

## A Case Report of New-Onset Atrial Fibrillation in a Young Male After Electrical Injury

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### ABSTRACT

Electrical injuries occur mostly as a consequence of home or workplace accidents. It can cause various manifestations from minor skin burn injuries to cardiac arrhythmias. Atrial fibrillation (AF) after electrical injury is a rare manifestation. A 28-year-old man presented to the emergency department with palpitation after an electrical injury accident from a live wire carrying 220 volts in his home. He had loss of consciousness for 2 minutes after the accident, but was conscious at admission. He had no history of cardiovascular disease. Blood pressure was 130/80 mmHg, heart rate was 150 beats/min irregularly irregular, respiratory rate was 20 breaths/min, body temperature was 36.6°C, and oxygen saturation was 98% on room air. There was an entry wound on the palmar aspect of the right hand and exit wound on the plantar aspect of the right foot. Electrocardiogram showed AF with rapid ventricular response at 150 - 200 beats/min. Laboratory tests and echocardiogram were in normal limits. Pharmacologic cardioversion with intravenous amiodarone was given, followed by maintenance dose. AF was converted into sinus rhythm in 1 hour after amiodarone administration. The patient was discharged one day later. AF can occur after a low-voltage electrical injury. Cardiac monitoring for at least 24 hours is indicated in all patients with loss of consciousness, documented arrhythmias or ECG abnormalities, or who have sustained a high-voltage injury.

### 1. Introduction

Electrical injuries are relatively common and occur mostly as a consequence of home or workplace accidents. It can occur as a result of lightning, low-voltage, or high-voltage injury. Burn injuries, neurological damage, cardiac arrhythmias, and even death can occur in patients who experienced electrical injuries.<sup>1</sup> The exact incidence of electrical injuries is unknown. In the United States, approximately 1000 deaths per year are due to electrical injuries.<sup>2</sup>

Cardiac arrhythmias due to proarrhythmic effect of electrical injury usually occur immediately after the accident. Common rhythm disturbances and electrocardiogram (ECG) changes that have been

reported include sinus tachycardia, sinus bradycardia, non-specific ST-T changes, QT interval prolongation, heart blocks, ventricular fibrillation, and asystole. Atrial fibrillation (AF) is a rare occurrence after electrical injury.<sup>3</sup> We report a case of new-onset AF that occurred following a low-voltage electrical injury in a young man patient with no prior cardiovascular disease.

### 2. Case Presentation

A 28-year-old man was brought to the emergency department in Dr. Agoesdjam Regional Public Hospital, Ketapang Regency, West Kalimantan with complaint of new onset palpitation after an electrical injury. He had touched a live wire carrying



220 volts during repair of an electric machine in his home. He had loss of consciousness for approximately 2 minutes after the accident, but was conscious at admission. He denied any chest pain or shortness of breath. He was a nonsmoker with no prior history of cardiovascular disease or other comorbidities.

On physical examination, he was alert and fully oriented with stable hemodynamic. Blood pressure was 130/80 mmHg, heart rate was 150 beats/min with irregularly irregular rhythm, respiratory rate was 20 breaths/min, body temperature was 36.6°C, and oxygen saturation was 98% on room air. The lung fields were clear and there was no cardiac murmur or gallop on auscultation. There was a burn injury on the palmar aspect of the right hand indicating the entry wound of electric current and the plantar aspect of the right foot showing the exit wound.

An ECG was performed immediately, which showed the patient to be in AF with rapid ventricular

response at 150 - 200 beats/min without any ischemic features (Figure 1). Laboratory test including troponin, complete blood count, liver function, and renal function, blood glucose, and serum electrolytes were within normal parameters. Transthoracic echocardiogram findings were normal. Pharmacologic cardioversion with intravenous amiodarone was given as 150 mg over 30 minutes, followed by maintenance infusion of 1 mg/min for 6 hours and 0.5 mg/min for 18 hours. The AF was converted into sinus rhythm in 1 hour after amiodarone initiation (Figure 2). After 24-hour cardiac monitoring and serial ECG, no arrhythmia was detected, and he was discharged satisfactorily with medications of oral amiodarone and topical treatment for burn wound. One week later, the patient followed up to the outpatient clinic without any complaints and the ECG remained in sinus rhythm.

