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Request for Assistance in

Preventing Fatalities of Workers Who Contact Electrical Energy

December 1986

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health

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REQUEST FOR ASSISTANCE IN PREVENTING FATALITIES OF WORKERS WHO CONTACT ELECTRICAL ENERGY

ATTENTION!

PROMPT EMERGENCY MEDICAL CARE CAN BE LIFESAVING FOR WORKERS WHO HAVE CONTACTED EITHER LOW VOLTAGE OR HIGH VOLTAGE ELECTRICAL ENERGY. IMMEDIATE CARDIOPULMONARY RESUSCITATION (CPR) FOLLOWED BY ADVANCED CARDIAC LIFE SUPPORT (ACLS) HAS BEEN SHOWN TO SAVE LIVES.

SUMMARY

Recent incidents that have come to the attention of NIOSH have shown that electrocution victims can be revived if immediate cardiopulmonary resuscitation (CPR) or defibrillation is provided. While immediate defibrillation would be ideal, CPR given within approximately 4 minutes of the electrocution, followed by advanced cardiac life support (ACLS) measures within approximately 8 minutes, can be lifesaving. This alert describes recommendations that can be used to help save the lives of workers who contact electrical energy. Editors of appropriate trade journals, safety and health officials, and especially those who work with electrical equipment, are requested to bring these recommendations to the attention of owners, managers, and workers.

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BACKGROUND

It has been estimated that at least 700 occupational electrocutions occur each year [1]. Therefore, a primary goal of occupational safety programs must be to prevent workers from contacting electrical energy. Effective measures include safe work practices, job training, proper tools, protective equipment, and lockout/tag-out procedures.

Investigations by NIOSH, as part of its Fatal Accident Circumstances and Epidemiology (FACE) Project, also have revealed that once an electrical energy incident occurs, emergency response plans are often lacking, even in organizations which promote safety. Hence, a secondary goal of safety programs must be to provide appropriate emergency medical care to workers who contact electrical energy.

The National Electrical Code divides voltages into two categories: greater than 600 volts (high voltage) and less than or equal to 600 volts (low voltage) [2]. Momentary contact with low voltages produces no thermal injury, but may cause ventricular fibrillation (very rapid, ineffective, heartbeat) [3].

In contacts with high voltage, massive current flows may stop the heart completely. When the circuit breaks, the heart may start beating normally [3]. Supporting respiration by immediate mouth-to-mouth techniques may be required, even if heartbeat and pulse are present. If extensive burns are present, death may result from subsequent complications [4].

APPROPRIATE STANDARDS AND GUIDELINES

The revised "Standards and Guidelines for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC)" published in June 1986, is a product of the 1985 National Conference on CPR and ECC. There are two parts: basic cardiopulmonary resuscitation (CPR) and advanced cardiac life support (ACLS). A lay person can be trained in CPR to support circulation and ventilation of the victim of cardiac or respiratory arrest, until ACLS (provided by medical professionals using special equipment) can restore normal heart and ventilatory action [5].

Speed has been found to be critical to resuscitation: immediate defibrillation would be ideal. The highest success rate has been achieved in those patients for whom CPR followed cardiac arrest within approximately 4 minutes, and ACLS was begun within approximately 8 minutes of the arrest [5]. CPR often must be initiated immediately by lay individuals at the scene of the incident. It should be noted that CPR skills can be gained in 4-hour courses similar to those taught by the American Heart Association or the American Red Cross.

NIOSH CASE REPORTS

Case #1 - SUCCESSFUL RESUSCITATION

A 30-year-old construction worker was working on a fire escape in a building being renovated. Another worker handed the victim a metal pipe, and he was holding it with both hands when it contacted a nearby high voltage line, completing a path-to-ground. The worker instantly collapsed from this contact with electrical energy. Approximately 4 minutes after he collapsed, the fire department rescue squad arrived and began CPR. Within 6 minutes, a paramedic unit was on the scene providing defibrillation and other ACLS measures. They were able to establish a heartbeat and pulse, but the individual continued to require respiratory support during transport to the hospital. He regained consciousness and was discharged within two weeks. He did have to return for further medical care for burns he received on his hands (current entrance) and buttocks (current exit) [6].

