The Application of Personalized Medicine in Female Cancers

ARTICLE INFO

Article Type

Editorial

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Received: 27 March, 2023
Accepted: 20 April, 2023
e Published: 13 September 2023

Article History

ABSTRACT

Personalized medicine, also known as "precision medicine," is the science of individualizing cancer care by treating tumors based on their genetic makeup rather than their location of origin. Personalized medicine or precision medicine was first defined for management of cancer patients with the idea that information of patient's genes, proteins, metabolites and environment can be applied for its individualized management and it encompasses prevention, screening, diagnosis, prognosis, treatment, follow up, detection of recurrence and categorization of patient to defined subgroups for more effective treatment. Current evidence suggests the relative success of this approach in cancer patients. The development and implementation of personalized medicine required a set of objectives and valid biomarkers through genomics, transcriptomics, and proteomics and metabolomics knowledge of huge sample cohorts regarding confounding factors, such as age, gender, habits, diet, and environment. Personalized medicine in reproductive medicine is still in its nonage since it is not yet a fully strengthened mature arena. Reproductive medicine is at the preliminary stage of discovering and validating genomic, protein and metabolite biomarkers. Perhaps what is currently being offered as personalized treatment of infertile patient is more based on "the best expert opinion of the attending clinician" than "the best evidence-based data available".

Keywords: Gestational Diabetes Mellitus (GDM); Treatment; Managing; Guideline; Review Article.

Editorial

Personalized medicine, also known as “precision medicine,” is the science of individualizing cancer care by treating tumors based on their genetic makeup rather than their location of origin (1). Personalized medicine or precision medicine was first defined for management of cancer patients with the idea that information of patient’s genes, proteins, metabolites and environment can be applied for its individualized management and it encompasses prevention, screening, diagnosis, prognosis, treatment, follow up, detection of recurrence and categorization of patient to defined subgroups for more effective treatment. Current evidence suggests the relative success of this approach in cancer patients. The development and implementation of personalized medicine required a set of objectives and valid biomarkers through genomics, transcriptomics, and proteomics and metabolomics knowledge of huge sample cohorts regarding confounding factors, such as age, gender, habits, diet, and environment (2).

Personalized medicine in reproductive medicine is still in its nonage since it is not yet a fully strengthened mature arena. Reproductive medicine is at the preliminary stage of discovering and validating genomic, protein and metabolite biomarkers. Perhaps what is currently being offered as personalized treatment of infertile patient is more based on “the best expert opinion of the attending clinician” than “the best evidence-based data available” (3).

Although cancer incidence and prevalence are increasing at an alarming rate, progress in treatment has been slow, and treatment benefits are measured in weeks to months. Traditionally, patient care is given by physicians based on pathological examination, symptoms of the disease, and history of medications. Following advancements in diagnostic science and early detection markers, a number of cancer types can be detected before pathological symptoms develop. These markers are biochemical, epigenetic, genetic, imaging, metabolomics, and proteomic. Technologies can be used to detect these markers in clinical samples with an option of multiplexing. Use of more than one marker in the same sample generally increases the sensitivity and specificity of cancer detection and helps a physician to diagnose early and accurately. This information is of great significance because individual specific treatment regimens can be designed based on the presence and stage of cancer as concluded from profiles of markers discussed above (4).

Modern personalized medicine is based on targeted therapy. In targeted therapy, it is essential that information about the altered pathway and the components leading to cancer are available. For example, Herceptin is used in female breast cancer patients who express higher levels of HER-2. Gleevec is prescribed in chronic myeloid leukemia to inhibit tyrosine kinase. In these patients, reciprocal translocation between chromosome 9 and chromosome 20 occurs, resulting in hyperactivation of abl-driven protein signaling. The treatment of gynecological cancer has become a pioneer in the application of precision medicine. Genetic screening and deciding whether to use targeted medicine have become routine for oncology clinicians. The combination of targeted medicine and conventional radiotherapy and chemotherapy improves the efficacy of tumor treatment. However, precision medicine has not been widely used in gynecological oncology, and targeted medicine is not as efficient as we predicted because the pathogenesis of gynecological tumors is not fully understood. Bevacizumab, a type of vascular endothelial growth factor receptor (VEGFR) blocker, has been proven to be efficient in the inhibition of tumor metastasis, but no clinical statistics verify that it prolongs the overall survival rates of ovarian tumor patients. Some studies have identified some signaling pathways that are related to endometrial cancer pathogenesis, but effective targeted drugs are still lacking (5).

Genotyping of CYP2D6 (cytochrome P450, family 2, subfamily D, polypeptide 6) and its effect on breast cancer treatment by tamoxifen shows the importance of personalized medicine in the treatment of patients (6) or therapy based on Erb-B2 expression of breast cancer. It has shown promising results in the field of personalized medicine (7). Metabolomics, a new addition to the field of personalized medicine, is the study of low molecular weight molecules or metabolites found in cells and biological systems. The metabolome is a measure of the output of biological pathways and, as such, is often considered more representative of the functional state of a cell than other "omics" metrics such as genomics or proteomics.

Conclusion:

As personalized medicine becomes more common and widely used, those who pay for treatment will be affected. For insurance companies, it is more expensive to provide health care when more tests are performed to diagnose a disease. In the long term, personalized medicine will be beneficial because information about an individual's disease and response to various interventions and treatments will be used in the development of disease prevention approaches. For personalized medicine to succeed, population models must be revised. If an accurate diagnosis is made to avoid unnecessary and ineffective treatments,

avoid side effects, and provide more effective targeted treatments, it will cost the payer less in the long run. It also helps promote the concept of "pay for performance" and reduce healthcare costs. Ethical issues and genetic testing are other issues to be considered for the implementation of personalized medicine and data should be collected and analyzed in these aspects.

Currently, we only see a few successful examples of personalized medicine, such as measuring erbB2 and EGFR in breast and lung cancer patients before choosing appropriate treatments. Successful implementation of personalized medicine requires infrastructure and technology to measure molecular analytes and collaboration between all stakeholders. In personalized medicine, a key task is to identify and validate key proteins, different expression patterns, and gene variants associated with disease or disease susceptibility. Today's biomarker is tomorrow's theranostics. Theranostics is a term used to describe the proposed process of diagnosis and treatment for individual patients.

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