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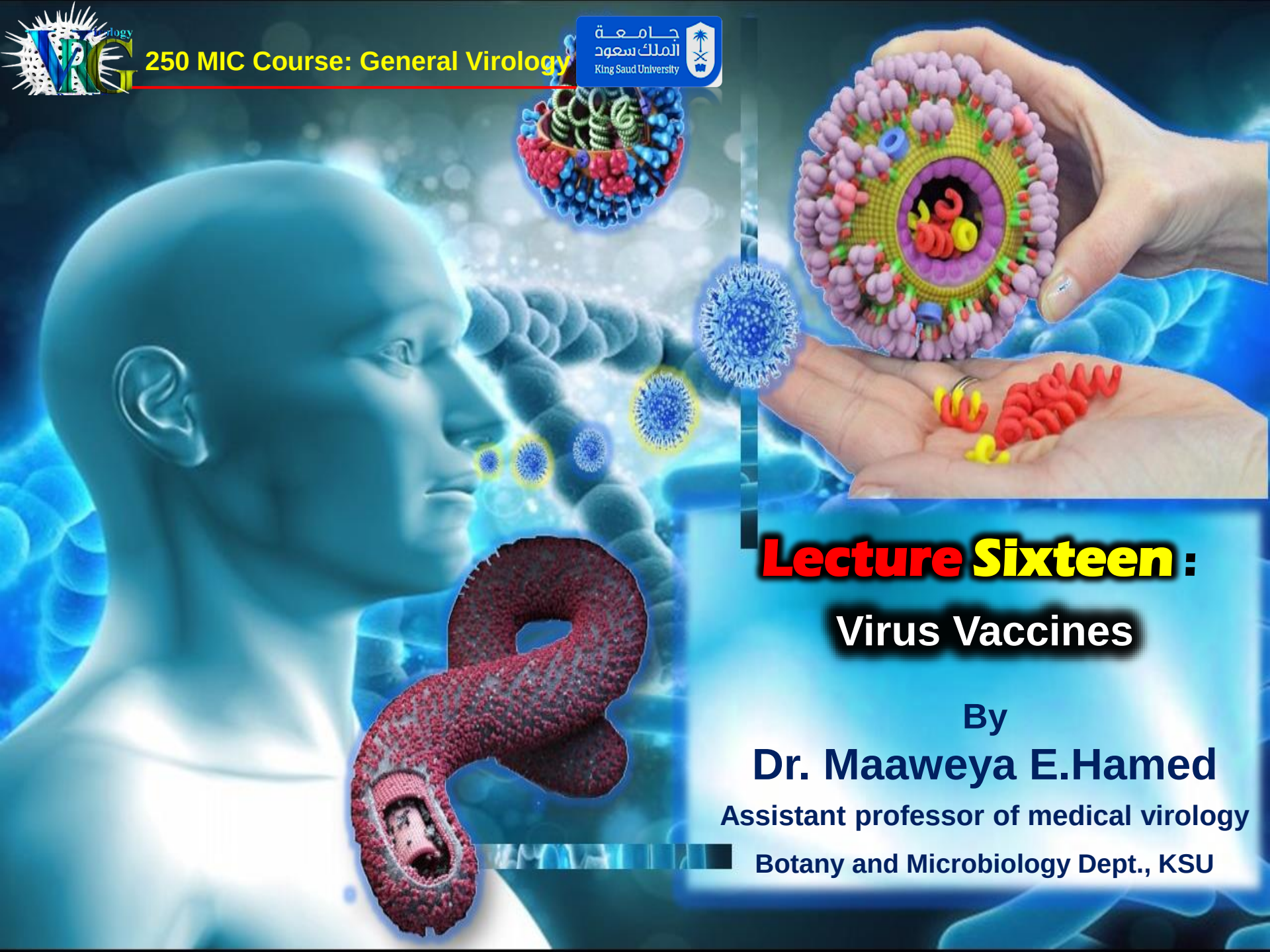

Lecture Sixteen :

Virus Vaccines

By

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Learning outcomes

- Active vs. Passive Immunization
- Designing Vaccines
- Whole-Organism Vaccines
- Purified Macromolecules as Vaccines
- Recombinant-Vector Vaccines
- DNA Vaccines
- Synthetic-Peptide Vaccines
- Multivalent Subunit Vaccines

