

## Electrical Injuries

Electrical injuries are injuries that result from either direct or indirect contact with an electrical current. It is estimated that about 130,000 emergency room visits and 1,000 fatalities per year are related to electrical injuries in the United States (1,2). However, the actual number of electrical injuries that occur each year is unknown since many injuries go unreported when medical attention is not sought. Indicators of injury can include loss of consciousness, confusion, numbness, tingling, and muscle spasms, however, these symptoms are not indicative of the extent of the injury (1). Electrical injuries can range in severity from mild to severe. Several factors contribute to the severity and presentation of the injury including voltage, amperage, and pathway of the electrical current (1,2). Voltage refers to the electrical potential difference between two points. Amperage refers to the measure of the amount of energy that flows through an object, and the pathway of the electrical current describes the route of the flow of energy through the body. Electrical injuries are typically referred to as either high or low voltage, with 1,000 volts generally being the threshold between the two. Research has shown that voltage alone does not determine the severity of cognitive impairment that can result from an electrical injury. In fact, low voltage injuries can have a more significant impact on cognitive functioning than high voltage injuries in some cases (1,3,4).

Research on the impact of electrical injuries on cognitive functioning is limited. Many of the studies available are case studies involving one or two individuals, though there are a few that have looked at larger groups. No specific neurocognitive profile has been identified for electrical injury patients, yet there appears to be consensus about the direct link between electrical injuries and the resulting changes in cognitive functioning that often occur (2,3,4,6). Several studies discuss findings of mild to moderate diffuse neuropsychological deficits, including impaired attention and concentration, memory, overall intellectual functioning, and mental processing speed (3,4,6). In one study, Duff and McCaffrey examined 8 previous studies and combined the results of the 65 patients across studies. They found impaired performance across eight neuropsychological domains: overall neuropsychological functioning, overall intelligence, attention and concentration, speech and language, sensory-motor, visual-motor, memory and executive functioning (3). Thirty three percent of the results fell into the impaired category, with memory showing the most impairment, followed by attention (3).

Electrical injuries are commonly compared with mild brain injuries because of their diffuse symptoms, potential for both immediate and delayed neurological damage, and frequent lack of findings on imaging (1,4). Imaging studies suggest that electrical injuries have a more significant impact on brain functioning rather than on brain structure (1,4). For example, MRI and CT scans are often not indicative of structural impairment while EEGs may show impairment in the brain's electrical activity (1,4). Interestingly, much of the research on electrical injuries describes a delayed onset in symptoms and deterioration in cognitive functioning over time, followed by an increase in emotional distress (1,4,5,6). This process is different from the typical pattern seen in mild brain injuries.

In addition to cognitive changes, several studies found that psychiatric disorders, such as depression, anxiety and PTSD, are common among survivors of electrical injuries and the prevalence of these disorders tends to increase over time (3,5,6). In a study by Ramati and colleagues, a 78% incidence rate of psychiatric disorders was found among the sample they examined. Additionally, patients with more than one psychiatric disorder experienced decreased cognitive functioning in the areas of verbal memory, executive functioning, and attention relative to patients with only one psychiatric diagnosis (5). Interestingly, it was also found that individuals in the later stages of recovery were at a greater risk for increasing psychiatric symptoms. Although, psychiatric symptoms appear to be common in individuals who have sustained an electrical injury, several studies have attempted to control for this and have found that they do not account for neuropsychological findings (1,5,6).

With regards to prognosis, research suggests that only 25-30% of electrical injury survivors are able to return to their previous employment and one third of individuals are unable to return to work at all as a result of their injury (depending on the severity of the injury) (1,5). As such, a neuropsychological evaluation is recommended after injury to assess for changes in cognitive functioning and to identify areas of strength and weakness. Ongoing evaluations may be necessary to monitor for potential progressive decline. A vocational assessment may also be helpful in determining an individual's interests and abilities if they are unable to return to their previous employment. In addition, cognitive rehabilitation can help the individual to relearn cognitive skills that have been lost or altered and can also be used to teach compensatory strategies. It is possible that EEG biofeedback could be a useful treatment in addition to cognitive rehabilitation.

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#### References

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