Chinese Journal of Traumatology 19 (2016) 249–250

Contents lists available at ScienceDirect

Chinese Journal of Traumatology

journal homepage: http://www.elsevier.com/locate/CJTEE

Invited review

Definition and application of precision medicine

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ARTICLE INFO

Article history:
Received 9 April 2016
Received in revised form
25 April 2016
Accepted 25 April 2016
Available online 29 June 2016

Keywords:
Precision medicine
Individualization
Diagnosis and treatment

In 2011, four major research institutes in America—Academy of Science, National Academy of Engineering, National Institutes of Health and National Science Foundation, released a joint research plan on precision medicine. In January 2015, President Obama announced a propose on research of precision medicine in State of the Union Address, aiming to cure and close to cure cancer, diabetes and other diseases, and obtain the medical records of individuals and families that they may need.[1,2]

On the 25th February 2016, the White House declared to implement several activities including a health research with one million participants to promote President Obama's proposal on precision medicine.

It is hoping to recruit one million volunteers by 2019, collecting such relevant data as medical records, genetic information, life-style, etc. The goal in 2016 is to recruit 79,000 volunteers.

When we look back recent 10 years, we can say that we have marched a great progress on medical fields – cancer, Alzheimer's disease and others.

According to the definition promulgated by the National Institute of Health (NIH), precision medicine refers to a new treatment and prevention method based on understanding of individual gene, environment and life-style.[3]

Precision medicine, by applying genomics, proteomics and other relevant technologies to analyze and identify the biomarkers of large sample groups and specific diseases, is to provide precise and individualized treatment to certain patients and diseases. With the convergence of humanity, ethics, economy, sociology and other knowledge elements, precision medicine aims to minimize iatrogenic damage and medical expense and reach an optimal therapeutic effect.[4]

In Chen's article[5] *The Prospect of Precision Medicine Based on Modified Antibody/Immunocell Therapy*, the author revealed the application and development of precision medicine. It is an immunotherapy characterized by enhancing targeting and validity, and realized by combination of traditional immunotherapy with gene engineering technology to modify the structure and function of antibody and immune cells.

In Dong's report,[4] the concept of precision surgery has triggered a technological reform in hepatic surgery featured by collective innovations and an integrated application of modern and traditional surgery, transforming traditional and extensive surgery into individualized precision surgery with higher precision and efficiency, realizing a goal of minimal surgical invasiveness, maximal liver protection, minimizing medical consumables and optimal effects. In author's opinion, as a new surgical idea and technical system, precision hepatic surgery is the only way to improve surgical treatment quality in the 21st century.

In order to realize precision medicine, the following strategies should be implemented: comprehensive cooperation, large-scale biological specimen banks and database, large simple size, and new technologies.[1] Some domestic medical fields have fulfilled or almost fulfilled these conditions.

The following mistakes should be avoided in the implementation of precision medicine[6]:

(1) Instead of negating traditional medicine, it is prior to recognize that traditional medicine is the basis of precision medicine.
(2) Precision medicine is not equal to a simple convergence of new technologies. For instance, information relevant to genomics knowledge needs effective integration with genetics, metabonomics and clinical phenotypes (including symptoms, signs, biochemistry, image and pathological features) to compose a complete individualized biological database, by which to contribute to a diagnosis and treatment based on individualized patient's condition.

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Peer review under responsibility of Daping Hospital and the Research Institute of Surgery of the Third Military Medical University.

http://dx.doi.org/10.1016/j.cjtee.2016.04.005

(3) Precision medicine is not equal to a simple individualized medicine, but a medicine mode combined standardization with individualization.

In Shi and Sun's report,[7] *Application of Precision Medicine in Oncotherapy*, the authors believe that a new epoch of precision medicine will come true with the development of biomedical technology, the constantly renewed conception on oncotherapy and rapidly developed antineoplastics.

The development of medical oncology consists of three stages: chemistry treatment dominated by cytotoxic agent; individualized molecule-targeted treatment and gene-driven precision medicine. In the future, cancer treatment will not be categorized according to the types of cancers (such as lung cancer, esophagus cancer, etc), but classified by the types of genic change (such as epithelial growth factor receptor, etc).

