

THE INFLUENCE OF THE ENVIRONMENTAL FACTORS ON THE HUMAN CADAVER

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Abstract

The authors present the role of the environmental factors in the evolution towards putrefaction or preservation of the cadavers which were either buried or remained for a long period of time in the same place where the death occurred. This article is based on a rich array of cases met during the professional activity of the authors, legal medicine doctors at SJML Bihor-Oradea. There is at least one example of a case for every possibility of the cadaver's evolution, based on the environmental factors where it has been found. The conclusions of the analysis specify the two main directions of the evolution of a cadaver, based on the environmental factors which it has been exposed to: either towards the rapid decomposition or slow decomposition of the cadaver into the primary mineral elements, or on the contrary, towards the preservation of the cadaver for a shorter or longer period of time. The essence of this work is to convey the fact that it has been demonstrated and proven how important it is from a medico-legal and judicial stand point to know and to correctly interpret the environmental factors which act upon the human cadavers.

Key words: human cadavers, environmental factors, forensic medicine

INTRODUCTION

After death, the human body becomes a cadaver. Frequently, there are situations when the cadaver does not follow the usual course to inhumation with the specific ritual encountered in different cultures and religions. The cadaver may remain either, for a short period or longer period of time in the place where death has occurred, being found days, weeks, years or even thousands of years later. In these situations the environmental factors are those which will influence the evolution of the cadaver towards one of the following: rapid decomposition or the preservation under different forms. On the other hand, a cadaver exposed to the external environment can be a source of pollution, meaning that it can become a source of infection, soil

contamination, and especially water contamination. Most often the nature acts in such way that the cadaver either decomposes rapidly, and all organic substances disappear, the only remaining substances being the inorganic ones (minerals), or the decomposition is limited or absent, and the cadaver conserves for an unlimited period of time (Dermengiu, 2002; Moraru, 1967).

For most societies, the need to “manage” a deceased person is done according to a very precise religious set of rules, which are basic hygiene rules, in other words, rules for public health. Some illustrating examples are: The Muslim burials which take place in the first 24 hours after death, more precisely before the sunset on the same day as the death occurred; the cadaver is buried in dry, sandy soil. The Jewish bury the cadaver without clothing, just wrapped into a white linen shroud; the cadaver is introduced into a plain, rough, wooden box which is buried in a grave dug into the sand. Why are all these rules necessary? The dry sandy soil facilitates a rapid dehydration of the cadaver, resulting in preservation; the rough wooden box has spaces between the boards which allow the rapid dehydration; the short period between the time of death and burial does not allow the onset of putrefaction. (Beliş, 1995)

MATERIAL AND METHOD

We further present the two courses of evolution of the cadaver when it remains over a period of time in the same place where the death occurred.

I. The evolution towards the development of destructive modifications: The cadaver is in contact with the air, at high temperatures (on a field, in the woods, in isolated buildings, etc). The precocious signs of death appear rapidly (cadaveric rigidity-rigor mortis, cadaveric lividity-livor mortis, internal organ autolysis), and they are followed by the tardive signs of destructive type, the main one being putrefaction. The cadaver begins the putrefaction process and decomposes. A very important and beneficial role in this process is played by the necrophagous insects and their larvae. Slowly the cadaver becomes skeletonized, all the soft tissues disappear and only the skeleton remains, sometimes partially covered by clothing. If the cadaver is aggressed by small animals (example: rodents), or larger animals (dogs, cats, foxes) will break apart, fragment, and this fact will create medico-legal and juridical problems regarding the identification, or if fractures are produced, they will create problems in the interpretation of the fracture’s mechanism (did the fractures happen while the person was alive or after death, are they due to animal aggression?).

