ULBS

Universitatea "Lucian Blaga" din Sibiu

Interdisciplinary Doctoral School

Doctoral Field: MEDICINE

PhD THESIS

DEATH-INDUCING SYNDROMES AS A RESULT OF TRAUMATIC LESIONS IN MEDICAL AND FORENSIC PRACTICE

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Trauma is a lesional or functional change that results from the action of a form of energy outside the body. This term can be equivalent to the notion of *lesion*, but the latter must be distinguished from the notion of *traumatism*, which specifies only the action of an external form of energy on the human body that can cause morphofunctional changes.

Forensic expertise is primarily concerned with the post-traumatic lesional changes, which can cause morphofunctional disorders or even death. Their explanation is made by describing and defining lesions and not by using the general term of *traumatism.*

Traumatology is the medical science dealing with the study of the traumatic factors and the local and general effects produced by these ones on the human body. It is the most important concern of the forensic expertise because, in modern life, traumatisms have become more and more frequent. The increase in the incidence of road accidents, work accidents, falls and acts of violence explains why mechanical trauma is today one of the major concerns of medicine in general and of forensic medicine in particular.

A traumatism can cause, in addition to local injuries, a series of general morphofunctional changes that are expressed by a characteristic clinical symptomatology and by a series of changes in the biochemical and endocrine-hormonal variables that characterize the notion of "traumatic disease". The traumatic disease is gradually installed, and the clinical manifestations are not always directly proportional to the severity of the lesions (e.g., in people with multiple health conditions, posttraumatic changes are of greater magnitude). A number of factors can aggravate the traumatic disease: meteorological, increased body reactivity, psychic constitution, associated organ defects. [4.52]

The aim of the research is to contribute to substantiating the causality concept in medical and forensic practice and to develop a working tool that guides the forensic specialist in the correct establishment of the mechanical post-traumatic death-inducing chain and the causal relation as an indispensable factor of the correct legal framing.

Research objectives:

I. Dynamic clinical and statistical evaluation of mechanical post-traumatic death-inducing syndromes in the casuistry of Sibiu County Forensic Service

II. Identifying and interpreting the types of causalities in deaths following mechanical traumatic injuries. Series of forensic cases.

III. Elaboration of a working algorithm for the establishment of the mechanical post-traumatic death-inducing chain and the causal relation between the traumatic event and death.

The paper observes the traditional research plan in the medical sciences, consisting of a general part and a special part, in which the results of the personal research are presented.

The general part, structured in 3 chapters, approaches traumatology notions (general, systemic and topographic) (Chapter I), death-inducing syndromes (Chapter II) and forensic causality (Chapter III), presented in a synthetic and analytical manner – theoretical background for the personal study. The theoretical and practical notions in the investigation of mechanical posttraumatic deaths were the result of the systematic analysis and meta-analysis of the critical apparatus consisting of 118 bibliographic titles, bringing together the most relevant publications regarding the approached topic, 103 being communicated in the last decade.

The personal contributions part is made up of 7 chapters. The research is the result of an interdisciplinary cooperation, which has capitalized the experience of specialists from several clinical specialties, within the Sibiu County Clinical Emergency Hospital and Sibiu County Forensic Service.

The research methodology is presented in Chapter IV. The results were obtained following an observational study, having as research method the ambispective (retrospective and prospective) longitudinal epidemiological enquiry, fully researching the study material. The study material consisted of 1050 forensic autopsies, performed over a period of 10 years, within the Sibiu County Forensic Service.

Design of Personal Research: Each study has been dedicated a chapter. In study I, each type of traumatism was studied in relation to the following parameters: infobiographic data (gender, age, residence environment) and clinical parameters (type of trauma - mono/ polytrauma, production circumstances, tanatogenesis). The second study consists of a series of 5 clinical cases that exemplify the five types of causality regarding deaths following mechanical traumatic injuries. Each case is accompanied by a critical analysis. The third study presents a

judgement algorithm of the causal relation in the deaths following mechanical trauma, exemplifying the type of causality regarding the clinical and forensic series of the previous study.

