G12 Over Diagnosis of Low Voltage Electrocution

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After attending this presentation, attendees will understand the mechanisms of death in electrocution; be provided easily conducted analyses to prevent over diagnosis of electrocution; recognize that over diagnosis of electrocution is relatively common.

This presentation will impact the forensic community and/or humanity by understanding the pitfalls which can occur in investigation of low voltage electrocutions and techniques to employ to reduce over diagnosis.

The fact that electrical burns are the only significant finding in low voltage electrocutions is well known in the forensic pathology community. The fact that electrical burns are seen in only approximately 50% of low voltage electrocutions is also well known. Further, it is generally understood that a high index of suspicion is required if there is a possibility that an electrical circuit may have killed someone, as the autopsy will not identify the cause of death in approximately 50% of cases.

Unfortunately, the above works to create over diagnosis in some cases. The author has encountered eight cases of over diagnosis of low voltage electrocution in the past eight years in his consultative practice of forensic pathology. Of these cases, the author was a consultant to the defense in seven and to the plaintiff in one. The possibility of bias could thus be argued, but then again, the government-hired death investigator also has a bias to determine a cause of death, and in the majority of these cases, if electrocution was not diagnosed, the cause of death was certainly obscure. Invocation of electrocution made a tidy diagnosis in an otherwise puzzling case in the majority of cases.

The eight cases presented show variable circumstances, with varying degrees of certainty that the death could not have been electrocution.

In each case there was a possibility of electrocution because some source of electricity was available to the deceased prior to his or her demise.

In each case, the approach will be to show that for there to be an electrocution, there must be a circuit of more than 16 mamps through the person immediately prior to the death. 16 mamps is used a minimal figure as that is the average “no let go” value for alternating current passing from hand to hand. Further, it is necessary to show that the circuit of more than 16 mamps traversed the body through the chest or the head or both. With low voltage electrocution the mechanism of death is either asphyxia (rarely) or ventricular fibrillation (commonly.) Asphyxia is produced by prolonged exposure (minutes) of the chest causing tetanic contractions of the chest musculature during a throughthe-chest circuit or by seizures induced by a through-the-head circuit. Ventricular fibrillation requires a through the chest circuit, of probably more than 100 mamps of current flow, but of very brief duration, as little as 0.2 seconds.

For there to be a circuit of more than 16 mamps through a person there must be exposure to voltage sufficient to overcome the resistance to current flow which the human body presents. For contact through the skin, requiring the skin to be minimally keratinized, moist and flushed, the resistance is greater than 1000 ohms. Thus to achieve 16 mamps of current flow requires 16 volts as a minimal voltage to achieve “no letgo.” As will be shown, one of the cases involved batteries have a voltage below 16 volts, thus making it a case of over diagnosis.

Further, low voltage direct current probably requires much higher current flows than seen with alternating current making the DC current case even more unlikely.

In one of the cases, the conduit through which wires passed caused the insulation to be cut, causing a short circuit which blew the fuse to the transformer. Upon replacement of the fuse, the cut wire arced periodically. As the conduit was grounded, it was never ever to have a voltage, and thus insufficient voltage provided a way to determine over diagnosis.

In another case, the possibility of ground leakage, producing a force field of varying voltages over distance was proposed as the mechanism of electrocution. Demonstration of shoes with high dielectric (resistance to the flow of electricity) made the over diagnosis unlikely.

In four of the eight cases the autopsy demonstrated causes of death from other causes than electricity. These included traumatic asphyxia, ruptured AV malformation of the lung, aortic stenosis with cardiomegaly and buried left anterior-descending coronary artery with ischemic changes new and old in the distribution of the LAD.

In two of the cases the deaths were witnessed. In both of these cases there was no involuntary movement produced by the flow of electricity. A circuit through a person sufficient to cause death causes involuntary contraction of the muscles in the circuit 0.2 seconds after the initiation of the circuit. This results in a scream or shouts if the current passes through the chest. In addition, if the circuit passes through the upper extremity there is involuntary flexion. If the circuit passes through the trunk and lower extremities there is involuntary extension. Both of these phenomena should be described by witnesses who could see and hear the soon to be deceased. In two the presented cases no such movements were heard or seen.

However, the most striking and uniform absence in all of the presented cases is the pathway to ground.

 ** Presenting Author*

In none of the presented cases was there a demonstrable pathway to ground. To have an electrical circuit there must be a source of electrons and something conductive to allow them to flow to a place with fewer electrons. In a low voltage electrocution there must be a circuit of more than 16 mamps from an energized source and the person must be grounded to complete the circuit. In all eight cases there is complete absence of pathway to ground, thus an analysis of pathway to ground which is simple and easy to do, is the most important criteria to employ in the investigation of a possible electrocution.

Autopsy, Electrocution, Cause of Death

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