Precision medicine plan is a new medical mode for deep understanding of patients' genetic information and genomic information so as to realize disease prediction and to make effective prevention, diagnosis and treatment. By doing so it is easier for doctors to select sensitive drugs, optimal dose and time for medicine usage and meanwhile the least side effect.[7]

Fan et al[8] reported the role of image fusion technology in precision medicine. They proposed that the development of image fusion technology from anatomical image to anatomical and functional image, which not only has improved the image diagnosis level, but also laid a solid foundation for precision radiotherapy.

Radio-resisted hypoxic cell is considered to be one of the main reasons for local recurrence after radiotherapy. Hypoxic cell images can be used to assess hypoxic condition of tumor cells and therefore to direct the establishment of precision radiotherapy plan, which has been becoming one of the worldwide research hotspots.

Precision medicine has been widely applied in foreign countries as shown in Table 1.

Some doctors emphasized that they had applied individualized medical treatment clinically a long time ago, for instance, transfusions based on blood types in World War I.[9] However, precision medicine discussed today is a completely new concept and technology, in which the diagnosis and treatment of diseases rely on genomics and specific biomarker technique.

In clinical literature reviews, it seems not innovative for widely mixed use of “precision”, “personalized” and “individualized”. Although the three terms share similarities, precision emphasizes more on synchronization of new concepts, diagnosis and treatment.[9]

It is reported in many molecular disease researches that different tumors have their own genomics features — some are of specificity, while some are of nonspecificity and eurypalynous. More definitive treatments can be put forward by further understanding of these theories.[2]

Table 1
Examples of precision medicine application.[9]

Medical field	Disease	Biomarker	Intervention
Cancer	Chronic myeloid leukemia	BCR-ABL	Imatinib
	Lung cancer	EML4-ALK	Crizotinib
Hematology	Thrombosis	Factor V Leiden	Avoid prothrombotic drugs
Infectious disease	HIV/AIDS	CD4+T cells, HIV viral load	Highly active antiretroviral therapy
Cardiovascular disease	Coronary artery disease	CYP2C19	Clopidogrel
Pulmonary disease	Cystic fibrosis	G551D	Ivacaftor
Renal disease	Transplant rejection	Urinary gene signature	Antirejection drugs
Hematology	Hepatitis C	Hepatitis C viral load	Direct-acting antiviral agents
Endocrine disease	Multiple endocrine neoplasia type 2	RET	Prophylactic thyroidectomy
Metabolic disease	Hyperlipidemia	LDL cholesterol	Statins
Neurology	Autoimmune encephalitis	CXCL13	Immunotherapy
Psychiatry	Alcohol-use disorder	GRIK1	Topiramate
Pharmacogenomics	Smoking cessation	CYP2A6	Varenicline
Ophthalmology	Leber's congenital amaurosis	RPE65	Gene therapy

Today's clinical medicine has entered a new era of precision medicine. Its general goal is demand-orientated, and to reduce morbidity, mortality and disability of major diseases, raise the quality of medical service by technical innovation, and eventually let our human being live a healthier life.

References

1. Zeng XF. The step towards precision medicine. *Chin Med News*. 2015;30:11.
2. Collins FS, Varmus H. A new initiative on precision medicine. *New Engl J Med*. 2015;372:793–795. http://dx.doi.org/10.1056/NEJMp1500523.
3. Tian G. Precision medicine: how the genomics can change medical mode. *Life World*. 2015;41:42–45.
4. Dong JH. Modern concept and clinical practice of precision hepatic surgery. *Chin J Dig Surg*. 2012;11:8–10.
5. Chen ZN. The prospect of precision medicine based on modified antibody therapy/cellular immunotherapy. *Chin Med News*. 2015;30:11.
6. Dong JH. Building precision medical system to achieve the best healthy benefit. *Natl Med J China*. 2015;95:2497–2499.
7. Shi YK, Sun Y. Development direction of oncotherapy in precision medicine era. *Natl Med J China*. 2015;95:2518–2521.
8. Fan TY, Li JB, Yu JM. The role of image fusion technology in precision medicine. *Foreign Med Sci Sect Radiat Med Nucl Med*. 2004;28:163–165.
9. Jameson JL, Longo DL. Precision medicine — personalized, problematic, and promising. *New Engl J Med*. 2015;372:2229–2234. http://dx.doi.org/10.1056/NEJMsb1503104.