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E-Content

IFTM University, Moradabad

Presentation on

Vaccines

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Pharmacy academy

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VACCINES

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Introduction

Definition:

A vaccine is a biological preparation that improves immunity to a particular disease. It contains certain agents that not only resembles a disease-causing microorganism but it also stimulates body's immune sustem recognize the foreign agents.

History:

•British physician Edward Jenner, who in 1796 used the cowpox virus (*Latin variola vaccinia*) to confer protection against smallpox.

•In 1885 the French microbiologist Louis Pasteur and Emile Roux developed the first vaccine against rabies.

(Ref: www.wikipedia.org, www.britannica.com, www.pathmicro.med.sc.edu)

Types

Vaccines are dead or inactivated organisms or purified products derived from them. There are several types of vaccines in use. They are:

- Whole-Organism Vaccines
  - Killed
  - Attenuated

- Purified Macromolecules as Vaccines
  - Toxoids
  - Capsular polysaccharides
  - Recombinant microbial antigens/Surface antigens

- Recombinant vaccine

- DNA vaccine

- Multivalent Subunit Vaccines

(Ref: Kuby, book for Immunology)

Whole-Organism Vaccines

Many of the common vaccines currently in use consist of inactivated (killed) or live but attenuated (avirulent) bacterial cells or viral particles.

- Killed/Inactivated.
- Attenuated.

Killed/ Inactivated: Some vaccines contain killed, but previously virulent, micro-organisms that have been destroyed with chemicals, heat, radioactivity or antibiotics.

Attenuated: Some vaccines contain live, attenuated microorganisms. Many of these are live viruses that have been cultivated under conditions that disable their virulent properties, or which use closely related but less dangerous organisms to produce a broad immune response.

(Ref: Kuby, book for Immunology)

Classification of common vaccines for humans:

Disease or pathogen	Type of vaccine
WHOLE ORGANISMS	
Bacterial cells	
Anthrax	**Inactivated**
Cholera	**Inactivated**
Pertussis*	**Inactivated**
Plague	**Inactivated**
Tuberculosis	**Live attenuated**
Typhoid	**Live attenuated**

(Ref: Kuby, book for Immunology)

Disease or pathogen	Type of vaccine
Viral particles	
Hepatitis A	**Inactivated**
Influenza	**Inactivated**
Measles	**Live attenuated**
Polio (Sabin)	**Live attenuated**
Polio (Salk)	**Inactivated**
Rabies	**Inactivated**
Rotavirus	**Live attenuated**
Varicella zoster (chickenpox)	**Live attenuated**
Yellow fever	**Live attenuated**

(Ref: Kuby, book for Immunology)

Purified Macromolecules as Vaccines

- Inactivated exotoxins.
- Capsular polysaccharides.
- Recombinant microbial antigens/Surface antigens.

(Ref: Kuby, Book for Immunology)

Inactivated exotoxins/Toxoid

• Toxoids are vaccines which consist of exotoxins that have been inactivated, either by heat or chemicals. These vaccines are intended to build immunity against the toxins, but not necessarily the bacteria that produce the toxins.

• Some examples are botulinum antitoxin and diphtheria antitoxin.