Based on the action of the environmental factors the decomposition of the cadaver is either faster or slower. The higher the temperature and humidity, the faster the evolution is towards putrefaction. (Beliş, 1995)

Example: male, 28 years old, athletic built (weight-110kg, height-190 cm), shepherd, known with epileptic condition, went missing from the sheepfold on an August day, when the maximum day temperature was 30 degrees and the night temperature was 19 degrees. He was found 9 days later at the edge of a corn field, in the sun, wearing only shorts and a shirt, with an empty vodka bottle next to him. The cadaver was 90% skeletonized, the only areas which still had soft tissue (muscles and fat) were the buttocks and the posterior areas of the thighs. The only skin found was on the feet, which were covered by shoes. The internal organs were gone for the most part. The cadaver did not have any fractured bones. The state of cadaver after 9 days was due to extremely rapid putrefaction and the action of flies and other necrophagous insects and their larvae. The autopsy conclusions were based on the data received from the criminal investigation team, and on the previous medical history of the deceased. It was established that his death was non-violent, most likely due to an epileptic crisis induced by alcohol consumption.

II. The evolution of a cadaver under the influence of particular environmental factors is completely different based on the physical and chemical properties of these factors, resulting in a natural preservation of the cadaver.

A. The dry heat and lack of humidity, at times associated with rapid air currents, sometimes preserves the cadaver extremely well, even spectacular, creating a natural mummification of the cadaver due to its rapid dehydration. The lack of water does not allow the development of putrefaction. The mummified cadaver is very light due to the fact that it loses up to 80% of its initial weight. (Baciu, 2003; Dragomirescu, 1999)

Example: 1. In an underground water system with 40 cm pipes which transported superheated water, a male cadaver was found, his height was 175 cm, lightly dressed, laying on a mattress; the cadaver's weight was 17.5 kg; it was easily identified due to the preservation of the facial features, and his tattoos which he got while alive were perfectly visible on the dry skin; the investigation established that his death occurred 3 years prior to the cadaver being discovered; it was not possible to establish the exact cause of death, only the fact that the cadaver did not have post-traumatic lesions.

2. Female, 58 years old, victim of a traffic accident, undergoes autopsy and she is buried in the cemetery in the village Valea lui Mihai, Bihor County, where the soil is sandy and very dry; it is requested an exhumation after one year since burial; when the casket, which was practically buried in sand, was opened, the state of the cadaver strikes due to its extremely good preservation; this happened because of the cadaver's dehydration and total lack of putrefaction; only small parts of the cadaver were covered in white mold deposits; it was possible to observe the traumatic lesions, which

allowed for the reconstitution of the mechanism which caused these lesion during the accident.

The mummification has also other advantages. The very good preservation thorough mummification of the cadavers is seen in some places as wonders, miracles, divine signs, etc. Important deceased religious figures from the past are often presented to the public as miracles because of the good preservation of the cadavers through mummification due to environmental conditions. (Dermengiu, 2002). However, it is not hard to explain why a monk who died in a cave situated in the desert, found deceased after a long time, is in a good state of preservation. Subsequently, the mummified cadaver is displayed and presented to the public as a miracle.

B. When the cadaver is exposed for a long time to an intensely mineralized environment, with acid pH, the form of preservation is called lignifications (or tanning).

The typical condition for this kind of cadaver preservation is found in the muddy swamps and the acid swamps. There are areas with heavy mineralized and acidic soils, especially in the areas of oil exploitations. (Mihalache et al., 2007).

Example: male, 44 years old, buried in the vicinity of the village Suplacu de Barcau, without an autopsy being performed, even though the death was violent; the exhumation of the cadaver was requested one year after the death occurred; the soil where the casket was buried was swampy; the casket was brought up to the surface with difficulty because it was practically under water; upon the removal of the casket lid, it was found that water had infiltrated into the casket and the cadaver was immersed for one year; it was found that the cadaver was well preserved, the skin was dark color, brown, indurated; the internal organs were also well preserved and around the neck it was possible to perfectly examine the hanging groove; it was possible to remove organs for the histopathological examination, which emphasized the importance of the hanging groove, it was confirmed that the hanging took place while the person was still alive.

