ELECTRIC SHOCK AND VENTRICULAR FIBRILLATION

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[Folgorazione e fibrillazione ventricolare]

SUMMARY

Electricity can cause an electrical hazard with different effects on the human body. The authors linger on tetanization on the respiratory arrest, burns, and particularly focus on the ventricular fibrillation responsible for 90% of deaths from electrocution. They report the therapeutic aids to be implemented in hospitals and conclude that the electrical risk can not be eliminated but can be controlled through information or treated with resuscitation aids to be implemented promptly.

Key words: Electrocution, risk threshold, ventricular fibrillation, microshocks, resuscitation

RIASSUNTO

L'energia elettrica può comportare un rischio elettrico con diversi effetti sul corpo umano. Gli autori si soffermano sulla tetanizzazione, sull'arresto respiratorio, sulle ustioni ed in particolare attenzionano la fibrillazione ventricolare responsabile sul 90% delle morti per folgorazione. Riportano i presidi terapeutici da attuare in ambito ospedaliero e concludono affermando che il rischio elettrico non può essere eliminato ma può essere controllato attraverso l'informazione o trattato con presidi rianimatori da attuare tempestivamente.

Parole chiave*: Folgorazione, soglia di rischio, fibrillazione ventricolare, microshock, rianimazione*

Introduction

Electricity is one of the essential "components" for everyday life, so every day we are all exposed to electrical hazards. Medical procedures can often expose the patient to more risks than the normal home life or the workplace since in this case the skin, mucous membranes or the membranes are often penetrated or removed. Therefore, in the hospitals the electrical or electronic systems in close contact with the patient make it particularly prone to the risk of electric shock, wich be divided into:

• Macroshock, connection between an electrically active part and a part of the outer surface of the human body;

• Microshock: connection between an electrically active part and an internal part of the human body. Our work will show how many and which may be the current effects on the body. It will show the aspects concerning a microshock with the intent to highlight also the different types of electrical systems, claiming that a good design of these systems is the main parameter to lower the risk threshold.

Effects

The most frequent and most important effects of electricity on the human body are tipically four: tetanization, respiratory arrest, burns, and ventricular fibrillation. The later is responsible of the 90% of deaths for electrocution and it sets up when an external current which passes through the heart alters the timing and coordination with loss of normal pump function.

If the arhythmia continues for more than a few seconds: the blood pressure becomes zero, the pulse disappears with a cardiac arrest. The probability of initiation of the ventricular fibrillation depends on several factors, including: the intensity of the current, equivalent to 100 mA in case of Macroshock and 100 uA in the case of Microschok; the path of current, because the lower is the resistance for a path, the greater is the value of current: the higher the probability of VF for paths interesting right hand-left hand, Hand-chest, hand/hands-feet; the duration of contact with high risk if the time is more than the cardiac cycle (0.5/1 sec); finally, there is a moment in which the normal cardiac cycle is very unstable, therefore if the shock coincides with the “vulnerable period”, which lasts about 400 ms and is represented by the ascending trait of the T wave in the ECG, there is a very high probability of triggering.

Therapeutic provisions

In rescuing a strucking, it is important to make sure you shut the power (by pulling the plug or switch) to avoid becoming a second victim. In case this is not practicable, you must remove the victim from the leads, only with an insulating medium: the handle of a broom or a chair or any object of wood that is useful to help. In performing this maneuver is critical to wear shoes with rubber soles, or put under your feet a newspaper, a book, a rubber mat or plastic.

Since the electric current affects vital organs like heart, lungs and brain, the strucking is by definition a critically ill patient, and therefore must be performed resuscitation support, configuring the intervention according to the guidelines provided for the patient with polytrauma:

• Air: evaluation and management of the airway and upper cervical spine immobilization, endotracheal intubation must be guaranteed as quickly as possible;

• Breathing: Oxygenation and ventilation, must be supported continuously, ventilation / oxygenation of the patient with 100% oxygen, 15 liters/min;

• Circulation: stabilization of the circle. Defibrillation must be performed immediately, if the defibrillator is available locally, if not, start CPR "core" until the arrival of the AED.

Immediately after dispensing the first electric shock (150-200-360 J with biphasic defibrillator, 360 J with monophasic defibrillator) should immediately resume CPR, starting from the chest compressions, with frequency of 30:2, for five cycles (about 2 minutes). If the pace has not changed: defibrillate the second time and go back to basic CPR. If the pace has not changed: give adrenaline 1mg IV every 3-5 minutes, defibrillate the third time and go back to basic CPR. After 5 cycles of CPR reassess the pace if it is not changed: administrate an antiarrhythmic:

a) Amiodarone: intravenous bolus of 300 mg diluted in 20-30 ml of glucose 5% by rapid infusion, it may be given an extra dose of 150 mg by rapid infusion if persists refractory or recurrent VF;

b) Lidocaine, used in cases where amiodarone is not available: in bolus of 1-1.5 mg / kg repeated every 3-5 minutes up to a maximum of 3mg/kg;

c) Magnesium sulphate, in bolus of 1-2 g diluted in 10 ml of glucose in 5 minutes. In presence of restoring a spontaneous circulation, care should be taken to stabilize hemodynamics, respiratory and metabolic activity of the patient, paying particular attention to the timely treatment of peri-arrest arrhythmias (post-resuscitation therapy).

The Patients who are particularly vulnerable to the onset of VF, in hospitals, are those who have undergone cardiac catheterization interventions or diagnostic tests involving the application of probes that operate internally and/or near the heart.

The microshock’s accident in those patients are usually caused by “leakage current” in the electromedical devices or from potential differences from the conductive surfaces connected to mass due to elevated currents that flow in the mass circuit.

To prevent these risks in medical locations where the parties have applied for use in applications such as intracardiac interventions, surgery, or the patient is subjected to vital treatments, where the lack of electricity, can involve danger to life (Group 2, IEC 62-5), the requirements are:

• the Equipotentialization, a special connection to which they refer all conductive surfaces, the masses of the sockets and the masses of all equipment in contact with the patient, and the Isolation transformer, which provides protection against ground faults of electronic instruments in the room and the continuity of energy supply from which depends upon the patient’s life.

Conclusions

The electrical accidents are more common than you might imagine, each of us is daily in contact with electricity without knowing that the snare or the danger is lurking. The electrical risk can not be eliminated, but can be controlled through training and informing employees. If there is already an electrical damage must intervene with a timely and adequate resuscitative treatment.

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