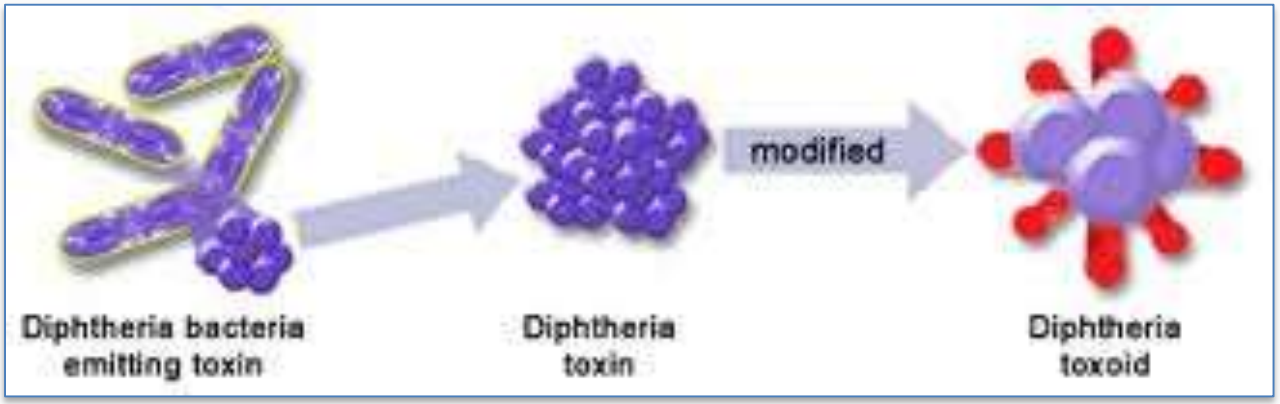


Fig: Modification of toxin to toxoid

(Ref: Kuby, www2a.cdc.gov)

Capsular polysaccharides

- The virulence of some pathogenic bacteria depends primarily on the anti phagocytic properties of their hydrophilic polysaccharide capsule.

- Coating of the capsule with antibodies and or complement greatly increases the ability of macrophages and neutrophils to phagocytose such pathogens.

- The current vaccine for Streptococcus pneumoniae, which causes pneumococcal pneumonia, consists of 23 antigenically different capsular polysaccharides.

(Ref: Kuby, www2a.cdc.gov)

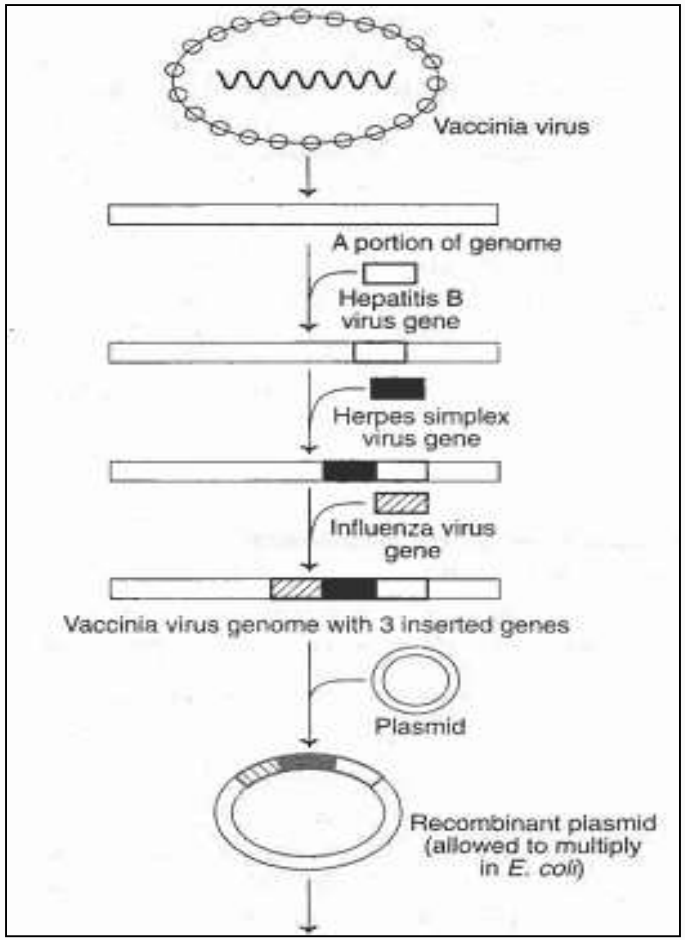
Recombinant microbial antigens/Surface antigen

• The gene encoding any immunogenic protein can be cloned and expressed in bacterial, yeast, or mammalian cells using recombinant DNA technology.

