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## Quantum Toxicological Research is Very Important, Which Should be Paid Attention

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**Abstract:** This review introduces the concept of quantum toxicology, its research methods, the adverse effects of quantum on human body, importance of quantum toxicology, the future development prospects and its role in pharmacology research. Quantum toxicology research is very important in pharmacology and toxicology, which should be paid attention.

**Keywords:** quantum; quantum toxicology; quantum pharmacology

Recent years, in China, rapid developments of quantum science, quantum communication, quantum radar, quantum dot, quantum computer, quantum camera etc. appeared one after another. Quantum is used more and more widely<sup>[1-2]</sup>. But in the process of use of quantum, some adverse effects appear in the human body, so there is also some quantum toxicology research<sup>[1-3]</sup>.

### 1 What is quantum toxicology?

#### 1.1 What is quantum?

In the field of micro world, some physical changes in the smallest unit, which are not continuous. The smallest unit is called quantum. Quantum is an indispensable basic individual. For example, a "light quantum" is the smallest unit of light, and the "energy quantum" is the smallest unit of energy. In modern understanding means, the possible smallest discrete unit of any physical property, such as energy or matter, is quantum<sup>[3]</sup>.

#### 1.2 What is quantum biology?

Quantum biology is a discipline that studies life science with quantum theory. Quantum biology can study quantum levels of molecular dynamic structures,

energy transfer and so on. Quantum biology can study the mechanism of carcinogens and mechanism of drug action.

#### 1.3 What is quantum biochemistry?

Quantum biochemistry is a branch of quantum biology. It is the science of studying the substance between the carcinogenic activity of chemicals and the electronic structure of molecules. It can also study the mechanism of action of carcinogens and the mechanism of drug action. It can study the the conformation and function of biological macromolecules (including mutation). Roberts<sup>[4]</sup> and Wu et al<sup>[5]</sup> used quantum chemistry to study the relationship between anticancer activity and electronic structure of pyridine pyrimidine derivatives. Quantum pharmacology is application of molecular quantum mechanics to the study of chemical structure and biological activity<sup>[4]</sup>.

#### 1.4 What is quantum mechanics?

Quantum mechanics is the fundamental branch of physics, which describes physical phenomena at the very tiny scale.

#### 1.5 Quantum toxicology concept

In the 21st century, the human genome project

implements the study of toxicological effect of quantum (such as light quantum) on organism, and its toxic mechanism and prevention.

At the same time, quantum toxicology is also the application of the theory and method of quantum science (such as the use of quantum chemistry, quantum biochemistry, quantum biology, quantum mechanics etc.) to study the toxic effects of exogenous chemistry on organism. Quantum toxicology explores the essential problem of toxicology from the electronic behavior of atoms and molecules in organism and its change in the course of the life by using theory and method of quantum mechanics. It can be used to understand the relationship between the carcinogenic activity of chemicals and the electronic structure of molecules. Quantum toxicology can be applied to ecological medicine<sup>[5-6]</sup>. Quantum pharmacology is the application of molecular quantum mechanic to study the pharmacology and to understand the relationship between chemical structure and biological activity<sup>[6-7]</sup>.

## 2 The role of quantum toxicology in drug research

Quantum toxicology can play an important role in the drug design, toxicity identification, structure-effect relationship and metabolic mechanisms. Su Yanlei et al<sup>[8]</sup>, Chinese scholars, used the method of quantum chemistry software Hyper-chen7.0 to study the anti-tumor mechanism of drug 5-fluorouracil. The results they found were consistent with the study of medicinal chemistry. Quantum chemistry has emerged as a more and more important discipline in the medicine, due to the increase in computation power in the latest 20 years. It can help the design of new drugs with better effects and less side effects. Zhang<sup>[9]</sup> is a researcher of our country who studied the carcinogenesis of condensed ring aromatics with MOPAC2000ANI method. He found that at the mouth part of the angle of the SED ring aromatics, because carbon atoms have the largest negative electronic charge and the high density of electronic cloud, they can produce the electrophilic reaction easily. Hydrogen atoms have the largest positive electronic charge and the lowest density of electronic cloud, so they can produce the nucleophilic reaction easily.<sup>[9]</sup> The results suggest that the site activity

of the polycyclic aromatic hydrocarbons is the highest, and that the cause of the carcinogenesis of the polycyclic aromatic hydrocarbons has a corner. Quantum toxicology has potential development prospect. Quantum science leads to the medical sciences into the era of molecular medicine. Quantum science can explain some mechanism in the poisoning and carcinogenesis. It has the significance of prevention and control.

