Journal of Controlled Release 243 (2016) 250–268

Contents lists available at ScienceDirect

Journal of Controlled Release

journal homepage: www.elsevier.com/locate/jconrel

Review article

Precision targeted therapy of ovarian cancer

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ARTICLE INFO

Article history:
Received 8 July 2016
Received in revised form 9 October 2016
Accepted 12 October 2016
Available online 14 October 2016

Keywords:
Genetic profiling
Targeted therapy
Nanotechnology
Personalized medicine
siRNA

ABSTRACT

The review is aimed at describing modern approaches to detection as well as precision and personalized treatment of ovarian cancer. Modern methods and future directions of nanotechnology-based targeted and personalized therapy are discussed.

Contents

Abbreviations: ADCC, antibody-dependent cellular cytotoxicity; CDC, complement-dependent cytotoxicity; cDNA, complementary DNA; CEL-seq, single-cell RNA-sequencing; DOC, doxorubicin; EMA, European Medicines Agency; ER, estrogen receptor; FRα, folate receptor alpha; HER, human epidermal growth factor receptor; LHRH, luteinizing hormone releasing hormone; MAB, monoclonal antibody; MDA, multiple displacement amplification; MIBI, multiplexed ion beam imaging; mRNA-seq, mRNA sequencing; NGS, next generation sequencing; OS, overall survival; P4, predictive, preventive, personalized and participatory; PARE, personalized analysis of rearranged ends; PARP, poly-ADP ribose polymerase; PEG, poly(ethylene glycol); PFS, progression-free survival; PLD, PEGylated liposomal doxorubicin; QOL, quality of life; qRT-PCR, quantitative reverse transcription polymerase chain reaction; SNP, single nucleotide polymorphism; SNS, single-nucleus sequencing; SRM, selected reaction monitoring; TDS, targeted delivery system; VEGF, vascular endothelial growth factor; WGA, whole-genome amplification.

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http://dx.doi.org/10.1016/j.jconrel.2016.10.014

1. Introduction

Ovarian cancer is one of the most deadly malignancies that can form in the female body. Current statistical analysis reveals ovarian cancer as the 5th leading cause of cancer-related mortality in women worldwide [1]. It is also labeled as the most prevalent and lethal gynecologic cancer as well [2]. As a result, considerable research efforts have been dedicated to understanding ovarian cancer mechanisms and various methods for possibly treating the disease. Unfortunately, there has been little progress transitioning the research into effective clinical applications. Only 20% of the new cases of ovarian cancer are detected in an early stage and 5-year survival rates for patients with advanced-stage ovarian cancer is roughly 30% [3]. Therefore, additional translational research must be carried out in order to progress the current state of clinical care of ovarian cancer.

For many years, scientists researched cancer in a reductionist approach, examining single targets or pathways. Years of researching various cancers with this approach have made many great improvements in the field of oncology, but it appears there is a limit to its efficacy, especially in improving patient mortality from ovarian cancer. In recent times, it has become evident that cancer is a disease driven by multiple cellular pathways, which can be affected in any number of ways [4]. Morphological and molecular studies investigating ovarian cancer make it clear that it should not be classified as a single disease, but a collection of disease subtypes with altering origins and significantly different clinical behaviors [5,6]. In addition, tumors often have heterogeneous cell populations, comprised of various differentiated cell types, which form a unique microenvironment [7]. Therefore, new approaches to cancer medicine are required in order to improve treatment outcomes. The concept of systems biology has been brought up over the past few years and applied to cancer in efforts of developing so-called predictive, preventive, personalized and participatory (P4) cancer medicine [8].

Systems biology takes a broader, more holistic approach to understanding the basic biology of cancer (Fig. 1) [9]. It takes into account the various biological scales (genetics, signaling pathways, etc.) and their interaction to form the complex biological system found in a tumor [10–12]. The main objective of cancer systems biology is essentially to develop personalized cancer medicine. In order to achieve this, data on the different biological scales must be integrated for a more detailed picture of tumorigenesis, cancer stratification, and progression (Fig. 2) [9]. Various models can also be designed in order to detect, diagnose, and predict the outcome of particular treatment [13–15].

The present review will discuss advancements made in various fields of research that can be applied to personalized ovarian cancer medicine. It will emphasize different technologies developed over the years and their applications to personalize care of ovarian cancer patients in the clinic.

2. Emerging technology for precise diagnosis of ovarian cancer

The field of oncology has always been an ever-expanding area of medical care due to the massive investments and advances in the basic sciences. New developments in various fields of research have

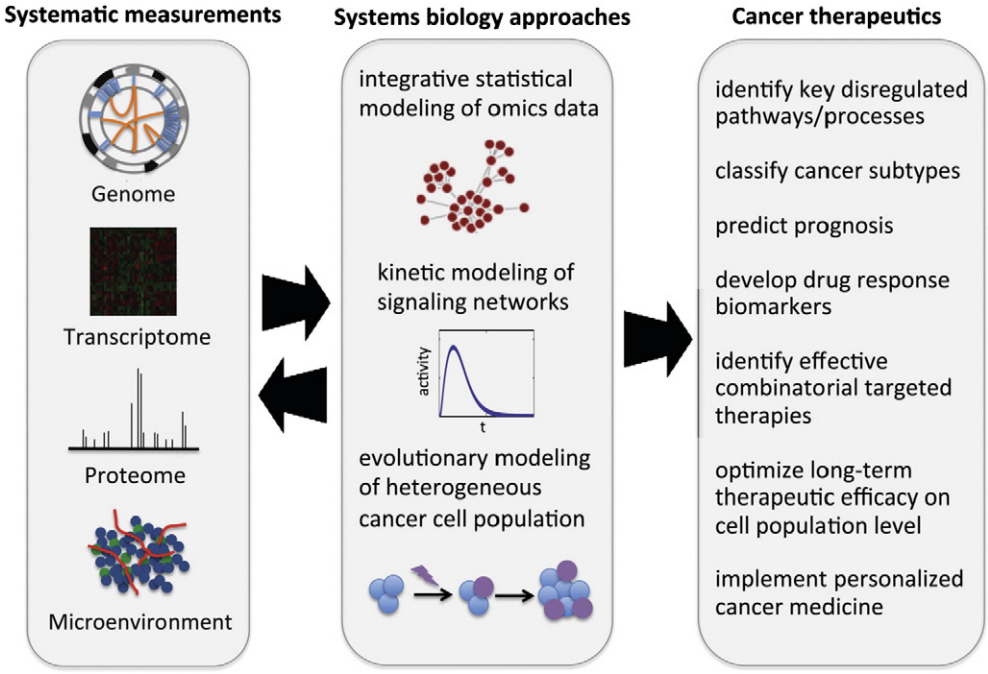

Fig. 1. Systems biology approaches in cancer therapy.
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