• The first such recombinant antigen vaccine approved for human use is the hepatitis B vaccine. This vaccine was developed by cloning the gene for the major surface antigen of hepatitis B virus (HBsAg) and expressing it in yeast cells.

(Ref: Kuby, book for Immunology)

Recombinant Vaccines:



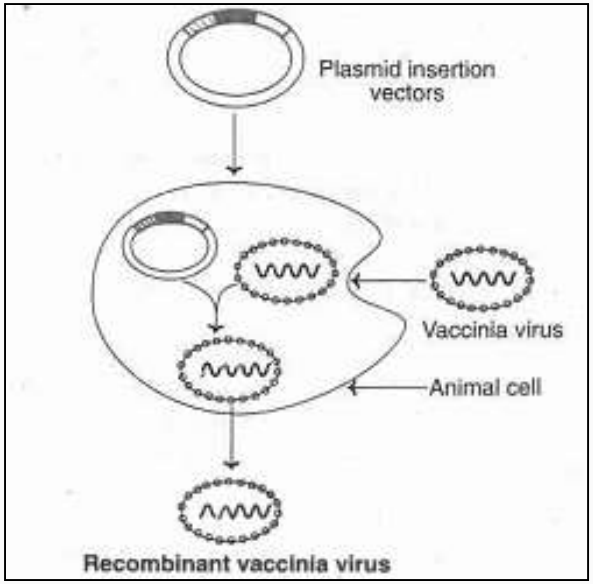


Fig: Production of vaccinia vector vaccine.

(Ref: Kuby, book for Immunology)

DNA Vaccines:

