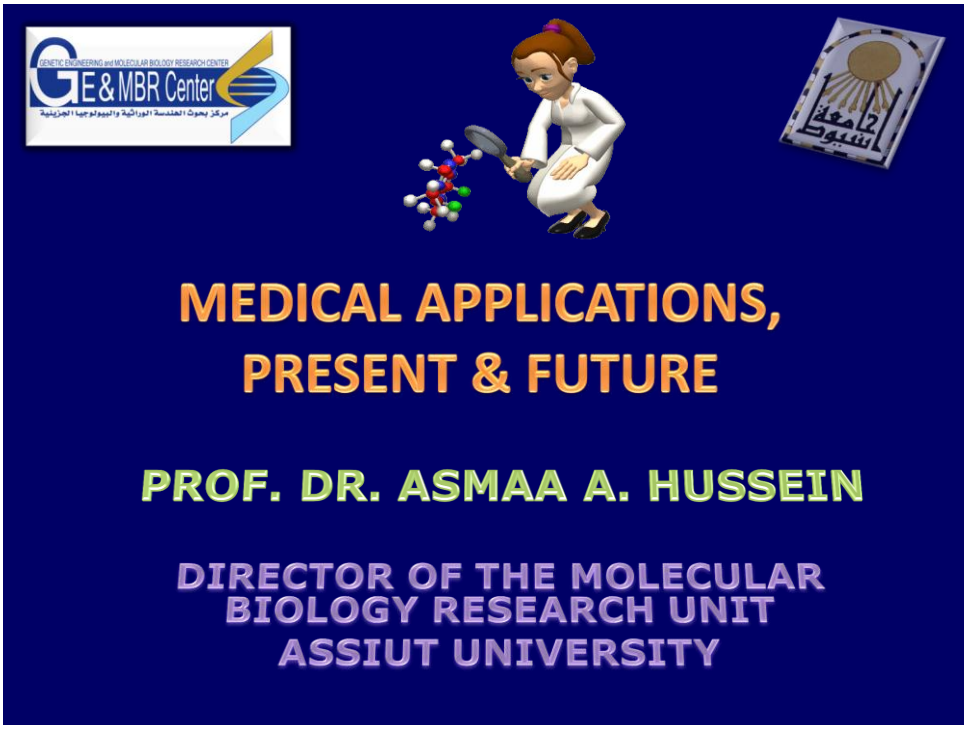
GE&MBR Center
MEDICAL APPLICATIONS,
PRESENT & FUTURE
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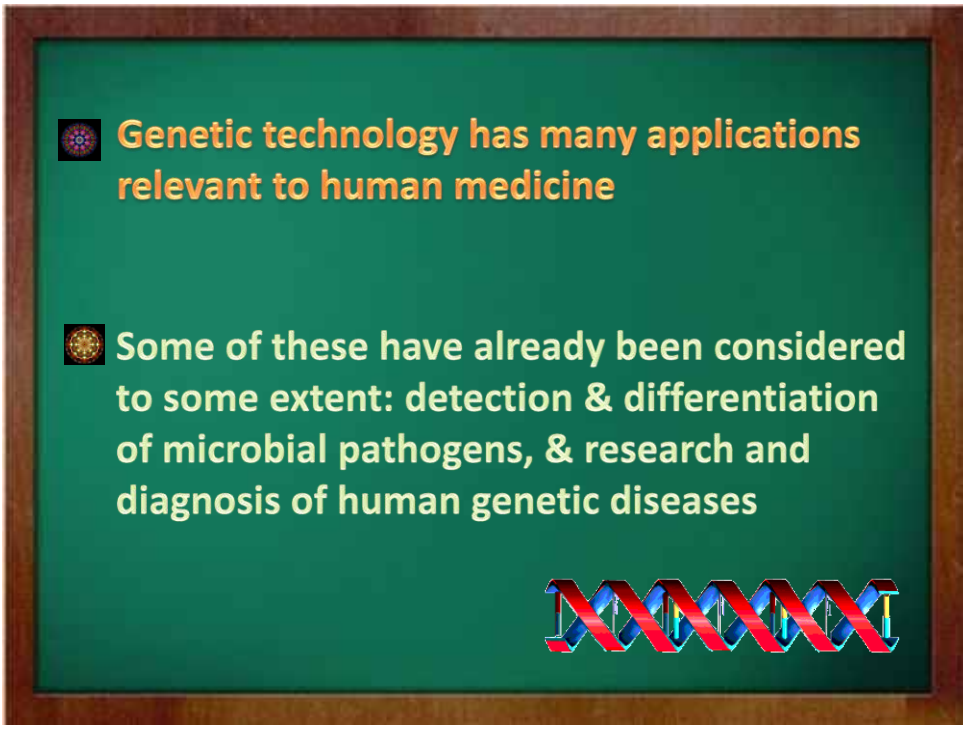

Genetic technology has many applications relevant to human medicine
Some of these have already been considered to some extent: detection & differentiation of microbial pathogens, & research and diagnosis of human genetic diseases

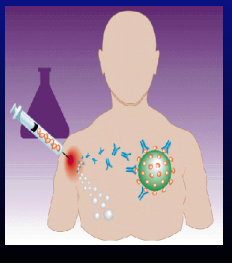
VACCINES

Conventional

- Subunit vaccines ← Recombinant genes expression
- Killed whole organism
- Toxoids ← Specific mutagenesis
- Live attenuated ← Gene replacement
- Live recombinant ← Insert foreign genes
- DNA VACCINES ← CLONED DNA