Study I. Research Objective: Dynamic clinical and statistical evaluation of mechanical post-traumatic death-inducing syndromes in the casuistry of Sibiu County Forensic Service. **The research methodology** was the retrospective epidemiological survey. **The study material** consisted of 1,050 deaths from mechanical traumatic lesions, from a period of 10 years (January 1, 2007 to December 31, 2016), within the casuistry of Sibiu County Forensic Service. The data were collected from the medical forensics reports (Autopsy Reports), toxicological analysis bulletins, medical records of the Emergency Room and clinical observation sheets. We analysed the infobiographic parameters (gender, age, residence environment) and clinical parameters (type of trauma - mono/polytrauma, production circumstances, tanatogenesis).

Of the total deaths resulting from the mechanical traumatic injuries, from the casuistry of the Sibiu County Forensic Service between 2007-2016, more than 60% were due to a single trauma, the rest were due to the polytrauma. Cranio-cerebral trauma accounted for more than half of the deaths secondary to single traumatism, followed by trauma of the limbs in terms of percentage (15%). Over 80% of all deaths from cranio-cerebral trauma have occurred in males, and more than half of these have been reported in people from urban areas. Also, more than two-thirds of all these deaths were reported among 40-79 year olds, and the distribution of cases related to the production circumstances revealed a maximum share of domestic accidents (57%). In 58% of cases, the deaths as a result of cranio-cerebral trauma were caused by the simple fall, followed by deaths due to hitting from harsh objects and/or by compression (from road accidents to passengers), in a percentage of 23%. In more than 1% of cases, death occurred by shooting.

Of the deaths-inducing syndromes secondary to cranio-cerebral trauma, meningo-cerebral haemorrhage recorded the highest weight (58%), followed by bronchopneumonia (15%). 60% of the deaths from craniofacial trauma occurred in males, with approximately the same weights per residence area, with urban predominance (53%). An incidence peak in the sixth decade of age (one third of cases) has been noted, and nearly half of them occurred in a domestic accident. 20% of them were due to aggression.

Most deaths (40%) occurred through the mechanism of falling, the compression mechanism being involved in more than 10% of cases. Of the death-inducing syndromes secondary to the cranio-facial trauma, the meningo-cerebral hemorrhage recorded the maximum

weight, followed by the subarachnoid hemorrhage. In nearly 85% of cases, deaths due to cervical trauma occurred in males, in a percentage of 54% of those living in rural areas. Most deaths resulting from cervical trauma were found in the sixth decade of age, with equal shares (46%) in terms of suicides and aggressions. More than 60% of the death-inducing syndromes of the cervical trauma were represented by external haemorrhage. Male predominance (87%) was found in the case of deaths from thoracic trauma, and two thirds of the cases occurred in people from urban areas. More than half of this type of deaths occurred in people aged 30-59 years.

Almost one-third of the death-inducing syndromes of thoracic trauma were represented by haemopneumothorax, followed by internal haemorrhage (one quarter). 85% of all abdominal trauma deaths occurred in men, and two thirds in people from urban areas. Over half of them occurred in people of the 4th and 6th decade of age. The death-inducing syndrome with a maximum weight (50%) regarding the abdominal trauma was represented by internal haemorrhage, which occurred in 43% of road accidents, by hitting from harsh objects from the inside a motor vehicle, in the event of a sudden deceleration. Deaths from vertebro-medullary trauma were mostly encountered in males (78%), with urban predominance (52%) and nearly two-thirds in the VI, VII, VIII age groups.

The maximum share (52%) of the death-inducing syndromes of the vertebral-medullary trauma was represented by the vertebral-medullary sprains/ fractures-dislocations. The maximum share (52%) of deaths as a result of limb trauma occurred in females, with two-thirds of these cases coming from urban areas, and almost half (45%) of them in people aged over 80. The maximum share of the death-inducing syndromes of limb trauma was recorded by cardiac decompensation, followed by external haemorrhage. Over two-thirds of deaths following polytrauma occurred in males, 58% of these coming from urban areas. Over 53% of these cases occurred in the age range 30-59 years. The death-inducing syndrome with maximal weight in the case of individuals with multiple traumas was the internal haemorrhage (36%).

