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Opinion

Pharmacology and Toxicology: Two Scientific Interdisciplinary Specialties in the Core of Clinical Sciences

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Pharmacology and Toxicology are two core disciplines in clinical research. Clinical research is a branch of healthcare science that determines the safety and effectiveness of medications, devices, diagnostic products and treatment regimens intended for human use [1]. It is critical to distinguish clinical research and clinical practice. While in the first one, evidence is collected to establish a treatment, in the latter one established treatments are used. Moreover, Clinical research involves the study of human beings in a systematic investigation of human biology, health, or illness, designed to develop or contribute to generalizable knowledge. Clinical practice is a set of activities where the main purpose is to diagnose, prevent, treat, or care for an illness or condition in a particular individual or group of individuals with the goal of meeting the needs of and benefiting that individual(s) [2].

Pharmacology is the study of drugs and covers theirs sources, uses, metabolism, excretion, adverse effects, interactions and contraindications [3].

Toxicology is a branch of biology, chemistry, and medicine (more specifically pharmacology) concerned with the study of the adverse effects of chemicals on living organisms [1,4].

Clinical Pharmacology

Clinical pharmacology is both old and young. As a scientific discipline and academic subject clinical pharmacology is young having originated from the middle of the 20th century. It is difficult to find who first coined the name since opinions differ between countries. Several distinguished pharmacologists active in the middle of the century brought pharmacology and clinical know-how about drugs together and helped to transform drug evaluation from the trial and error state to a scientific discipline [5].

This scientific discipline at its best requires an overview of all aspects of medicine where drugs are used, be it internal medicine, pediatrics, neurology, psychiatry, geriatric medicine or oncology [6]. Therefore, clinical pharmacology, an interdisciplinary specialty requiring collaboration with drug experts representing other professions, is defined as a medical specialty that should integrate pharmacological and medical knowledge and thereby promote and take responsibility for the rational use of drugs in individual patients and in the population at large [6]. In the professional meaning, clinical pharmacologists are specialized physicians in clinical pharmacology. Through their several years of postgraduate medical fellowship and training, clinical pharmacology has been successful in several areas of pharmacological research from controlled clinical trials and pharmacovigilance to clinical pharmacokinetics, pharmacogenetics and more recently pharmaco-epidemiology originating from drug utilization research [6].

Clinical Pharmacologist roles vary from one aspect, domain or structure to others. Without developing its various clear roles, it is important to state that clinical pharmacology plays key roles in various domains including: research, teaching, patient care, pharmaceutical

industry and governments. Recently, we have come to acknowledge emerging roles of clinical pharmacologists in area such as biologics and biosimilar, and global public health.

Despite the various roles of clinical pharmacology in numerous domains, this disciplines presents certain weakness. The weakest point of the discipline today is its vague roles in health care. Another weak point is that clinical pharmacologists are too little used in teaching pharmacology to medical students in many countries [6]. Regardless, the depth knowledge in the discipline, it is important to understand the pharmacology, as the principle of cure, that is, from the right patient, right time, right medication, right dose via the right route [7].

Clinical Toxicology

Toxicology has been defined as the qualitative and quantitative study of the adverse or toxic effect of chemicals and other anthropogenic materials or xenobiotics on organisms. As one of the multidisciplinary fields of science, dealing also with food and cosmetics for public consumption both in alive or dead victims, its scope has been enlarging [8]. In simpler terms, it is the study of the changes in a living being, especially its different organs, on exposure to or administration of a chemical in different doses [9]. It has its impact on human life, from the stage of conception in the womb to the last moments of life as researchers know that no substance is risk-free. This assertion brings us to affirm that all chemicals can cause harm at some level of exposure, summed up in the phrase "the dose makes the poison," meaning that exposure to a specific small amount of any substance will have no detectable impact on normal biological processes and is considered safe [10].

The process of all toxicological studies starts with rodents (rats and mice), bringing this mistaken on to larger animals (like dogs and monkeys) when the situation demands [9]. Due to the essential predictive or speculative reality of this science, as humans cannot be used in experimenting with unknown chemicals, it is quite important to raise the notion of clinical toxicology as specialized discipline and being identified as sub-specialty of emergency medicine [11]. Therefore, the results of the animal studies have to be extrapolated to humans and this is the most difficult exercise, considering the wide difference in the organ systems of men and animals [9].

Clinical toxicology focuses on the clinical presentation and management of toxic substances and associated diseases [12,13]. A clinical toxicologist is concerned with humans-his, laboratory is the hospital and his experimental subjects are human beings, who do not give an option for experiments [9]. He/she has also an important role in the controlled clinical testing of newly developed drugs. However; we should point out that much information in clinical toxicology can come from epidemiology, i.e., by collecting information on victims of previous exposures.

Within the sphere of medical in terms of toxicology, beside the clinical toxicology, there is also what we call "Forensic Toxicology" or "Medicolegal Science". It is the branch of toxicology that plays a key role in crime investigation. While a clinical toxicologist is concerned with a living human being and how to keep him alive if, intoxicated, a forensic toxicologist is concerned with the dead human, investigating the cause of death, utilising the same techniques as the clinical toxicologist [9].

Clinical pharmacology and clinical toxicology are two key essential disciplines/sciences in the core of clinical sciences and practice. They have proven to be very important in clinical setting as multidisciplinary sciences. In developed countries, a large number of legislations have come up to protect the humans from real and imaginary chemical onslaught especially since 1970. These disciplines have done well in countries, which have adhered to the World Health Organization recommendations to provide services that facilitate rational prescribing of drugs. However; clinical toxicology and clinical pharmacology knowledge is still lacking among healthcare providers in developing countries. Therefore, special trainings/programs such as fellowship in clinical toxicology or clinical pharmacology are strongly recommended to improve significantly the knowledge health care providers.

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