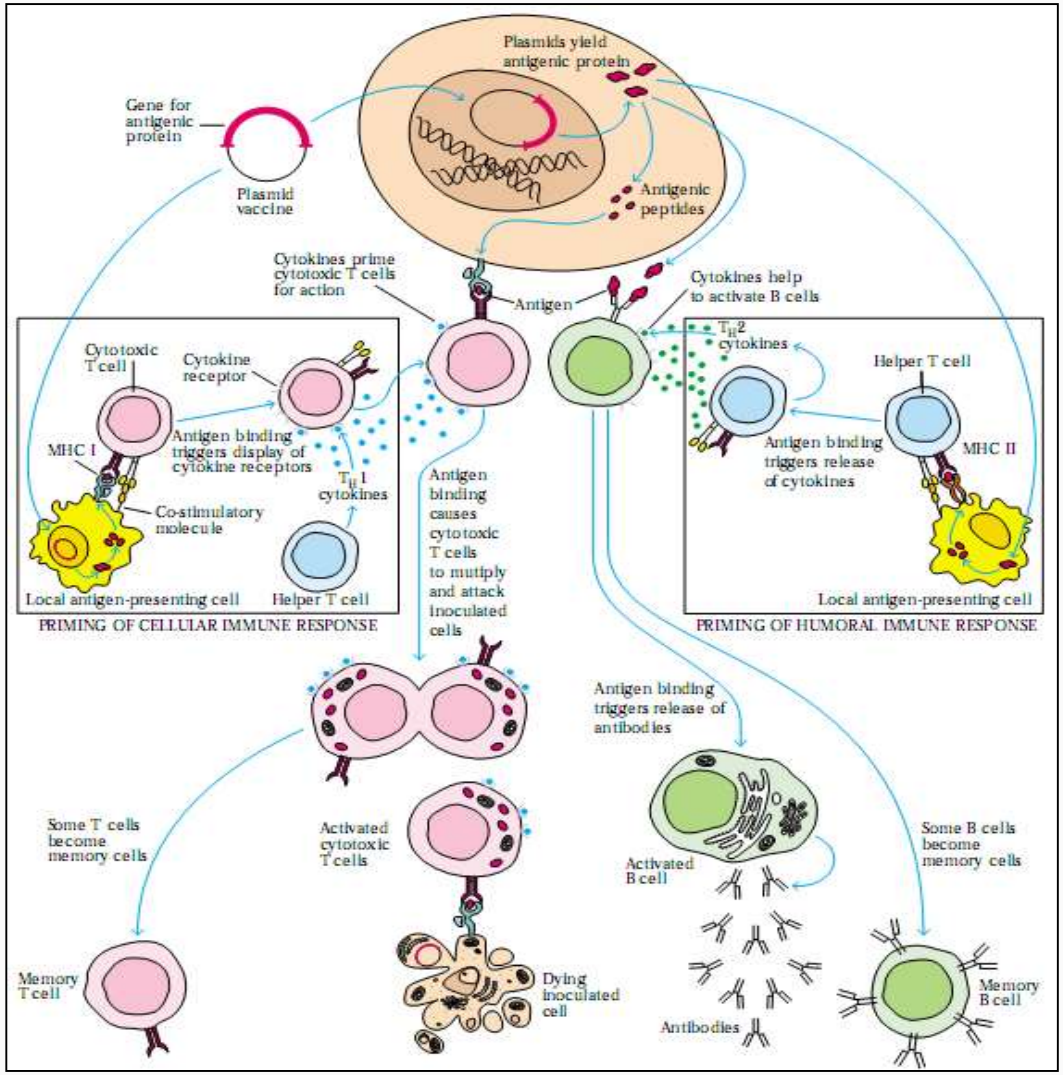
