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Cost-effectiveness Considerations of Individualized Cancer Chemotherapy

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Abstract

The running cost for clinical cancer treatment has risen dramatically. It is a huge burden to government fiscal budgets and cancer patients' medical expenditure. Previously, we often create new drug and methodology of high cost and waste human resources for development of many less effects and expensive anticancer drugs or other sophisticated methodologies. These efforts will greatly increase therapeutic costs. Now some countries, such as USA or Japan, are overburden with high expense of medical resources in human diagnosis and therapy, especially for human cancer therapy. One of the major obstacles to controlling cancer growth and metastases is the inappropriate use of anticancer drugs. Treatment using individualized cancer chemotherapy (ICC) has been attracting increasing attention and will continue to show beneficial outcomes in the future. Increasing efforts to develop ICC strategies are generally paralleled with rising fee of diagnostic and prediction of drug responses and expense of anticancer drugs. Systematic evaluation of the relationship between the running costs and benefits of ICC is crucial for updating the ICC systems and making it available in the long run. In this editorial, we address and discuss this matter from different angels.

Keywords: Cancer chemotherapy; Cost-effective; treatment cost; Clinical cancer therapy; Neoplasm metastasis; Personal chemotherapy; Drug combinations

Background

The running cost for clinical cancer treatment has risen dramatically. It is a huge burden to government fiscal budgets and cancer patients' medical expenditure. Previously, we often create new drug and methodology of high cost and waste human resources for development of many less effects and expensive anticancer drugs or other sophisticated methodologies. These efforts will greatly increase therapeutic costs. Now some countries, such as USA or Japan, are overburden with high expense of medical resources in human diagnosis and therapy, especially for human cancer therapy. Thus, we ought to careful check our spending corresponding with the outcome of human cancer treatment and a new name of cost-effective strategy is denominated and was further systematically studied.

One of the major obstacles to controlling cancer growth and metastases is the inappropriate use of anticancer drugs. Treatment using individualized cancer chemotherapy (ICC) has been attracting increasing attention and will continue to show beneficial outcomes in the future. Cost-effectiveness is a long-standing medical problem pervasive in all areas of disease control and is also an early concern about mathematics of cost-effective evaluations of diagnosis and drug responses in ICC. Increasing efforts to develop ICC are generally paralleled with rising fee of diagnostic and prediction of drug responses and expense of anticancer drugs. Systematic evaluation of the relationship between the running costs and benefits of ICC is crucial for updating the ICC systems and making it available in the long run. Since the cost of anticancer and antimetastatic therapy is a critical matter to consider, the balance between cost and effectiveness is an unavoidable ICC research project [1-7] and we cannot overlook them.

Routine Cost of Cancer Chemotherapy

Background

Routine cancer chemotherapy is expensive. Generally the cost of a cancer therapy is more than 10,000 USD. If a patient needs an antibody therapy, the running cost of cancer chemotherapy will exceed to 10,000 USD, let alone ICC strategies. So the cost-effective study is an important task for saving the money of cancer patients and optimizing a therapy.

Calculation of Cost-Effectiveness

The cost-effectiveness ratio or data is calculated as ratio of costs and quality-adjusted-life-years (QALYs) by Markov analysis. Incremental cost-effectiveness ratio (ICER) <€20,000 is regarded as cost-effectiveness in developed countries [2]. However ICEF might be much lower for cost-effectiveness in developing countries. Apart from cost, the toxicities of a therapy must also be included for selection of a therapy. Some drugs, such as antibodies are very expensive, the calculated ICER is higher than ICER of chemical drugs only. It seems chemical drugs are better than antibodies. However the overall survival of antibodies plus chemical drugs is much longer than overall survival of chemical drugs alone. It is the financial conditions of cancer patients to decide what kind of a therapy a patient may chose [3].

Considering more than $10,000 expenditure of common cycles of drug combination and hospital residence fees, the cancer biomarker or bioinformatics detection fee ($100-5,000) is relatively cost-effectiveness. After detecting cancer biomarkers, it will increase the quality adjusted life year (QALY) of cancer patients, especially in some early stage of cancer [4-7].

For the late stage of cancer patients, it ought to use antimetastatic drugs targeting formed metastatic foci. These types of antimetastatic drug development are currently lacking licensed drugs worldwide. In

Allelic variants	SNP	Caucasian	Africa Americans	Asians	Hispanic
CYP2B6*2	C64T	5.3-9.0	0	4.7	
CYP2B6*3	C777A	0.5		0	
CYP2B6*4	A785G	4.0-32.6	16.7	9.3	14.3
CYP2B6*5	C1459T	9.5-13	9.0	1.1	0
CYP2B6*6	G516T	25.6		16.4	
	A785G				
CYP2B6*7	G516T	0-0.3		0	
	A785G				
	C1459T				
CYP2B6*8	A415G	1.0	0	0	0

SNY, single nucleotide polymorphism Ref 12
Similar data can be seen from reference 12.