Two Types of Immunization

- Passive Immunization
  - Methods of acquisition include natural maternal antibodies, antitoxins, and immune globulins
  - Protection transferred from another person or animal
- Active Immunization
  - Methods of acquisition include natural infection, vaccines (many types), and toxoids
  - Relatively permanent

Acquisition of Passive and Active Immunity

ACQUISITION OF PASSIVE AND ACTIVE IMMUNITY

Type	Acquired through
Passive immunity	Natural maternal antibody
	Immune globulin*
	Antitoxin†
Active immunity	Natural infection
	Vaccines‡
	Attenuated organisms
	Inactivated organisms
	Purified microbial macromolecules
	Cloned microbial antigens (alone or in vectors)
	Multivalent complexes
	Toxoid§

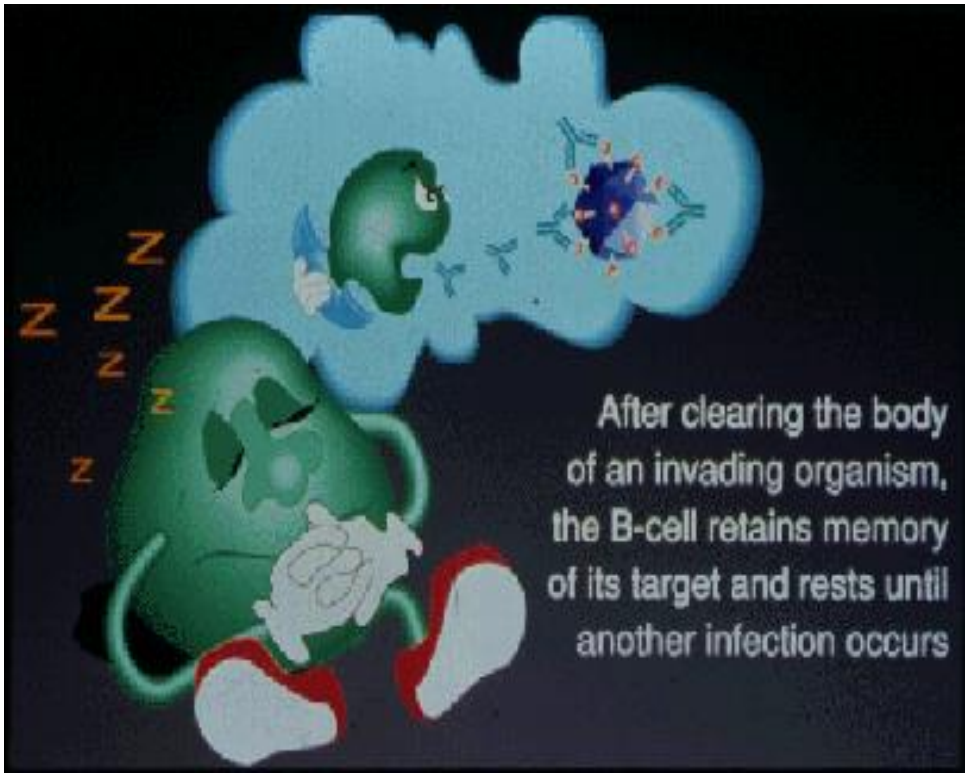
Common Agents For Passive Immunization

COMMON AGENTS USED FOR PASSIVE IMMUNIZATION

Disease	Agent
Black widow spider bite	Horse antivenin
Botulism	Horse antitoxin
Diphtheria	Horse antitoxin
Hepatitis A and B	Pooled human immune gamma globulin
Measles	Pooled human immune gamma globulin
Rabies	Pooled human immune gamma globulin
Snake bite	Horse antivenin
Tetanus	Pooled human immune gamma globulin or horse antitoxin

Active Immunization

- Natural Infection with microorganism or artificial acquisition (vaccine)
- Both stimulate the proliferation of T and B cells, resulting in the formation of effector and **memory** cells
- The formation of memory cells is the basis for the relatively permanent effects of vaccinations



Principles Underlying Vaccination

- Concept of Immunity
  - Self vs. Non-self
  - Antigen specificity
  - Indicated by presence of effector cells
  - Protection from infectious diseases using above methods

Effectiveness of Vaccinations

- Small percentage of recipients will respond poorly
    - Role of genetic determinants