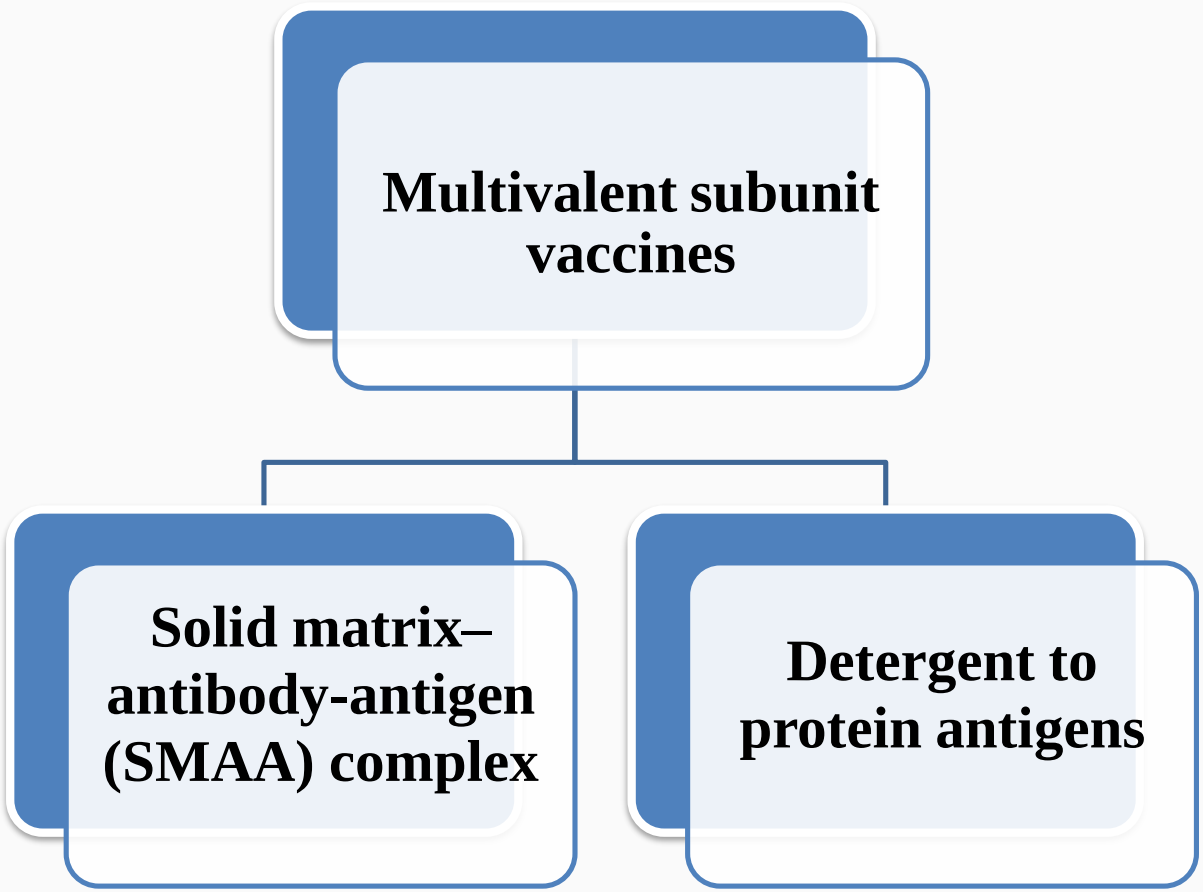


