Particularities of Medical Education in the Field of Forensic Toxicology. Studying Dangerous Chemical Agents in Forensic Research

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Abstract: *The various insufficiencies or even diseases generated by the intoxication with the various substances, affect the quality of life - both of the intoxicated person and of those in the social environment in which he lives and works. The present article aims to analyse a series of perspectives regarding the role and importance of studying chemistry in the professional training of future doctors, especially residents in the field of forensic medicine.*

Keywords: *forensic chemistry; learning chemistry; forensic medicine; intoxication.*

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Introduction

Poisonings with various substances are common causes of invalidity or even death, which is why the field of forensic toxicology can be considered extremely important in the training of young doctors, both in general medical studies and especially in specialized studies/ residency in the field of forensic medicine (Iov et al., 2019).

Forensic reports often highlight the effects that different ingested substances have on patients (Radu & Bulgaru-Iliescu, 2016) depending on age, health status, but also other vulnerability situations such as microclimate in that the person lives and works, the toxicity of the work environment (Hunea, Knieling, Job, Riscanu, David, Ciuhodaru, & Bulgaru Iliescu, 2017); Damian, Rohozneanu, Glodeanu & Tabian, 2017) physico-chemical and microbiological characteristics of the area where the person lives, pollution level, contamination of water and air sources, contamination with various substances from food sources (Furnica et al., 2017) as well as the way of life.

The various insufficiencies or even the diseases generated by the intoxication with the various substances affect the quality of life - both of the intoxicated person and those of the social environment in which he lives and works (Gemene, Unguru & Sandu, 2018). The present article aims to analyse a series of perspectives regarding the role and importance of studying chemistry in the professional training of future doctors, especially residents in the field of forensic medicine.

Particularities of teaching chemistry in forensic toxicology studies

Awareness of the importance of studying chemistry in the formation of future physicians in general as well as those who specialize in the field of forensic medicine is a key element of the didactic activity within the medical specialties in which the forensic toxicology is studied.

The literature shows that the use of concrete examples in the sphere of forensic toxicology can be a serious motivation for students to approach the study of chemistry starting from the concrete understanding of the reactions that take place in the body in the various biological processes - normal or pathological (Testa, 2019).

The concrete examples of pathologies determined by the intoxication with various substances determine the increase of the student's motivation to participate actively in the course and to understand the physico-chemical phenomena studied as well as the anatomical-physiological

particularities presented during the course (Kaplan, 2019; Ciubara et al., 2018; Damian, David, Moldoveanu, Iov, Nedelea, Knieling & Sandu, 2017).

L.J. Kaplan (2019) considers forensic chemistry to be one of the most interesting and integrative subdivisions of chemistry in general, at least from the perspective of the students who find this type of studies as generating professional and scientific satisfaction (Huidu, 2017). The mentioned author shows that general forensic chemistry is applied in forensic chemistry, combined with specific models from other branches of chemistry. What sets this branch of chemistry apart from its other branches is the legal context in which the toxicological investigation must be conducted.

The broad involvement of forensic medicine in the development of criminology and forensics makes it necessary to know the forensic chemistry both by the doctors who follow the specialization in the field of forensic medicine (Damian, Bulgaru Iliescu, Rohozneanu, Glodeanu, Diac, David & Hunea, 2017). and by other specialists, criminals or criminologists, as well as by lawyers (Ignatescu, 2013) or magistrates who need to be familiar with the specialized language in which the forensic expert reports are written, when physical – chemical changes are involved that alter the person's health or even cause his/her death (Kaplan, 2019).

In the preparation of the future doctors it is all the more important to study the chemistry in the forensic context as they will be called to establish diagnoses and to carry out expertise regarding the various intoxications, acute or chronic, to evaluate the degree of danger of the poisoning and the its medical consequences.

Forensic chemistry and public health

In this context, we cannot fail to draw attention to the importance of the study of forensic chemistry by the future specialists in public health. They will have to propose solutions to reduce the risks to public health as well as to the different biological contexts or microclimates that may occur as a result of contamination of the environment with different substances, infestation of water or food with various harmful chemical compounds, radioactive emissions (Diac et al., 2017) natural or artificial, raised in a particular geographical space or in a dangerous context (Iov et al., 2019; Crauciuc et al., 2018).

Students can be introduced to the study of chemistry with applications in the forensic and public health fields starting from concrete examples, such as that of possible fluorine poisoning, substances that occur

naturally in human tissues and are often used in the sphere of public health, to combat the lack of fluoride in the body when it is naturally lacking in nutrition due to the particularities of the microclimate in which individuals live. However, fluorine poisoning can occur when the concentration of these substances in the body exceeds normal limits, which can cause pathogenic conditions, including increasing the risk of genetic abnormalities. Thus fluorine used for example in toothpaste can be the cause of serious illnesses, including cancers (Crauciuc et al., 2018; David et al., 2018).