- Herd Immunity

    - Majority of population is immune, so chance of susceptible individual contacting infected individual is low

    - Measles Epidemic

Herd Immunity

- Factors affecting herd immunity
  - Environmental Factors: crowded conditions, seasonal variations
  - Strength of Individual's Immune System
  - Infectiousness of Disease: greater the risk of infection, the higher percentage of people need vaccines to attain herd immunity
- When enough people are vaccinated, chance of germ infecting the non-immunized population is small
- Can lead to disappearance of diseases (smallpox)
  - Vaccination no longer necessary

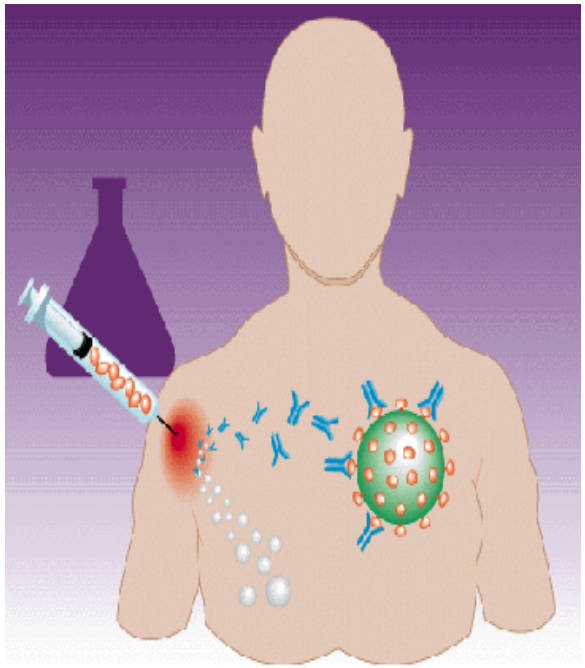
Development of Vaccines

- Common misconception that activation of the immune system results in protective immunity

- Multiple factors affect decisions when making vaccines

1. Activation of specific branch of immune system

2. Development of immunological memory



Types of Vaccines

- Whole-Organism
  - Attenuated Viral/Bacterial
  - Inactivated Viral/Bacterial
- Purified Macromolecules
  - Polysaccharide
  - Toxoid
  - Recombinant Antigen
  - Recombinant-Vector
- DNA
- Synthetic Peptide
- Multivalent Subunit

Whole-Organism Vaccines

- Many common vaccines used consist of inactivated or attenuated bacterial cells or viral particles
- Includes attenuated and inactivated vaccines

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 BCG†
Typhoid	Live attenuated
Viral particles	
Hepatitis A	Inactivated
Influenza	Inactivated
Measles	Live attenuated
Mumps	Live attenuated
Polio (Sabin)	Live attenuated
Polio (Salk)	Inactivated
Rabies	Inactivated
Rotavirus	Live attenuated
Rubella	Inactivated
Varicella zoster (chickenpox)	Live attenuated
Yellow fever	Live attenuated
Purified macromolecules	
Toxoids	
Diphtheria	Inactivated exotoxin
Tetanus	Inactivated exotoxin
Capsular polysaccharides	
Haemophilus influenzae type b	Polysaccharide + protein carrier
Neissera meningitidis	Polysaccharide
Streptococcus pneumoniae	23 distinct capsular polysaccharides
Surface antigen	
Hepatitis B	Recombinant surface antigen (HbsAg)

Attenuated Viral or Bacterial Vaccines

- Attenuation – to reduce in force, value, amount, or degree; weaken
  - Achieved by growth under abnormal culture conditions
  - Bacillus Calmette-Guerin (BCG)
  - Act as a double edged sword, as they have distinct advantages and disadvantages…

The Future of Attenuation…

- Genetic engineering techniques provide new methods of attenuation
- Herpes virus vaccine for pigs
- Possible elimination of reversion?

Adjuvants

- Adjuvants are CRITICAL for the use of inactivated vaccines
- Most widely used are aluminum salts (mainly hydroxide or phosphate)
- Effects include liberation of antigen, chemoattraction, and inflammation

Impact of Vaccines on Public Health

- Between 1977 and 1980, smallpox was eradicated in the United States
  - Global eradication is currently a major consideration
  - Phenomenon of herd immunity
- Measles occurrences at a record low


Thank
You