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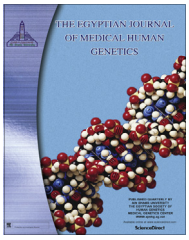

ORIGINAL ARTICLE

Some aspects of genetics and pharmacogenetics understanding by pharmacy students in Ukraine

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Abstract *Background:* Prescription and administration of drugs are still carried out without taking into consideration the individual's needs of a particular patient on the post-Soviet territory. A pharmacist may play a crucial role in the field of pharmacogenetics development in any country, nevertheless his/her role is uncertain even in the countries where pharmacogenetics is intensively developed. The aim of the present work is to analyze students' awareness about pharmacogenetics in the National University of Pharmacy (NUPh) since its development is delayed in Ukraine.

Methods: Field investigations have been used in this work. The material analysis based on questioning 637 students of the 1st–4th year majoring in pharmacy has been carried out.

Results: The analysis of the future pharmacists' awareness in the field of genetics and pharmacogenetics, as well as the study of the sex specificity of this awareness, has been carried out for the first time in Ukraine. It has been stated that more than 70% of the students questioned got the information about pharmacogenetics in University for the first time. However, only more than one-third of respondents (37.7% of males and 43.9% of females) correctly understand the idea of this discipline. About half of the students questioned thought that pharmacocorrection of hereditary diseases was impossible. It has been shown that on the whole females were more informed about pharmacogenetics than males. So, they can become more active persons of pharmaceutical market in future.

Conclusion: The awareness about pharmacogenetics and its role in personalized medicine is not satisfactory both in Ukraine and other countries. Thus, it is necessary to pay more attention to the aspects of pharmacogenetics when training competent up to date specialists in the field of pharmacy. Effective development of the appropriate infrastructure in pharmacogenetics testing and its introduction among the population of Ukraine are also necessary.

1. Introduction

Unfortunately, prescription and administration of drugs are still carried out without taking into consideration the individual's needs of a particular patient on the post-Soviet territory.

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At the same time, investigations into the field of personalized medicine are intensively carried out in the western world. The problem of the individual's approach to treatment is crucial in modern medicine. It is connected with the range of important discoveries in the field of molecular mechanisms of drug action. These discoveries are related to the levels of pharmacodynamics (receptors) and pharmacokinetics (enzymes). A series of new interdisciplinary subjects appeared not known so far, such as pharmacogenetics, pharmacogenomics, pharmaceutical biotechnology, etc. Thus, it is necessary to develop educational programs for pharmaceutical and medical students, as well as for specialists in advanced training, who work in the health care system [1]. The mentality changes of a future pharmacist and his/her adaptation to biological introduction, particularly genetic novation, are needed. There is a positive experience of interaction between geneticists, clinicians and pharmacists though it is rather insufficient.

Pharmacogenetics studies interindividual differences in relation to drugs due to genetic variation between people and, therefore, it is an important part of personalized medicine. Relevancy of pharmacogenetic tests is obvious due to occurrence of adverse reactions when underestimating the genetic polymorphism system, including variations in drug metabolism. For example, Holland scientists showed that in 39.5% cases adverse reactions appeared as a result of genetic factors, and the necessity of genetic expertise was initiated directly by the medical staff [2]. Adverse reactions due to genetic variations are particularly obvious in cancer patient treatment [3], and in recent years pharmacogenetic information is intentionally included into specifications of common drugs. Thus, the Food and Drug Administration takes into control this procedure in the USA [4]. The examples of drugs labeled with pharmacogenetics information include cytostatics 6-mercatopurine and irinotecan [5]. The personalized administration of drugs has become the applied aspect of the analysis results of human genetic polymorphism. There are some perquisites for gradual introduction of pharmacogenetic tests and genetic passports as a pharmaceutical service. Among them there is decoding of the human genome [6], and, consequently, understanding of genetic influence on drug metabolic pathways in the body.

