Modern Surgery - Chapter 40. Injuries by Electricity

John Chalmers Da Costa
Jefferson Medical College

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Effects Produced by Lightning.—An individual may be struck directly, or he may be shocked by an induced current, the lightning having struck a nearby object. A person can be struck while in a room, but there is more danger when exposed, especially in the open country. To be under a single tree during a thunderstorm is dangerous, but to be in a wood or under a hedge is reasonably safe. The victim of lightning may be killed instantly. Death is the fate of over one-third of those struck. Tidy states that out of 54 cases, 21 died and 33 recovered. Post-mortem examination may fail to reveal a lesion, but in many cases severe burns are discovered; in some there are laceration of tissue, crushing of bones, and fearful injury. Burns are especially apt to occur at the points where the current entered and emerged. The clothes are usually singed and torn. The typical lightning-marks are arborescent tracings, representing the course of blood-vessels, produced by disorganization and effusion of blood as the fluid travels through it. Occasionally metal objects, such as buttons, knives, money, keys, etc., are fused, and spread as a metallic film over a considerable portion of the surface of the body. Bichat stated that in death from lightning rigor mortis does not occur. This statement is now known to be an error (see the three cases reported by M. Tourdes). As a rule, there is early rigor mortis, retained fluidity of blood, and distention of the brain with venous blood. The cause of death by lightning was supposed by Hunter to be due to destruction of muscular contractility, and by Richardson to the resolution of the blood into gases. It seems probable that some deaths are due to actual disorganization of vital structure and that others are due to shock or inhibition. An individual struck by lightning may recover even when he is apparently dead. Sestier reported 77 cases struck by lightning, and in 7 of them the persons were apparently dead for a number of hours.* Brouardel says in such cases the death-like state may be ascribed to inhibition, caused by a maximum degree of stimulus.† When death from lightning is not immediate, the condition may be as above outlined, the individual being apparently dead, without obvious respiration or pulse. He may be insensible, with slow and labored respiration, a weak and irregular pulse, and dilated pupils, and may remain in this condition for a few minutes or for several hours. The above condition is not to be distinguished from severe concussion of the brain. Every individual suffering from the effects of lightning should have his entire body carefully examined to see if physical injuries exist (fractures, wounds, burns, ecchymoses, arborescent tracings). The consequences of lightning-stroke are many and various. There may be rapid and complete recovery, gradual recovery, traumatic neurasthenia, sloughing burns, partial paralysis, which is usually recovered from (Nothnagel), but which may be permanent; hysteria, blindness, change of character, and actual insanity.

Treatment.—Do not pronounce a person dead until a thorough attempt at resuscitation has been made. Do not give alcoholic stimulants. If the

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* Sestier, "De la Foudre," Paris, 1866. Quoted by Brouardel in his lectures upon "Death and Sudden Death."
† Benham's translation of Brouardel's lectures upon "Death and Sudden Death."
respiration is feeble and apparently absent, make tongue traction and em-
ploy artificial respiration. Apply the stream of a cold douche to the head, rub
the limbs with mustard, put a mustard plaster over the heart and another to
the back of the neck, wrap the individual in hot blankets, and give enemata of
hot saline fluid. In some cases venesection has seemed to be of benefit.
When the individual reacts, treat any existing condition symptomatically,
and treat particular physical injuries according to their character.

Effects of Artificial Currents.—Workmen for electric companies,
pedestrians in the streets of a city which is lighted by electricity or in which
trolley cars are employed, roofers, and firemen are liable to be injured by
electricity. An alternating current is decidedly more dangerous than a con-
tinuous current of equal strength. An artificial current acts like lightning.
It may produce instant death; it may produce unconsciousness, delirium,
stertorous respiration, Cheyne-Stokes' breathing, or clonic spasms. Its
effects can be often recovered from. Not unusually the victim is apparently
dead, but subsequently recovers. D'Arsonval reports the case of a man
who was apparently killed by the passage of 4500 volts. No attempt at resus-
citation was made for one-half hour, and yet he recovered when artificial
respiration was employed. Donnellan reports a case of recovery after the
passage of 1000 volts. Slight shocks may cause temporary numbness, and
even motor paralysis. An electric shock frequently causes burns or ecchy-
moses, and occasionally wounds. Wounds caused by electricity bleed pro-
fusely and are apt to slough. An electric burn looks like a blackened crust;
it is surrounded by pale skin, and for twenty-four hours remains dry, when
inflammatory oozing begins and the skin around it reddens. These burns
are not as painful as are ordinary burns, but recovery requires a long time.
When inflammation begins and suppuration occurs, tissue is extensively
destroyed; tendons, bones, and joints may suffer; some portions become
deeply excavated, and other portions show dry adherent masses of dead and
dying tissue, and a burn which was at first small may be followed by a large
area of moist gangrene; * lack of tissue-resistance, due to trophic disturbance,
is largely responsible for the progress of the sloughing.

Treatment.—If a person is in contact with a live wire, the first thing to do
is, if possible, to shut off the current. If it is not possible to shut off the cur-
cent, catch a portion of the clothing of the victim and pull him away from the
wire, but do not touch his body with the bare hand. If a pair of rubber
gloves can be obtained, the subject can be moved with impunity and the wires
can be safely cut. If it is not possible to drag a person away from electric
wires, the surgeon can wrap his hands in dry cloth and lift the portion of the
body in contact with earth or wire, and thus break the circuit and permit of
removal of the body. † A dry cloth can be pushed between the body and the
ground, and the body can then be removed from the wires. It may be pos-
sible to push the wires away by means of a dry piece of wood, or to cut them
with shears which have wooden handles and which are perfectly dry. Treat
the general condition in the manner set forth in the article on lightning-stroke
(page 1067). Very severe burns may be caused. The author has dressed a

* See the article by N. W. Sharpe on "Peculiarities and Treatment of Electrical In-
† See the directions in Med. Record, Dec. 28, 1895, from Med. Press.
number of electric burns with hot fomentations of salt solution during the first few days. This facilitates the separation of the sloughs and seems to aid the weakened tissues in resisting microbic invasion; after sloughs separate, the part is dressed with dry sterile gauze. Antiseptic dressings can be used from the beginning, but they often fail entirely to arrest the sloughing. Iodoform produces much irritation. Ointments are very unsatisfactory. When the dressings are changed, the part should not be washed with corrosive sublimate, as this agent produces irritation; peroxid of hydrogen should be employed, followed by hot normal salt solution. Sharpe removes sloughs by applying the following mixture: 2 parts of scale pepsin, 1 part of hydrochloric acid, U.S.P.; 120 parts of distilled water. This mixture is washed off after two hours with peroxid of hydrogen. The same surgeon treats necrosis of bone by injecting every few hours a 3 per cent. solution of hydrochloric acid, using every second day the pepsin solution, and when necrotic areas come away packing with gauze. Skin-grafting by Reverdin's method or Thiersch's method is rarely successful. In some regions it is possible to slide a large flap in place to cover a granulating area which will not heal. In a very severe case amputation or resection may be necessary.