CASES OF DEATH DUE TO ELECTROCUTION OF FISHERMEN USING CARBON FISHING RODS – MORPHOLOGICAL ASPECTS

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ABSTRACT

With the development of technologies for fishing and the affordability of the fishing rods made of light enough and durable materials (carbon fibers, which are conductive) in recent years there are more frequent cases of death among fishermen using such accessories too close to high-voltage power lines. Given to their length such fishing rods may easily come into contact with parts of the electricity network, located close to different ponds, while not excluding the possibility of fulmination during thunderstorms. The morphological changes found in cases of deceased fishermen using carbon fishing rods without considering the danger of the nearby overhead power lines are presented. The established morphological findings are based on data of the Department of Forensic Medicine and Deontology, Medical University – Sofia. Materials and methods: complete forensic medical examination – anamnestic and criminology data, examination of the accident scene, forensic autopsy of the body of the deceased. Results: Fatal accidents associated with fishing rod contact with overhead power lines involve carbon-fiber rods. If a carbon fiber fishing rod is used in proximity of a power line there is a significant risk of a fatal electric shock, due to the fact that these fishing rods are excellent conductors of electricity. It is not necessary for the rod to touch the cables because the electricity may arc ("jump") over considerable distances. Predisposing factors are the wet feet and shoes of the fishermen, which reduces the resistance of the skin and makes easier the passage of the electric current through the human body. The morphological changes due to the effect of the electric current represented in the present research are mainly in the skin – from small electrical burns on the palms of the hands and tips of the fingers (entry sites) and soles of the feet (exit sites) to carbonization of the body, depending on the duration of contact with the source of electricity as well as its voltage.

Key words: *death from electricity, carbon fishing rod, high-voltage power lines, electrical burns, carbonization*

INTRODUCTION

Today's fishing rods are made from lightweight, durable materials such as fiberglass or carbon fiber - commonly called graphite. Carbon fiber is a material consisting of fibers about 5–10 μm in diameter and composed mostly of carbon atoms. Using a carbon fiber fishing rod near a high voltage power line could be very dangerous, resulting in a fatal electric shock (1).

In recent years there are more frequent cases of death among fishermen using such accessories too close to high-voltage power lines. Given to their length such fishing rods may easily

come into contact with parts of the electricity network, located close to different ponds, while not excluding the possibility of fulmination during thunderstorms. The passage of a substantial electrical current through the tissues can cause skin lesions, organ damage and even death. This type of injury is called "electrocution" (1, 2).

The purpose of this study is to make a morphological analysis with a comprehensive forensic evaluation of cases of deceased fishermen using carbon fishing rods without considering the danger of the nearby overhead power lines based on data of the Department of Forensic Medicine and Deontology, Medical University – Sofia.

MATERIALS AND METHODS:

In the Department of Forensic Medicine and Deontology, Medical University – Sofia was made a complete forensic medical examination of the bodies of deceased fishermen including gathering anamnestic and criminology data, examination of the accident scene and full forensic autopsy of the body of the deceased, including toxicological analysis of biological materials to prove or exclude the influence of drugs on the body at the time of the incident.

RESULTS

For the past few years in the Department of Forensic medicine and Deontology, Sofia, we have examined several cases of deceased fishermen. In all cases these men were fishing using carbon fiber fishing rods standing nearby a high voltage power line. In some of the cases they accidentally touch those power lines with the carbon rod, as in others the electricity arced ("jumped") over a distance. If a carbon fiber fishing rod is used in proximity of a power line there is a significant risk of a fatal electric shock, due to the fact that these fishing rods are excellent conductors of electricity (3). Predisposing and supporting factor in these cases are wet shoes, respectively legs of the victims (figures 1 and 2). The macroscopic morphological changes due to the effect of the electric current represented in the present research are mainly in the skin – from small electrical burns on the palms of the hands and tips of the fingers (entry sites) and soles of the feet (exit sites) to carbonization of the body, depending on the duration of contact with the source of electricity as well as its voltage (1, 4).

