Translational medicine

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Introduction

The definition of translational medicine (TM) is not clear, but it constitutes a novel approach, the purpose of which is to provide a benefit to the patient in the shortest period of time possible. Biomedical research is focused on discovering new diagnostic tools and new treatments through a highly specialized multidisciplinary approach. TM uses scientific discoveries to generate new tools that improve human health by reducing the incidence of morbidity and mortality. It encourages multidirectional investigation, basic research integration, and disease diagnosis and treatment-oriented research.

The term TM was coined in the decade of 1990, but the use of the concept did not begin until the dawn of year 2000. In 2003, clinical research of the Institute of Medicine (USA) described translational research terminology and model as a process based on basic science and directed to clinical research in order to establish a public health policy, among other perspectives. The University of Cincinnati (Children's Hospital Medical Center) considers TM as capable of transforming scientific discoveries into new instruments and clinical applications that improve people's health (*Transforming Translation – Harnessing Discovery for Patient and Public Benefit*, 2007). The Welcome Trust institute, in Great Britain, broadens the TM definition and turns it into innovative studies, with new products for the medical, pharmaceutical and biotechnological industry; i.e., it translates discoveries into commercial products as soon as possible. The Scripps Institute, in Florida, incorporates another distinctive element into the same process by gathering investigators from academic and industrial worlds, different physicians and specialists to create technological platforms where bioinformatics specialists and genomics, pharmacokinetics and clinical experts combine their knowledge for the study of different pathologies. At the National Institutes of Health (NIH), the TM concept acquires a more advanced sense. It is about going from bench to bedside, which should set the pace for biomedical research for the first quarter of the 21st century. The intention is to catalyze the combination of new knowledge acquired in basic laboratories with developments, observations, technologies and innovations produced in all fields of multidisciplinary research. For this, the NIH promoted a broad consortium with more than 60 participating institutions, including universities, companies and hospitals, with the purpose of sharing knowledge, technologies and even projects both for the development of new therapies and to approach improvements or new visions, resulting from multidisciplinary strategies, with a contribution of 10,000 million dollars to TM centers. Along the same lines, the Howard Hughes Medical Institute, one of the most prestigious research institutions in the USA, has set funding programs in motion for clinical investigators actively participating in basic research projects. The *Science Translational Medicine* journal promotes TM, which enables investigators to efficiently apply new outcomes on different fields of knowledge. Scientists in laboratories use clinical samples for diagnosis, by means of biomarker analysis, or to elucidate the difference between normal and pathologic status. Investigators from the University of California in Irvine described, in the *American Journal of Translational*

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Research, that clinical researchers' observations should be linked to basic research in order to find altered mechanisms in the patient.

Translational medicine achievements

The Johns Hopkins University and a group of investigators demonstrated that losartan, a drug that is widely used in the treatment of high blood pressure, can prevent the development of aortic aneurisms found in mice designed to reproduce the Marfan syndrome, a genetic disease that affects the connective system. This drug has now been tested as therapy in a group of children with this syndrome, and has been found to inhibit the development of these life-threatening anomalies in the aorta. In the technological field, sophisticated algorithms have been developed for the processing of high-resolution images in order to detect and localize prostate tumors in an early stage. Another area of research was the meningitis B vaccine. The group led by Rino Rappuoli, from IRIS, Chiron SpA, in Sienna (Italy), identified a candidate vaccine using a translational approach called "reverse vaccinology", by means of the genome sequence. In the field of ophthalmology, many patients with glaucoma have to self-administer eye drops numerous times during the day; at Yale University, microspheres have been developed that contain the drug timolol maleate, which can be injected in a spot in the eye, where the microspheres secrete controlled amounts of timolol for over one month. Gold nanoparticles, or nanoshells, developed at the University of Texas for the detection of cancer cells by fluorescence spectroscopy are yet another example.

Biomedical research

Scientists use TM to broaden their knowledge base in order to discover ways to prevent diseases and develop useful products, such as medications and procedures, to treat and cure diseases. Biomedical research requires the contribution and participation of human teams with different abilities, such as physicians, veterinarians, informatics specialists, engineers, technicians, investigators and a variety of scientists of life sciences' different fields. It is about beliefs or theories that can be proven or refuted through of observations and experimentation, first in animals whose characteristics best represent the process of disease in human beings. Almost all important medical advances in this century have been based on research in animals.

Research of translation in pharmacogenomics

The capability to more accurately design drugs of medical interest and test them in animal models for later use in patients is yet another example of TM application. Several pathological processes, in combination with pharmacogenomics, are used to understand how genomic variation often produces confusion in medical personnel, when the expected response to the treatment applied to the patient is not obtained.

Translational research in cardiovascular diseases

For translational research application in health and in the care of patients with congenital conditions, collaborative groups have been created through permanently-interacting consortiums. The Cardiovascular Development Consortium collaborates with research teams using animal models to understand the transcriptional regulation networks that control heart development. Clinical investigators recruit children for the study of causative genes and to assess the effects of genetic variation in patients with congenital heart conditions. The consortiums complement the Cardiovascular Cell Therapy Research Network in order to promote and accelerate clinical research in the assessment of new treatment strategies for these diseases.

Translational regenerative medicine

This is a field of medicine with the potential to heal damaged tissues and organs, offering solutions and hope to patients who currently are not beyond repair. Regenerative medicine uses tissue engineering and molecular biology to replace or regenerate human cells, tissues or organs. It uses drugs targeting specific molecules (e.g., proteins) on the surface of or within cells in order to arrest cancer cells growth and dissemination, while limiting damage to normal cells. Targeted therapies use different types of drugs, and each medication works differently. This approach is broad and uses the advances in stem cell technology for clinical care.

Evidence-based policy

TM evidence-based policy promotes a more rational, rigorous and systematic point of view for health. Evidence-based policy is founded on the premise that policy decisions should be better supported by available proof, in addition to including a rational analysis. The new direction should link scientific evidences to decision-making in order to expedite their use in patients lacking other therapeutic alternatives.

Conclusions and challenges

Available information converges in the idea that TM can be highly useful to facilitate the arrival of new basic science-generated diagnostic and therapeutic tools to the clinical setting, or of clinical findings to basic knowledge. For example, the development of a new drug usually takes from 10 to 14 years for its use in patients and requires an investment that goes up to tens of millions of pesos. With new genomic and proteomic techniques innovation, thought is changing to better understand the so-called TM. Currently, a future is foreseen in biomedical research that will make it more accurate in pathologies of different areas, such as oncology and infectious, cardiovascular and endocrine diseases, among others. It is urgent for laboratory and imaging workup and multidisciplinary teams to interact and comprehensively analyze the patient as soon as possible, in order to establish an early diagnosis, implement an appropriate treatment (precision medicine) and, especially, to advance in prevention in order to make of medicine a new form to address the pathologies that affect humankind.

The *Gaceta Médica de México* editors, Dr. Alejandro Treviño Becerra (editor), Dr. Francisco Espinosa Larrañaga (coeditor) and the undersigned, invite academicians and healthcare professionals to promote the practice of TM in our country and make of research an application for the patient; at the same time, we put this journal's pages at your disposal to disseminate your experiences and research outcomes in TM.

Recommended literature

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