ORIGINAL RESEARCH PAPER

Biochemistry

KEY WORDS:

BIOCHEMISTRY THE LANGUAGE OF MEDICINE

Dhastagir Sultan Sheriff

Faculty of Medicine, Benghazi University, Benghazi, Libya

Biochemistry is one of the fundamental basic medical subject that can be called as molecular tongue of medicine.[1] The field is growing in leaps and bounds in every aspect of cellular and molecular biochemistry. Rather the application of fundamental basic research in Biochemistry has a remarkable effect on the development of modern medicine. The recent trend in medical education is trying to shorten the period of teaching basic medical science subjects including Biochemistry to undergraduate medical students. The introduction of competency based teaching has resulted in shortening the duration of teaching Biochemistry to Medical students.[2]

Biochemistry is now a lifeline for medical subjects including paraclinical and clinical subjects. We cannot make medicine as a science that will help produce clinicians to treat the patients. Medicine is much more than that. It is a science which has a research component and also a molecular language that help define health and disease. Every branch of medicine has biochemical component and biochemistry needs to be taught in all semesters of medical education. Basic science is the foundation stone for development of applied science whether it is science or medicine.[3] Basic Medical Sciences play an important role in the development of Medicine. Rather basic medical science research is one of the key areas that need to be developed. Now there is an emphasis for medical colleges to develop research and research projects. There is an active dialogue going on as how to promote research activities and implement practical guidelines to promote basic research in postgraduate studies.

"Basic science is the foundation of applied medical science."[3]

We could cite several examples to justify the claim that basic medical research is necessary for the development of medical sciences.

The following three examples are discussed to justify how basic research in medical education helped to promote the science of Medicine:

- Structural chemistry
- Enzymology
- Coenzyme

Structural chemistry

The path breaking work of Bengt S.Samuellsson on the structural chemistry of prostanoids has revolutionized the field of medicine and therapeutics...His basic research on prostanoic acid had several implications in clinical areas related to thrombosis, inflammation and allergy.[4]

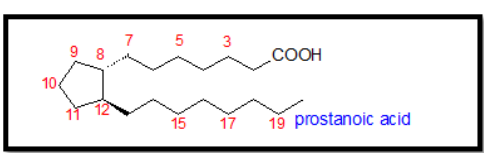

Fig.1. Prostanoic acid, the parent compound for various derivatives formed from it

Prostanoids are synthesized from prostanoic acid by specific enzymes with stereo-specificity and chirality on every functional group.[3] Different prostaglandins differ in their configuration of the pentane ring between 8 to 12 carbon (Prostaglandin A, B, D, E, F), prostaglandin hydroperoxide (PGG and PGH), prostacyclin (PGI) and thromoboxanes.[4-5] the basic research conducted helped to produce drugs based on the structural elucidation of differences in prostanoids synthesized from prostanoic acid. Following are the list of drugs through the scientific knowledge gained through basic research.

Table.1.The drugs formulated based on these findings were

Low dose acetyl salicylic acid	Prevention of acute myocardial infarction and stroke
Misoprostol	Prevention of gastric ulcer
Celeocoxib	COX 2 inhibitors for treatment of inflammation and pain
Dinoprostan	Obstetric use
Alprostadil	For acute treatment of congenital heart defects
Iloprost and triprostanil	Treatment arterial pulmonary hypertension
Latanoprost	Treatment of glaucoma
Montelukast and Zafirlukast	Leukotriene antagonists for treatment of asthma and rhinitis
Zileuton	5-lipoxygenase inhibitor for asthma

2.Fatty Acid Synthase II and Malarial parasite:

Surolia and associates had found a separate pathway of fatty acid synthesis (FAS), named as FAS II pathway, in apicoplast, a secondary plastid of algal region. (FAS-II).Malarial parasites proliferate exponentially during asexual blood-stage replication. Midgut sporozoite production and intra hepatic development demand excess supply of nutrients including fatty acids. *Plasmodium* parasites obtain fatty acids de novo via type II fatty acid biosynthetic pathway. This pathway was different from human fatty acid synthesis pathway. This has resulted in the production of a drug called triclosan (2, 4, 4'-trichloro-2'-hydroxydiphenyl ether) that inhibited FAS II pathway with a rapid inhibitory action.[5-6] indirectly affecting the replication of plasmodium parasites.

3. "Nicotinamide adenine di nucleotide (NAD), a coenzyme, a key factor of energy production and mitochondrial function"

Nicotinamide adenine di nucleotide (NAD) is one of the most abundant coenzyme that participates in 500 different biochemical reactions and about 300 grams is present in the human body.[6]

NAD+ is a dynamic molecule constantly getting synthesized, degraded and recycled in different organs. NAD has two different pools, the free pool and protein associated bound pool. The ratio of free to bound NAD varies in different organelles, types of cells, tissues and according to the age of the person. NAD also fluctuates rapidly locally and different tissues.[6]

The cytosolic and mitochondrial NADH/NAD+ and NADPH/NADP+ redox states regulate various metabolic

processes and energy production. These metabolic states are dependent on NAD formation from NADH through cytosolic processes like glycolysis, electron transport chain, and oxidative pathways like Krebs cycle or fatty acid oxidation.

NAD is reported to be the key signaling molecule that declines with age and it is suggested that replenishing NAD may restore the declining metabolic state of the individual and therefore, slow down the process of aging. In vitro supplementation of Nicotinamide mononucleotide (NMN), an intermediate in the biosynthesis of NAD is recommended as anti-aging factor because NAD cannot cross mitochondrial membrane.

There are many more such biochemical studies of basic research that have contributed immensely to the promotion of health as well as in developing newer fields like genomic medicine

The field of medicine requires the development and training of basic scientists and medical professionals to develop the science in medicine. The bank of such professionals will help to develop research, train the health professionals to conduct research and produce of clinicians with greater clinical acumen to practice evidence based medicine. Research is the prime stimulus of curiosity. Teaching is to kindle curiosity in the learner's mind, a key component of medical education. It is not in the concrete structures and buildings of a university lies the lamp of learning. It lies in the curious intellectual pursuit of fundamental research for the development of medicine so rightly shown by Watson and Crick which helped to develop molecular medicine. The language of molecular medicine is Biochemistry. Therefore, medicine and medical education requires mitochondrion of Biochemistry for the growth of medicine.

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