The main and wide spread type of pharmacogenetic polymorphism is SNP (single nucleotide polymorphism). It studies differences in genetic material of DNA separate nucleotides (adenine, thymine, guanine and cytosine). SNP occurs in the human genome practically over each 300–400 b.p. Less significant are STRs (short tandem repeat), VNTRs (variable number tandem repeat) and other types of genetic polymorphism. Interpopulation pharmacogenetic polymorphism is more pronounced, especially, between the individuals of different races and ethnic groups. The differences between individuals within a population may also be quite obvious and clinically significant due to possibility of adverse reaction development because of either variations in pharmacodynamics or pharmacokinetics. A great number of papers are devoted to polymorphism of enzyme gene CYP2D6, which takes part in metabolism of many drugs, including narcotic analgesics and antidepressants. For example, the role of CYP2D6 in codeine metabolism is well-known. A person who doesn't have potency of this enzyme (a poor metabolizer), practically doesn't feel the analgesic effect of codeine, while ultra-rapid metabolizers are subjected to serious opioidergic effects, even to lethal outcomes [7]. It has been shown that in some populations not less than 50% of people can have at least one of two alleles of CYP2D6 with the reduced functional activity, which prevents codeine turning into active metabolite morphine and makes codeine analgesia ineffective [8]. CYP2D6 polymorphism also predetermines the therapeutic effect of oxycodone and hydrocodone [9]. SNP-genotyping of patients receiving tramadol as a post-operative analgesic in one of the Asian populations showed that 27% of them were moderate, 70% – quick and 2.9% – ultra-rapid metabolizers. Nevertheless the profiles of adverse reactions in different groups significantly differed. The widespread alleles were CYP2D6*1 and CYP2D6*10 [10].

Pharmacogenetics suggests three possible areas of activity: (1) development of methods and identification of areas of research, (2) evaluation of pharmacogenetic tests in clinical practice, and (3) conducting educational activities and infrastructure development for the pharmacogenetic test introduction [11].

The main role in pharmacists' competence to modern requirements is their constant qualification growth although in some cases pharmacists do not realize the importance of advanced training. In particular, there is evidence concerning the effect of advanced training reflected in the employment history on the competency of pharmacists. Pharmacists with work experience from 0.1 to 21 years took part in the investigation, which was held in the UK. The results showed that registration of certificates of professional development didn't influence pharmacist's activity. The most experienced participants of the investigation could less explain changes in their practical activity after trainings. The conclusion about the necessity of further investigations into the role clarification of the self-regulatory pharmacist's behavior was made [12]. In Scotland, 543 pharmacists took part in the investigation into time recording spent on advanced training. It has been shown that 9.8% of respondents have never passed advanced training. According to the sector of employment the rest of the respondents spent on average from 45 to 68 h for their qualification improvement [13]. The complex study as to relationship assessment of pharmacists' professional development has shown that such events are not approved by pharmaceutical community everywhere and not exclusively, especially in cases of qualification rechecking. Totally 22 works made from 2000 to 2010 were included into analysis in the UK [14]. Canadian researchers consider intra- and interdisciplinary cooperation necessary in conducting activities to advanced training of specialists working in the health care system [15]. It has been shown that two main motivational factors of curricula among students of pharmacy higher schools were knowledge and experience gaining, as well as a wish to get special skills [16]. These data clearly testify that not all events as to pharmacists advanced training are necessary and useful to subjects of such interaction.

The first step toward development of pharmacogenetic test protocols introduction into clinical practice was made in 2001, when with antidepressant administration, physicians began to recommend genotyping of the cytochrome gene CYP2D6. However, in spite of the early optimism, an up to date pharmacogenetic test is limited by the use of only a few clinical directions, in particular, cancer and psychiatry [17]. It is important to understand that before the introduction of a specific pharmacogenetic test into medical practice, it is necessary to conduct randomized clinical trials to evaluate its suitability