Fig: Use of DNA vaccines raises both humoral and cellular immunity

Multivalent Subunit Vaccines



(Ref: Kuby, book for Immunology)

Solid matrix-antibody-antigen (SMAA) complex

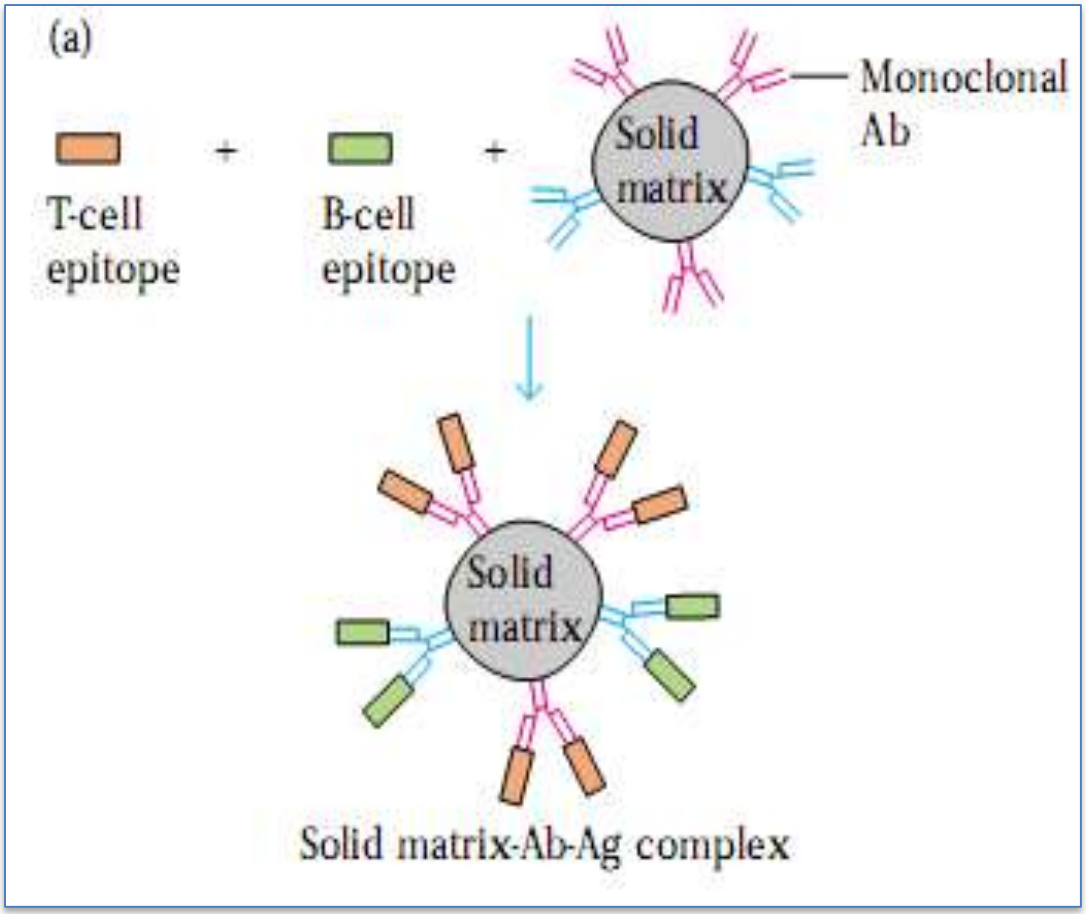
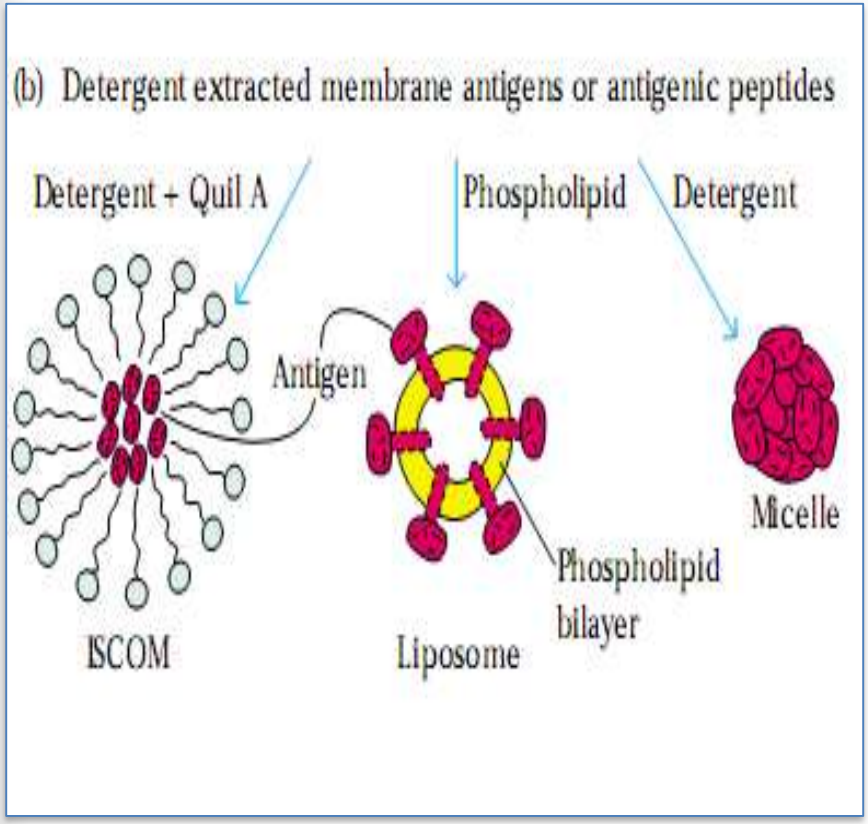


Fig: Solid matrix Antigen

(Ref: Kuby, book for Immunology)