## 3 Adverse effects of quantum on human body

### 3.1 Toxicity of quantum dots materials

In recent years, due to the wide application of quantum dot materials in scientific research, the possible toxic effects have attracted the attention of scholars both at home and abroad. Quantum dots have excellent spectral properties and broad application prospects. Because of their unique fluorescence properties, it has been successfully applied in the field of life science. As a new type of nano materials, its radius is less than or close to the exciton Bohr radius of nanoparticles, quantum dots. When its size is small enough, it will produce quantum effects such as tunneling effect etc. The toxicity research of quantum dots is part of the quantum toxicology. TGA-CdTe quantum dots have been found that they have a certain toxicity on human liver cells, and also will damage DNA<sup>[6]</sup>. While at high concentration exposure (CdTe,  $100 \mu\text{g} \cdot \text{mL}^{-1}$ ), red Qds and green Qds caused different decreases in cell metabolic activity with (46.8%+2.3%) and (68.8%+1.4%) respectively. It indicated that smaller Qds had greater potential toxicity. The adverse effects of quantum dots on the human body may be caused by the combination of physical and chemical factors. The effects of light from different spectra on the body are different<sup>[9-10]</sup>.

### 3.2 Ultraviolet rays

Ultraviolet ray is a high energy photon. Ultraviolet light quantum blood therapy in the last century in China and the former Soviet Union was used for the treatment of cerebral vascular disease and achieved good results. But in 1992 Zhuang et al<sup>[10]</sup> reported that the cell cycle blocking method were used in 12 cases who received ultraviolet light quantum blood therapy in treatment of cerebral vascular disease. With micro-

nucleus analysis, they found that micronucleus frequency positively increased along with the time of the treatment, and it was significantly different from that in the control group or before the treatment ( $P < 0.01$ ). Even after 2 months of the treatment, the micronucleus frequency was still obviously different from that in the normal control group ( $P < 0.01$ ). The results in the experiments above indicate that the damage of the human blood cell *in vitro* induced by the radiation of ultraviolet rays can't be repaired in a short period. Micronuclear rates can be measured by a special instrument<sup>[10-12]</sup>.

### 3.3 Laser photon

Laser is a kind of special light source, which has the characteristics that the other light sources do not have. So it has been used, both at home and abroad, for the treatment of freckle, cancer etc. But laser can be used as a weapon to harm the human body, and even to cause death.

### 3.4 The importance of quantum toxicology

Quantum toxicology can study the mechanism of toxic action of drug, chemical and quantum. It can help the design of new drugs with better effects and less side effects. Ma et al<sup>[13]</sup>, a group of researchers in China, studied the antitumor activity of flavonoids by using the quantum chemical method. It is found that flavonoids can prevent carcinogens from activating carcinogenic intermediates, and thus have antitumor effects. Quantum toxicology has potential perspective in pharmacology and toxicology.

## 4 Research methods

Quantum toxicology can be used in traditional toxicology experiments such as methods of molecular toxicology and nano toxicology etc. Quantum toxicology will also study the toxic mechanism, structure-effect relationship between the xenobiotics and target molecule in the body, etc. with the methods and theories of quantum science (such as quantum chemistry, quantum mechanics etc<sup>[13]</sup>).

## 5 Development prospects of quantum toxicology

In the future, quantum mechanics theory and methods should be applied to study the electronic behavior around the drug molecules and the stability of

the various conformations of drug molecules<sup>[13]</sup>.

Along with the development of quantum science, the quantum aspects of chemical reactions that promote a toxicological effect may be central for predicting toxicity of quantum-compounds, nanotechnology compounds and other toxic mechanisms<sup>[14-16]</sup>.

Therefore, we suggest that quantum toxicology should be organized by multidisciplinary researchers to work together to develop new software to improve computing power and make the results more accurate. In the field of quantum medicine, the real change of the electromagnetic field of the human body can be measured by isolating the influence of the external electromagnetic field, and more sensitive instruments will be created, both of which will improve the level of diagnosis and treatment. With the development of quantum science, many toxic, carcinogenic mechanisms will be clear, so the prevention and control is more effective, leading to improving people's health and longevity.

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