Case #2 - UNSUCCESSFUL RESUSCITATION

An 18-year-old male restaurant worker contacted electrical energy when he kneeled to plug a portable electric toaster into a 110-120 V/20 amp floor outlet. After a scream was heard, the victim was found convulsing on the damp floor, with one hand on the plug and the other on the receptacle box. The assistant manager went to the electrical panel, but was unable to locate the appropriate circuit breaker. A coworker attempting to take the victim's pulse received an electrical shock, but was not injured. After telephoning the emergency medical service, the assistant manager returned to the panel and de-energized all of the circuits (3 to 8 minutes after the worker contacted electrical energy). The injured worker was covered with a coat to "keep him warm." After about 5 minutes, another call was placed to the emergency squad, and the assistant manager "yelled" for an off-duty employee who lived in an apartment across the lot, who came and began CPR. The emergency service was on the scene 10 minutes after receiving the first call. ACLS measures were available, but the resuscitation was unsuccessful and the worker was pronounced "dead on arrival" at the local hospital. The exact time span between the worker contacting electrical energy and the beginning of CPR is unknown, but it is reasonable to assume that it was longer than 4 to 6 minutes. Paramedics with ACLS capability arrived 10 minutes after receiving the call, but more than 10 minutes after the accident occurred [7].

CONCLUSIONS

In Case #1, basic life support was begun within 4 minutes by the fire department rescue squad who happened to be stationed nearby. They were experienced and had up-to-date knowledge in CPR techniques. In

this case, CPR was begun within the 4-minute recommendation. An ambulance, equipped and staffed to provide ACLS, arrived within 6 minutes. The standards and guidelines [5] for CPR within 4 minutes, and ACLS within 8 minutes, were met and the worker did survive.

In Case #2, the worker's contact with electrical energy was prolonged and a coworker who aided him received an electrical shock, because coworkers did not know how to de-energize the circuit. The optimal times for CPR and ACLS were exceeded, and the resuscitation was unsuccessful. Providing appropriate medical care after an electrical energy incident will not guarantee success. However, as has been reported elsewhere [5] and supported in the NIOSH case reports, the chance for successful resuscitation after cardiopulmonary arrest is best when the criteria for providing emergency medical care are met.

RECOMMENDATIONS

1. PREVENTION

PREVENTION must be the primary goal of any occupational safety program. However, since contact with electrical energy occurs even in facilities which promote safety, safety programs should provide for an appropriate emergency medical response.

2. SAFE WORK PRACTICES

No one who works with electrical energy should work alone, and in many instances, a "buddy system" should be established. It may be advisable to have both members of the buddy system trained in CPR, as one cannot predict which will contact electrical energy.

Every individual who works with or around electrical energy should be familiar with emergency procedures. This should include knowing how to de-energize the electrical system before rescuing or beginning resuscitation on a worker who remains in contact with an electrical energy source.

All workers exposed to electrical hazards should be made aware that even "low" voltage circuits can be fatal, and that prompt emergency medical care can be lifesaving.

3. CPR AND ACLS PROCEDURES

CARDIOPULMONARY RESUSCITATION (CPR) and first aid should be immediately available at every worksite. This capability is necessary to provide prompt (within 4 minutes) care for victims of cardiac or respiratory arrest, from any cause.

Employers may contact the local office of the American Heart Association, the American Red Cross, or equivalent groups or agencies, to set up a course for employees.

Provision should be worked out at each worksite to provide **ADVANCED CARDIAC LIFE SUPPORT (ACLS)** within 8 minutes (if possible), usually by calling an ambulance staffed by paramedics. Signs on or near phones should give the correct emergency number for the area, and workers should be educated regarding the information to give when the call is made. For large facilities, a prearranged place should be established for company personnel to meet paramedics in an emergency.

We are requesting that employers, worker representatives, editors of appropriate trade journals, and safety and health professionals assist in disseminating these recommendations to those individuals and organizations responsible for providing a safe workplace. Suggestions or questions related to this announcement should be directed to Mr. John Moran, Director, Division of Safety Research, National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, West Virginia 26505-2888, telephone (304) 291-4595.

We greatly appreciate your assistance.

J. Donald Millar, M.D., D.T.P.H. (Lond.)
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Director, National Institute for
Occupational Safety and Health
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