Other technologies

- Synthetic peptides
- Conjugate vaccines



Killed vaccines (such as the Salk polio vaccine):

In which a suspension of the pathogen was inactivated (by heating) , so as to retain its immunogenicity but rendering it incapable of causing disease

LIVE ATTENUATED VACCINES:

- Which use a mutant strain of the pathogen which is attenuated (i.e. it has lost the ability to cause disease) but is still immunogenic
- Many vaccines are of this type, including vaccinia (smallpox vaccine), oral polio vaccine (Sabin), & BCG (an attenuated strain of *Mycobacterium bovis)*

Toxoids:

- Some bacterial diseases are due to the ability of the bacterium to produce a specific toxin; immunity to the toxin gives protection against the disease
- **If you can inactivate the toxin (by chemical treatment), the resulting *toxoid* will be an effective vaccine**
- **For example diphtheria & tetanus vaccines**

Subunit vaccines:

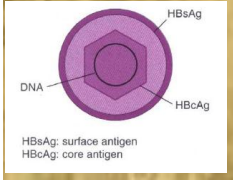
If you can identify the key (protein) antigen from the pathogen that is needed for a protective effect, you can clone the gene responsible using an expression vector & produce large quantities of the protein

This has many advantages

IT IS CHEAPER

The production process is safer

It is easier to produce a safe vaccine

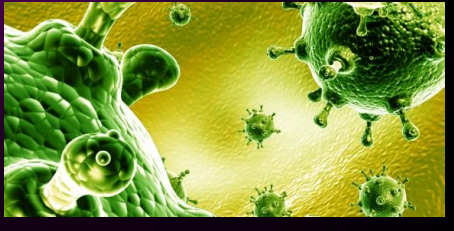


Live attenuated vaccines:

- You have to produce many different variants & test each one for both properties: the loss of virulence, & the ability to produce protective immunity
- Genetic technology provides rational ways of achieving these goals in a controlled manner. With some of the smaller viruses, it is possible to use sitedirected mutagenesis to modify selected genes with the goal of attenuating the virus
- With larger viruses, this is usually not possible directly, but indirect techniques can be used to introduce defined mutations

Live recombinant vaccines

- One of the novel advances in vaccine technology that has been made possible by genetic manipulation is the construction of vaccines that confer immunity to several diseases simultaneously
- **This can be achieved by inserting the genes for key antigens from different pathogens into a single live vaccine**



DNA vaccines

- Injection of DNA, usually as a recombinant plasmid containing the relevant genes, is able to stimulate an immune response to the product of those genes, & in some cases this leads to protective immunity
- This presumably occurs because the plasmid is taken up by some of the cells in the body, resulting in expression of the genes carried by the plasmid

Detection & Identification of Pathogens:

- The standard procedure for detecting a pathogen causing an infectious disease is to grow it in the laboratory from a suitable clinical specimen (such as sputum or blood)
- However, many viruses, & some bacteria, are difficult or even impossible to grow in the laboratory. In these cases, molecular methods - especially PCR - provide an important tool for the laboratory diagnosis of infection, & are now in common use in clinical virology laboratories

Human Genetic Diseases

Identifying disease genes

One of the most important applications of gene technology lies in the ability to detect genetic mutations that result in specific diseases, or in a predisposition to the development of such a disease

Genetic diagnosis

The identification of mutations that give rise to human genetic diseases not only leads to significant insights into the nature of those diseases but also provides a mechanism for molecular diagnosis

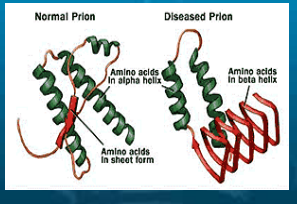
Gene therapy

Knowing which mutation, in which gene, causes a disease is not a prerequisite for treating it

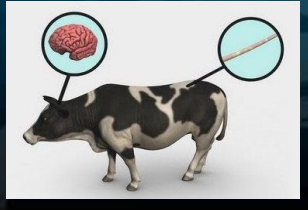
Western blot has a wide range of applications in medical diagnosis:

1. **Western blot is applied in a confirmatory HIV antibody in human serum sample**

2. **Under appropriate conditions, the western immunoblotting technique is quantitative**



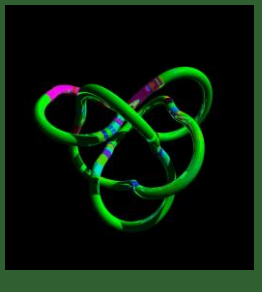
3. **Western blot application in the definitive test for Bovine Spongiform Encephalopathy (Mad Cow Disease")**



4. In veterinary field, western blot is applicated in the medical diagnosis for some viruses. The initial test was the ELISA. So, there can be false positives with the ELISA test. An initial positive for these viruses are followed up by western blot test

5. Medical diagnosis application of western blot in a confirmatory test for Hepatitis B infection






6. WESTERN BLOTTING IS ALSO APPLIED IN SOME FORMS OF LYME DISEASE DIAGNOSIS TEST. WESTERN BLOTTING IS USED IN COMBINATION WITH ANOTHER TECHNIQUE OF ELISA


SINCE ELISA MIGHT SOMETIMES YIELD FALSE-POSITIVE RESULTS, WESTERN BLOTTING WORKS AS A CONFIRMATION TOOL FOR THE TEST RESULT OF ELISA