The carbon fishing rod in such cases is a conductor of electricity (not an isolator), which can carry out high voltage discharge from the nearest non-isolated (technologically) phase conductor of the transmission lines through the fingers of the hand of the victim, which was holding the rod, respectively the victim's body and legs to the ground (figure 3).

The most common type of high-voltage power line carries a voltage of 20 kV (kilovolts) and the minimum distances (clearances) from such power lines are 2m beneath the line and 3m when measured sideways along the ground. The higher the voltage the larger is the minimum clearance. The minimum clearance for the highest-voltage power lines carrying 400 kV is 5m (2, 5, 6).

DISCUSSION

The severity of tissue damage is directly related to a number of physical factors, which include: current, voltage, resistance and time of exposition. In electrocution there must be a pathway for electrons across part of the body which, in fatal cases, contains vital structures.

The current enters the body at one point (most often the hands), called entry site (figures 4 and 5), and then leaves it at an exit point (usually the earth or neutral conductor of the electricity supply), called exit site (figures 6, 7 and 8). In fatal electrocution three major events may occur, which are a threat to life:

- The most common is the passage of the current across the heart. The fatal process is a cardiac dysrhythmia, usually a ventricular fibrillation ending in asystole.

- Less often, the passage of the current across the chest and abdomen may lead to respiratory paralysis from spasm of the intercostal muscles and diaphragm.
- Rarely, the current passes through the head and neck. In such instances there may be a direct effect on the brain stem so that cardiac and respiratory centers are paralyzed (1, 2).

It is well known that direct current is less dangerous than alternating current (1), because it is much more likely to cause cardiac arrhythmias, as well as tetanic muscle spasm, which prevents the victim form releasing the live conductor. Furthermore, the degree of damage is proportional to the actual quantity of electricity flowing through them. This quantity is expressed by the number of electrons per unit time. According to Ohm's Law, current depends on the applied voltage, the resistance of the tissue and the time for which the current is flowing (1, 2).

The major barrier to an electrical current is the skin (1). The resistance of the skin varies greatly according to the thickness of the keratin-covered epidermis (it is greater at the soles and finger-pads).

The point of contact on the body surface may leave skin lesions, called electrical burns or electrical marks. Another mark may also appear where the body was earthed or "grounded". It must be emphasized that fatal electrocution may occur with no skin marks.

The skin lesion is a thermal burn form heating of the epidermis and dermis as the current passes. In most of the cases examined in the Department of Forensic medicine and deontology Sofia, were detected electrical burns on the entry and exit sites, and in one case – carbonization of the almost entire human body. The morphological macroscopic characteristic of the electrical burns was different depending on the type of contact with the source of electricity:

- When the skin has been in a firm contact with an electrical conductor the passage of the current trough the high skin resistance heats up the tissue fluids and produces steam. This may split the layers of the epidermis or the epidermal-dermal junction and produces a raised blister. When the current ceases, the blister cools and collapses, producing a grey or white ring with an umbilicated center. The mark sometimes produces the shape of the conductor (linear wire or a shaped metal object).
- If the contact is less firm, so that an air-gap exists between the skin and the conductor, the current jumps the gap as a spark. It is at extremely high temperatures, which causes the skin keratin to melt. On cooling, the keratin fuses into a hard brownish nodule, raised above the surrounding surface. This is called "spark lesion".
- In many electrical burns these two types are combined, as a result of movement of the hand or the body against the conductor, or because of irregularity of the shape of the conductor (1, 4, 5).

In high voltage burns (from high tension transmission cables) where the voltage is in the multiple volte range, sparking may occur over many centimeters. Due to this spark the clothes may set fire, especially if they are synthetic, which in sufficient duration of exposure could cause severe burns and even carbonization of the body (figures 9, 10 and 11).

CONCLUSION

Today's most popular fishing rod tends to be graphite (carbon fiber) for its light weight characteristics and its ability to allow for further and more accurate cast, as well as it is more sensitive, allowing the anglers to feel bites from fish easier. However carbon fiber is a very good electric conductor. This is the reason they are very dangerous if used near high voltage power line, because a fatal electrocution may occur if the angler doesn't pay enough attention to maintain the necessary distance from such sources of electricity.

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