Recent Advances in Medicines

on March 10, 2005

Good Evening Everyone,

It was very nice of Dr. Althaf to ask me to talk about the advances in Medicine. To talk about this vast area in a few minutes, that too, just before the cultural programme is a difficult task. I will make an effort to highlight a few of the major advances in the area of medicine. I must admit I left out a large portion of improvement made in the surgical areas and equipment including laser based equipment.

Up until 1950's it was the time of herbal medicine. These were traditional systems used by various civilizations across the globe. This could be called the Herbal Era of medicine.

The early 1950's saw the advent of synthetic medicines and rational thinking as we know about the disease states. Advances made in chemistry and pharmacology greatly advanced the treatment of various diseases, but not all. However, the basic drawback was that we were basically treating the symptoms of the disease with out a greater understanding of the underlying causes.

The period 1900 – 2000 could be aptly called the Pharmaceutical Era.

During the pharmaceutical era itself, substantial progress has been happening in an entirely different area in Man's quest for better understanding of himself.

In 1953, the basic DNA structure and concept were developed followed by a rudimentary understanding of the genetic code also evolved around 1968.

In 1973, biotechnology was defined and a new branch of science taking into account various scientific discipline was born.

In 1978, recombinant insulin was made.

In 1980, oil eating microbes were patented by Dr. Chakraborthy, a revolutionary step, which provided substantial impetus to subsequent research work in biotechnology.

Today, we are in the genomic era. The human genome project began in 1990 and completed the targeted work by 2003, much before the deadline assigned.

The progress made in the last 20 years was amazing if one looks at it now. In short, the advances made in the last 10 – 15 years is equal or even surpasses the advances made in the last 100 years.

A number of medical scientific disciplines evolved in the last 20 years. Just a brief review of these disciplines itself would indicate the directions we are going.

Pharmacogenomics:

It is the observational process of pharmacology with the analytical strengths of genomics. In simple language, pharmacogenomics decipher how one's genetic inheritance affects the body's response to drugs.

The promise of pharmacogenomics and its practical extension of personalized medicine will certainly lead to the early development of precision pharmaceuticals, that is, drugs and dosages tailored to a person's genetic composition.

Pharmacogenomics could also help profile a person's risk of developing a particular disease.

Structural pharmacogenomics:

Structural pharmacogenomics is emerging as a means of rational drug design to overcome the resistance of organisms to anti-infectives.

The 20th Century saw great advances in the treatment of infections. Since the introduction of penicillin in 1943, a number of new classes of antibacterial drugs and several safe and effective vaccines were introduced and gave rise to the belief that bacterial infections could be controlled and even mastered. This once widespread belief soon turned incorrect and today multiple drug resistance threatens our ability to treat many infections.

Anti-viral chemotherapy arrived much later and the nature of the viral life cycle led to the belief that anti-viral drugs could be toxic to the host. But today, we understand viral replication and viral resistance is part of the virus's ability to adopt and overcome the various drug & drug combinations and their effects.

In the case of antivirals and anti-bacterials resistance emerges due to drug target modifications. Anti-bacterial resistance may be due to enzymatic inactivation also.

Toxicokinetics:

Toxicokinetics is an assessment tool for the safety assessment of a drug.

In early 1980's we saw pharmacokinetics as part of ADME data to assess systemic exposure either as an integral component of the pre-clinical toxicity studies or in specially designed supportive studies.

The concepts advanced out of toxicokinetics will make the drugs of future far more safer, tolerable and effective.

Proteomics:

Many disease processes are manifested through changes in cellular proteins. Such changes include the expression of aberrant receptor proteins, an increase or decrease in the activity of a particular enzyme, the production of antibodies against a cellular component and any number of other processes involving proteins. Proteomics is the study and comparison of the full protein complement of cells and their interactions, using large scale methods for the simultaneous analysis of many proteins.

Today, this powerful technology is being used to study many biological processes. The experimental or clinical goals range from insights into pathogenesis, cancer diagnosis and prediction of clinical outcome to identification of the therapeutic targets.

Therapeutic vaccines:

Vaccines by definition are prophylactic, but the recent past has seen the emergence of therapeutic vaccines to alleviate the suffering of those already with a disease.