C. When the cadaver is in a humid environment without oxygen or little oxygen for a long period of time, in clay soils or stagnant water, the preservation is called saponification (or adipocere). The saponification of the cadaver's fat tissues and also the solidifying of the fatty acids by hydrogenation occur. (Iftenie, 2006)

Example: an obese 70 years old female, missing from her residence, three months later her cadaver was found into an abandoned water well at the edge of the village; in this water well the villagers used to discard the cadavers of their deceased domestic animals; when removed from the water well, the woman's cadaver was relatively well preserved especially the anatomical segments which were submersed under water (head, thorax,

abdomen); on these areas the skin was whitened, friable, and the subjacent adipose tissue was transformed into adipocere, with a gray-greenish color, gelatin like, greasy, with an ammonia smell; the examination of the cadaver which was preserved in this manner allowed the exclusion of violent lesions caused prior to death.

D. An environmental factor extremely important in the cadavers' preservation for an unlimited period of time is the cold. The lower the temperature, the better the preservation of the cadaver. A frozen cadaver can last without modifications for hundreds of years. (Dermengiu et al., 2012)

Example: male, 35 years old, amateur mountain climber, missing following an avalanche; the search goes on for 5 months, and in the spring of the following year he is randomly found, still buried under the melting snow; the cadaver was partially frozen and perfectly preserved and the histopathological examinations which followed were able to establish the cause of death: asphyxia, and have excluded the presence of lesions.

DISCUSSIONS

Regardless the direction of the evolution of the state of the cadaver, due to the influence of the factors present in the environment where the cadaver remains for a period of time after death, there will be a series of problems which will make it difficult to perform the medico-legal expertise. Problems such as:

- Putrefaction: modifies the characteristics of the wounds and destroys the conclusive character of the lesions; necrophagous insects produce artifacts which imitate traumatic lesions; hinder the cadaver's identification in such a way that after years it can only be done by examining the teeth and bones; (Dragomirescu, 1996); causes difficulties in assessing the date of death, and in the execution of the laboratories examinations (example: bacteriological determination) or in detecting toxic substances (the putrefaction decomposes the organic toxins, ptomaines give false positive reactions – identical to the alkaloids'). (Beliş, 1995)
- Mummification: makes the conclusive character of the violent lesions hard to be identified; generates difficulty in the assessment of the date of death; the mummified cadavers can be destroyed by insects which feed on dry, soft tissues (moths, mites).
- Lignification: it does not cause problems for the medico-legal expertise; it preserves the cadaver indefinitely (example: the cadaver in Tollund, 2000 years old); allows toxins determination. (Cocora, 2003)
- Adipocere (saponification): the cadaver is very friable, and it has to be maneuvered with great care; it has to be kept away from heat to avoid destroying the saponified fats (Dermengiu et al., 2012)

- Freezing: the autopsy must be performed immediately after defrosting due to rapid putrefaction; it causes the loosening of the cranial sutures and as a result a differential diagnosis with cranio-cerebral traumatism is required.

CONCLUSIONS

1. The environmental factors by their complexity and diversity act upon the human cadaver in two ways: the natural preservation of the cadaver or its decomposition through the putrefaction process.
2. The forensic pathologists, especially, need to know how the environmental factors act upon the cadaver, and they need to interpret correctly the modifications which occur on the cadaver due to the action of these environmental factors.
3. Taking into consideration and correctly interpreting the action of the environmental factors upon the cadaver, the forensic pathologist can estimate the date of death, and moreover, may establish the cause of death.
4. The natural preservation of the cadavers eases some medico-legal activities such as organ sampling for histopathological and toxicological examination, all these being very useful in establishing correctly and with certainty the cause of death.
5. A better institutional collaboration between the specialists who analyze and follow the environmental factors (meteorologists, specialists from the national environmental protection agency, etc.) and the forensic pathologists is required in order to provide the pathologists with relevant data in due time about the environmental conditions in a specific region at a particular time (the moment of the person's death in the area where death occurred).

Knowing the action of the environmental factors upon the cadavers, the phenomena which is being publicized as being wonders or even supernatural phenomena can be explained and scientifically proven by the forensic pathologists.

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