Detergent to protein antigens



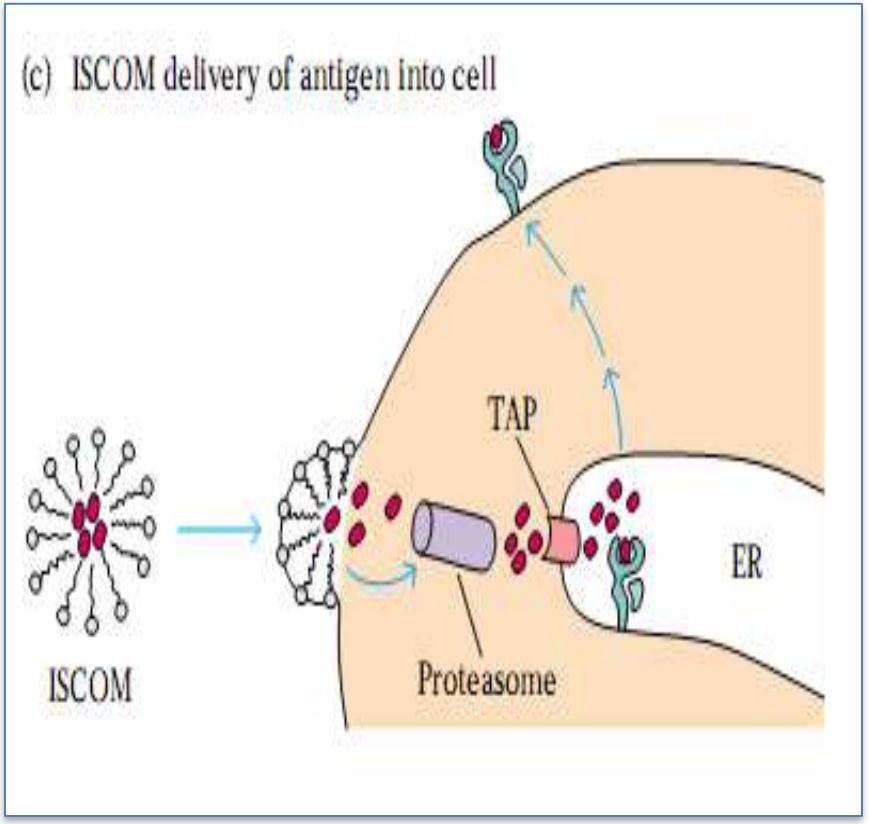


Fig: b. Detergent extracted membrane antigens or antigenic peptides
c. ISCOM delivery of antigen into cell