Table 1: Ethnic frequency (%) of allelic variants in CYP2B6.

future, we ought to boost this type of drug discovery, development and clinical utilization [8-11].

Cost-effective Study from Methodology Consideration of Individualized Cancer Chemotherapy

Cost-effective study from methodology consideration of individualized cancer chemotherapy is the basic part of individualized cancer chemotherapy. There are a lot of different options from different methodologies of individualized cancer chemotherapy. Which methodology is the best one to a specific patient? One consideration is clinical situation of a patient, and the other consideration is cost.

Cost-effective of Different Predictive Methodologies

Amongst genotyping of different polymorphisms of genes of metabolizing enzyme or drug response molecules, which one might be more suitable to a patient and how much single nucleotide polymorphism (SNP) we ought to detect that can make cost balance and beneficial outcomes. This type of problem is a new subject. There are a lot of SNP in a specific gene, some SNP are important to therapy, some SNP are often negligible for drug response prediction. In clinical practice, how to genotyping these genes of metabolizing enzymes and drug targeting molecules is also a cost-effective problem. These information and experience are based on previous experimental data and clinical evidence accumulation [12]. If there is enough clinical evidence of polymorphism of some genes responsible for some varied drug responses, the doctor then may decide genotyping of these genes in routine ICC strategies.

For drug sensitivity testing, the running cost of *in vivo* drug sensitivity test methodology is several-fold higher than *in vitro* drug sensitivity test methodology. Thus, *in vivo* drug sensitivity test methodology ought to be less frequently used owing to the high running cost of *in vivo* drug sensitivity test.

The evaluation of the cost-effectiveness of individualized cancer chemotherapy can be different according to different systems. The evaluation of the effects of individualized cancer chemotherapy can be between inhibition of primary tumors and survival benefits. For drug sensitivity tests, it is often reported that there is marked benefit on inhibition of primary tumors. However, it is reported in the same time that there is no survival benefits even though primary tumor is inhibited by using drug sensitivity tests [13]. The calculation of cost-effect of drug sensitivity tests will be differently calculated according to different evaluation systems.

On the other hand, treatment effects to primary tumors might be

different from treatment effects to metastatic tumors by using different drug categories. Their intimate relationship must be carefully analyzed according to patients' clinical situations and anticancer or antimetastatic drugs being used.

Cost-effective results are statistically drawn from clinical data and be used to predict the therapeutic benefits of patients. So with the time go by, the cost-effective prediction will be more matured and helpful for cancer patients' therapy.

The Keys to Cost-Effective Study of Individualized Cancer Chemotherapy

Cost-effective study of individualized cancer chemotherapy is no easy task. It needs to know exactly the cost and benefits of each category of diagnosis and anticancer therapy. It is a system for designing a therapeutic regime based on consideration of budget and patients' clinical situations. The drug sensitivity testing or genotyping of drug response molecules or metabolizing enzyme genes needs certain amount of money. However their survival benefits are conditional and currently are not stead forward. In other hand, some gene polymorphism is not occurred in some ethnic group—ethnic frequency equals zero (Table 1), so in these ethnic group, there is no need to genotyping these gene polymorphism before initiating a therapy [12]. So the genotyping of drug response molecules or metabolizing enzyme genes needs differently pharmacogenetics protocols according to patients' ethnic group and running cost of a patient. Thus economic or ethnic consideration of patients' real situation is the important things to do. Previous, anticoagulant prophylaxis in operative ovarian cancer patients has been proved to be cost-effective.

Amongst different categories of expenditure of individualized cancer chemotherapy, choice of excellent drug is the first step. Methodologies, such as drug sensitivity test, biomarker detecting or pharmacogenomics are further steps possibly to make a therapy perfect yet the cost will increase in the same time. Whether a therapy can be beneficial, it always depends on expenditure and patients' clinical situations. If a cancer patient is very old (older than 65 years age) and in late stage, only use of antimetastatic drugs and anticoagulant or traditional Chinese medicine assistant therapy seems more acceptable. If a patient is young (15-35 years old) or cancer patients in early stages, the success of a therapy is more likely to happen and a completely ICC seems a best way.

Future Trend

Cost-effective consideration for drug combinations or assistant therapy is one part work of a clinician and basic cancer chemotherapy studies, especially when some high priced drugs are intended to be used.

In the future, standard automatic software will be perfected and might help us to make satisfactory decision and optimized therapeutic outcomes before individualized cancer chemotherapy begins. The production and perfection of standard software must be innovated and based on much needed data and upgraded with times.

Conclusion

The ultimate goal of cost effective study of individualized cancer chemotherapy is to maximize therapeutic outcome by minimum cost or funds from cancer patients. The cost of individualized cancer chemotherapy of prediction of drug responses (100-5,000 USD) is relatively less cost than the cost of some expensive anticancer or

antimetastatic drugs or hospital resident fees. Overall, generally individualized cancer chemotherapy is cost-effective, especially for young and early stage of cancer patients. The more appropriately use of funds and predictions of anticancer drug responses, the more therapeutic benefits a patient might achieve for a specific cancer patient.

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