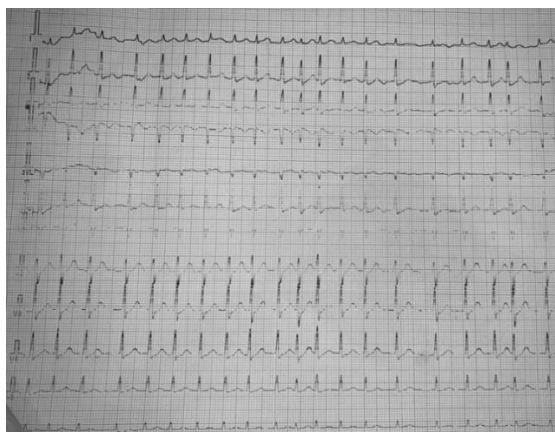


Figure 1. Initial ECG showing AF with rapid ventricular response at 150 - 200 bpm

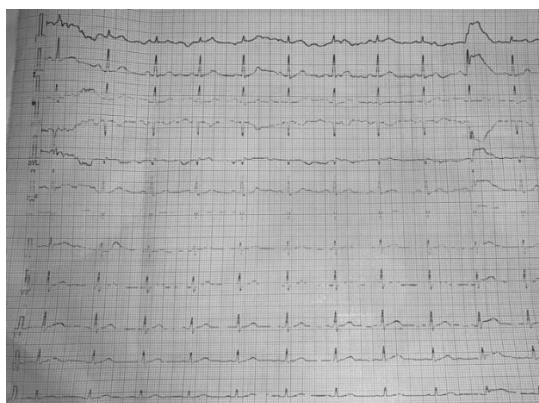


Figure 2. Serial ECG after 1 hour of amiodarone administration showing normal sinus rhythm with heart rate of 75 bpm.



### 3. Discussion

There are several types of electrical injuries, including direct electric shock, electric arc, electric flash, and lightning strike.<sup>4</sup> Most deaths in adults due to electrical injury are work-related, and electrical injury is a frequent cause of work-related deaths. Electrical injuries are classified as high voltage (1000 V or more), or low voltage (less than 1000 V). Typical household electricity has 110 to 230 V, and high-tension power lines have more than 100,000 V. A lightning strike can produce more than 10 million V.<sup>5</sup>

Electrical injury can cause multisystem effects including skin, respiratory, cardiac, neurological, and renal. In the cardiac structures, damage can occur in myocardium, valves, coronary arteries, and conducting system. Myocardial ischemia/infarction, transient hypertension, left ventricular dysfunction, valvular/myocardial rupture, hemorrhagic pericarditis, and arrhythmia can occur as a consequence of electrical injury.<sup>6</sup> The incidence of arrhythmia following electrical injury varies between 10% to 36%.<sup>7</sup> Arrhythmias or ECG changes that can be found after electrical injury are sinus tachycardia, sinus bradycardia, premature ventricular contractions, ventricular tachycardia, ventricular fibrillation, QT prolongation, bundle branch blocks, and atrioventricular blocks, and ST-T changes.<sup>8</sup> Cardiac arrest is the most devastating manifestation after electrical injury. Ventricular fibrillation is the most common cause of cardiac arrest in electrical injury. Ventricular fibrillation is more common with low-voltage electrical injury (mostly alternating current/AC), whereas asystole is seen more often with high-voltage electrical injury (mostly direct current/DC).<sup>9</sup>

There are differences in electrical resistance in various body tissues, where electric current tends to flow through blood vessels and nerves. The heart is susceptible to injury after the electric current crosses the midline.<sup>10</sup> Arrhythmias induced by electrical injury are usually occur immediately after electrical accidents, and only in very rare cases delayed manifestation are found.<sup>2</sup> The mechanism of occurrence of arrhythmia following electrical injury is

rather unclear and is likely multifactorial. The possible mechanisms include arrhythmogenic foci due to necrosis of myocardium, alterations in the sodium/potassium concentrations, and changes in myocytes membrane permeability. Rhythm disturbances can also be caused by anoxic injury in cases where respiratory arrest precedes cardiac injury.<sup>3</sup> Low-voltage injury is less likely to cause death than high-voltage injury. The causes of death are often ventricular fibrillation and paralysis of the central respiratory center and respiratory muscles.<sup>11</sup>