Bronchopneumonia occurred in the evolution of polytrauma occurred in 57% of road accidents. The highest weights of these polytraumas occurred by hitting from harsh objectives and/ or by compression from the inside of a vehicle (in road accidents to passengers) (48%) and falling from heights (35%). Three quarters of the polytraumas complicated by toxic-septic shock were due to road/rail accidents, half of them occurring by falling from heights, the rest by hitting from harsh objects and/ or by compression inside a motor vehicle (in road accidents to

passengers). Two-thirds of polytraumas complicated with pulmonary thromboembolism occurred in some road accidents. The simple fall, the fall from the height and the hitting from harsh bodies and/ or compression inside a motor vehicle (in road accidents to passengers) were responsible for the production of polytraumas with consecutive pulmonary thromboembolism.

Study II aimed at: identifying and interpreting the types of causality in the deaths due to some mechanical traumatic injuries; case studies. The study consists of presenting a series of forensic cases that exemplify the five causalities in deaths following mechanical traumatic injuries. Each case is accompanied by a critical analysis. The cases were selected from the archives of the Sibiu County Clinical Forensic Service.

The ways in which traumatic injuries lead to death are very varied, being determined by the diversity of the death-inducing chains, which in turn, are influenced by trauma (type, topography, intensity), individual biological background (age, organic strength), and the clinical management (promptness and accuracy of diagnosis and treatment). The diversity of the death-inducing processes has both medical and legal implications (through the causal relation determined), leading to different legal framing of the deed of the one who is guilty of producing the trauma.

Study III. Objective of the research: Elaboration of a working algorithm for the establishment of the post-traumatic mechanical death-inducing chain and the causal relation between the traumatic event and death. **The research method** was represented by a combination of qualitative research methods: critical analysis of the specialized literature; critical analysis of cases; the group consisting of 7 members, having the following structure of clinical specialties, a primary surgeon, 4 forensic experts (2 primary doctors, 2 specialist doctors), a primary neurosurgeon and an orthopedic primary physician.

The accurate setting of the death-inducing syndrome and, implicitly, of the post-traumatic causal relation requires a thorough knowledge of both the concepts of forensic medicine and the concepts of clinical medicine, as well as a critical analysis of each case, taking into account not only the data obtained after the autopsy, but also the entire medical history.

Conclusions:

At the end of the paper, it is emphasized the **novelty element** brought by the research, which provides a clinical judgment algorithm, to guide the forensic practitioner in identifying

death-inducing chains and the causal relation, useful in particular in the interpretable forensic cases.

The proposed tool can be implemented at the level of all Forensic Services, providing a way to improve the knowledge in the field and a good practice model that can be developed and improved in the traumatology casuistry.

Equally, the dissemination of the protocol to other county forensic services would allow, in the future, for a critical analysis of the different ways of interpreting causality links in particular cases, as well as in cases of similarities. The proposed tool may be the starting point of an initiative to bring together both forensic experts, professionals from the clinical medical and surgical specialties involved in the clinical management of the patients with mechanical injuries, and professionals in the legal system whose collaboration, especially in particular or difficult cases, can lead to the development of guides to lead practice.

The research carried out has some **objective and subjective limits**: in the analyzed cases, it is possible that the medical history to be incomplete, in the absence of life-long investigations, the functional diseases, not revealed on the autopsy, are being omitted. On the other hand, it is possible that the forensic specialist may not have had access to all the medical documentation of the case, or some medical records consulted may have had errors. Although the causal relation is a unitary notion, its approach from the medical, forensic and legal points of view is not totally superposable, due to the intervention of the patient's individual factor.

The results of the doctoral research have been disseminated through 6 scientific papers published in journals indexed in International Databases.