharmacy Wing, Jodhpur, Rajasthan, India
[2]B.N. Girls College of Pharmacy, Udaipur, Rajasthan, India

Article Received on: 19/05/11 Revised on: 23/06/11 Approved for publication: 09/07/11

* Rajiv Jaithlia, 48, Indira Nagar, Jaipur road, Madanganj-Kishangarh, Distt. - Ajmer-305801,Rajasthan, India, E-mail: rajivjaithlia@gmail.com,

ABSTRACT
The present study shows new era in nanotechnology, here designed a new type of nanoparticles that could effectively and safely deliver vaccines for diseases such as HIV and malaria. They engineered nanoparticles, made of concentric fatty globules, which they claim may be effective carriers of artificial viral proteins. These synthetic particles elicit a strong immune response comparable to that produced by live virus vaccines, but should be much safer.
KEYWORDS: Nanoparticle, Nanotechnology, Viral vaccine.

INTRODUCTION

A vaccine is a biological preparation that improves immunity to a particular disease. A vaccine typically contains an agent that resembles a disease-causing microorganism, and is often made from weakened or killed forms of the microbe or its toxins. The agent stimulates the body's immune system to recognize the agent as foreign, destroy it, and "remember" it, so that the immune system can more easily recognize and destroy any of these microorganisms that it later encounters. Vaccines protect the body by exposing it to an infectious agent that primes the immune system to respond quickly when it encounters the pathogen again. In many cases, a dead or disabled form of the virus is used. Other vaccines consist of a synthetic version of a protein or other molecule normally made by the pathogen.[1, 2, 3] [figure- 1]

GENERAL METHOD FOR PREPARATION OF NANOVACCINE

Preformulation studies for vaccine

For designing a vaccine, we try to provoke at least one of the human body's two major players in the immune response: T cells, which attack body cells that have been infected with a pathogen; or B cells, which secrete antibodies that target viruses or bacteria present in the blood and other body fluids. For diseases such as HIV, the pathogen tends to stay inside cells, a strong response from a type of T cell known as "killer" T cell is required. The best way to provoke these cells into action is to use a killed or disabled virus, but that cannot be done with HIV because it's difficult to render the virus harmless. There is danger of using live viruses, so trails are in way for synthetic vaccines for HIV and other viral infections such as hepatitis B, which are safer and do not elicit a very strong T cell response.[2,4]

Preparation of Nanovaccines

Trails have done for encasing the vaccines in fatty droplets called liposomes, which could help promote T cell responses by packaging the protein in a virus-like particle. But, these liposomes have poor stability in blood and body fluids. New development, nanovaccine created vaccine-delivering nanoparticles by placing lipid spheres inside one another.[1]

This gives liposomes by packaging many of the droplets together in concentric spheres. Once the liposomes are fused together, adjacent liposomes walls are chemically "stapled" to each other, making the structure more stable and less likely to break down too quickly following injection.[2,6]

Mechanism of action

Once the nanoparticles are absorbed by a cell, they degrade quickly, releasing the vaccine and provoking a T cell response.[1, 5, 6]

Testing

Various trails done on mice, the nanoparticles to deliver a protein called ovalbumin, an egg-white protein (commonly used in immunology studies because biochemical tools are available to track the immune response to this molecule), they found that three immunizations of low doses of the vaccine produced a

strong T cell response after immunization, up to 30 percent of all killer T cells in the mice were specific to the vaccine protein.[1, 2]

Uses

- Nanoparticles ability to deliver malaria vaccine in mice.
- To deliver antigen of viral infections, i.e. HIV virus and Hepatitis B virus.[1, 2, 4, 7]

Advantages

- Nanovaccines have potential to deliver safe and more effective vaccine.
- Encapsulated nanoparticles easily deliver antigen, protects the antigen from degradation and is found to be effective with a single dose due to slow release of the antigen.
- A low dose of antigen is required, and efficient processing by antigen presenting cells and stability during storage. [7, 8, 9]

Disadvantages

- Cost of production.
- Nanoparticles may change shape, size but not composition, which may change their toxicity.
- Reproducibility of formulation during manufacturing is one of the major hurdles in the use of nanoparticles as vaccines.[7, 8, 9]

CONCLUSION

Strongest T cell responses generated by Nanovaccine in compare to strong viral vaccines. These synthetic particles elicit a strong immune response comparable to that produced by live virus vaccine but should be much safer.[1, 2, 5]

- Scientists are trying to develop the nanoparticles to deliver cancer vaccines and HIV vaccines.
- Carbon nanotubes may be used to deliver vaccine.
- Nanoemulsion may deliver smallpox, influenza, anthrax and HIV vaccine.[1, 7, 8, 9]

REFERENCES

1. Anne Trafton, MIT News Office, Massachusetts Institute of Technology. Editorial adaptations by Science Daily staff. Available from URL: http://web.mit.edu/newsoffice/2011/nano-sized-vaccines-0222.html. accessed on 12/05/2011
2. http://blogs.terrapinn.com/vaccinenation/2011/03/06/nano-sized-vaccines/ accessed on 15/05/2011
3. http://www.zeitnews.org/nanotechnology/nano-sized-vaccines.html. accessed on 16/05/2011
4. http://nanotechnologytoday.blogspot.com/2011/03/mit-engineers-have-designed-new-type-of.html accessed on 17/05/2011
5. http://mhs.blog.ui.ac.id/ahmad054/archives/2011/02/224 accessed on 17/05/2011
6. http://www.zeitnews.org/nanotechnology/nano-sized-vaccines.html accessed on 18/05/2011
7. Recent Developments In Nanovaccine, Available from URL:http://www.slideshare.net/akk786/recent-developments-in-nanovaccine accessed on 18/05/2011
8. Dhruba JB et. al., Novel nanoparticles for the delivery of recombinant hepatitis B vaccine, Nanomedicine: Nanotechnology, Biology, and Medicine 2008; 4: 311-317.
9. Zhengrong et. al., The effect of co-administration of adjutants with a nanparticle-based genetic vaccine delivery system on the resulting immune responses, European Journal of Pharmaceutics and Biopharmaceutics 2003: 55.

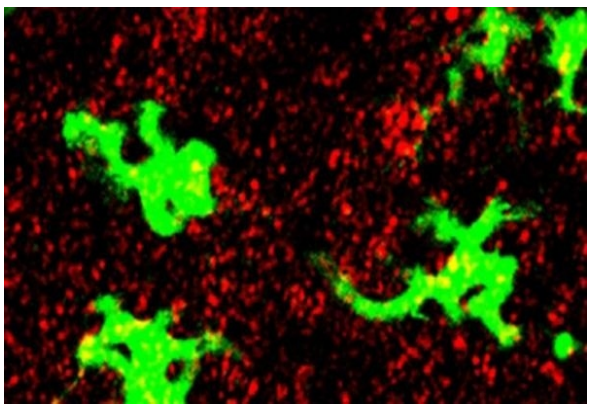

Figure 1: Nanovaccine