(Ref: Kuby, book for Immunology

Mechanism of a vaccine

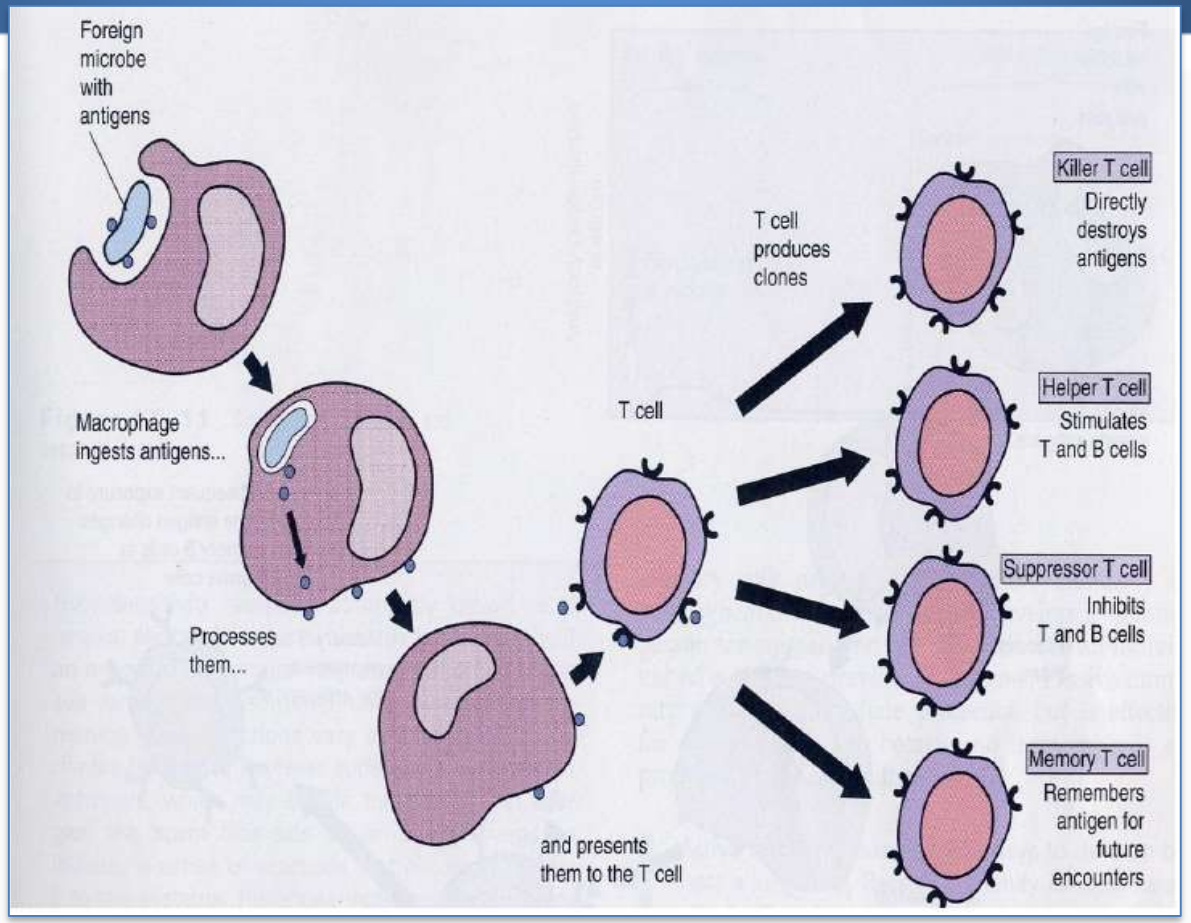


Fig: Mechanism of vaccine

(Ref: www.pathmicro.med.sc.edu)

Effectiveness

Vaccines do not guarantee complete protection from a disease.

Adjuvants:

•An **adjuvant** (Latin, *adiuvare:* to aid) is a pharmacological or immunological agent that modifies the effect of other agents, such as a drug or vaccine. They are often included in vaccines to enhance the recipient's immune response to a supplied antigen, while keeping the injected foreign material to a minimum.

(Ref: www.wikipedia.org)

Risks associated with vaccines

Vaccines also have some sort of risks, like:

- The primary risk associated with vaccines, especially vaccines that utilize live organisms, is that the vaccine itself causes illness.

- Another risk is that the vaccine may behave as a super antigen and over stimulate the immune system.

- Yet a third risk is that some individuals may have an allergic reaction to the vaccine, especially vaccines produced in Embryonated chicken eggs and in transgenic plants.

(Ref: www.wikipedia.org)

Recent Research:

- Approaches for designing a preventive HIV vaccine.
- Vaccine against Dengue Vaccine.
- NIH Scientists Identify New HIV-Inhibiting Protein.
- NIH Scientists Find Cause of Rare Immune Disease: Genetic Mutation Leads to Cold Allergy, Immune Deficiency and Autoimmunity.
- NIH Found a Gene That May Play a Role in Type 1 Diabetes.

(Ref: www.niaid.nih.gov)

Conclusion

Vaccines are one of the most effective health interventions ever developed. Three types of vaccines are currently used in humans: attenuated (avirulent) microorganisms, inactivated (killed) microorganisms, or purified macromolecules. Recombinant vector vaccine and Plasmid DNA vaccines are also used. They induce both humoral and cell-mediated immunity. Some boosters (called adjuvants) are also used in association with vaccines for increasing the immune response. As the vaccines have a lot of benefits, they do carry some harmful effects too.

Reference

Source:

•Janes Kuby, 2007, Vaccines, Immunology, W.H. Freeman and Company, Newyork, sixth Edition, Pg. 413- 428.

•Satyanarayana U., 2010, Vacines, Biotechnolgy, BOOK'S AND ALLIED (P) Ltd, Kolkata, sixth edition, Pg. 211-212.

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