The patient in our case had an electrical injury precipitated new-onset AF. The short duration, spontaneous resolution following pharmacologic cardioversion, and an absence of a prior cardiovascular history, and lack of other potential causes favored electrical injury induced AF.<sup>12</sup> AF after electrical injury is very rare. In a study of 480 patients with electrical injury in which the majority of patients (96.2%) had suffered a low-voltage injury, the most frequent ECG abnormalities were sinus bradycardia (n = 50) and sinus tachycardia (n = 21). New onset AF was only detected in one patient, which later had a spontaneous conversion to sinus rhythm in a few hours.<sup>13</sup> In another study of 145 patients with electrical injury, cardiac complications were found in 4 patients, in which only one case of AF which converted to sinus rhythm after digoxin administration.<sup>14</sup>

If the patient's clinical condition is generally good and has a normal ECG at the time of admission, the probability of developing a serious arrhythmia is very low. Cardiac complications are more common in patients who experience loss of consciousness. Cardiac monitoring for at least 24 hours is indicated in patients with electrical injury when there is a history of loss of consciousness, documented arrhythmias either before or after arrival in the emergency department, ischemic evidence on ECG, or who have sustained a high-voltage electrical injury (Figure 3). Other indications of cardiac monitoring include soft tissue damage and burns, troponin increase, and pregnant women.<sup>15,16</sup>



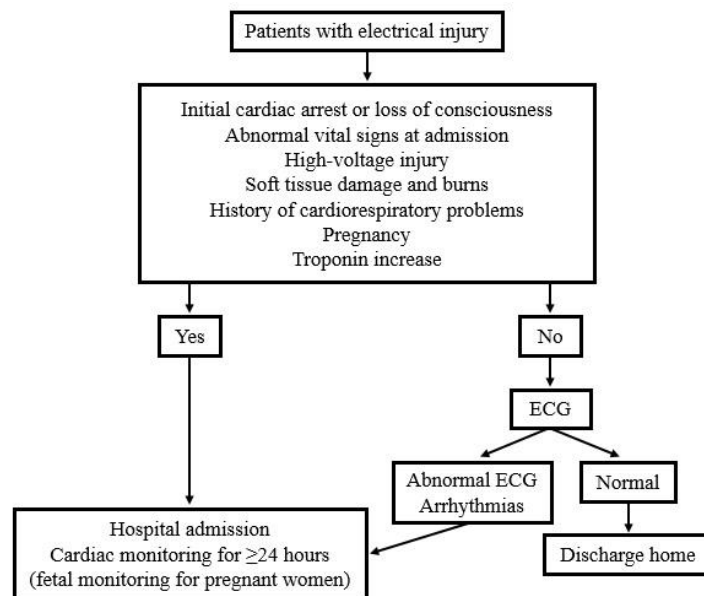


Figure 3. Management of patients with electrical injury.<sup>16</sup>

Considering the acute new onset of AF with stable hemodynamic in the patient in our case, we decided to perform pharmacological cardioversion with amiodarone and sinus rhythm was successfully restored. In case of AF with unstable hemodynamic, electrical cardioversion should be performed immediately. Since the patient in our case had a history of loss of consciousness and AF at admission, the patient was kept on cardiac monitoring for 24 hours.

#### 4. Conclusion

Electrical injuries occur mostly as a consequence of home or workplace accidents. AF after electrical injury is a rare condition and can be infrequently caused by low-voltage injury. Although cardiac arrhythmias rarely occur after electrical injury, cardiac monitoring for at least 24 hours is recommended in all patients with loss of consciousness, documented arrhythmias or ECG abnormalities, or who have sustained a high-voltage injury.

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