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Mini Review

Anticancer Drug Development Innovation

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Abstract

Anticancer drug development is facing new challenge—including areas of biomedical knowledge, pharmaceutical modification, a number of cutting-edge technology utility and economic burden. Many past obstacles and dilemma still remain. Many factors can impact drug developmental quality. To update drug development system, past convention must be refreshed in the future. This Article provides these areas of multi-disciplinary insights of anticancer drug discovery, design and developments currently and in future.

Keywords: *Anticancer Drug Development; Neoplasm Metastasis; Modern Technology, Pharmaceutical Innovation, Drug Combination; Cancer Stem Cells; Individualized Cancer Therapy*

Introduction

Cancer is different types of malignant disease that costs life of millions annually worldwide. A great part of current therapeutic limitation in the clinic is a lack of effective anticancer drugs [1-5]. As a result, the convention of drug discovery, development and manufacture needs to be reconstructed [6-11]. Over the past two decades, the convention of anticancer drug discoveries and developments globally changed slightly [12-13]. For this reason, new proposals for anticancer developments (experimental pipelines and clinical assessment) are emerging [12-13]. Correspondingly, the pharmacological and biomedical study for drug developments must be reorganized.

Curent challenges

An adventurous industry

Single anticancer drug licensing expenditure can be as high as two billion UDS in developed countries. Myriad chemicals, bio-agents and herbal drugs are still waiting to be evaluated [6]. No country worldwide can persistently provide this huge sum of pharmacologic/clinical exploration expense. More importantly, key biological or pathological issues that lead to clinical therapeutic failures, such as neoplasm metastasis (unpredictable nature), enigma of cancer stem cells and drug resistance (after long-term drug utility and tumor evolution) are unresolved [12-18]. Following topics will discuss these drug development drawbacks and limitations.

Multinational partnership and projects

Owing to highly economic investments and revenue shrinkage for anticancer drug discovery and developments, expanding global participation is quite necessary-including broader range of experts (medical chemists, pharmacologists and clinical doctors), pharmaceutical markets (diagnostic instrument, a variety of therapeutic options and personalized or precise medicine) for the expense of future global grant/social funds [19].

Policy and importance of genomic study

New genomic data explosion by modern DNA sequencing for genetic pathways and network are used to greater number of normal people and cancer samples/patients [20]. It needs time to consume and ethical safeguards [21]. In future, almost all patient's genomes might be easier determined. Who can use these types of human personal information? No widely accepted solution has been established. In future, this topic needs to be more frequently discussed.

Limitation of anticancer drug development

A great diversity of cancer models

Different types of animal or human tumor modality is suitable for different anticancer drug evaluations (wide-spectra and narrow-spectra). Facing with this enormous tumor models, proper budget regulatory systems may be a way to control budgets [19].

Drug assessment routine perfection

No good anticancer drug has been developed without animal tumor model utility. Different tumor inoculation routes may affect the outcomes of new compound responses/efficacy in experimental identifications and clinical evaluations. Common *In vivo* tumor models can be transplanted by various systems, such as subcutaneous locations (sc), intraperatoneal (ip), intravenous (iv), hollow-fiber (hf), ectopic tumor origins or xenografts from human cancer tissues, organoids and patients derived xenografts [19,22-23]. Different tumor origins may obtain different types of anticancer agents. Similarly, environmental factors, surroundings and neo-vasculature can facilitate tumor survival and seeding into distant sites [24-27]. With this diversity of tumor and new compounds, anticancer drug developments are waiting for evolutionary actions and updating [28].

Tumor metastasis models

Antimetastatic agents or drugs developments need to be greatly promoted because 90% cancer mortality is from neoplasm metastasis [29-34]. Current antimetastatic drug development is imperfect. The obvious example is that some agents highly effective to animal tumor metastasis models are useless in clinical trials. Currently experimental tumor metastatic models are insufficient for harvesting enough effective antimetastatic drugs that can cure patients with metastatic cancers. Shortage of wide-spectra and highly active antimetastatic drugs is a serious problem for clinical utilities and therapeutic paradigms [13-18]. Many scientific discoveries can answer parts of these questions.

Apart from diversity of metastatic models, good selection of different metastatic models for various antimetatatic drugs is quite necessary. Deeper biomedical knowledge generation and insights can support new pharmacological studies and make it a great difference.

Computational assistance

Medicinal chemistry

In anticancer drug development study, medicinal chemistry plays key role. After medicinal chemistry study, we can find effective agents as early as possible. After medicinal chemical and pharmacological study, it is obvious that natural chemotherapeutic drugs are many times more effective and less toxicity in cancer treatments [35-38]. Thus, developments of natural chemotherapeutic drugs will be a great pharmaceutical topic in future.

Joint-efforts for computational assistance

Computational design and analysis of experimental and clinical data can help predicting possible effective agents without any initial or further drug activity evaluations. It can save times for anticancer drug developments. It needs to welcome mathematical or physics-majored researchers to join in [39-41].

Diagnostic and personalized medicine

Technical advances

Parallel to human tumor model innovation, avant-garde experimental equipment and lab facilities may improve the anticancer drug evaluation qualities, shorten evaluating courses, and make drug evaluations more precisely in the clinic [42-48]. Nonetheless the quality improvements for anticancer drugs at this moment have been very limited while the cost of drug developments is soaring since this Millennium. Generally, rapid technological advancements (tumor models and screening automation) help a great deal. Overall, we welcome all positive advancements of biomedical technology into anticancer drug developments.

Importance of team work

Not only chemical/biomedical scientists, mathematical or physics-majored students or scholars are also very important for anticancer drug developments and basic biomedical studies [39-41]. The high quality communications and teamwork between biomedical scientists and mathematicians may eventually fill the gap between experimental investigations and clinical therapeutics.

Drug Combination

Multi-targets of tumor treatment

Cancer is a malignant disease (multiple causality and steps-genetic and non-genetic) that is often difficult to be managed by single therapeutic drug and option. To overcome these obstacles, anticancer drug combination is a useful way to improve therapeutic outcomes in clinical cancer trials. Obviously, it did not do very well in the past. These kinds of efforts need long-term hard work and sustainable governmental support. It needs shortcut and larger assessment experimentally and clinically in future [49-50]. We shall not overlook these kinds of biomedical study.

Cancer stem cells

Due to the shortage of available anticancer drugs in clinical cancer trial, molecular diagnosis of tumor origins/categories for new tested compounds is important for experimental, preclinical and clinical drug evaluation. Some tumor functionality, such as cancer stem cells (tumor cell revival property) needs to be addressed from therapeutic perspective [51-53]. However, this kind of biomedical efforts does not work because only less than 10% cancer stem cells are present in solid tumor tissue. If we can find some solutions for neoplasm metastasis and cancer stem cells, cancer pharmacotherapy will be improved. As a result, any small breakthroughs will be a useful pathway for receiving smarter cancer therapeutics (Table).

Categories	Current	Future
Animal models	Mice	Large animals
Drug targets	Anti-proliferative	Antimetastatic
Tumor origin	Primary	Cancer stem cells
Drug efficacy	Single	Drug combination
Mechanisms	Tumor-oriented	Immune-oriented

Table: *Future trends of anticancer drug developments.*

Conclusion

Owing to the slow progresses of anticancer drug discovery and development, several pathways (tumor models, drug targets, mechanisms, cancer pathogenesis, neoplasm metastasis and clinical applications) can be made to facilitate drug development and cost reduction. In the future, higher efficient therapeutic options against tumor metastasis may be emerging. We welcome global participations in new eras of anticancer drug discovery and developments.

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