Voluntary intoxication with substances, such as that occurring in the situation of alcohol, drug or ethno botanical consumption, is both a medical-legal problem but also of public health. From the perspective of forensic chemistry, studying the content of intoxicants and how they interact with various compounds existing in the biological structure of the body can also be a benchmark for capturing students' interest in studying chemistry as a particular discipline of interest for their training in the field of forensic medicine or public health (David et al., 2018).

Studies on the impact of substance use on the body, especially by teachers involved in teaching courses in the field of forensic medicine, which allow direct interaction with students, making them feel involved in the research process, it inspires the students' passion for research in the context of practicing evidence-based medicine. In the context presented, a study is conducted on a young man who dies shortly after cocaine abuse (David et al., 2018).

During the autopsy, samples were taken regarding urine, blood, gastric contents, which were analyzed by specific physico-chemical and microbiological methods, observing changes in the structure of the brain, lungs and heart¹. The particularities of the forensic expertise of the deceased person following the consumption of a cocaine overdose represent a practical approach in teaching forensic medicine in general and in particular the role of chemistry in studying the intoxication with substances from the perspective of the pathology they can determine.

We mention in this context the closed-circuit television system existing within the Institute of Forensic Medicine in Iași, which allows students to observe in real time the activity that is carried out within the institute, especially the autopsies, allowing students and residents to contact

¹ The experiment was described in detail in the article "Study on forms of intoxication with cocaine and evolutionary aspects" (David et al., 2018), in the context of the present article the experiment being presented only from the perspective of the didactic potential that it has in the context of approaching the students of the specific of forensic chemistry.

directly with the practical activity of the institute, and for the teachers to explain to the students in real time the procedures and maneuvers performed during the autopsy, their results and the arguments on which the proposed diagnosis is based².

Elements of forensic thanatology and their teaching to medical students

Forensic medicine is generally an attractive element for students studying forensic medicine, both from the perspective of medical and legal studies.

Understanding the causes of death and how it happened is an element of novelty, putting the student in a position to reflect on the human condition and its finitude (Scripcaru, Damian & Scripcaru, 2012). Moving beyond the philosophical and sociological aspects (Damian, Sandu, Necula, Bizgan & Ioan, 2013) with which they meet in studying the chapters related to forensic medicine thanatology, students should become familiar with the specificity of the post-mortem diagnosis, given that the purpose the forensic autopsy is the accurate reconstruction of the death circumstances - both of its causes and the mechanisms after which the death occurred, the associated pathologies and their role in the death occurrence, the moment of death, etc.

Post-mortem biochemical analysis is the one that provides particularly important information regarding the forensic case (Damian et al., 2017). Post-mortem biochemical determinations are especially important when morphological alterations such as diabetes mellitus, alcoholism, etc. are non-existent and generally in such cases where such investigations provide information necessary to establish the mechanism of death (Furnica et al., 2017). The research focuses on the concentration of different substances in humoral fluids, thus allowing students to become acquainted with the full specificity of post-mortem diagnosis (Chao & Lo, 1993; Kala & Chudzikiewicz, 2003).

For the purpose of a clearer understanding by the students of the modalities of making the post-mortem diagnosis, their involvement in carrying out laboratory determinations of the level of the different

² Particular merit should be given to the Professor PhD Diana Bulgaru-Iliescu for the involvement in the introduction of this audio-video training system, which allows the real-time transmission of the images from the autopsy room and their reception in the classroom, where they can be watched by residents, students, together with teachers from "Gr. T. Popa" University of Medicine and Pharmacy from Iași, who is active in Forensic Medicine Institute Iași Romania.

substances in the humoral fluids (Ioan, Damian, Jitaru & Damian, 2015) of the deceased person is the key- element to their professional training, due to the concrete experience thus achieved which adds to the theoretical knowledge taught in the classroom.

Conclusions

The implications of chemistry in forensic medicine require solid knowledge of chemistry, including laboratory chemistry, but also solid knowledge in the field of forensics and forensic medicine. Although chemistry used in forensic medicine may be considered a separate discipline, its transdisciplinary approach is absolutely necessary for training students – both future doctors preparing for a career in forensic medicine, as well as the chemists and laboratory technicians who will perform the analyses themselves, both in the field of toxicology, forensic and medical thanatology, as well as public health specialists.

Good training of future specialists in the field involves direct contact with the laboratory but also familiarization with the different substances, with the mechanisms by which they act in the human body and with the effects that they can have in different situations.

Laboratory applications of forensic chemistry can be used as a motivational source for teaching chemistry to both medical students and law students and theoretical and industrial chemistry respectively.

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