The efforts in developing the therapeutic vaccine is based on the fact that it is closely related chemically to the etiological agent that causes the disease, so that the immune response directed against it can act against the causative agent.

The number of disease for which vaccines are under development are many. Diseases include HIV, Hepatitis B, Tuberculosis, parasitic diseases, gastric ulcers, autoimmune diseases, Myasthenia gravis, Systemic Lupus Erythematosus, Type 1 diabetes and rheumatoid arthritis.

Copolymer 1, (Copaxone ®) used today as a vaccine against multiple sclerosis (MS) is an excellent example of a beneficial treatment for this auto-immune disease, based on its similarity to the myelin basic protein (MBP), one of the putative causes of Multiple Sclerosis.

Another interesting development is in the area of Alzheimer's disease.

Alzheimer's disease, one of the most devastating neurological disorders remains without an effective cure. One of the main characteristics of the disease is the accumulation of extracellular protein deposits called amyloid Plaques. The main constituent of these amyloid Plaques is the amyloid- β Peptide.

What researches have now found is that a proteolytic process can produce this item and immunization with Amyloid β peptide (A β) inhibited the formation of Amyloid plaques and associated dystrophic neuritis. These results raised the possibility of a vaccination with Amyloid beta-peptide against AD.

Another interesting development is a vaccine to prevent the build up of atherosclerotic plaques. Initial studies using a peptide based vaccine showed that plaque formation can be reduced upto 70 %.

Stem cell research:

In November 1998 researchers first reported the isolation of human embryonic stem (ES) cells. This discovery opened possibilities to research new ways of treating diseases. Embryonic Stem cells, which are derived from several-day-old embryos, can theoretically differentiate into virtually any type of human cell, from blood cells to

skin cells. These cells may therefore be used to repair and regenerate various tissues in the body. These cells could become transplant therapies for type II diabetes, spinal cord injury, neurodegenerative disorders like Parkinson's disease, muscular dystrophies, atherosclerosis and wound healing.

Discussions surrounding the ethical issues in using stem cell research is a hot bed of controversies across the globe.

Bioinformatics:

Today's drug discovery, based on genomics and proteomics depends on analysis of large amounts computationally demanding data.

For example, a typical protein structure takes 3 – 10 megabytes of storage. Multiply this by 100,000 or more proteins thought to comprise the human proteome. Add to this the hundreds of thousands of corresponding protein structures from the pharmacological model species such as rat, mouse, dog & primates or to the millions of protein structures from the various genomic model species, as well as the entire spectrum of infectious disease agents.

Now you are looking at billions of megabytes of data.

This just begins to define the challenge as well as the opportunity. The challenge is in the creation of mathematical algorithms capable of handling this type of data. Each of these data sources contains a wealth of information that today remains largely invisible or inaccessible.

Bioinformatics is focused in developing ways and means of analyzing such huge amounts of data.

DNA Array:

A high throughput method for investigating the effect of therapeutic agents (proteins, drug molecules) on gene expression.

DNA arrays are quickly becoming one of the popular ways to study large-scale expression profiles for pharmaceutical purposes, as well as in basic research.

Expression levels can be measured simultaneously for hundreds or thousands of genes depending on the number of DNA targets spotted on the arrays.

Tissue Engineering :

Tissue Engineering is the manipulation of tissue and cells under artificial conditions with applications in regenerative medicine.

CONCLUSION :

What I have said is just an aerial view of what is going to emerge in the near future in modern medicine. New medical technologies are fast coming up making present technologies obsolete. New drugs are produced replacing existing ones. And new knowledge is coming up in place of present knowledge. Modern researches and new inventions are sure to take us to new horizons. Of course, all these will contribute much to the well being of humans. It will add more quality to one's life, especially in the old age. BUT AT WHAT COST? This is a major question that looms large before all of us in the medical field. The new technologies and new drugs that are to come out are going to be very expensive. Poor people in our country will not get the benefit of these researches and inventions in the near future. People in the third world countries also will not get this bliss

of these initiatives. This is the big question that you all have to think about at your end. We should strive together to make the results of modern research available to the ordinary man and woman. Of course at an affordable price.

THANK YOU ALL.